DESCRIPTION OF MAP UNITS
NORTHEAST ASIA GEODYNAMICS MAP

TECTONOSTRATIGRAPHIC TERRANES
(Arranged alphabetically by map symbol)

ACH Anui-Chuya terrane (Continental margin turbidite) (Early to Late Paleozoic) Gorny Altai (Altai)

The Anui-Chuya terrane consists of two adjacent blocks: northwestern Anui block and southeastern Chuya block. The blocks are similar in the structure of Cambrian-Silurian sections, but differ in composition and age of Devonian rocks.

The oldest deposits are the Gornoaltaiskaya series that consists of sand-shale flysch sequence with polymictic and oligomictic clastic material. Also occurring are interbeds of siliceous-clay shale, which increases to the west, farther from the North Asia Craton. A Middle and Late Cambrian is indicated by sponge spicules in a marginal facies adjacent to the Baratal terrane. Unconformably overlying is a Ordovician and Silurian unit that consists of shelf carbonate and terrigenous deposits that are similar to those in the coeval Charysh terrane. A facies zonation, from shallow-water marine deposits to carbonate platform deposits to deeper sedimentary deposits occurs. The age range is from the Arenig, locally from the Middle and even Late Ordovician through Late Wenlock to Pridoli.

Three generally unconformably overlying Devonian series occur. An Early Devonian section consists of marine carbonate-terrigenous sedimentary rocks with a facial zonation similar to that of the Late Ordovician and Silurian section. Eifelian and Early Givetian tectonism is indicated by disconformities at the base of the Eifelian, between the Eifelian and Givetian, and between the early and late Givetian. The tectonism is associated with Early Givetian volcanism with subaerial and submarine eruption of calc-alkaline siliceous lava of the Kurota suite. Relative stagnation occurred in the Late Givetian and Franian with accumulation of fine-grainded terrigenous sand-clay-silt sedimentary rocks and calcareous sedimentary rocks. The latter contain remnants of marine fauna and fragments of continental flora in the lower horizons. Terrane also contains Late Devonian and Early Carboniferous calc-alkaline, plumasite, alkaline and subalkaline granitoids.

REFERENCES: Yolkin and others, 1994; Shokalsky and others, 1996; Volkov, 1966; Buslov and others, 1998.

AG Agardag terrane (Oceanic) (Vendian and Cambrian) (Southern Tuva)

Occurs in southern Tuva as a tectonic lens between the Tuva-Mongolian superterrane and the Tannuols island-arc subterrane. Consists of three units. The first unit consists of strongly-deformed, melange with fragments of ophiolite including ultramafic rocks, gabbro, basalt, plagiogranite, siliceous and siliceous-clay shale, and graywacke with a U-Pb zircon isotopoic age of 570±1 Ma for the plagiogranite. Volcanic-sedimentary varieties are considered as Kuskunug suite of, probably, Vendian-Early Cambrian age. The second unit consists of limestone with shale, sandstone and tuffaceous sandstone of the Karakhol suite with sparse remnants of Early Cambrian archaeocyata and trilobites in limestone and shale. The third unit mainly consists of conglomerate (locally with boulders), gravelstone, and sandstone with the horizons of olistostrome-like rocks of the Shurmak suite of possible Middle Cambrian age. Vendian and Early Cambrian coarse-clastic rocks apparently mark the beginning of collision in the associated island-arc system. Terrane is interpreted as a back-arc basin deposited on oceanic crust that was assoicated with a Vendian and Cambrian island arc system.

REFERENCES: Luchitsky, 1970, Berzin, 1979; Izokh and others, 1988; Izokh, 1999.

AI Amil terrane (Accretionary wedge, type A) (Vendian and Cambrian) (Western Sayan)

Consists chiefly of the Dzhebash series, that is more than 5,000 m thick, that contains volcanic-sedimentary rocks that are metamorphosed to greenschist facies. The lower part of the series is dominated by paraschist derived from metamorphosed clay-, marl-, silt- and sand-bearing sedimentary rocks with local rhythmic bedding. The upper

part is dominated by orthoschist derived from mafic and andesite tuff, tuffaceous sandstone and volcanic flows, with local interbeds of marble, mica-bearing piedmontite and magnetite quartzite. In the southern part of the terrane, up section, the metamorphic schist is replaced by less metamorphosed sandstone and phyllite. The volcanic-sedimentary unit is interpreted as forming in the Vendian-Middle Cambrian as an accretionary wedge in front of a volcanic island arc. The peak of high temperature metamorphism is interpreted as occurring in the middle and late Paleozoic from K-Ar isotopic ages 284 to 364 Ma for mica in the metamorphic schist. Terrane is intruded by diorite-granodiorite of the Bolsho Porog complex and granite-granosyenite of the Dzhoi complex. No overlapping units occur. The Amil terrane, and companion Borus and Dzhebash terranes, are interpreted as a system of large tectonic lenses that are tectonically linked to the North-Sayan island-arc terrane.

REFERENCES: Zonenshain, 1963; Korobeinikov and Isakov, 1965; Kazakov, 1967; Klyarovsky, 1972; Kheraskov, 1979; Berzin, 1995; Zaltsman and others, 1996.

AL Alambai terrane (Accretionary wedge, type B) (Vendian and Early Cambrian) (South Salair and northern Gorny Altai)

Consists of a sedimentary and volcanogenic assemblage of the Alambai and Kivdin suites with bodies of strongly deformed and serpentinized dunite, harzburgite, and lesser pyroxenite. Volcanogenic rocks consist of chlorite and amphibole-bearing pillow-basalt, tuff and subvolcanic bodies that are interpreted as within-plate basalt. Also occurring are subordinate graywacke, siliceous shale, siliceous-clay shale, turbidite and carbonate deposits. The blocks and lenses of carbonate rocks, with subordinate volcanic rocks and siliceous-terrigenous rocks of the Kivdin suite are interpreted as fragments of within-plate volcanic uplift structures. A Vendian and Early Cambrian age is indicated by spores, microphytoliths and algae remnants. To the east, the Alambai terrane is thrust over early Paleozoic island-arc units in the Salair and Gorny Altai regions. To the west, the terrane is overlapped by the Cenozoic deposits of the West-Siberian plain.

REFERENCES: Grigor'yev, 1988; Berzin and Kungurtsev, 1996; Shokalsky and others, 1996; Tokarev and others, 1996; Nechaev and others, 1999.

AM Akiyoshi-Maizuru terrane (Accretionary wedge, type B) (Carboniferous and Permian) (Japan)

Consist chiefly of sandstone, conglomerate, and shale with chert, basalt, limestone and ophiolite. Terrane is divided into two units the Akiyoshi accretionary-wedge complex, and the Maizuru forearc formation. The deposited Maizuru forearc formation is deposited on the Yakuno Ophiolite. The Akiyoshi accretionary-wedge complex is mainly a chaotic mixture of Middle to Late Permian trench-fill sedimentary rocks. Aso occurring are Middle Permian pelagic chert, basalt, and limestone the are the remants of Carboniferous to Permian seamounts. The chert, basalt and limestone occur as allochthonous blocks in flysch and melange that is interpreted as forming during the subduction of an oceanic plate. Parts of the terrane is metamorphosed under high pressure conditions. Overlying Triassic units are sandstone, shale, conglomerate, limestone, and tuff of marine to non marine facies, locally with coal beds and containing bivalves such as Halobia and Monotis, Triassic index fossils, as the most dominant fauna. Jurassic shallow-marine to non-marine sedimentary rocks overlie the Permian accretionary complexes and consist predominantly sandstone, shale, conglomerate, and limestone, with bivalve marine fauna.

REFERENCES: Hayasaka, 1990; Kanmera and others., 1990.

AN Angurep terrane (Metamorphic) (Middle Silurian and older) (Southern Salair)

Consists of a series of nearly vertical tectonic sheets of the Alambai accretionary-wedge complex. Composed of garnet amphibolite with subordinate gneiss, marble, and quartzite. Three, fault-separated sequences are recognized according to the degree of metamorphism: (1) granulite and high-temperature eclogite; (2) high-pressure epidote amphibolitE; (3) moderate-pressure epidote amphibolite. Unit also exhibits retrograde greenschist metamorphism. Terrane is intruded by zonal gabbro-pyroxenite bodies with a Sm-Nd isochron age of 421±1 Ma age. Petrochemistry of igneous rocks indicates a high-sodium low-alkaline series.

REFERENCES: Tokarev and others, 1996; Gibsher and others, 2000.

ANV Aniva terrane (Accretionary wedge, type B) (Middle Triassic through early Late

Cretaceous) (Southern Russian Far East)

Consists chiefly of a melange formed of: (1) lenses of Middle Triassic, Jurassic, and Early Cretaceous oceanic high-titanium tholeiite, alkalic basalt, and chert; (2) fragments of guyots with late Paleozoic and Late Triassic limestone caps; (3) local exotic bodies of intensely metamorphosed ultramafic and mafic rocks; and (4) a matrix of Albian to Cenomanian turbidite and olistostromes. Individual cherty bodies range from early Middle Triassic to early Cenomanian as determined by radiolarian and conodont assemblages. Complexly folded and faulted and metamorphosed to transitional blueschist-greenschist facies. K-Ar white mica isotopic age of 54 Ma. Terrane contains a collision-related biotite granite that intruded after metamorphism. Terrane is correlated in part with Hidaka terrane of Hokkaido Island. The Aniva terrane is tectonically paired to the East Sikhote-Alin volcanic-plutonic belt.

REFERENCES: Geology of the U.S.S.R., Sakhalin Island, 1970; Dobretsov, 1978; Rikhter, 1986; Khanchuk and others, 1988; Bekhtold and Semenov, 1990.

AO Agoi terrane (Pre-Paleozoic) (Metamorphic) (Eastern Tuva)

Consists of biotite and biotite-amphibole schist and gneiss, often with sillimanite, garnet and cordierite. Amphibolite, mica-bearing quarztite and graphite-bearing marble occur locally. Metamorphosed to amphibolite and epidote-amphibolite facies. Age of metamorphism and age of protlith unknown. parental rocks has not been estimated yet. Terrane occurs adjacent to Vendian-Cambrian island-arc units, within the large areas of early Paleozoic granitic intrusions.

REFERENCES: Makhin, 1959; Parfenov, 1967; Il'in and Kudryavtsev, 1960.

AR Argunsky terrane (Passive continental margin) (Paleoproterozoic through late Paleozoic) (Eastern Mongolia, Northeastern China, Transbaikalia)

In Northeastern China, terrane consists mainly of two sets of metamorphic rocks: (1) Paleoproterozoic and Mesoproterozoic metamorphic rocks, chiefly biotite-hornblende-plagioclase gneiss, biotite plagioclase gneiss, amphibolite, marble, quartz schist, and biotite schist; that exhibit regional-grade, dynamo-thermal metamorphism of lower amphibolite facies; and (2) Neoproterozoic metamorphic rocks, chiefly sericite-chlorite-shale, sericite-quartz-shale, crystalline limestone, ferrous quartzite, and diopside-plagioclase-gneiss, that exhibit low-temperature regional dynamic metamorphism of lower greenschist facies. Terrane is overlapped by Cambrian and Ordovician marine sedimentary rocks, and by angular-unconformably overlying Late Jurassic and Early Cretaceous siliceous-volcanic rocks. Bordered by Derbugan fault to the southeast.

REFERENCES: Bureau of Geology and Mineral Resources of Inner Mongolian Autonomous Region (Inner Mongolian GMRB), 1991; Dong Shenbao, 1993; Zhou Yuwei and others, 1993.

In eastern Mongolia and Transbaikalia region, terrane strikes northeast from Eastern Mongolia and forms a unit that is 13,000 km long and from 200 to 250 km wide. Terrane borders on the Onon terrane (OS) to the northwest, and the Nora-Sukhotin-Duobaoshan (ND), Mandalovoo-Onor (MD) terrane to northeast, and east, and the Idermeg terrane (ID) to the south and southeast. In some areas to the north, the tectonic borders of the terrane are a left-lateral fault or overthrust, but in most cases their tectonic nature of the contact is not clear.

The basement of the terrane consists of gneiss-like calc-alkaline palingenic biotite granite and leucogranite of the Dyrbylkeiksky and Urulunguebsky complexes. The U-Pb isotopic age of the former is 740±20 Ma (Bibikova and others, 1979), the Rb-Sr isotopoic age is 782±6 Ma (Rutshtein and Chaban, 1997). The Rb-Sr isotopoic age of the latter is 850±20 Ma (Bibikova and others, 1979). These weathered granitoids are overlain by middle Riphean sedimentary rocks of the Daurian series that consists of metamorphosed sandstone, siltstone, marble, and dolomite, limestone, siliceous rocks, and carbonaceous shale. The top of the sedimentary section consists of the Byrkinsky suite that contains layered bodies of basalt, rhyolite, and picrite metamorphosed to greenschist facies (Rutshtein and Chaban, 1997). The basalt is either a low-Ti variety similar to N-MORB, and a high-Ti variety similar to T-MORB (Gusev, Peskov, 1996). The volcanic rocks are interpreted as forming during rifting of a passive margin. The basement of northeast part of terrane consists mainly of two sets of metamorphic rocks: (1) Paleoproterozoic metamorphic rock consisting of lower amphibolite facies, biotite-hornblende-plagioclase gneiss, biotite-plagioclase gneiss, amphibolite, marble, quartz schist and biotite schist; (2) the Neoproterozoic metamorphic rock consisting of

lower greenschist facies sericite-chlorite-schist, sericite-quartz-schist, marble, ferrous quartzite, and diopside-plagioclase-gneiss (Dong Shenbao, 1986).

Overlying Vendian and Cambrian sedimentary rocks consist of the Gazimiursky sedimentary basin that forms part of the Argunj series. The lower part of the section consists of coarse-grained quartz sandstone and gravelstone that are succeeded by intercalated dolomite, limestone, marl, and terrigenous rocks. The age of is derived from abundant fauna, including archaeocyates, trilobites, brachiopods, bivalves, and micro-gastropods (Anashkina and others, 1997). Overlying Silurian through Early Carboniferous rocks consists of terrigenous sedimentary rocks with minor carbonate of the Gornozerentuy sequence, and the Talovsky suite that contains terrigenous sedimentary rocks with rare interbeds of greenstone and interbeds of intermediate and siliceous tuff. Also occurring is the Alenuysky complex containing Carboniferous intermediate and siliceous subvolcanic bodies. Also occurring are rare small layered massifs of gabbros and monzonites of the Late Carboniferous Taininsky complex that is interpreted as forming during intraplate activity. The youngest rocks in the terrane are late Paleozoic sedimentary rocks of the Early-Borzja fore-arc basin (Early Carboniferous through Early Triassic), granitoids of the Permian Undinsky complex of the North-Gobian volcanic-plutonic belt, and sedimentary rocks of marine molasse of the Early Jurassic Upper Borzja sedimentary basin.

The overlapping and stitching complexes are continental molasse of the Middle Jurassic Upper Gazimur suite, and sedimentary and volcanic-plutonic rocks of Trans-Baikalian-Daxinganling sedimentary-volcanic plutonic belt of Middle Jurassic through Early Cretaceous age. The age of accretion of the terrane to the eastern North Asia Craton is defined from the time of formation of continental molasse of the Middle Jurassic Upper Gazimur suite.

REFERENCES: Kotlyar and Popeko, 1974; Kozlov, 1972; Rutshtein and Chaban, 1997; Bibikova and others, 1979; Dong Shenbao, 1986; Efremov and others, 1998; Gusev and Peskov, 1996; Zorin and others, 1998a.

AT Altai terrane (Continental margin turbidite) (Precambrian and Cambrian through Devonian) (Southern Gorny Altai, Northwest China, Mongolia)

In northwest China forms the main part of Altay Mountains, and consists of two parts: (1) Precambrian migmatite, schist, marble, and other metamorphic rocks with algae and micro-flora fossils; (2) Ordovician, Silurian, and Devonian flysch, that unconformably overlaps the Precambrian basement, and consists mainly of metasandstone, metasiltstone, metashale, metatuff, metamorphosed clastic rocks, chert, and other sedimentary rocks, with local brachiopoda, anthozoan corals. Carboniferous marine and limnic terrigenous rocks unconformably overlap the Altay terrane. The southern part of Altay terrane is interpreted as a late Paleozoic continental margin arc.

REFERENCES: Yang Sennan, 1984; Ren Jishun and others, 1980; Bureau of Geology and Mineral Resources of Xinjiang Uygur Region (Xinjiang GMRB), 1990.

In western Mongolia, consists chiefly of: (1) Middle to Late Cambrian sandstone, siltstone and shale grading upward into coarse-grained deposits that are more than 6,000 m thick (Altay series); (2) unconformably overlying Silurian conglomerate, sandstone, siltstone, tuff with minor basalt, andesite, rhyolite, and limestone containing brachiopods and tabulata corals. Middle to Late Cambrian rocks are metamorphosed to greenschist facies and strongly deformed into northwest trending, open to isoclinal folds. Preaccretion granitic rocks consist of calc-alkalic diorite, granodiorite, and granite of Tsagangol complex, that yield K-Ar ages of 400 to 456Ma. The Altay terrane is overlain by a Devonian sedimentary-volcanic-plutonic assemblage, Early Carboniferous shallow marine sedimentary rocks, Permian volcanic-sedimentary rocks, and Early to Middle Jurassic coarse nonmarine sedimentary deposits. Postaccretion granite rocks include Late Devonian, Middle to Late Carboniferous and Early Permian granite, leucogranite, and alaskite.In Mongolia, the Altai terrane is interpreted as a continental margin fragment that was tectonically linked to the Hovd continental-margin turbidite terrane in the Devonian.

REFERENCES: Berzin., 1995; Volochkovich and Leont'ev, 1990; Byamba and Dejidmaa, 1999; Demin and Demin., 1993; Dergunov and others, 1980, 1989; Dobretsov and others, 1995; He Gouqi and others, 1991, Gavrilova and others., 1975, Windley and others, 1994, Zonenshain and others, 1990.

In the southern Gorny Altai, consists of Middle-Late Cambrian thick sand-shale flysch that formed at the foot of a continental slope. The lower part of the section consists of gray and green-gray, quartz-plagioclase clastic material. Upwards, the rocks are more polymictic. The flysch-like unit may be underlain by ophiolite and locally by

island-arc rocks. Middle and Late Ordovician deposits with marine fauna fossils opccur adjacent to the southwestern margin of the terrane, range up to 2000 m thick and consist of gray and green and rare red, polymictic calcareous sandstone, shale, and calcareous siltstone, with gravelstone and conglomerate interbeds and limestone lenses. The relationship to the Cambrian deposits is unclear. Silurian and Devonian deposits occur in several parts of the terrane and consist of sandstone and siltstone, and molasse with limestone lenses of Early-Late Silurian age as indicated by coral, brachiopods, trilobites, and conodonts. The Silurian deposits disconformably overlap the Cambrian flysch that is metamorphosed to greenschist facies in the pre-Silurian. The molasse deposits are coarse-clastic rocks (conglomerate, gravelstone, coarse-grained sandstone), mainly siliceous-quartz composition, and subordinate siltstone, shale, marl, and limestone that contain Wenlock and Ludlow brachiopods, rugose corals, and Tabulata corals. In the southwestern part, the Silurian deposits are conformly overlapped by Lokhkov limestone (Sarymsaktin suite). The central and eastern areas are partly covered by Early-Middle Devonian volcanic-sedimentary rocks.

Locally, the Cambrian sequences are zonally metamorphosed to amphibole facies that occurred during middle Paleozoic strike-slip faulting and related tectonic piling. An east-west-striking metamorphic zone in southern Gorny Altai, in the South-Chuya ridge area, contains the youngest metamorphic event, with a Rb-Sr isotopic age of 357± 21 Ma for tourmaline-bearing granite. In the northwest, the intrusive units are dominated by possibly two or more generations of Devonian plumasite low-alkaline granite with U-Pb isotopic ages of 401±4 and 375±29 Ma, and Jurassic raremetal-plumasite granite with Rb-Sr isotopic age of 204±2, and U-Pb isotopic ages of 182±19, and 196 ±4 Ma.

REFERENCES: Berzin and Dobretsov, 1994; Bespajev, 1997; Dergunov and others, 1980; Grigor'yev, 1988; Kozlov, Dubatolov, 1994; Plotnikov and others, 1998; Shokalsky and others, 1996; Vladimirov and others, 1997; Volochkovich and Leontjev, 1964; Zonenshain and others, 1990.

AV Atamanov terrane (Granulite-paragneiss) (Paleoproterozoic) (Yenisey Ridge)

Occurs in the southern part of the South Yenisey Ridge to the east of the Kuzeev terrane. Extends for 70 km and ranges up to 25 km wide. To the east, the terrane is intruded by Taraka granite with a isotopic age of 1780±10 Ma (Bibikova and others, 1993). Consists mainly of high-aluminous garnet-biotite, cordierite-garnet-biotite, garnet-sillimanite-cordierite gneiss and granulite (Nozhkin, 1999). Migmatite, gneiss, and pegmatite are widespread. Protoliths are clay and polymictic sedimentary rocks (Precambrian…, 1986; Popov, in press). The relationships with Taraka granite and granulite metamorphism suggests the terrane is Paleoproterozoic.

REFERENCES: Precambrian ___, 1986; Nozhkin, 1999; Popov, in press.

AY Ayansk terrane (Passive continental margin) (Ordovician through Late Carboniferous) (Yakutia)

Consists chiefly of Ordovician, Silurian, Devonian, and Late Carboniferous shallow-marine limestone, quartz sandstone, siltstone, diabase, conglomerate, breccia, dolomite, and argillite (Aldomsk, Lantarsk, Ulukansk, Tanchinsk, and Jikandisnsk suites). Also locally contains Early and Late Devonian, deep-marine tuffaceous rocks, and radiolarian chert, but relation to shallow-marine rocks is unclear. Paleozoic rocks are intruded by inferred late Paleozoic gabbro. The Late Ordovician, Silurian, and Middle and Late Devonian limestone contains abundant brachiopods. Late Carboniferous argillite contains Angara flora. Late Devonian diabase, conglomerate, and breccia may be rift-related. Paleozoic stratigraphic units are unconformably overlain by Late Jurassic andesite and volcaniclastic rocks of Uda volcanic-plutonic belt (unit ud) which links Ayansk terrane to Siberian platform.

REFERENCES: Krasny and others, 1966; Shilo, 1982; Zmievsky, 1990.

BA Beitianshan-Atasbogd terrane (Island arc) (Devonian through Carboniferous) (Northwest China, Mongolia)

In northwest China, consists of: (1) intermediate-mafic, intermediate-siliceous, siliceous volcanic rocks, chert, limestone, tuff, sandstone, and siltstone, with Devonian brachiopods, anthozoan marine corals; (2) andesite-porphyry, intermediate-siliceous tuff, tuffaceous sandstone, siltstone, basalt, and interbedded flysch and limestone with Carboniferous fusulinids and brachiopods. Unconformably overlapping units are Permian andesite, rhyolite,

sandstone, limestone, and conglomerate. The Early Permian strata contain brachiopods and the late Permian strata contain flora.

REFERENCES: Ren Jishun and others, 1980; Bureau of Geology and Mineral Resources of Xinjiang Uygur Aut. Reg.(Xinjiang GMRB) (1990).

In southwestern Mongolia, consists of: (1) undated biotite gneiss, migmatite, orthogneiss, amphibolite, metagabbro, metadiorite, metarhyolite, and metagranite; (2) Ordovician and Silurian greenschist facies metamorphosed sandstone, siltstone, argillite, phyllite, chert, and quartzite, and minor marble and pillow basalt (Tomort Formation); (3) Early and Middle Devonian conglomerate, sandstone, siltstone, basalt, andesite, dacite, rhyolite, tuff, breccia, and radiolarian chert, and rare fossiliferous limestone lenses (Ehiyn gol Formation); (4) Mississippian conglomerate, sandstone, siltstone, limestone lenses with brachiopods and bryozoan. The terrane is intruded by Silurian(?) tonalite, granodiorite, monzodiorite, and granite (Naransevestey Complex) and Late Devonian and Early Carboniferous granodiorite, quartz-diorite, and granite, minor gabbro and diorite (Gobi-Tienshan Complex).

Overlap and stitch complexes are Pennsylvanian and Early Permian volcanic and volcaniclastic rocks, and the Noyon foreland basin that contains Late Permian to Jurassic alluvial and lake sedimentary rocks, and alkaline granite plutons (Transaltai Complex). Terrane was formerly interpreted as western part of South Gobi microcontinent (Zonenshain, 1972; Ruzhentsev, 1985) or a northern slope and rise (Ruzhentsev and others, 1987). This study interprets the terrane as an intensely deformed and metamorphosed, displaced fragment of an island arc and forearc or backarc basin.

REFERENCES: Zonenshain, 1972; Ruzhentsev, 1985, Ruzhentsev and others, 1987; Badarch, 1990.

BD Badzhal terrane (Accretionary wedge, type B) (Permian through Jurassic) (Southern Russian Far East)

Southern part of the terrane consists of : (1) Paleozoic limestone olistoliths embedded in a clastic matrix; (2) chert inclusions with Permian and Triassic conodonts and Mesozoic radiolarians; (3) turbidite deposits with Late Triassic *Monotis* and *Holobia*, and Middle and Late Jurassic pelecypods and ammonites; (4) chert and siliceous shale with Late Triassic and Jurassic radiolaria and conodonts; and (5) small lenses of mafic volcanic rocks. Previously studies indicated terrane consisted of widespread Carboniferous and Permian clastic rocks and limestone with macro- and microfauna, chert, mafic volcanic rocks, and Triassic and Jurassic clastic and rare volcanic units. Mesozoic units occur mainly in the eastern and southeastern part of the terrane.

Terrane is interpreted as a Triassic to Middle Jurassic accretionary wedge complex that consists of tectonically intermixed oceanic and continental slope deposits. Limestone units, that contain Carboniferous and Permian Tethyan fauna, are interpreted as caps to seamounts. Mesozoic deposits in the southeastern part of the terrane may constitute a subterrane. A series of metamorphic domes with amphibolite-facies metamorphism occur near the boundary with the Turan terrane of the Bureya superterrane. The domes are interpreted as forming during formation of the accretionary complex.

Postaccretion rift-related Cenozoic alkalic basalt and sedimentary rocks of the Sakhalin-Primorye volcanic belt occur in narrow, north-striking basins within the terrane. The Badzhal terrane is interpreted as tectonically linked to the Khingan-Okhotsk active continental margin to the south. The Cretaceous granitic and volcanic rocks of the Khingan-Okhotsk belt link together the Turan and Malokhingansk terranes of the Bureya superterrane, and the Badzhal, Galam and Ulban terranes.

REFERENCES: Krasny, 1966; Romanchuk and Maiboroda, 1974; Shevelev and Kuzmin, 1990; Natal'in, 1991, 1993; Zablotsky and others, 1991.

BG Bayanleg terrane (Accretionary wedge, type A) (Ordovician to Devonian) (Gobi Altay)

Consists chiefly of an intensely-deformed, thick assemblages of Ordovician to Devonian sandstone, siltstone, shale, chert, tuff, and rare coral and crinoid-bearing limestone that contain small bodies of ultramafic rocks and gabbro (Bayanleg ultramafic belt). Intensely faulted, sheared, mylonitized, and metamorphosed to greenschist and amphibolite facies, and intruded by sills of gabbro, diorite and foliated biotite granite. K-Ar isotopic ages are 430 to

450 Ma for the amphibolite, 395 to 330 Ma for gabbro (Pinus and others, 1981, 1982). Terrane is interpreted as a subduction zone assemblage that was tectonically linked to the Mandalovoo island arc terrane.

REFERENCES: Pinus and others, 1981, 1982; Kuznetsov, 1983; Ruzhentsev and others, 1987; Badarch, 1990.

BH Bayanhongor terrane (Oceanic) (Neoproterozoic) (Western Mongolia)

Forms a northwest-trending, discontinuous, narrow belt that consists of a large ophiolite allochton that structurally interleaved with the southern part of the Orhon terrane. Consists of two synformal belts bordered by serpentinite melange zones. The largest and northern synform consists of serpentinite melange with a length of up to 300 km and a width of 1-10 km. The second southern synform includes small zones of serpentinite melange that vary from 5 to 10 km long, and range up to 5 km wide. The ophiolite complex includes metaperidotite, cumulate, gabbro, sheeted dikes, and basalt pillow. Sm-Nd whole rock isotopic age from gabbro is 569 Ma (Kepezhinskas and others, 1991).

The metaperidotites consist of harzburgite serpentinite, and the cumululate rocks consist of alternating harzburgite, dunite, werlite, clinopyroxenite, and less common orthopyroxenite. Thickness of layers varies from 1.5 to 40 m, with a total thickness of 350 m. In the cumulate rocks are small lenticular bodies of rodingite gabbro (lower gabbro) at the base, and individual small dikes of rodingite diabase at the top of the section. The upper gabbro consists of a 50 m layer of mainly mesocratic gabbro both massive and with local pegmatoid structure. Sheeted dikes consist of aphyric and porphyritic basalt and diabase with screens of gabbro. Thickness of sheeted dikes varies from 500 m to 1200 m. Pillow lava unit consists of plagiophyric and aphyric basalt and diorite. Terrane is moderately to intensely folded and thrust-faulted, and structurally overlies highly-deformed sedimentary rocks of Orhon terrane. Terrane is overlain by Late Ordovician, Silurian, Devonian, Early Carboniferous sedimentary rocks, and is intruded by early and late Paleozoic granitic rocks. The fault juxtaposition of the Early Carboniferous sedimentary rocks requires extensive post Carboniferous tectonic displacement within the terrane. Terrane is interpreted as a fragment of oceanic crust that was tectonically linked with Orhon and Zag Haraa terranes in early Paleozoic.

REFERENCES: Perfiliev and Kheraskov, 1980; Kopteva and others; 1984; Kepezhinskas and others; 1991; Ryazantsev, 1994; Kotov and others, 1995; Teraoka and others, 1996;Dergunov and others; 1997; Takahashi and others, 1998; 1999; Takahashi and others, 1999.

BI Birusa terrane (Paragneiss) (Paleoproterozoic to Neoproterozoic) (Eastern Sayan)

Extends in a northwestern direction for 350 km long and varies from 70 to 100 km wide. Consists of the Khailamin and Alkhadir units:. Khailamin unit consists of biotite, garnet-biotite gneiss, plagiogneiss, amphibolite, two-pyroxene, and pyroxene-hornblende gneiss. Migmatites are widely distributed, and amphibolite derived from mafic metavolcanic rocks and charnockite occur locally. Metamorphic grade ranges from amphibolite to granulite facies. The lower part of the Alkhadir unit consists of high-magnesia orthoamphibolite, similar to metakomatiite, serpentine-chlorite and biotite-actinolite schist, and overlying marble and high-alumina mainly biotite-garnet gneiss.

A well-marked metamorphic, structural and stratigraphic unconformity occurs between these units. Most researchers interpret that the age of Khailamin unit as Archean and Paleoproterozoic(?), and the age of the Alkhadir unit as Paleoproterozoic, Mesoproterozoic, and Neoproterozoic(?). Terrane is unconformably overlapped by Neoproterozoic terrigenous-carbonate deposits (Karagas and Oselok units) and in the northeast by the Paleoproterozoic and Mesoproterozoic terrigenous-carbonate deposits, including Devonian volcanogenic and volcanic-sedimentary rocks. The terrane is intruded by biotite, two-mica and muscovite granite, and leucogranite of the Sayan complex, and by Early Devonian biotite, subalkaline and alkaline granite and granosyenite. It is assumed that the age of Sayan granite is the Paleoproterozoic.

REFERENCES:.Galimova and Bormotkina, 1983; Sez'ko, 1988; Brintsev, 1994; Nozhkin, 1999.

BK Belaya-Kitoy terrane (Metamorphic) (Archean?) (Eastern Sayan)

Consists of several northwest-trending tectonic lenses and sheets that dip steeply (70-85°) to the southwest. Chiefly composed of gneiss with variable amounts of mica, amphibole, clino-orthopyroxene, and garnet, and less abundant amphibolite, marble, and calciphyre with gneissic granite and alaskite. Blastomylonization and

metamorphic diaphthoresis of epidote-amphibolite and greenschist facies occur locally. Metamorphic rocks are similar to Archean units of adjacent areas in the North Asian Craton, from which the Belaya-Kitoy terrane is separated by the large, regional, strike-slip Main Fault in the Eastern Sayan. K-Ar isotopic ages of biotite and amphibole range from 206 to 478 Ma, with a peak of 285-312 Ma. The ages are interpreted as reflecting a superposed thermal event in a late Paleozoic strike-slip zone.

REFERENCES: Polkanov and Obruchev, 1964.

BL Baladek terrane (Metamorphic) (Paleoproterozoic through Ordovician) (Southern Russian Far East)

Consists chiefly of a crystalline basement complex and younger stratified units. Basement complex consists of anorthosite, gabbro-anorthosite, gabbro, gabbro-norite and pyroxenite (Malotokhikansk and Tokhikansk complexes). Anorthosite is intruded by granite and granodiorite with preliminary U-Pb isotopic ages ranging between 2.2 and 2.6 Ga, and K-Ar isotopic ages ranging between 964 and 365 Ma. Unconformably overlying stratified units are: (1) Early Cambrian red conglomerate, sandstone, siltstone, basalt, and limestone (Shevlinsk and Usttimptonsk suites); (2) Late Cambrian limestone, sandstone and siltstone; (3) thick units of sandstone, siltstone, conglomerate, limestone, and marl that contain Early Ordovician algae and yield K-Ar glauconite ages of 491 and 495 Ma.; (4) Mississippian sandstone; and (5) Triassic and Early to Middle Jurassic marine clastic rocks that unconformably overlie older rocks and are interpreted as a forearc basin to the Uda volcanic-plutonic belt, part of the Mongol-Okhotsk active continental margin, that occurs along the Stanovoy block of the North Asian Craton. The terrane is unconformably overlapped by Late Jurassic marine clastic deposits and Early Cretaceous nonmarine clastic deposits (Uda-Zeya sedimentary basin) that links the Baladek terrane with the North Asian Craton Margin. Early Cambrian archaeocyatheans of terrane are similar to those of Siberian Platform and differ from archaeocyatheans in limestone olistoliths in the nearby Galam terrane. The Baladek terrane bounded to south by the Uligdansk dextral-slip fault and is interpreted as a fragment of the North Asian Craton Margin.

REFERENCES: Kirillova and Turbin, 1979; Karsakov and others, 1987; Belyayeva, 1988; Martynyuk and others, 1990; Krasnyi and others, 1996.

BLK Belokurikha terrane (Metamorphic) (Late Permian and older) (Northern Gorny Altai)

Forms a tectonic sheet that is thrust over the accretionary wedge Alambai terrane. Chiefly composed of metapelite, lesser amphibolite, and quartz-banded iron ores metamorphosed to epidote-amphibolite facies. Age of parental rocks and initial stage of metamorphism not yet estimated. Locally, these rocks experienced superimposed low-pressure high-temperature metamorphism and granitization as indicated by U-Pb zircon isotopic ages of 311± Ma. Terrane is intruded by a massif of Late Permian and Triassic high-potassium granite with a U-Pb zircon isotopic age of 232±4.7 Ma, or a Rb-Sr whole rock isotopic age of 245±8 Ma. To the the north, the terrane is overlapped by Cenozoic sedimentary rocks.

REFERENCES: Blyuman and Petrov, 1973; Kargopolov and others, 1995; Shokalsky and others, 1997; Vladimirov and others, 1997.

BM Baikal-Muya terrane (Island arc) (Neoproterozoic) (Transbaikalia)

Extends from Lake Baikal in the west)to Vitim River and consists of ophiolite fragments that occur in tectonic slabs and wedges. Ophiolite consists of basalt, hemipelagic sedimentary rocks, gabbro and alpine type ultramafic rocks. Basalts are N-MORB, E-MORB, and IAB types. Age of ophiolite unknown, but ophiolite is intruded by Neoproterozoic island arc magmatic rocks. The island arc complex consists of basalt-andesite-plagiorhyolite (upper Kilyansky suite), gabbro-plagiogranite intrusive bodies, tuffaceous-volcaniclastic turbidites marginal to the arc rocks. The ophiolite and island arc complexes are metamorphosed to greenschist facies. Ophiolite and island arc complexes are locally deformed into steep isoclinal and inverted folds with variably-oriented axes. The island arc complex contains Riphean microfossils (Stanevich, Perelyaev, 1997) and exhibits U-Pb zircon isotopic ages of 923 Ma for plagiorhyolite (Konnikov and others, 1994), Sm-Nd isotopic age of 825 Ma for gabbro (Isokh and others, 1998), Rb-Sr isotopic ages of 774 and 773 Ma for gabbro (Tsygankov and others), and Rb-Sr isotopic ages of 880 and 730 Ma for plagiogranite. Accretion of the terrane to the North-Asian Craton is interpreted as occurring at the end of Riphean. Accretion was associated with formation of intermontane depressions filled with continental sub-alkaline basalt and rhyodacite, tuff, and coarse clastic sedimentary rocks (Padrinsky series, Tuluinsky suite,

Zhanokinsky complex). The Padrinsky series is deformed into linear folds with shallow-dipping (30°) limbs. The Zhanokinsky volcanic complex dips horizontally and subhorizontally. Close to fault zones, the folds are steep, vertical and inverted. Comagmatic with extrusive rocks are gabbro, diabase, and leucogranite (Vitim complex). The Rb-Sr isotopic age of the extrusive rocks is 765-712 Ma (Bulgatov, 1983; Zagruzina and others, 1984). Overlying and intruding the terrane are Vendian-Cambrian non-metamorphosed terrigenous-carbonate sedimentary rocks in the Upper Angara sedimentary basin and granite of the Konkudero-Mamakan complex with U-Pb zircon isotopic ages of 556 and 470 Ma (Sryvtsev and others, 1992) for alkaline-syenite (Synnyrsky complex), lamprophyre (Kadali-Butuinsky complex). Seismic data indicate that fragments of terrane are underlain at depth by oceanic crust.

REFERENCES: Bolonev and others, 1983; Bulgatov, 1983; Bulgatov, 1988; Izokh and others, 1988; Sryvtsev and others, 1992; Konnikov and others, 1994; Zagruzina and others, 1984; Bulgatov, 1995; Stanevich and others, 1997; Bulgatov and Zaitsev, 1998; Tsygankov and others, 1998.

BR Baratal terrane (Accretionary wedge, Type B) (Late Neoproterozoic through Early Cambrian) (Southeastern Gorny Altai)

Consists of a combination of tectonic sheets and nappes that dip to the southwest and are thrust over Vendian-Early Cambrian island-arc units to the southeast. From lower to upper, the imbricated-thrust structure consists of several units. (1) An ophiolitic melange that consists of harzburgite, serpentinite, garnet amphibolite, eclogite, basalt and greenschist with barroisite, stilpnomelane, and glaucophane. K-Ar isotopic ages of amphiboles are 535±24 Ma for eclogite are 487±22, 473±13 Ma for garnet amphibolite, and 523±23 Ma for garnet-free amphibolite. K-Ar isotopic ages for chlorite and chlorite-muscovite matrix from the greenschist are 540±24 and 567±11 Ma, respectively. The garnet amphibolite and eclogite are N-MORB type. (2) A late Riphean-Early Cambrian(?) sedimentary-volcanogenic assemblage that contains a series of sheets of marine and oceanic island basalt (main part of the Arydzhan and Sagalak suites), limestone, shale, chert, sandstone, and polymictic and carbonate olistostromes, and a local siliceous-carbonate assemblage. And (3) alternating tectonic sheets of chert, marine slide breccias of siliceous composition (olistostromes), shale, and basalt.

An imbricated nappe consists of Vendian-Early Cambrian siliceous-carbonate rocks (Baratal suite) with lenses of polymictic olistostromes in the base. The total thickness of the imbricated-thrust structure is greater than 10 km. In the southwest, the terrane is overlain by the Middle and Late Cambrian continental margin molasse with olistostrome horizons, and locally by Early and Middle Devonian sedimentary-volcanogenic rocks that were part of an active continental margin. The terrane is cut by northwest-striking strike-slip faults of late Paleozoic-early Mesozoic? age.

REFERENCES: Gusev, 1991; Dobretsov and others, 1992; Buslov and others, 1993; Buslov and Watanabe, 1996.

BRG Barguzin terrane (Metamorphic) (Late Neoproterozoic) (Transbaikalia)

Stratified units are as follows. (1) The Ulokitsky suite that consists of tuffaceous-basalt-terrigenous rocks, flood basalt, and gabbro-diabase sills. (2) The overlying Nyandoninsky sandstone-shale suite of interbedded sandstone, limestone, flood basalt, tuff, gabbro-diabase and gabbro-diabase. The igneous rocks have high Ti and P contents, are enriched in light REE, and are close in composition to continental rift basalt. And (3) the Barguzin shale sequence suite. Total thickness is 7,000 m. The Nyandoninsky and Barguzin suites contain microfossils of the Middle and early Late Riphean age (Dolnik and others, 1990), and are metamorphosed from greenschist to amphibolite facies around the contact zone of the Barguzin-Vitim batholith that contains a staurolite zone from 5-15 km width (Bolonev and others, 1983). Farther from from the contact, this zone is replaced by a garnet zone (staurolitechlorite-muscovite and garnet subfacies) with a width of 10-15 km. At a greater distance from the contact of batholith is a chlorite-actinolite-biotite zone with a width of 10-20 km. The last subfacies is characteristic of the rocks of all suites, even for: rocks of the lowest Ukolkitsky suite. The zonal metamorphism is a kyanite-sillimanite facies series. The sedimentary rocks in the terrane are deformed into northeast-trending linear fold. The terrane is overlapped by Vendian-Cambrian non-metamorphosed, variegated basalt-terrigenous, terrigenous, and fauna-bearing carbonate sedimentary rocks of the Upper Angara sedimentary basin (Bolonev and others, 1983). Early, middle and late Paleozoic granite batholiths intrude the terrane and have U-Pb zircon isotopic ages of 440, 425, 390, 307, 301-300 Ma (Rytsk and others, 1998). Seismic data indicate a continental crustal basement below the terrane (Bulgatov, 1988).

REFERENCES: Bolonev and others, 1983; 1983; Bulgatov, 1998; Dolnik and others, 1990; Rytsk and others, 1998.

BS Borus terrane (Accretionary wedge, type B) (Early Cambrian) (Northwest Sayan)

Consists of the following sequences. (1) An ophiolitic assemblage with a lower part of serpentinized dunite, harzburgite, lherzolite, and lesser werlite with small lenses of gabbro-amphibolite, and an upper part of metabasalt, tuff, siliceous and black shale, phyllite and clastic rocks that formed from erosion of volcanic-siliceous deposits (Chingin suite). Blocks of high-pressure rocks, jadeite and garnet amphibolite, occur within the serpentinite melange. (2) A presumed island-arc assemblage of weakly metamorphosed pyroxene porphyry, mafic tuff, volcaniclastic rocks, siliceous shale, and marble-like limestone with sparse Early Cambrian archeocyata. The Kantegir gabbro-diorite-plagiogranite assemblage, that occurs in the ultramafic rocks, is interpreted as part of an island-arc. Kantegir assemblage is correlated with the Main massif granitoids of the North-Sayan terrane. And (3) coarse-clastic deposits, ranging in size from boulder conglomerate to sandstone, and tuffaceous rocks of unknown age, with clasts of mafic volcanic rocks, chert, limestone and ultramafic rocks. These coarse-clastic deposits occur in small, fault-bounded zones and less deformed and metamorphosed compared to the other units. The Borus terrane is intruded by Middle Silurian and Early Devonian granitoids of the Bolshoy Porog and Dzhoi complexes.

REFERENCES: Isakov and Korobeinikov, 1969; Sobolev and Dobretsov, 1977; Kheraskov, 1979.

BU Bureya terrane (Metamorphic) (Neoproterozoic through Triassic) (Southern Russian Far East)

Occurs in the northwestern part of the Amursk superterrane. Consists mainly of early Paleozoic metamorphic core complexes composed of large lower and the upper units. The lower unit (Amursk and Gudzhalsk suites) consists of gneiss, schist, marble, quartzite, and amphibolite that are metamorphosed to amphibolite facies. The upper unit consists of marble, quartzite, and metasandstone that is metamorphosed to greenschist facies. In the northwestern and southeastern parts of the terrane, near the boundary with the Nora-Sukhotinsk and Malokhingansk terranes, metamorphosed gabbro, pyroxenite, and peridotite intrude gneiss and schist, amphibolite, and marble. Older, weakly metamorphosed overlap assemblages are (1) silicic and intermediate volcanic rocks, sandstone, and siltstone (Turansk suite); (2) Neoproterozoic limestone (Melgiysk suite) with plant microfossils; (3) Cambrian clastic rocks and limestone (Allingsk and Chergelensk suites) with Archaeocyatheans. Younger overlap assemblages are Middle and Late Devonian clastic rocks with marine faunas that form wall rocks to abundant late Paleozoic and possibly early Mesozoic granitic rocks. Widespread early Paleozoic granitic rocks (Kiviliysk and Sularinsk complexes) intrude the terrane and consist of (1) predominantly biotite and hornblend-biotite granite, granodiorite, and diorite of the subduction-related Tyrma-Bureinsk complex; (2) minor Permian granosyenite, syenite, quartz syenite, and coeval volcanic rocks; and (3) large plutons of leucogranite and silicic volcanic rocks of possibly Triassic age. The large Bureya sedimentary basin overlaps the eastern part of the terrane. The narrow Umelkan-Ogodzhin belt overlies the northern flank of the terrane and sutures the Turan, Mamyn, Gonzha, and Oldoi terranes. The Cretaceous Khingan-Okhotsk volcanic-plutonic belt intrudes the southern part of the terrane.

REFERENCES: Sigov, 1973, Zmiyevsky, 1979, Kozlovsky, 1988, 1980, Natal'in, 1991.

BY Baydrag terrane (Cratonal) (Neoproterozoic and older) (Northwest Mongolia)

Consists chiefly of Early Precambrian crystalline basement and Riphean sedimentary cover. The Precambrian basement comprises of the Baydrag and Bumbuger structural-metamorphic complexes. The Byadrag complex consists of interbedded amphibolite, pyroxene-bearing schist, and leucocratic pyroxene-bearing plagiogneiss, with migmatized biotite plagiogneiss that contain boudin-like bodies of amphibolitized two-pyroxene plagiogneiss. The migmatized biotite plagiogneiss range from quartz diorite to trondhjemite, whereas the two-pyroxene plagiogniesses are derived from calk-alkaline diorite and quartz diorite. A U-Pb zircon age for the biotite plagiogneiss is 2646±30 Ma (Mitrofanov and others, 1985). The Bumbuger complex comprise two series: (1) an alternating series of amphibolite two-pyroxene schist and leucocratic pyroxene-bearing gneiss; (2) alternating fordterite-bearing marble, quartzite, pyroxene-amphibole, garnet schist, garnet-biotite gniess, and leucocratic pyroxene-bearing plagiogneiss. Protoliths are metavolcanic rocks, mainly bimodal basalt and rhyolite with subordinate metasedimentary rocks (Kozakov, 1986).

Post-tectonic granitoids consist of thin veins and dikes of amphibole granosyenite, granodiorite and granite with isotopic ages of 1825±5 Ma. Unconformably overlying Riphean sedimentary units consists of basal coarse sandstone grading upward to a ridge-forming quartzite, metasandstone, stromatolitic dolomite, limestone, and carbonate-sedimentary rocks. K-Ar ages of these rocks are 840 Ma. The postaccretion units consists of Late Ordovician conglomerate, sandstone, and coral limestone, Silurian graptolite-bearing shale, Devonian intermediate to felsic volcanic rocks, sandstone, and siltstone, and Early Carboniferous shallow marine sedimentary rocks. Stitch complexes includes the early Paleozoic Baydrag complex and late Paleozoic plutons. The Baydrag complex consists of biotite plagiogranite and diorite with isotopic ages of 469 to 551 Ma.

REFERENCES: Mitrofanov and others, 1981, 1985; Kozakov, 1986; Bibikova and others; 1990; Ryazantsev, 1994; Kotov and others, 1995; Teraoka and others, 1996;, Dergunov and others, 1997; Kozakov and others, 1997; Takahashi and Delgertsogt, 1997; Takahashi and others, 1998, 1999.

BZ Bazibai terrane (Metamorphic) (Late Neoproterozoic and Cambrian) (Eastern Sayan)

Occurs in a horst of metamorphic rocks within the less metamorphosed Vendian-Cambrian volcanic-sedimentary island-arc rocks. Consists of gneiss, schist, amphibolite, and less marble metamorphosed to epidote-amphibolite and amphibolite facies. The age of metamorphic rocks is unknown with interpreted as early Paleozoic.

REFERENCES: Nikulchenko and others, 1962; Lebedev and others, 1993; Berzin, 1995.

CA Central Angara terrane (Passive continental margin) (Neoproterozoic) (Altai)

Occurs in the central part of the Yenisey Ridge to the east of West Angara terrane in a belt about 300 km long and ranging up to 50-70 km wide. Terrane consists of: (1) Late Riphean(?) terrigenous and terrigenous-carbonate sedimentary rocks metamorphosed to greenschist and more rarely to epidote-amphibolite facies of the Sukhopit unit that contains quartz-chlorite-serpentine schist, flysch deposits, limestone, and dolomite; and (2) unconformably overlapping sedimentary rocks of Tungusik unit that contains coaly mudstone, flysch, and limestone and dolomite. These deposits are intruded by calc-alkaline granite of the Tataka-Ayakhta complex with a isotopic age of 760 Ma and that exhibits a contact metamorphic halo (Datsenko, 1984). To the north, terrane is overlapped by the Vendian-Cambrian terrigenous-carbonate deposits.

REFERENCES: Khomentovsky and others, 1972; Kornev and others, 1974; Postel'nikov, 1980.

Central Aldan Superterrane (Yakutia)

Forms the central part of the Aldan-Stanovoy shield. To the west, is bounded by the West Aldan composite terrane along the Amga tectonic melange zone, and to the east is bounded by the East Aldan superterrane along the Tyrkanda tectonic melange zone. The Central Aldan superterrane consists of the Nimnyr and Sutam terranes that are separated by the Seim overthrust with an age of 2.3-1.9 Ga (Gorokhov and others, 1981). The terranes are dominated by granitoid orthogneiss and lesser sedimentary rocks (Dook and others, 1986).

REFERENCES: Gorokhov and others, 1981; Dook and others, 1986.

CANM Nimnyr terrane (Granulite-orthogneiss) (Paleoproterozoic) (Yakutia)

Nimnyr terrane (with areal dimensions of 150 km×200km) occurs in the western part of the Central Aldan superterrane. The structural pattern of the terrane is defined by a widely-developed granite-gneiss domes. The largest is the Timpton dome (with areal dimensions of 175×200 km) in the northern part of the terrane (Dook and others, 1986). The cores of the domes consist of orthogneiss, including granite-gneiss, charnockite- and enderbite-gneiss with amphibolite bodies that comprise more than 50 percent of the terrane area. The external parts of the domes are composed of a paragneiss complex consisting of two rock assemblages: (1) the Kurumkan Group that includes quartzite and high-alumina gneiss with lenses of calciphyres and iron quartzite (Khil'tova and others, 1988; Dook and others, 1986); and (2) the Fedorov Group that contains amphibole, diopside-amphibole, and two pyroxene-amphibole plagiogneiss, and rare schist with bands and lenses of diopside, phlogopite-diopside rock, and calciphyre. Less common is diopside-amphibole and two-pyroxene schist with lenses and beds of calc-silicate rocks and calciphyre

(Petrova and others, 1975; Cherkasov, 1978; Velikoslavinskiy, 1976; Petrova and Smirnova, 1982; Beryozkin and Kitsul, 1979). The terrane is metamorphosed to low and middle pressure granulite facies.

Sm-Nd isotopic studies of high-alumina gneiss (similar in chemical composition to pelite and siltstone) and of interlayered biotite-hypersthene plagiogneiss (chemically corresponding to tuff and graywacke) indicate that protoliths for the former formed from breakdown of the rocks with a Nd age of 2.85-3.06 Ga, while protoliths for the latter were derived from the rocks as old as 2.33-2.4 Ga (Kovach and others, 1995b). The Fedorov Group resulted from metamorphism of protoliths with a model Nd age of 2.1-2.3 Ga (Kovach and others, 1995a). The lower age limit of the granulite metamorphism of the Kurumkan Group is estimated at 2.3 Ga, whereas that of the Fedorov Group is 2.15 Ga. Similar conditions of the granulite metamorphism of both groups (Dook and others, 1986) suggest that they were most intensely metamorphosed after 2.15 Ga. The upper age limit of high-temperature metamorphism is constrained by the emplacement of aplite-like granite dated at 1.9±0.15 Ga (Sal'nikova, 1993). Diaphthoresis of amphibolite facies rocks and the accompanying metasomatism are dated at 1.9-1.8 Ga (Murzaev, 1969; Mikhailov and Levchenkov, 1971; Pozharitskaya and others, 1973). Orthogneiss with a Nd model age of 2.3-2.5 Ga (Sal'nikova, 1993) contain relics of granite-gneiss and tonalite-trondhjemite gneiss which are relatively older. The latter are probably relics of the basement rocks upon which primary sedimentary rocks accumulated (Dook and others, 1986).

REFERENCES: Murzaev, 1969; Mikhailov and Levchenkov, 1971; Pozharitskaya and others, 1973; Petrova and others, 1975; Velikoslavinskiy, 1976; Cherkasov, 1978; Beryozkin and Kitsul, 1979; Petrova and Smirnova, 1982; Dook and others, 1986; Khil'tova and others, 1988; Sal'nikova, 1993; Kovach and others, 1995a.

CAST Sutam terrane (Granulite-paragneiss) (Late Archean) (Yakutia)

Sutam terrane occurs to the east of the Nimnyr terrane and is shaped as a triangle with a base of 100 km and a height of 250 km. The terranes are separated by the Seim thrust which is defined by intensely layered rodding gneiss of the granulite metamorphic facies. Structural pattern of the terrane is defined by linear sublongitudinal folds. Most of the terrane consists of paragneiss of the Seim Group, the rest consists of granite- and enderbite-gneiss (Khil'tova and others, 1988).

The Seim Group consists mainly garnet-biotite gneiss and plagiogneiss, sometimes with sillimanite and cordierite, with lesser hypersthene-biotite, two-pyroxene, and diopside-amphibole plagiogneiss, and rare quartzite, calc- silicate rocks, and calciphyres. The rest consists of magnetite quartzite (Khil'tova and others, 1988).

Metamorphism of para- and orthogneiss in different parts of the Sutam terrane occurred under different conditions (Dook and others, 1986). In the Seim block, metamorphism was at middle pressure granulite facies, whereas in the Sutam block, metamorphism was at high pressure granulite facies. These rocks exhibit the most high-temperature and high-pressure granulite facies of the Aldan-Stanovoy shield. Sm/Nd data show that parental rocks of paraneisses range in age from 2.5 to 2.9 Ga, whereas those of orthogneiss are as old as 3.0 Ga. Their synchronous metamorphism occurred after 2.5 Ga. The upper age limit of the early granulite metamorphism of the Seim Group rocks is constrained by the time of formation of garnet-biotite rodding gneiss in the zone of the Seim thrust which is dated at 2.28±0.06 Ga by Rb-Sr isotopic studies (Gorokhov and others, 1981). Overlap assemblages include Late Riphean and Vendian rocks of the sedimentary cover of the North Asian Craton.

REFERENCES: Gorokhov and others, 1981; Dook and others, 1986; Khil'tova and others, 1988.

CACG Chogar terrane (Granulite-orthognesiss) (Archean) (Yakutia)

Chogar terrane (with areal dimensions of 500x100 km) occurs on the southeastern margin of the Aldan-Stanovoy shield. Limited K-Ar data indicate that the terrane consists mainly of Archean

rocks (Karsakov, 1983). The terrane consists of two equal-area blocks that are separated by a northeast-striking fault. The eastern block consists of the Chogar complex that contains hornblende-two-pyroxene, garnet-hornblende-two-pyroxene schist and, locally, ultramafic schist, and lesser amphibolite and quartzite, iron-quartzite layers, aluminous gneiss, and garnet granulite. Metamorphism is sapphirine-quartz subfacies of hypersthene-sillimanite facies (Karsakov, 1983). The western block is marked by a extensive high-pressure amphibolite facies rocks. The dominant rocks are diorite plagiogneiss with lenses and bands of amphibole schist with lesser quartzite and aluminous gneiss.

REFERENCES: Karsakov, 1983.

CH Chuja terrane (Paragneiss) (Late Archean through Neoproterozoic) (Transbaikalia)

Extends to northeast. In southwest it borders on the North-Asian craton and Olokit-Delunuran terrane along the overthrust, in the northeast it borders on the complexes of the Patom sedimentary basin (along the strike-slip fault fault). To the north, terrane is composed of: (1) Early Riphean (Bramynsky complex) hypersthene-diopside- plagioclase-amphibole schist and amphibolite (Neelov, Podkovyrov, 1983) metamorphosed to amphibolite facies with K-Ar amphibole of 3.5-3.0 Ga; and (2) Late Archean plagiogneiss with layers of quartzite, marble, amphibolite, bedded plagiogranite gneiss, and diorite gneiss (Chuysky series). To the south, the terrane consists of the widespread metamorphic complex of the Late Archean Ukuchiktinsky series (Manuilova and others, 1964). Thickness is about 5000 m. The parageneses of metamorphism consists of the cordierite-andalusite-muscovite, biotite-muscovite-andalusite, andalusite-garnet-muscovite-biotite and sillimanite-biotite-muscovite subfacies of the amphibolite facies (Bolonev and others, 1983). The Paleoproterozoic units of the Chuysky terrane are: (1) hypersthene granitoids (Tatarnikovsky complex) with Rb-Sr ages of 2,030 Ma (Sryvtsev and others, 1980); (2) gneiss-like granite and granodiorite (Chuya complex) with Rb-Sr ages 1,848 Ma (Makrygina and others, 1993); (3) subalkaline granitoids (Abchadsky complex) and trachyrhyolite-trachyrhyodacite (Ilovirsky suite) with U-Pb zircon ages of 1,862 Ma (Neimark and others, 1990); (4) REE metasomatite with U-Pb zircon ages of 1,007 Ma (Predtechensky and others, 1990); and (5) dikes and stocks of Early Riphean diabase and gabbro-diabase. The cratonal and Riphean units are interpreted as accreting to the North Asian Craton in the Late Riphean with intrusion of stocks and dikes of granite-porphyry (Yazovsky complex), with U-Pb zircon ages of 730 Ma, into the Chuysky cratonal terrane (Ivanov and others, 1995). Post-accretionary units are granite batholiths (Mama complex) with U-Pb zircon ages of 350-300 Ma (Neimark and others, 1990; Ivanov and others, 1995; U-Pb), REE pegmatite and metasomatite with U-Pb zircon ages of 413, 370, and 320 Ma (Predtechensky and others, 1990).

REFERENCES: Manuilova and others, 1964; Sryvtsev and others, 1980; Bolonev and others, 1983; Neelov, Podkovyrov, 1983; Makrygina and others, 1993; Neimark and others, 1990; Predtechensky and others, 1990; Ivanov and others, 1995.

CHN Cheongjin terrane (Accretionary wedge, type B) (Permian) (Korea)

Consists of serpentinite melange with blocks of gabbro, basalt, schist and the Permian Tuman Group. Intruded by Early Permian granite of the Tumangang Complex and the Jurassic Daebu granite.

REFERENCES: Geology of Korea, 1993.

CHR Charysh terrane (Continental margin turbidite) (Cambrian through Devonian) (Northwestern Gorny Altai)

Consists of a basal unit of Cambrian green sand-siltstone flyschoid sedimentary rocks with units of motley, coarse-grained sandstone, gravelstone and conglomerate with clasts of red jasper and quartzite (Charysh and Suetka suites). Upward is an unconformably overlying gray terrigenous-carbonate sedimentary complex of Ordovician-Silurian age with organic fossils. The lower part of the complex contains Arenig (Early Ordovician) graptolites and contains deep-water, fine-terrigenous flysch that is overlain by shelf deposits and slope deposits. The upper part is dominated by Late Ordovician and Silurian shallow-water carbonate reef deposits that comprise a carbonate platform. In the northeastern part of the terrane, the Silurian deposits occurri in the graben-like depression of the Kurja-Akimov zone and are overlain by Early Devonian shallow-water marine carbonate-terrigenous deposits, and by Early Givetian volcanic rocks of the Altai volcanic belt. The terrane is intruded by Middle Devonian alkaline

and subalkaline granitoids with a U-Pb age of 381±4 Ma, Late Devonian calc-alkaline and plumasite granitoids with U-Pb age of 364±8 Ma, and Late Permian-early Triassic REE granite with a U-Pb age of 251±2 Ma.

REFERENCES: Kulkov and Severgina, 1989; Yolkin and others, 1994; Sennikov and others, 1997; Vladimorov and others, 1997; Iwata and others, 1997.

CT Central Taimyr superterrane (Taimyr Peninsula)

Occupies the central part of the Taimyr Peninsula. Extends in a northeastern direction for 600 km long and ranges up to 70-100 km wide. Consists mainly of the Chelyuskin, Mamont-Shrenk, Faddey, and Kolosovsky terranes that were accreted in the Neoproterozoic, and was accreted onto the North Asian Craton during Vendian obduction. The Central Taimyr superterrane is overlapped by the Vendian-Carboniferous cover of marine sedimentary rocks and by the Jurassic-Cenozoic marine and nonmarine sedimentary rocks.

REFERENCES: Zonenshain and others, 1990; Uflyand and others, 1991; Vernikovsky, 1996, 1997.

CTC Chelyuskin terrane (Island arc) (Neoproterozoic) (Northeast and Central Taimyr Peninsula)

Occurs in a northeastern direction 300 km long and ranges up to 100 km wide. Consists of two units: (1) a lower unit of serpentinite and serpentinite mélange with fragments of Neoproterozoic ophiolite, and limestone with spilite and bedded jasper, and black shale; and (2) an upper unit of a thick assemblage of Neoproterozoic island arc volcanic and sedimentary rocks consisting of tholeiitic basalt, andesite basalt, rhyolite, plagiogranite, tuff, sandstone, siltstone, black chert, breccia, and dolomite with the Late Riphean stromatolites and microphytolites. The subterrane is metamorphosed to greenschist facies. The lower unit is interpreted as a Neoproterozoic oceanic crust (ophiolite) sequence, and the upper unit is interpreted as a Neoproterozoic island arc sequence. The ophiolite forms the Chelyuskin and Stanovoy northeast-striking belts. A U-Pb zircon age for Chelyuskin plagiogranite is 740±38 Ma, and a Rb-Sr isochron age is 727±83 Ma. These ages are interpreted as the upper age of the Chelyuskin ophiolite. A Sm-Nd model age of 850-750 Ma probably is the oldest age (Vernikovsky and others, 1993, 1994).

REFERENCES: Zonenshain and others, 1990; Uflyand and others, 1991; Vernikovsky and others, 1993, 1994, 1996, 1997; Vernikovsky, 1996.

CTF Faddey terrane (Metamorphic) (Neoproterozoic and older) (Northeastern Taimyr Peninsula)

Occurs in the central part of North Taimyr and extends in a northeastern direction for 100 km long and ranges up to 30-50 km wide. Consists chiefly of an isolated structural block that consists of high-grade metamorphic (epidote-amphibolite and amphibolite facies) metaclastic rocks (plagiogneiss and schist), and metamafic rocks transformed into biotite-amphibole schist and amphibolite, with minor quartzite, marble, and calciphire. The rocks often exhibit severe cataclasis, mylonitization, and diaphthoresis, especially in marginal parts. The gneiss contains migmatite-granite and autochthonous granite with U-Pb zircon isotopic age of 850 Ma, and a Sm-Nd model age of 1.8-1.9 Ga for continental crust (Vernikovsky, 1996). Recent studies interpret the terrane as an overthrust slice of the craton (Makhlaev, 1978).

REFERENCES: Ravich, 1954; Makhlaev, 1978; Zabiyaka and others, 1986; Vernikovsky, 1995, 1996, Vernikovsky and others, 1998.

CTK Kolosovsky terrane (Passive continental margin) (Late Neoproterozoic) (Central Taimyr Peninsula)

Extends in a northeastern direction for 200 km and ranges up to 30-50 km wide. Consists of carbonate rocks, limestone, and dolomite with Late Riphean stromatolites and microphitolites (Kaban`kov and others, 1978; Bezzubtsev and others, 1978; Yakshin, 1980). A belt of volcanogenic rocks consisting of necks and explosion pipes, occurs in the central and

southwestern parts of the terrane where the limestone and dolomite are intruded by the dikelike bodies of gabbro-diabase and are overlapped by trachibasalt and basalt tuff, pillow-like and rope-like basalt, and rare felsic tuff. This complex of volcanogenic rocks may have formed during rifting of a Late Riphean-Vendian active continent margin. The relation of these carbonates with volcanic-sedimentary and crystalline units of the Chelyuskin and Mamont-Shrenk terranes is conjectural because of lack of reliable observations of relationships. Either tectonic contact occur, or the carbonate rocks are separated by concealed exposure from the other complexes. Terrane is interpreted as a fragment of a passive continental margin, probably the North Asian Craton (Kaban`kov and others, 1978; Uflyand and others, 1991), and was accreted in the Neoproterozoic with the other terranes of the Central Taimyr superterrane.

REFERENCES: Kaban`kov and others, 1978; Bezzubtsev and others, 1978; Yakshin, 1980; Uflyand and others, 1991; Vernikovsky, 1996.

CTM Mamont terrane (Metamorphic) Mesoproterozoic and Neoproterozoic) (Taimyr Peninsula)

Occurs in the central part of Taimyr between the Mamont and Shrenk Rivers with dimensions of about 50 x 50 km. Consists of biotite-sillimanite and garnet-biotite gneiss and schist; and metamafic rocks transformed into biotite-amphibole schist and amphibolite with bodies of amphibolite gabbros and granitoids. Granitoids comprises about 50% of the terrane and forms elongated lens, plates, and massifs lying concordantly with strike of folded structures, with sizes of tens to hundreds km^2. Granitoids are mainly two-mica and biotite porphyry granite of normal and subalkaline potassium-sodium series (Ravich, Chaika, 1962; Makhlaev, 1988; Zakarov and others, 1993; Vernikovsky, 1996). S-type origin is suggested by a autochthonous bedding, ratio of petrogenic components, REE inheritance, and frequent garnet. A Th-U-Pb method zircon age of about 900 Ma is exhibited by the Shrenk granite using Cameca IMS 1270 ion-microprobe located at the Swedish Museum of Natural History, Stockholm (Pease and others, 2001). Two interpretations exist for the terrane. (1) Terrane may be uplifted Archean and Lower Proterozoic North Asian Craton basement (Bezzubtsev, 1981; Bezzubtsev and others, 1986; Zabiyaka and others, 1986). Or (2) terrane may be high-grade metamorphosed rocks and granitoids tectonically combined with other terranes (island-arc, back-arc, and carbonate) of the Central Taimyr superterrane.

REFERENCES: Bezzubtsev, 1981; Bezzubtsev and others, 1986; Zabiyaka and others, 1986; Ravich, Chaika, 1962; Makhlaev, 1988; Zakarov and others, 1993; Vernikovsky, 1996; Pease and others, 2001.

DB Dibinsky terrane (Accretionary wedge, Type A) (Late Neoproterozoic) (Eastern Sayan, Mongolia)

Consists of Riphean sedimentary and sedimentary-volcanogenic formations of the Dibinsky sequence that contains predominantly rhythmically layered sedimentary rocks mainly siltstone with sandstone, carbonate rocks and conglomerate with gradational layering. Olistostrome horizons occur with serpentinite olistoliths. Diabase and gabbro-diabase form both subvolcanic bodies (sills or dikes) (Belichenko and others, 1988). Terrane is overlapped by the Vendian-Cambrian carbonate-terrigenous rocks.

REFERENCES: Belichenko and others, 1988.

DL Daldyn terrane (Granulite-orthogneiss) (Middle Archean) (Yakutia)

Consists mainly of enderbite and mafic schist of the Daldyn and Late Anabar Groups with lesser metasedimentary rocks inncluding quartzite and carbonate rocks. Enderbite derived from tonalite and quartz diorite. Two-pyroxene and hypersthene mafic schist and enderbite-schist form two bands in the central part of the terrane, and geochemically correspond to tholeiite basalt. Igneous rocks of the terrane are divided into calc-alkalic, alkalic, and subalkalic series, and are comparable to island arc volcanic rocks (Rosen and others, 1994). Terrane is multiply deformed mappable, linear, compressed, northwest-trending folds with steeply dipping hinges and axial surfaces. Enderbite of the Daldyn terrane exhibits a U-Pb concordia zircon age of 3.2+0.32 Ga. A Sm-Nd isochron age of

3.1+0.8 Ga exists for mafic granulite (Rosen and others, 1994). The data suggest an age of 3.1 Ga for the protolith of the terrane. Terrane underwent intense metamorphism of granulite facies and to the north exhibits hypersthene-sillimanite zone of granulite facies (Vishnevskiy, 1978; Lutz and Oxman, 1990). Granulite metamorphism and synchronous deformation exhibit a U-Pb discordia zircon age of 2.8 Ga (Rosen and others, 1994). Terrane is bounded by the Kotuykan and Billyakh melange zones to the west and east, respectively, and is cut by the Major Anabar strike-slip fault containing pseudotachylite, mylonite, and cataclasite. Terrane can be traced to the north and south beneath sedimentary cover by geophysical data.

REFERENCES: Vishnevskiy, 1978; Lutz and Oxman, 1990; Rosen and others, 1994.

DN Dongwuzhumuqin-Nuhetdavaa terrane (Island arc) (Cambrian through Middle Devonian) (Northeastern China, Mongolia)

Consists of the Dongujmqin terrane in China and the Nuhetdavaa terrane in Mongolia. In northeast China, consists of: (1) Early Cambrian crystalline limestone intercalated with shale with archaeocyatha and trilobite fragments; (2) Middle and Late Ordovician andesite, low-grade, metamorphosed fine-grained clastic rocks intercalted with limestone with trilobites, brachipods and corals; (3) Late Silurian low-grade, metamorphosed sandstone, slate and intercalated lenses of limestone with brachipods; And (4) Early and Middle Devonian sandstone, siltstone and fine sandstone intercalated with lenses of limestone, volcanic rocks, tuff and Late Devonian clastic rocks, slate, mud rocks, and siltstone with brachipods and corals. Terrane is unconformably overlain by Early Carboniferous andesite, tuff and fossil plant-bearing terrestrial clastic rocks, and by Early Permian andesite, tuffaceous sandstone. Terrane is intruded by Late Carboniferous calcic-alkaline granite.

REFERENCES: Bureau of Geology and Mineral Resources of Xinjiang Uygur Aut. Reg.(Xinjiang GMRB), 1990; Tang Kedong, 1990; Xie Tonglun, 1980.

In eastern Mongolia, consists of: (1) middle to late Riphean (?) gneiss, schist, stromatolite marble, and limestone; (2) Early to Middle Cambrian sandstone and siltstone, and minor conglomerate and olistostrome, (3) Middle to Late Ordovician sandstone, siltstone, and phyllite, minor conglomerate and limestone with corals; (4) Silurian sandstone, siltstone, and argillite, and minor coral limestone that are metamorphosed to greenschist facies and contain deformed lenses of serpentinite and gabbro; (5) Early to Middle Devonian thick sandstone, siltstone, and argillite, and minor basalt, andesite, tuff, conglomerate, and limestone with brachiopods and corals. Terrane is intruded by Silurian granite and granodiorite, and by minor quartz diorite with K-Ar isotopic ages of 419-435Ma. Terrane is overlain by Early Carboniferous shallow-marine sedimentary rock, Middle to Late Carboniferous and Permian subalkalic and alkalic volcanic and volcaniclastic rock, and is stitched by Middle to Late Carboniferous and Permian granite and leucogranite, and by Triassic and Early Jurassic rare metal granite.

REFERENCES: Geology of Mongolian People's Republic, 1973; Tang, 1990; Hsu and others, 1991, Badarch and Orolmaa, 1998.

DR Derba terrane (Passive continental margin) (Late Neoproterozoic) (Eastern Sayan)

Consists of tectonic wedges and sheets composed of rocks of various ages and environments. Generally consists of three sequences, from bottom to top. (1) Alygzher suite of biotite, biotite-amphibole, biotite-amphibole-pyroxene gneiss and schist with garnet, cordierite, sillimanite, and graphite and lesser graphite-bearing quarztite, marble and calciphyres. (2) Derba suite of graphite-bearing marble and quarztite with subordinate gneiss and schist. And (3) Zhaima suite of graphite-quartz and quartz-mica schist, quarztite, and calciphyres interbedded with marble-like limestone. Locally, the suite consists of alternating thin layers. A total thickness of the three sequences is 8-9 km. Sequences are apparently overlain by carbon-rich shale-carbonate deposits that are exposed along bounding faults and resemble Late pre-Cambrian accretionary units. The terrane is interpreted as metamorphosed sedimentary rocks of the North Siberian passive continental margin. Terrane exhibits a strongly compressed nappe-imbricated structure in which individual sheets have a linear orientation and steep layering. In the central parts of the terrane the rocks are metamorphosed to amphibolite facies. The periphery exhibits epidote-amphibolite and greenschist metamorphism, with several tectonic lenses of strongly metamorphosed rocks. Pre-Vendian and Camrian-Ordpvician(?) collisional granite occur widely distributed in the southeastern part of the train with a majority of K-Ar biotite ages of 417-542 Ma for granite. The central area is intruded by a diagonal belt of Early Devonian rift-related granitoids. The Riphean(?) Derba terrane is separated from the ancient blocks of the North-Asian Craton Margin by the Main strike-slip fault of Eastern Sayan.

REFERENCES: Khomentovsky, 1957; Polkanov and Obruchev, 1964; Berzin, 1967; Parfyonov, 1967; Sez'ko, 1982.

DZ Dzhida terrane (Island arc) (Late Neoproterozoic and Early Cambrian) (Transbaikalia, Mongolia)

In Mongolia, terrane occurs southeast of Hovsgul lake, north of Hangay strike-slip fault and extends to northeast for 250 km and ranges up 170 km wide. Consists of five thrust panels of late Precambrian and early Paleozoic rocks composed of the following two groups of rock. (1) Dismembered Precambrian ophiolite containing dunite, harzburgite, sheeted dike, boninite lava and tholeiitic basalt. And (2) Vendian to Early-Cambrian volcanic rocks subdivided into high titanium subalkalic basalt and calc-alkalic basalt-andesite-rhyolite series. The former are interpreted as seamount volcanic rocks and later are interpreted as oceanic island arc volcanic rocks (Al'mukhmedov and others, 1996, Tomurhuu, 1999). Volcanic rocks of all thrust panels are depositionally overlain by Cambrian(?) calcarenite-terrigenous rocks, tuffaceous flysch with archaeocyatha, and local olistostrome. In the island arc volcanic rocks are small bodies of gabbro and palgiogranite with K-Ar ages of 540 Ma (I'lin, 1982). Post accretionary assemblages are Middle Ordovician S- type granite and Silurian marine molasse.

REFERENCES: I'lin, 1982, Kheraskova and others, 1987, Tomurtogoo, 1989, 1997, Al'mukhmedov and others, 1996, Tomurhuu, 1999.

In Transbaikalia, terrane extends in a sublatitudinal direction for nearly for 300 km and ranges up to 150 km wide. Consists of five thrust panels of Vendian-Cambrian rocks. These thrust panels consists chiefly of units similar to those described above for Mongolia. The carbonate and silicic-greywacke sedimentary rocks with Early Cambrian fauna are interpreted as seamounts (Belichenko, 1977, 1996; Kheraskova and others, 1987). Olistostrome horizons also occur. Intruding these units are small and later large massifs of gabbro-plagiogranite (Nashituy complex) that form the base of the island arc. Ophiolites occur in the lowermost part of the terrane and consist of Late Riphean(?) restite alpine type ultramafic rocks and basalt of mid-oceanic type. They are commonly strongly serpentinised and deformed. The tholeiitic metabasalt is characterised by extremely low K/Na ratios, are somewhat depleted in SiO_2. CaO dominates over MgO with moderate TiO_2. Compositions correspond to of spreading zone basalt.

Overlapping units are flyshoid sedimentary rocks of the widespread Late Cambrian to Devonian Dzhida suite that contain fragments of graptolites, bryozoans (Almukhamedov and others, 1996). Younger granitoids in Mongolia have a K-Ar isotopic age of 542 Ma (Middle Ordovician) (Il'in, 1982), to 430 Ma (Distanova, 1975). The upper part of the overlapping units consists of Devonian variegated molasses with siliceous volcanic rocks (Khurliksky suite). All sedimentary rocks of the terrane are intruded by K-series, S-type granitoids with isotopic ages of 380-320 Ma (Il'in, 1982).

REFERENCES: Belichenko, 1969; 1977; Distanova, 1975; I'lin, 1982; Kheraskova and others, 1987; Tomurtogoo, 1989, 1997; Al'mukhmedov and others, 1996; Belichenko and others, 1996; Tomurhuu, 1999.

DZA Dzhagdy terrane (Accretionary wedge, type B) (Late Carboniferous and Permian) (Southern Russian Far East)

Consists of Late Pennsylvanian(?) and Early Permian, intensly-deformed, phyllite, chert, metabasalt, microquartzite, and limestone lenses (Dzheskogon, Nekter, and Bochagor suites), and late Paleozoic(?) gabbro and amphibolite. The limestone contains an Early Permian Tethyan fauna (corals, fusulinids). Six stages of deformations and associated greenschist facies are recognized with begining stage being the most intensive with formation of recumbent and overturned isoclinal folds and associated thrust faults with northern vergence.

REFERENCES: Kirillova and Turbin, 1979; Natal'in and others, 1985; Martynyuk and others, 1990; Natal'in and Popeko, 1991; Natal'in, 1993; Popeko, Natal'in, and others, 1993, Krasnyi and others, 1996.

DZE Dzhebash terrane (Accretionary wedge, type A) (Late Neoproterozoic and Early Cambrian) (Northwestern Sayan)

Consists of the Dzhebash volcanic-sedimentary series that are metamorphosed to greenschist and epidote-amphibolite facies, and contains the Tebin (lower) and Urten (upper) suites. The Tebin suite consists of monotonous

paraschist derived from rhythmically-layered sandstone, claystone, and calcareous sedimentary rocks. Metavolcanic rocks from 10-30 m thick paraschist packages in the lower part, and dominate the upper part of the Urten suite. The volcanogenic rocks consists of tuff, tuffaceous sandstone, basalt, and andesite, are metamorphosed to chlorite-albite-epidote-actinolite schist and metaporphyries. Also occurring in the Dzhebash seriesthere are beds and lenses of marble-like limestone; the thickest horizon of carbonate rocks varies up to 50-150 m thick and occurs below the base of the Urten suite. Horizons limestone lenses are interpreted as forming from submarine landslides. Also occurring are interlayered micaceous quarztite, quartz-hematite schist, and piedmontite quartzites. Peak metamorphism likely was in the middle Paleozoic metamorphism most clearly displayed in the northeastern and southwestern extremities of the terrane. A K-Ar biotite isotopic age is 364 Ma, and a K-Ar muscovite isotopic age is 356 Ma for mica from an ultrametamorphosed granite-gneiss in the Dzhebash series. Terrane is intruded by Early Devonian(?) gabbro and gabbro-diorite of the Bichebalyk complex, diorite and granodiorite of the Bolshoi Porog complex, and granite and granosyenite of the Dzhoi complex. Overlapping deposits are Devonian continental volcanic-sedimentary rocks, which occur in small, graben-like depressions along the faults that bound the terrane. The age of the Dzhebash suite is unclear; the volcanic-flysch unit may have formed in the Vendian-Early Cambrian in an accretionary wedge or at the front of a growing island arc.The Dzhebash, and related Borus and Amil terranes form a system of large tectonic lenses that are tectonically linked to the North-Sayan island-arc terrane.

REFERENCES: Zonenshain, 1963; Korobeinikov and Isakov, 1965; Kazakov, 1967; Klyarovsky, 1972; Sobolev and Dobretsov, 1977; Kheraskov, 1979; Berzin, 1995; Zaltsman and others, 1996.

ED Edren terrane (Island arc) (Devonian and Early Carboniferous) (Southwestern Mongolia)

Occurs south of Transaltay fault and forms narrow, northwest trending block in southwestern Mongolia. Consists of: (1) Early Devonian basalt, andesite, tuff, radiolarian chert, sandstone, siltstone and lenses of limestone, with brachiopods; (2) Middle to Late Devonian interbedded tuff, conglomerate, sandstone, siltstone, chert; and (3) Early Carboniferous basalt, andesite, tuff, conglomerate, sandstone with lenses of limestone with brachiopods and bryozoans. Trace element data from Devonian volcanic rocks plots indicate formation in a volcanic arc and are most similar to the New Hebrides arc patterns. Terrane overlain by Middle Carboniferous conglomerate, sandstone, siltstone, and limestone with brachiopods, and Middle to Late Carboniferous and Early Permian subalkalic volcanic rocks. Postaccretion granitic rocks consists of Early to Middle Carboniferous diorite, granodiorite, granite, and Early Permian leucogranite. Terrane is interpreted as a fragment of an island arc that formed on oceanic crust or an accretionary wedge.

REFERENCES: Tikhonov, 1982; Gordienko, 1987; Ruzentsev and others, 1987; Suetenko and others, 1988; Yarmolyuk and Badarch, 1990; Lamb and Badarch, 2001.

East Aldan superterrane (Yakutia)

The East Aldan superterrane, with approximate dimensins of 450 by 500 km, occurs east of the Central Aldan superterrane, and includes the Uchur granulite-paragneiss terrane and the Batomga granite-greenstone composite terrane.

EUC Uchur terrane (granulite-paragneiss) (Paleoproterozoic) (Yakutia)

Occurs mostly in Yakutia and is defined by a structural pattern consisting of granite-gneiss domes measuring with average diameters of 150 km. The cores of the domes consist of granite-gneiss, charnockite-gneiss, and enderbite-gneiss. The paragneiss complex includes two rock assemblages: (1) garnet-biotite plagiogneiss interlayered with calc-silicate rocks, quartzites, sillimanite- and cordierite-bearing gneiss, and hypersthene, diopside, and two-pyroxene plagiogneiss, (2) hypersthene, hypersthene-diopside, and hypersthene-diopside-amphibole plagiogneiss with the hypersthene-bearing rocks prevailing., along with bands and lenses of hypersthene-amphibole, two-pyroxene-amphibole, diopside-amphibole schist, and calc-silicate and diopside granofels. Also occurring are thin sheets of garnet-biotite, garnet-hypersthene-biotite plagiogneiss, and gneiss. Metamorphic conditions were extensively studied by V.I. Kitsul (Dook and others, 1986). The grade of metamorphism is high-pressure granulite facies with average temperature of 780-820^0 C, pressures of 7 kbar. Sm-Nd isotopic data indicate that paragneiss is derived from the rocks of 2.6-2.1 Ga age, and that metamorphism probably occurred after 2.1 Ga.

The end of high-temperature metamorphism is estimated at 2.0-1.8 Ga based on Pb-Pb zircon isotopic age for charnockites in the Emelyali pluton.

REFERENCES: Dook and others, 1986; Glukhovskiy and others, 1993.

EBT Batomga composite terrane (Granite-greenstone) (Late Archean) (Yakutia)

Occurs on the northeastern margin of the Aldan-Stanovoy shield with average dimensions of 200 by 100 km. Forms a basement uplift covered by sedimentary rocks of the Siberian Platform. Ulkan fault forms western boundary and is traced under the platform by intense positive linear magnetic anomalies. Interpreted as an Archean granite-greenstone terrane though reliable age determinations are lacking now. Dominated by tonalite-trondhjemite orthogneiss (Batomga complex) with thin bodies of mafic schist, along with lesser granite gneiss and granite. Metamorphosed to amphibolite facies. Mafic rocks locally include parageneses metamorphosed to granulite facies.

Batomga complex occurs in five blocks (subterranes) that are separated by four northeast-striking zones that range up to 150 km long and 10 to 20 km thick. Within blastomylonite zones are tectonic greenstone wedges of volcanic-sedimentary rocks (Chumikan complex) that occur as biotite, two-mica, sometimes garnet- and fibrolite-bearing, microgneiss, metasandstone, quartzite, and tremolite marble, as well as fine-grained amphibole schist and amphibolite that are interpreted as metamorphosed tholeiitic basalt. Locally in the Batomga complex are two tectonic blocks of granulite facies rocks (Omninsk complex), about 40x50 km in size, that occur near the blastomylonite zones, and are dominated by garnet-biotite plagiogneiss and gneiss (with local sillimanite), marble, calciphyres, and calc-silicate rocks, with lesser orthopyroxene-amphibole, and two-pyroxene-amphibole schist.

The Batomga granite-greenstone, Uchur granulite-paragneiss terranes, and intervening Ulkan fault are overlain by volcanic-sedimentary rocks of the Ulkan Series with rhyolite with U-Pb zircon ages of 1.7-1.8 Ga (Neimark and others, 1992, Tugarinov and others, 1965) with intruding granites and hornblende syenites with U-Pb zircon ages of 1.7-1.72 Ga (Neimark and others, 1992).

REFERENCES: Tugarinov and others, 1965; Khil'tova and others, 1988; Petrov, 1990; Neimark and others, 1992; Fed'kin and others, 1996.

ER Eravna terrane (Island arc) (Late Neoproterozoic and Early Cambrian) (Transbaikalia)

Occurs in the central part of western Transbaikalia. It extends in the submeridional direction over 400 km with a width of about 250 km. Mostly separated from adjacent terranes by overlapping assemblages. Sedimentary rocks of the Eravna terrane also form scattered, variable-size xenoliths granitoids of the vast Barguzin-Vitim batholith. This relation hampers determing the original boundaries of the terrane. Consists of Vendian-Cambrian volcanic-sedimentary rocks of the Oldyndisnky suite. The volcanogenic part is predominantly rhyolite-dacite, dacite, andesite-dacite, and rhyolite volcanic rocks, with minor diabase and basalt porphyries. Pyroclastic units predominate over flows. Also occurring are widespread, subvolcanic, stock-like and sill-like bodies of lava breccia, and lesser dikes and sills of diabase and andesite porphyries. The volcanogenic rocks vary continuous from andesite-basalt to rhyolite. The Oldyndinsky suite contains SEDEX deposits of lead-zinc, pyrite-siderite, sulphide-hematite, and hematite. The sedimentary part of the suite consists mainly of limestone with minor carbonaceous-carbonate shale, siltstone, and sandstone, locally with reefs, bioherms, and biostromes containing archaeocyatheans, trilobites, algae. The Oldyndinsky suite is overlapped by sandstone and shale Late Cambrian-Ordovician Khimogildinsky suite and molasse and variegated sedimentary rocks of the Devonian(?) Istashinsky suite.

REFERENCES: Belichenko, 1969, 1977; Vasiliev, 1977; Kremenetskiy, 1982.

GA Govi Altai terrane (Continental-margin turbidite) (Cambrian through Devonian) (Mongolia)

Forms a narrow, up to 50km wide, and about 1800 km long belt in southern Mongolia. Consists of: (1) Cambrian(?) to Early Ordovician sandstone and argillite, minor volcanic rocks, and limestone; (2) Early to Middle

Ordovician sandstone and argillite, minor conglomerate, and limestone with brachiopods; (3) Silurian sandstone, argillite, minor limestone, olistostome, conglomerate, and volcanic and plutonic rocks; (4) Early to Middle Devonian conglomerate, sandstone, siltstone, coral-bearing limestone, sparse pillow basalt, and andesite, tuff; (5) unconformably overlying Middle to Late Devonian conglomerate, sandstone, argillite, sparse and limestone, and (6) Early Carboniferous conglomerate, sandstone, siltstone with marine fauna. Preaccretionary granite rocks include Late Silurian leucogranite and Middle Devonian diorite and granodiorite. Terrane is overlain by Middle to Late Carboniferous and Early Permian, mainly bimodal volcanic rocks and volcaniclastic rocks, and Middle to Late Triassic, and Late Jurassic to Early Cretaceous subalkalic and calc-alkalic volcanic rocks. Terrane is interpreted as early a Paleozoic continental margin turbidite basin that formed adjacent to an inactive and eroded island arc.

REFERENCES: Badarch, 1988, Tsukernik and others, 1986, Ruzhentsev and others, 1987, Badarch and Orolmaa, 1998, Lamb and Badarch, 1997, 2001.

GG Gargan terrane (Cratonal) (Archean and Paleoproterozoic) (North Huvsgol, Mongolia, Eastern Sayan)

In Mongolia, occurs north of the Hovsgol lake and forms small (50 by 70 km) block between the Hug and Hamar Davaa terranes Consists of Archean and Paleoproterozoic granite-gneiss, amphibolite, schist, marble and quartzite overlain by Vendian to Early Cambrian shallow-marine limestone, and intruded by early Paleozoic granite. Terrane is interpreted as a cratonal block that accreted to the Siberian continent in the Vendian.

REFERENCES: Belichenko and others, 1988; Fedrovskii and others, 1995.

Terrane occurs in the southeastern part of Eastern Sayan region, and extends along a southwest direction for over 50 km and ranges up to 20 km wide. Terrane is overthrust onto adjacentg terranes. Consists mainly of plagiogranite gneiss with inclusions of gneiss, amphibolite, and schist. Rb-Sr isotopoic age of plagiogranite gneiss is 3153±57 Ma. U-Pb zircon ages group at about 2 Ga and 460 Ma. The latter are interpreted as the result of early Paleozoic dome formation. The early Precambrian formations are overlapped by the Riphean carbonate and terrigenous-carbonate sedimentary rocks (Irkutny suite). The amalgamation of the Gargan, Dibinsky, Ilchirsky, and Hug terranes resulted in formation of the basement of the Tuva-Mongolian microcontinent which was later overlapped by the Vendian-Cambrian sedimentary cover composed of carbonate and terrigenous-carbonate sedimentary rocks (Bokson series). The Sumsunursky tonalites with Rb-Sr and U-Pb isotopic ages of 790 Ma intrude the crystalline rocks of the microcontinent basement and the overlapping Riphean carbonate sedimentary rocks.

REFERENCES: Belichenko and others, 1988, 1999; Fedorovskii and others, 1995; Aktanov and others, 1999;Khain and others, 1999; Kuzmichev, 1999.

GL Galam terrane (Accretionary wedge, type B) (Cambrian through Early Carboniferous) (Southern Russian Far East)

Consists chiefly of poorly-studied Paleozoic deposits. To the northwest the Galam terrane is separated from the Baladek terrane by the Uligdan dextral strike-slip fault; to the southeast terrane is bounded by the Tugur fault.

In the northwestern part of the terrane, Paleozoic rocks form an imbricate stack of thrust sheets that consist of three different age-rock associations: (1) coherently bedded turbidite; (2) basalt, ribbon chert, and siliceous shale; and (3) olistostrome. The olistostromes locally contain inclusions of anorthosite and granitic rocks similar to those in the Baladek terrane. Each age-rock association occurs in various tectonic slices and sheets separated by ductile faults that occur parallel to bedding of internal parts of the sheets. The internal parts of the sheets are relatively weakly deformed. The following sedimentary rocks in the terrane range from Cambrian to Permian. (1) Cambrian and Ordovician limestone with archaeocyaths, trilobites, inarticulate brachiopods, and algae occur as olistoliths in a flysch matrix. Siberian-type Archaeocyaths differ from in the Bureya superterrane. Thick Silurian sequences contain corals and brachiopods typical of the Okhotsk province. (2) Early and Middle Devonian flora oocur in the turbidites. The Middle and Late Devonian turbidites contain poorly preserved bryozoans and crinoids, and poorly preserved radiolarians sparese chert with post-Early Devonian age. (3) Early Carboniferous turbidites contain bryozoans, brachiopods, crinoids, and flora. And (4) Late Permian units contain abundant flora, and Carboniferous and Permian flora belong to the Angara paleophytogeographic province. Paleontological data suggest turbidite rejuvenation to the southeast.

The structure of the southeastern Galam terrane is similar to the northwestern part and the terrane consists mainly of Middle Devonian and Early Carboniferous turbidites and olistostromes, and Silurian and Early Devonian units are absent. Local oceanic chert and mafic volcanic rocks occur in individual tectonic slices and sheets. Middle and Late Devonian olistostromes contain inclusions of granitic rocks and limestone with Cambrian archaeocyaths and trilobites. The matrix in the olistostrome deposits is mainly greywacke, siltstone, and shale. The Devonian units contain corals, bryozoans, brachiopods (Verkhoyansk type), and flora, and the Early Carboniferous units contain foraminifers. Most of the Galam terrane is overlain by the Late Triassic-Jurassic overlap assemblage deposits of the Torom sedimentary basin, and the Cretaceous Khingan-Okhotsk volcanic-plutonic belt. Terrane is interpreted as an accretionary wedge complex that was tectonically linked to a Devonian volcanic arc which is partly preserved in the Okhotsk terrane. The current position is the result of dextral strike-slip faulting that occurred in the late Mesozoic.

REFERENCES: Karaulov, 1966; Gorekhov and Karaulov, 1969; Kozlovskiy, 1988; Natal'in, 1991; Natal'in and Popeko, 1991; Popeko and others, 1993; Krasnyi and others, 1996.

Galam terrane (Accretionary wedge – type A) (Cambrian through Early Carboniferous) (Northern part of the Russian Southeast)

Consists of an imbricate stack of thrust sheets of Cambrian, Ordovician, Silurian, Missisipian and Permian sedimentary and mafic volcanic rocks three age-rock associations: (1) coherently-bedded turbidite; (2) basalt, ribbon chert, and siliceous shale; (3) olistostrome; and (4) and gabbro, diorite, and plagiogranite with K-Ar isotopic ages of 388-317 Ma that intrude the Silurian deposits. Each age-rock association occurs in various tectonic slices and sheets that are separated by ductile faults that occur parallel to the bedding in sheets. Internal parts of the sheets are comparatively weakly deformed. The Early Cambrian, Silurian, Early-Middle Devonian sedimentary rocks contain faunal assemblages that differ from the assemblages in other parts of the Mongol-Okhotsk belt and in adjacent units to the south. Early Cambrian archaeocyatheans are similar to those in Siberian palaeobiogeographic province, and Silurian and Early-Middle Devonian brachiopods are similar to those in the Okhotsk terrane and Verkhoyansk fold belt. Overlapping sedimentary assemblages are: (1) Late Triassic-Jurassic shallow-marine terrigenous deposits of the Torom sedimentary basin; (2) Late Jurassic and Early Cretaceous terrigenous deposits of the Uda sedimentary basin; (3) Cretaceous bimodal volcanic rocks of the Khingan-Okhotsk volcanic-plutonic belt; and (4) the stitching Cretaceous granitoids of the Khingan-Okhotsk volcanic-plutonic belt. Right-lateral strike-slip displacement occured along the Uligdan fault which bounds Galam terrane on the north.

REFERENCES: Karaulov, 1966; Gorekhov and Karaulov, 1969; Kozlovskiy, 1988; Natal'in, 1991; Natal'in and Popeko, 1991; Popeko and others, 1993; Krasnyi and others, 1996.

GN Gonzha terrane (Passive continental margin) (Late Archean(?), Paleoproterozoic(?), and early Paleozoic) (Southern Russian Far East)

Contains of two basement series: (1) Late Archean(?) metamorphic rocks consisting of biotite, hornblende, garnet-biotite, pyroxene-hornblende gneiss and schist (Gonzhinsk series) that are metamorphosed to amphibolite facies; (2) Paleoproterozoic(?) sedimentary rocks that contain lenses of mafic rocks (Chalovsk series), both metamorphosed to greenschist facies; (3) early Paleozoic(?) cataclastic and foliated granitic rocks and plagiogranite occur with the metamorphic rocks; and Devonian and Early Carboniferous shallow-marine clastic deposits with limestone layers (Bolsheneversk, Imchansk, Oldoisk, and Tiparinsk suites) that are faulted against the metamorphic rocks. The first two units also contain lenses of ultramafic rock. Ages of metamorphic rocks are based on regional correlations. Post-amalgamation Jurassic shallow-marine marine and nonmarine clastic rocks overly and link the Gonzha, Oldoi, and Gar terranes. Early Cretaceous volcanic and granitic rocks of the Umlekan-Ogodzhin belt overlie or intrude the Gonzha, Oldoi, Mamyn, and Turan terranes.

REFERENCES: Krasny, 1966; Shilo, 1982; Volsky, 1983; Kozlovsky, 1988.

GR Gar terrane (Accretionary wedge, type B) (Proterozoic?) (Southern Russian Far East)

Consists chiefly of greenstone, metatuff, metasandstone, quartzite, phyllite, limestone, lenses of ultramafic rocks, and gabbro that are intensively deformed into schistose melange. May be Proterozoic(?) age, but only age constraint is clasts of ultramafic rocks and other units of the Gar terrane in overlapping Jurassic deposits. Terrane characteristically overlapped by a thick assemblage of Late Triassic clastic rocks (Kalakhtinsk, Malokalakhinsk, Naptarginsk, and Neupokoevs suites) with abundant Monotis and Halobia, and is also overlapped by Jurassic

sedimentary rocks (Uralovskinsk, Uskalinsk, Ayaksk, Depsk, and Molchanovsk suites) that also overly the Oldoi and Gonzha terranes.

REFERENCE: Krasny, 1966.

GS Gurvansayhan terrane (Island arc) (Silurian through Early Carboniferous) (Southern Mongolia)

Occurs in central part of southern Mongolia, south of Mandalovoo and Mandah terranes, and consists of at least four allochtonous sequences composed of Silurian to Early Carboniferous volcanic and volcaniclastic sedimentary rocks. Terrane typically consists of: (1) Pre-Late Silurian, dismembered ophiolite and serpentinite melange; (2) Late Silurian to Early Devonian tholeiitic pillow basalt and basalt-andesite, red chert, volcaniclastic sandstone, and siltstone; (3) Middle to Late Devonian volcaniclastic sandstone, siltstone, ash tuff and argillite, minor chert, conglomerate and olistostrome; and (4) Early Carboniferous conglomerate, sandstone and siltstone with olistostromes. Early Devonian basalt is similar to the Grenada basalt in the Lesser Antilles arc on the basis of major and trace element data. Terrane is overlain by Middle to Late Carboniferous and Permian volcanic and sedimentary rocks and by Jurassic continental deposits. Terrane is interpreted as a fragment of a Silurian to Early Carboniferous island arc and fore-arc and back-arc basin.

REFERENCES: Suetenko, 1973; Zonenshain and others, 1975; Ruzhentsev and others, 1985, 1987; Eenjin, 1983; Badarch, 1990; Badarch and Orolmaa, 1998; Lamb and Badarch, 1997, 2001.

HD Hangay-Dauria terrane (Accretionary wedge, type A) (Silurian through Late Carboniferous) (Transbaikalia, Mongolia)

Consists of two uneaqual parts, the larger extending from Central Mongolia to the northeast into the eastern Transbaikalia region and forms a band that is 900 km long and varies from 100 to 120 km wide. A smaller part, that has dimensions of 450 by 150 km, occurs in central Mongolia, and is separated from the larger part by a narrow zone of the Onon terrane. Generally, the terrane boundaries are not clear. Only in the northeast, the sedimentary rocks of the terrane locally are thrust onto the Onon terrane.

In Mongolia, terrane consists of: (1) Silurian(?) shallow marine sedimentary rocks; (2) Early to Middle Devonian basalt, andesite, tuff, chert, volcanoclastic sandstone; (3) Middle to Late Devonian sandstone, siltstone with olistostrome, and red chert containing Famennian conodonts; and (4) Early to Late Carboniferous interbedded sandstone, siltstone, chert, and minor boulder conglomerate. Terrane is overlain by Early Permian felsic volcanic rocks, Late Permian conglomerate, sandstone and siltstone with abundant flora, and Middle to Late Triassic and Jurassic sedimentary rocks. Postaccretionary granite rocks are the Late Carboniferous to Early Permian Hangay pluton belt and Late Triassic to Jurassic REE granite. The terrane is interpreted as a Devonian to Carboniferous accrettionary wedge composed dominantly of turbidite.

REFERENCES: Zonenshain and others, 1990; Teraoka and others, 1996; Kurimoto and others, 1997; Zorin, 1999, Parfenov and others, 1999b.

In the Transbaikalia, oldest part of the terrane consists of Paleoproterozoic metamorphic formations (Uleleisky sequence) that contains granitized biotite, biotite-muscovite, and biotite-amphibole gneiss, quartz-biotite and biotite-muscovite schist, marble limestone lenses, quartzite, and amphibolite. The lower part of the sequence contains mainly gneiss, and the upper part contains mainly schist. These rocks form xenoliths in the massifs of early Paleozoic granitoids that mainly consist of anatectic granites of a wide compositional range with smaller amounts of gabbro, gabbro-diorite, and diorite. The Late Paleozic formations of the Transbaikalia region include sedimentary rocks of the Devonian(?) Agutsinsky and Goryachinsky suites, Early Carboniferous Ingodinsky formation, and Late Carboniferous Gutaisky suite that contains brachypods and bryozoans. The Devonian and Carboniferous units consist of terrigenous sequences of alternating greywacke and polymictic sandstone, siltstone, and local conglomerate and limestone. The Agutsinsky suite and Ingodinsky formation contain mainly lenses of jasper, the mafic and intermediate volcanic rocks. The close spatial association of terrigenous sedimentary rocks, mafic and intermediate volcanic rocks, and jasperoid pf Devonian and Carboniferous age are interpreted as a subduction melange. The sedimentary rocks are intruded by calc-alkaline granitoids of the Late Carboniferous Daurian complex that occurs in large batholith-like plutons.

The Permian and Early Triassic Selenga and Middle Jurassic through Early Cretaceous Trans-Baikalian-Daxinganling sedimentary-volcanic plutonic belt forms an overlap or suture complexe. The Early Jurassic sedimentary rocks of the Dulankhor suite consist of variegated sedimentary breccias, conglomerate, sandstone, and calcareous-clay shale with abundant plant fragments and fresh-water bivalves are interpreted as continental molasse. The terrane is interpreted as a Devonian to Carboniferous accrettionary wedge composed dominantly of turbidite. The time of accretion of the Khangay-Daurian terrane to the North-Asian Craton occurred before the Permian as based on the overlapping Selenga belt assemblage.

REFERENCES: Kotlyar and Popeko, 1974; Kozlov and Svadkovskaya, 1977; Shergina and others, 1979; Zonenshain and others, 1990; Rutshtein and Chaban, 1997; Parfenov and others, 1999; Zorin, 1999.

HE Heilongjiang terrane (Accretionary wedge, type B) (Ordovician and Silurian) (Northeastern China)

Consists chiefly of fault-bounded units of: (1) tectonic lenses or olistoliths of marble and ultramafic rocks; (2) highly-deformed mylonite, schist, gneiss, amphibolite, and glaucophane schist; and (3) pillow basalt. Heilongjiang terrane generally metamorphosed to glaucophane schist facies. Whole rock $^{40}Ar/^{39}Ar$ age of of glaucophane schist is 455 Ma to 410 Ma. Terrane is interpreted as an accretionary wedge which was thrust over the Jiamusi terrane during accretion of Jiamusi terrane and Zhangguangcailing terrane. The northeast-striking part of Heilongjiang terrane is displaced by Dunha-Mishan Fault. Local blueschist facies metamorphism with occurrence of glaucophane.

REFERENCES: Dong, 1990; Zhang Xingzhou, 1991; Cao Xi and others, 1992; Zhang and Sklyarov, 1992; Ye Huiwen and others, 1994; Tang Kedong, 1995; Sun Jiapeng and others, 2000.

HG Hegenshan terrane (Accretionary wedge, type B) (Devonian through Permian) (Southeastern Mongolia, Northeastern China)

In southeastern Mongolia, forms wedge shaped block, squeezed between Nuhetdavaa and Hutag Uul terranes. Consists of variably metamorphosed and sheared rocks that includes: (1) Undated quartz-feldspar schist and gneiss; (2) Devonian calc-alkalic basalt, andesite, dacite, and volcaniclastic rocks, and minor limestone with brachiopods, corals and bryozoans; and (3) Early to Middle Carboniferous, shallow-marine, sedimentary rocks and coeval andesite to rhyolite volcanic rocks. These unites are unconformably overlain by Permian andesite, dacite, tuffaceous sandstone, siltstone, and minor fusulinid-bearing limestone that stitched together by Late Carboniferous and Permian granite, and Triassic to Early Jurassic alkalic granite. Terrane interpreted as displaced fragment of the Hegenshan ophiolite suture zone.

REFERENCES: Rhuzentsev and others, 1992; Badarch and Orolmaa, 1998; Tomurtogoo and others, 2000.

In China, consists of ultramafic rocks extending 700 km along an east-west strike and from 1 to 40 km wide. Ultramafic rocks are faulted agains Devonian through Cretaceous strata, and are interpreted as an ophiolite. Terrane consists of: (1) dunite, gabbro, olivine gabbro, and tholeiite with intercalated radiolaria-bearing pillow basalt, carbonatite, and tuff; (2) plagioclase-augite-peridotite with a K-Ar age of 380 Ma and Devonian chert with tadiolaria; and (3) Cretaceous through Permian marine carbonatite, terrigenous clastic rocks, and volcaniclastic rocks that unconformably overlap the Devonian units. The Hergenshan fault, along which the terrane occurs, is interpreted as one of many important late-Paleozoic sutures between the Siberian plate and the North China Cratopn. Terrane is interpreted as a fragment of an accretionary wedge.

REFERENCES: Xie Tuolun, 1980; Liu Jiayi, 1983; Cao Congzhou, 1986; Li Jinyi, 1987; Bureau of Geology and Mineral Resources of Inner Mongolian Aut.Reg. (Inner Mongolian GMRB), 1991; Wang Quan, 1991.

HI Hida terrane (Metamorphic) (Jurassic) (Central Japan)

Consists of metamorphic rocks and Jurassic granites overlap by Jurassic marine rocks and Jurassic to Early Cretaceous continental rocks. The Hida metamorphic rocks exhibit high-temperature amphibolite facies metamorphism that formed during Jurassic and Triassic igneous activity. The Unazuki Schist, derived from Carboniferous to Permian sedimentary rocks, formed in the Triassic during intrusion of igneous rocks. The Funatsu Granite, with K-Ar ages clustered around 180 Ma, intrudes the Hida metamorphic rocks and Unazuki Schist.

REFERENCES: Shibata and Nozawa, 1984; Adachi and others, 1992.

HL Herlen terrane (Oceanic) (Late Neoproterozoic through Early Cambrian) (Eastern Mongolia)

Occurs as a narrow fault-bounded lens up to 25 km wide and 200 km long between the Argunsky and Idermeg terranes. Consists of: (1) Vendian to Early Cambrian dismembered ophiolite, serpentinite melange, gabbro-norite, gabbro, troctolite, and pyroxenite; and (2) Early Cambrian tholeiitic basalt, andesite basalt, tuff, chert, and volcaniclastic sandstone, siltstone, minor conglomerate, and limestone. Post-accretion granitic rocks are Middle to Late Cambrian(?) granodiorite and granite. Terrane is overlain by Middle to Late Triassic and Jurassic nonmarine sedimentary rocks and intruded by Middle to Late Carboniferous, and Late Triassic to Early Jurassic granite plutons. Terrane is deformed into a series of tectonic sheets that are seperated by north-verging thrust faults. Both the Paleozoic and Jurassic rocks are folded and thrusted toward the north. Terrane is interpreted as displaced fragment of dismembered ophiolite or suture zone.

REFERENCES: Tectonics, 1974; Palei and Juravleva; 1978, Agafonov and Stupakov, 1983; Tomurtogoo, 1989, Byamba, 1996.

HM Hamar-Davaa terrane (Metamorphic) (Paleoproterozoic through Early Cambrian) (Mongolia, Transbaikalia)

In Mongolia, forms a northeast-east trending belt that extended for 400 km from northeast of Hovsgol lake to the southern side of the Baikal Lake in Transbaikalia region. Consists of: (1) Paleoproterozoic high-grade metamorphic rocks, including gneiss, schist, amphibolite, and marble; and (2) Late Riphean to Early Cambrian schist, quartzite, rhyolite, and marble. Metamorphic rocks of the Khamardavaa formation (Transbaikalia) have a Pb-Pb isotopic age of 1120± 110 Ma. Terrane is overlain by Silurian marine sedimentary rocks and intruded by Middle Ordovician and Devonian granodiorite and granite. The tectonic affinities and paleogeography of the Hamardavaa terrane are not clear. The terrane may be craton fragment or a metamorphic terrane that collided with Siberian continent in the Late Riphean, or fragment of a metamorphosed, back-arc basin or continental margin arc. The terrane is interpreted herein as a metamorphic terrane of uncetain affinity, possibly a displaced fragment of a cratonal terrane.

REFERENCES: Belichenko and others, 1988, 1994, Dobretsov and others, 1989, Parfenov and others, 1995, 1996; Zorin and others, 1994; Khomentovsky and Gibshir 1996; Tomurtogoo, 1997; Bulgatov, 1998.

In Transbaikalia region, terrane extends northeast from the Khubsugul Lake in the south through the Khamar-Daban ridge where it strikes sublatitudinally and further along Lake Baikal. Consists of the Khamar-Daban and Olhon subterranes.

Khamar-Daban subterrane consists of metamorphic rocks of the Sludianka, Khangarul and Khamar-Daban series, of debateable age from the Archean to the Proterozoic. U-Pb zircon isotopic ages of 481±5 through 474±5 Ma are interpreted as the age of granulite metamorphism. The Sludianka series includes hornblende-pyroxene schist schist, gneiss derived from graywacke, and marble and calc-granofels. The Khangarul series unconformably overlies the Sludianka series and consists of diopside schist, derived from andesite, and biotite gneiss, derived from graywacke, with interbeds of marble and calc-granofels. The Khamar-Daban series consists of the Bezymyansky carbonate-gneiss, Cornilovsky schist, and Shubutuy carbonate-gneiss-schist. Terrane exhibits zonal metamorphism, including kyanite-sillimanite and andalusite-sillimanite granulite facies. The U-Pb zircon age of syn-metamorphic, two-pyroxene plagiogranites is 481±5 Ma, and 474±5 Ma for post-metamorphic quartz syenite. Undated large masses of biotite and amphibole-biotite granitoids occur in the central parts of subterrane. Occurrence in areas amphibolite facies of metamorphism, and occurrence of granite-pegmatites and orthotectites within the granulite facies suggests granitoid formation during Ordovician zonal metamorphism.

The Olkhon subterrane consists of sedimentary rocks of the Olkhon and Anginsky series. The Olkhon series contains two-pyroxene and diopside-hornblende plagioschist, amphibolite, and biotite-amphibole schist derived from tholeiite metavolcanic rocks, small bodies of gabbro and ultramafic rocks, and biotite-garnet, biotite plagiogneiss and schist derived from greywacke, carbonate and calc-silicate sedimentary rocks. The Olkhon series is characterized by intensive granitization with formation of migmatite-granite domes. The Anginsky series contains marble and siliceous rock, amphibolite, and calc-silicate rocks that are metamorphosed to amphibolite and epidote-amphibolite facies. Amphibolite is derived from andesite basalt. The Anginsky series is interpreted as forming in a calc-alkaline island arc with final-stage eruption of alkaline basalt. Metagabbro and ultramafic rockss are small bodies in tectonic slabs. Locally, gabbroic rocks of the Ozersky complex form large masses. One gabbro body has a

Sm-Nd isochron age of 530±23 Ma, and a U-Pb zircon metamorphic age of 485±5 Ma. Zonal metamorphism varies from granulite to epidote-amphibole facies.

REFERENCES: Pavlovskiy, Eskin, 1964; Shafeev, 1970; Vasiliev and others, 1981; Bibikova and others, 1990; Makrygina and others, 1993; Fedorovsky, 1995, 1997; Kotov and others, 1997.

HU Hug terrane (Accretionary wedge, type B) (Neoproterozoic) (Northern Mongolia, Eastern Sayan)

In Mongolia, forms south-north trending narrow belt, between the Sangelin and Sarkhoy terranes. Forms a structurally complex assemblage of:1) Shishigt ophiolite composed of metaperidotite (with a thickness of 3.5 to 4.0 km), harzburgite, dunite, minor lherzolite, and clinopyroxene-bearing harzburgite, wehrlite, clinopyroxenite, layered gabbro, and diabase (800 m thick) with an uppermost part of plagiogranite; (2) Middle Riphean low potassium tholeiitic metabasalt, tuff, chert, metasandstone, phyllite, and minor dolomite (Hug series) with a minimum structural thickness of 6,300 m. The metabasalt is interpreted as forming in within plate settings or as an oceanic island tholeiite. The Riphean rocks are metamorphosed to blueschist facies with crossite, actinolite, winchite, and retrograded to greenschist-blueschist facies. A Rb-Sr isochron age of 829± 23 Ma exists for blueschist facies metamorphism, and 624±52 Ma and 640±20 Ma for greenschist facies metamorphism. Terrane occurs in a number of thrust slivers and sheets, and is overthrusted to the east along the Doodnuur thrust that contains breccia and slivers of Vendian to Early Cambrian limestone and dolomite. Postaccretion plutonicrocks are early Paleozoic diorite and granodiorite with Rb-Sr isochron ages of 491± 25Ma, Devonian alaskite granite, and nephelinite syenite. The Hug terrane is interpreted as an accretionary wedge that formed during the collision of the Sangelin block with the Sarkhoy island arc. Terrane is overlapped by the Vendian-Cambrian Boksonsky series.

REFERENCES: Sklyarov and Dobretsov, 1987; Dobretsov and others, 1989; Dobretsov, Kirkdyashkin, 1993; Kuzmichev, Zhuravlev, 1996; Sklyarov and others, 1996; Tomurtogoo, 1997; Enkhbat, 1999.

In southeastern Transbaikalia region, terrane extends in a sublatitudinal direction for over 125 km and ranges up to 25 km wide. A smaller volcanogenic part of the terrane contains of diabase, basalt, and mafic tuff, and small ultramafic rock and gabbro bodies. The larger part of terrane contains terrigenous-tuffaceous sedimentary rocks. The terrane is metamorphosed to blueschist. The gabbroic sills exhibit a Sm-Nd isochron age of 736±43. Before the Vendian, the terrane was amalgamated with the Ilchir, Gargansky, Sarkhoy and Dibinsky terranes to form part of the Tuva-Mongolian microcontinent. Terrane is overlapped by the Vendian-Cambrian Boksinsky series.

REFERENCES: Sklyarov, Dobretsov, 1987; Geology and ore-bearing capacity of Eastern Sayan, 1989; Kuzmichev, Zhuravlev, 1996.

HV Hovd terrane (Continental-margin turbidite) (Neoproterozoic through Silurian) (Mongolia Altay)

Occurs in the eastern foothills of the Mongolian Altay range and forms a narrow northwest trending belt between the Tolbonuur and Tsagaanshiveet strike-slip faults. Consists of a series of highly sheared and faulted slivers of: (1) Vendian to Cambrian(?) basalt, andesite, gabbro, and serpentinite melange, (2) Middle and Late Cambrian sandstone and siltstone metamorphosed to greenschist and amphibolite facies, and minor melange and olistostrome; (3) Early to Middle Ordovician sandstone, graptolite shale, and argillite; (4) Middle to Late Ordovician conglomerate, sandstone, siltstone, and limestone; and (5) Silurian spilite, diabase, sandstone, siltstone, and graptolite shale that are intruded by gabbro, diorite, granodiorite, and plagiogranite with K-Ar ages of 456-440 Ma. Boundaries between tectonic blocks and slivers are mainly strike-slip faults. Terrane is overlain by Devonian volcanic plutonic rocks, and Early to Middle Carboniferous volcanic-sedimentary rocks. Postaccretion granitic rocks are Devonian to Permian subalkaline granite, and Jurassic leucogranite. Terrane is interpreted as early Paleozoic continental margin turbidite basin that formed along a transform margin.

REFERENCES: Dergunov and others, 1980; Rozman, 1986; Volochkovich and Leontyev, 1990; Rhuzentsev and others, 1991; Berzin and others, 1994; Berzin, 1995; Byamba and Dejidmaa, 1999.

HX Hutaguul-Xilinhot terrane (Metamorphic) (Paleoproterozoic and Neoproterozoic) (Mongolia, Northeastern China)

In northeastern China, extends in an east-west direction and consists mainly of Paleoproterozoic phyllite, slate, quartzite, quartz schist, marble, and other low-grade greenschist facies rocks. Terrane is intruded by Devonian and Triassic granite, the latter with K-Ar isotopic age of 229 Ma, and is overlapped by the Jurassic and Cretaceous volcanic rocks

REFERENCES: Dong Shenbao, 1983; Bureau of Geology and Mineral Resources of Inner Mongolian Aut.Reg. (Inner Mongolian GMRB) 1991.

In southeast Mongolia, forms an east-west elongated block, north of Sulinheer terrane and is composed of: (1) Paleoproterozoic gneiss, schist, migmatite, marble, and quartzite; (2) Early to Middle Riphean schist, metasandstone, phyllite, minor marble, and limestone; (3) Middle to Late Riphean marble, quartzite, and limestone with stromatolites and oncolites; and (4) Devonian basalt, andesite, dacite, tuff, volcaniclastic sandstone, siltstone, phyllite, minor pillow basalt, and limestone with corals and crinoids. Preaccretion plutonic rocks includes Middle to Late Devonian granite and granodiorite. Terrane is unconformably overlain by Permian volcanic rocks and marine turbidite, and Early Cretaceous rocks. Terrane is intruded by Permian leucogranite, syenite, and Early Triassic alkalic granite. Trrane is interpreted as a displaced fragment of a cratonal terrane.

REFERENCES: Suetenko and Lkhasuren, 1973; Ruzhentsev and others, 1989, 1992; Badarch, 1990; Tang, 1990; Permian, 1991; Hsu and others, 1991; Byamba, 1996.

IB Izu-Bonin terrane (Island arc) (Miocene through Quaternary) (Japan)

Consists of basalt and andesite rocks ranging in age from Miocene to Quaternary. Miocene submarine formation consists of altered basalt and andesite, and minor clastic rocks. Many Quaternary volcanoes occur in the terrane. Terrane exhibits crustal structure typical of oceanic island arcs with about a 25-km-thick crust. The crustal structure is interpreted as: (1) upper volcanic rocks and pyroclastic layer; (2) intermediate tonalite layer; and (3) deeper mafic amphibolite layer. Terrane is interpreted as accreting onto the Japanese islands as the result of northward subduction of Philippine Sea Plate. Accretion of the island arc crust formed a collisional zone at the northern margin of the terrane. Tanzawa tonalite in the collision zone is interpreted as the intermediate layer of the island arc.

REFERENCES: Aramaki and others, 1990.

ID Idermeg terrane (Passive continental margin) (Proterozoic and Cambrian) (Eastern Mongolia)

Bounded by Herlen fault to the north and Ondorshil fault to the south. Terrane basement exposed in scattered small blocks (Idermeg, Bayan Terem and Middle Gobi, Oortsog blocks). Terrane consists of: (1) Paleoproterozoic gneiss, amphibolite, schist, and quartzite with K-Ar isotopic ages of 1050, 1120, and 970 Ma; (2) Middle to Late Riphean quartz-amphibole, quartz-biotite amphibole, and quartz-sericite-chlorite schist, and phyllite, quartzite, marble, and limestone with stromatolites and oncolites; and (3) unconformably overlying Early Cambrian sandstone, siltstone, phyllite, quartzite, minor conglomerate, and limestone with archeachyathids. Terrane is intruded by Middle to Late Riphean, and Middle to Late Cambrian granite and granodiorite, and is overlain by Devonian, Permian, Triassic, Jurassic sedimentary and volcanic rocks, and is stitched together by Carboniferous, Permian, and Mesozoic granite plutons. Terrane is interpreted as a fragment of passive continental margin that was overlapped by Permian continental margin arc, or as a fragment of a microcontinent.

REFERENCES: Amantov, 1966; Byamba and others 1990; Belichenko and others, 1994; Byamba, 1996; Parfenov and others, 1999b; Zorin, 1999.

IG Igarka terrane (Island arc) (Neoproterozoic) (Yenisey Region)

Terrane occurs along the Yenisey River, extends submeridional direction for100 km, and ranges up to 20-25 km wide. Consists of basalt, pillow basalt, andesite and basalt porphyry, tuff, and spilite with interlayered green and black shale, and quartz sandstone, and tuff-breccia containing a great quantity of schist debris, and metamorphosed limestone and dolomite. Intrusive complex include diabase sills and dikes, quartz porphyry, and granodiorite.

Terrane is unconformity overlain by Late Riphean carbonate and terrigenous-carbonate deposits that are unconformity overlain by Vendian-Cambrian terrigenous-carbonate units. Nappes with volcanogenic rocks are thrust eastward onto the Precambrian carbonate and terrigenous-carbonate deposits towards the Siberian Platform.

REFERENCES: Postel'nikov, 1989; Nekrasov and Berendeev, 1991.

IH Ih Bogd terrane (Oceanic) (Neoproterozoic and Early Cambrian) (Gobi Altay, Southwestern Mongolia)

Occurs chiefly in two narrow, fault-bounded thrust sheets that range up to one km wide and 6 to 15 km long, and in several other small lenses. Consists of deformed and poorly studied fragments of serpentinite melange and dismembered ophiolite, presumably Vendian to Early Cambrian ages. The serpentinite melange contains numerous blocks of amphibolite, pyroxenite, and metamorphic rocks. The ophiolite consists of serpentinized harzburgite, minor dunite with rodingite veins, layered gabbro with inclusions of pyroxenite and wehrlite, and dike swarms. The dike complex consists of subparallel diabase and basalt dikes, and screens of hornblende diorite. Terrane also contains Vendian to Early Cambrian(?) spilite, keratophyre, basalt, andesite, tuff, sandstone, phyllite, limestone with stromatolites and oncolites. Terrane intruded by Early Permian leucogranite and unconformably overrlain by Late Permian and Jurassic volcanic and sedimenary rocks. Terrane is interpreted as displaced fragment of ophiolite that between Idermeg and Gobi Altay terranes.

REFERENCES: Perfiliev and Kheraskov 1980; Byamba, 1996; Tomurtogoo and others, 2000.

IL Ilchir terrane (Oceanic)(Neoproterozoic through Ordovician) (Eastern Sayan, Mongolia)

In Mongolia, occurs in small 25x30 km area, north of Huvsgol lake, between Gargan terrane to the west and Hamardavaa terrane to the east. The terrane comprises a Neoproterozoic dismembered ophiolite complex containing dunite, harzburgite, gabbro, and Middle Cambrian to Early Ordovician sandstone, siltstone, and tuff intruded by Late Ordovician granite and granodiorite.

REFERENCES: Belichenko and others, 1988; Parfenov and others, 1995.

In the southeastern Eastern Sayan, terrane extends in a sublatitudinal direction for over 200 km with ranges up to about 25 km wide. Consists of: (1) a Riphean ophiolite composed of restite ultramafic rock, mafic flows and pillow lava, siliceous-terrigenous sedimentary rocks, and olistostrome (Ospinsky suite); and (2) Vendian to lower Cambrian island arc volcanic rocks. The ophiolite exhibits a U-Pb zircon age of 1010 Ma. After pre-Vendian amalgamation with Sarkhoy island arc terrane, Dibinsky and Khugeinsky turbidite basin terranes, and Gargansky cratonal terrane, these terranes were overlapped by Vendian-Cambrian sedimentary rocks (Bokson series) that consist Middle Cambrian to Early Ordovician sandstone, siltstone, and are intruded by Ordovician granite and granodiorite.

REFERENCES: Dobretsov and others, 1985; Belichenko and others, 1988; Parfenov and others, 1995; Khain and others, 1999.

IM Imjingang terrane (Accretionary wedge, type B) (Devonian) (Korea)

Consists of Devonian terrigenous rocks and volcanic rocks (Rimjin Group). Terrigenous rocks are conglomerate, sandstone, and shale with limestone layers. Mafic and siliceous volcanic rocks occur in the upper part of the section. Fauna and flora remains reveal rather irregular stratification, with some layers with Middle Devonian flora overthrusting layers Late Devonian brachiopods.

REFERENCES: Geology of Korea, 1993.

IS Isakov terrane (Island arc) (Neoproterozoic) (Yenisey Ridge)

Terrane extends in a submeridional direction fornearly 300 km long, ranges up to 50 km wide, and is thrusted onto the West Angara passive continental margin terrane situated to the east. Consists of Late Riphean volcanic-sedimentary units and ophiolites. Central part of the terrane consists of oceanic rock complex including fragments of ophiolite (metaperidotite, metagabbroic rocks, and tholeiite basalt), and phyllite, and carbonate-bearing quartz-mica schist. Locally occurring are parallel diabase and diabase-porphyry dikes and sills intruding metabasalt.

To east and west of paleooceanic units are calc-alkaline metarhyolite and metaandesite-basalt flows, metamorphosed tuff, tuffaceous sandstone, sandstone, phyllite, shale, and limestone. The island arc Porozhnensk plagiogranite has a U-Pb zircon isotoic age of 697±3.6 Ma (V. Vernikovsky and others, this report); this age is interpreted as the upper age boundary of the formation of island arc and ophiolite. Metamorphic minerals from metamafic rocks and metapelite have Rb-Sr and K-Ar isotopic ages of 600-620 Ma studies and are interpreted as time of terrane obduction onto the passive craton margin. Complexes in terrane are thrust bounded. Schist adjacent to faults are corrugately recrumpled, altered, and silicified with faulted carbonate rocks. Zones of serpentine melange occur within ultramafic rocks. Metamorphism in the southern and eastern parts of terrane ranges up to epidote-amphibolite facies with garnet in schist in metabasalt. To the north and west, away from terrane boundaries, metamorphism grade ranges to lower greenschist facies. Terrane is unconformity overlapped by Late Riphean and Early Cambrian terrigenous-sedimentary deposits of the Vorogovka-Chapa sedimentary assemblage.

REFERENCES: Mironov, Nozhkin, 1978; Postel'nikov, 1980; Kuzmichev, 1987; Vernikovsky and others, 1993, 1994.

JI Jiamusi terrane (Metamorphic) (Neoproterozoic and older and Early Cambrian) (Northeastern China)

Consists chiefly of: (1) sillimanite schist, quartz schist, felsic gneiss, graphite schist, and marble (Mashan Group) with thickness of over 9,000 m; and (2) migmatite, gneiss, quartz schist, graphite schist, banded iron formation, and marble (Xindong Group) with a thickness of over 7300 m; and Neoproterozoic-Early Cambrian carbonate and terrigeneous deposits. The oldest overlap assemblages are: (1) Early Devonian sandstone and slate (Xinzhong Formation) that unconformably overlay the Precambrian basement; (2) Middle and Late Devonian sandstone, slate, limestone, and dacite tuff (Qiligeshan Formation, Shangheitai Formation and Xiaheitai Formation); (3) Early Carboniferous sandstone and tuff; (4) Late Carboniferous tuff, sandstone, and slate and conglomerate (Tatouhe Formation, Zenzishan Formation, Guangqing Formation); (5) Early Permian siltstone and tuff (Erlongshan Formation), (6) Late Permian conglomerate, sandstone and slate (Chenshan Formation); (7) Early Cretaceou sandstone and conglomerate; and (8) Mesozoic and Cenozoic sedimentary rocks. The Jiamusi terrane underwent several times of regional metamorphism, and the highest metamorphism reach granulite facies. The oldest metamorphic age is 1300 Ma and the youngest metamorphic age is 500 Ma.

REFERENCES: Zhang Qinglong and others, 1989; Shao Jian and others, 1991;Cao Xi and others, 1992; Tang Kedong and others, 1995; Jiang Jisheng, 1996; Bureau of Geology and Mineral Resources of Heilongjiang (1993); Krasnyi and others, 1996, Wilde and others, 1997, 1999; Sun Jiapeng and others, 2000.

JT Japan trench terrane (Accretionary wedge, type A) (late Tertiary and Quaternary) (Western Pacific Ocean)

Consists chiefly of trench slope and trench fill deposits of Miocene through Quaternary sedimentary rocks in Japan and Izu-Bonin trenches. Contains a gravitational slide zone on inner trench slope. The trench interpreted as a tectonic errosion type. Coarser-grained sedimentary rocks are more dominant in the Quaternary section than in late Miocene and Pliocene section. The Quaternary sedimentary section consists of sediments formed in a forearc basin, in a slope basin, and on a trench floor. The latter are coarser-grained and accumulated more rapidly than the clay-rich sedimentary rocks on the trench slope. The lower slope contains a relatively large number of channels and a greater amount of slumped material than elsewhere. Channels commonly corss the forearc basin and trench slope, and provide transport paths for coarse-grained sediment to various parts of the margin.

REFERENCES: Von Huene and Arther, 1982, Wakita and others, 1992.

KA Kan terrane (Cratonal) (Paleoproterozoic) (Eastern Sayan)

Contains komatiite-basalt, tholeiite-basalt, leucobasalt, andesitobasalt, andesite-dacite-rhyolite, graywacke, and sparse carbonate rocks. Metamorphosed to amphibolite facies. Amphibolite and amphibole-gneiss with lenses and horizons of metaultramafic rocks predominate. Greenschist diaphthorites occur along bounding faults. Core of terrane contains granite-gneiss domes and linear, tectonically imbricated zones. U-Pb zircon ages for metamorphic rocks range from 1.7 to 2.3 Ga. K-Ar mica ages range from 530-560 Ma, and Rb-Sr biotite isochron age is 560 Ma. The age range indicates several superimposed thermal processes. Terrane contains plutons of various ages. The oldest are mafic massifs, now metagabbro, metadiorite, and epidote-amphibolite schist with K-Ar amphibole

isotopic age of 1175 Ma. Younger tonalite-tondjenite in the domes has a U-Pb zircon isotopic age of 1900 Ma and a Pb-Pb age of 1860 Ma, and a U-Pb orthite age of 1800 Ma. Similar K-Ar mica ages occur. Terrane intruded by Early Devonian syenite and granosyenite plutons, and is locally overlapped by Devonian volcanic-sedimentary units of the South Siberian rift-related volcanic-plutonic belt. Terrane is interpreted as a fragment of the Early Precambrian basement of the North Asian Craton that was displaced along the Main Fault in Eastern Sayan towards the Kuvai terrane.

REFERENCES: Polkanov and Obruchev, 1964; Volobuev and others, 1980; Nozhkin and others, 1989, 1996; Rumyantsev and others, 1998; Tsypukov and others, 1993; Rozen and others, 1994.

KBG Kabarga terrane (Accretionary wedge, type A) (Neoproterozoic and early Paleozoic) (Southern Russian Far East)

Occurs in an east-west-trending band from 10 to 25 km wide north of Lake Khanka between the Matveevka and Nakhimovka terranes. Consists of following units. (1) Micaceous schist interlayered with quartzite (Spassk Formation) occuring at the base and overlying, less metamorphosed graphite-muscovite schist interlayered with amphibolite and limestone (Mitrophanovsk Formation), with an overlying sequence of phyllite and sandstone resting (Kabarga Formation and jaspilite sequence). Total thickness of deposits about 2,700 to 3,000 m. (2) Overlying carbonate rocks (Smolinsk and Rudonosny Formations). The Smolninsk Formation consists of dolomite and limestone interbedded with chert and shale. The overlying Rudonosny Formation consists of: (1) a lower layer (80 m thick) of shale and graphite shale; (2) an intermediate ore-bearing layer (10-100 m thick) of jaspilite, ferromanganese, manganese, phosphorite siliceous ore and gangue quartzite; and (3) an upper layer (10-300 m thick) of shale interbedded with dolomite and limestone. The carbonate rocks are limestone and dolomite, intercalated with shale, and is about 700 m thick. The age of the Rudonosny Formation is assumed to be Early Cambrian, by analogy with similar fossiliferous deposits in the Maly Khingan Ridge area. Terrane also contains locally outcrops of serpentinite melange, and is deformed into a system of closely spaced folds of east-west, less common northwest and northeast trends.

REFERENCES: Khanchuk and others, 1996.

KBN Kalba-Narim terrane (Accretionary Wedge, type A) (Ordovician through Early Carboniferous) (Kalba-Narim area)

Occurs between the Devonian-Carboniferous Rudny Altai and Zharma-Saur island-arc terranes. Consists of three units (from northeast to southwest), Irtysh-Kurchum, Kalba-Narim and Chara. Irtysh-Kurchum unit chiefly composed of Early-Middle Devonian ane lesser Silurian sedimentary rocks, locally with olistostromes and lenses of serpentinitic melange. The Kalba-Narim unit consists of a monotonous Late Devonian and Early Tournaisian black shale turbidite sequence. The Chara unit consists of Early Carboniferous marine terrigenous, mainly sandstone and sandy siltstone, flysch sequence, and associated olistostrome and melange of the Chara ophiolitic belt or suture. The olistostromes and melange contain rocks of variable composition. The ophiolites consist of basalt and deep-water siliceous rocks, including units formed in seamounts, island-arcs, and reefs that contain abundant radiolaria, conodonts, graptolites, brachipods, and foraminifera of Ordovician(?) through Early Carboniferous age. Locally, the melange contains blocks of eclogite, garnet amphibolite, glaucophane, and winchite schist. K-Ar isotopic ages of high-pressure rocks range from 360-370 to 540-570 Ma. The Chara melange-olistostrome unit is structurally complicated and contains fragments of an accretionary wedge and island arc that may have fromed from extensive strike-slip displacement along a convergent continental margin. This unit and marine flysch-like sequences are overlapped by Middle-Late Carboniferous continental terrigenous deposits with lesser coal and volcanic rocks that are interpreted as a transition collisional. The intrusion of giant Late Permian-Early Triassic granitic plutons of the Kalba belt are interpreted as forming in the final stage of oblique collision during late Paleozoic and early Mesozoic strike-slip displacement along major faults such as the Irtysh strike-slip fault. Close to the fault, the degree of metamorphism ranges from lower greenschist to amphibolite facies the occurred during imbricated thrust and strike-slip deformation.

REFERENCES: Ermolov and others, 1981; Rotarash and others, 1982; Berlin and others, 1994; Iwata and others, 1994.

KE Kema terrane (Island arc) (late Early Cretaceous) (Southern Russian Far East)

Occurs in the Sikote-Alin region and chiefly consists of distal turbidite deposits, andesite and basalt flows, breccia, tuff, and interbedded shallow-marine volcaniclastic rocks with Aptian to Albian pelecypods. The volcanic rocks are mainly tholeiitic and calc-alkalic. Terrane is overlain by late Albian and younger igneous rocks of the East Sikhote-Alin volcanic-plutonic belt.

REFERENCES: Simanenko, 1986.

KH Khapchan terrane (Granulite-paragneiss) (Paleoproterozoic) (Yakutia)

Occurs in eastern Anabar shield and is bounded on the west by the Billyakh strike-slip and reverse-fault melange zone. Consists mainly of supracrustal rocks (Khapchan Group) including marble, calciphyres, calc-silicate rocks, garnet paragneiss with up to 40% carbonate rocks, and lesser enderbite and schist. Enderbites are similar to analogous rocks of the Daldyn terrane that are interpreted as derived subalkali and alkali basalt and andesite-basalt. Geochemical studies of the Khapchan Group paragneiss suggest derivation of garnet gneiss from graywacke, marble from limestone and dolomite, and calc-silicate rocks from marl formed in a shallow-water shelf environment. Peak metamorphism is middle granulite facies. Nd isotopic studies and Sm/Nd isotopic ratios yield a model age of 2.4 Ga for the Khapchan Group. A U/Pb zircon age of peak granulite metamorphism of is 2.0 Ga. The central and southern parts of the terrane are deformed into tight linear folds, whereas the northern part is deformed into several domes.

REFERENCES: Vishnevskiy, 1978; Lutz and Oxman, 1990; Rosen and others., 1994.

KHM Khamsara terrane (Island arc) (Cambrian) (Northeastern Tuva)

Occurs in relatively small outcrops of Cambrian rocks between large batholiths of Late Cambrian-Early Ordovician granitoids. Consists of two blocks: (1) Early Cambrian rocks in an eastern block and in the eastern part of the western block; and (2) farther west, Middle-Late Cambrian and younger rocks. Blocks are separated by a northwest-striking zone of metasandstone, metasiltstone, and metashale that may form a basement of the Cambrian section or slope deposits related to volcanic arcs and back-arc basins. Terrane consists of two units. (1) Khamsara suite with a miniumum 2-2.5 km thickness that is chiefly composed of andesite-basalt, andesite, and less siliceous volcanic rocks. The upper part consists of tuff, tuff-breccia, tuffaceous conglomerate, tuffaceous sandstone, siltstone, and limestone with Early Cambrian achaeocyata. (2) The Irgitkhem suite that is composed of boulder-pebble conglomerate, tuffaceous conglomerate, and andesite tuff and occurs only in the western extremity of the terrane. The clastic material is dominated by clasts of underlying volcanic rocks, and well-rounded granitic boulders and pebbles. Rounded clasts and poorly-rounded/angular blocks and lenses of limestone with Middle Cambrian trilobites are occur at various horizons. The limestone is interpreted as syngenetic with the Irgitkhem suite and formed in separated reers, or was redeposited to form olistostrome-like horizons. The Irgitkhem suite is interpreted as forming in the coastal part of a fore-arc trough during rapidly attenuating island-arc volcanism, intensive tectonism, and strike-slip movement along boundary of lithospheric plates.

REFERENCES: Chuchko and others, 1969; Bukharov, Zaikov, 1979; Berzin, 1979, 1995; Berzin and Dobretsov, 1994; Berzin and Kungurtsev, 1996.

KI Kanim terrane (Island arc) (Late Neoproterozoic and Early Cambrian) (Central Kuznetsk Alatau)

The Kanim terrane forms an imbricate unit between the fragments of back-arc structures and consists of four units. (1) Vendian and Early Cambrian(?) sedimentary-volcanogenic rocks (Kanym and Tajozhny suites), which is separated from the older deposits by faults. The main lithologies are 4hyolite-dacite and andesite-dacite lava and tuff with lesser mafic and andesite volcanic rock, black shale, and carbonate rocks. (2) An Early Cambrian sedimentary assemblage of sandstone, siltstone, shale, siliceous shale, and chert, layered archaeocyata-bearing limestone, and sparse interlayers of mafic volcanic rocks (Ustkundat suite). (3) An Aldanian-Early Lenian carbonate unit composed mainly of massive limestone (Usin suite) with a rich fauna including archaeocyata, trilobites, brachiopods, and other fossils. And (4) a local, fault-bounded volcanic-sedimentary assemblage (Bogoyul suite) that contains: (1) a lower part of mafic volcanic rocks with thin interbeds of siliceous shale and shales; (2) a middle part composed of shale, siliceous and mafic volcanic rock, volcaniclastic rocks, and massive and layered limestone; and (3) an upper part composed of fine- to coarse-grained clastic rocks with tuff lenses and Early Cambrian limestone

blocks with archaeocyata and trilobite. Terrane is interpreted as a small fragment of a magmatic back-arc. Terrane is intruded by early Paleozoic collisional granitoids, and is unconformity overlapped by Early Devonian the sedimentary-volcanogenic complex of the South Siberian rift-related volcanic-plutonic belt.

REFERENCES: Ekhanin, 1961; Gintsinger and others, 1969; Resolutions, 1979; Alabin, 1983; Grigor'yev, 1988.

KK Kizir-Kazir terrane (Island arc) (Cambrian) (Southwestern Eastern Sayan)

The Kizir-Kazir terrane consists of thre major units that occur in various tectonic lenses and sheets. The stratigraphic succession of individual sequences, ages, and interrelationships are not clear. Three units occur. (1) An Early Cambrian volcanic-terrigenous-carbonate assemblage with unknown basement. In the most of the terrane the assemblage is consists of reefoid limestone with trilobites, archaeocyata, and brachiopodes (Atdabanian, Botomian and Toyonian suites). In other areas, the assemblage consists of island-arc tholeiitic volcanic rocks, related limestone, shale and siliceous shale, and volcaniclastic deposits mainly in the eastern part of the terrane. (2) A Middle Cambriam (Amgaian) assemblage of volcanic-sedimentary deposits (Moiseev suite) containing trilobites and brachipods that conformly overlaps the Early Cambrian carbonate sequences. This assemblage consists of the following two suites. (a) A terrigenous-volcanogenic suite occurs in the northeastern terrane and is dominated by volcaniclastic rocks of variable grain size with subordinate horizons of volcanic rocks and lenses/interbeds of siliceous shale, limestone and carbonate-terrigenous rocks. And (b) a carbonate-volcanic-terrigenous occurs mainly in the western part of the terrane and is dominated by layered and massive limestone and calcareous rocks with subordinate andesite and siliceous volcanic rock and tuff. (3) A basalt-andesite calc-alkaline assemblage that unconformably overlaps Early and Middle Cambrian rocks and is mainly composed of pyroclastic material with subordinate sedimentary rocks (Kizir suite) with an interpreted age of Middle Cambrian (Mayaian) through Late Cambrian. Terrane is intruded by early Paleozoic collisional granitoids, and Early Devonian(?) rift granitoids. Terrane is unconformity overlain by Early Devonian rift-related sedimentary-volcanogenic complex and Middle Devonian-Carboniferous continental molasse.

REFERENCES: Musatov and Nemirovskaya, 1961; Mezhelovsky, 1962; Amgaian and others, 1971; Resolutions, 1979; Berzin and Kungurtsev, 1996.

KLM Kiselyovka-Manoma terrane (Accretionary wedge, type B) (Jurassic and Early Cretaceous) (Southern Russian Far East)

Occurs in a narrow band along the southern side of the Amur River terrane, north of the Amur fault. Stratigraphy and structure are poorly known. Distinguished from the adjacent Badzhal, Amur River, and Samarka terranes by occurrence of Jurassic and Early Cretaceous ribbon chert and siliceous shale, and Cretaceous flysch, Jurassic basalt and Early Jurassic limestone. Terrane also contains chert and mafic volcanic rocks in tectonic sheets and olistoliths in an Early Cretaceous olistostrome. Terrane is interpreted as tectonically linked to the Khingan-Okhotsk active continental margin.

REFERENCES: Filippov, 1988, Kuzmin, Kaidalov, 1990; Shevlyov, 1990, Natal'in, 1991.

KM Kamensky terrane (Continental margin arc) (Early and Middle Triassic) (Transbaikalia)

Occurs in the eastern part of Transbaikalia area, terrane extends in a sublatitudinal direction for over 100 km and ranges up to 15 km wide. Consists of volcanic-sedimentary rocks (Kamensky suite) and intrusive rocks (Bereinsky complex) of island arc origin. The volcanic-sedimentary rocks of the Kamensky suite consist of volcano-mictic conglomerate, congloerate breccia, breccias, tuffaceous sandstone, and tuffaceous siltstone. Coarse-grained lithologies predominate, and locally volcanic rocks comprise up to 50% of the section. Volcanic rocks consist of moderately- and high-aluminous basalt, andesite-basalt, andesite, dacite, and rhyolite, and contain greenstone, propylitic, and albite alteration. Volcanic rocks overlie Late Triassic sedimentary rocks (Mogotuy Formation). The Bereinsky complex contains two intrusive phases, an older phase of gabbros and diorite, and a younger phase of mainly granite. The intrusive rocks constitute a gabbro-diorite-trondjemite-plagiogranite association. Aluminiferous gabbro comprises up to 50% of the complex and is associated with lenses of amphibole-bearing peridotite (Rutshtein, 1973). Along the Mongol-Okhotsk fault the intrusive rocks exhibit intense dynamic greenschist facies metamorphism that is associated with Middle and Late Jurassic strike-slip faulting K-Ar isotopic ages of 169-159 Ma (Dril and Kuzmin, 1998). Overlap and stitching complexes formations are the Middle Jurassic Trans-Baikalian-

Daxinganling sedimentary-volcanic plutonic (Karbachinsky continental-sedimentary suite), and Late Jurassic granitoids (Kukulbey complex). These relations indicate a Pre-Middle Jurassic accretion to the North Asian Craton.

REFERENCES: Dolganev, 1963; Kuzmin, 1985; Okuneva, Konditerov, 1964; Rutshtein, 1973, 1997; Rutshtein and Chaban, 1997; Dril and Kuzmin, 1998.

KN Kular-Nera terrane (Continental margin turbidite) (Permian through Early Jurassic) (Yakutia)

Forms a broad, northwest-trending belt and consists chiefly of: (1) a thick assemblage of Permian, Triassic, and Early Jurassic hemipelagic and pelagic mudstone, siltstone, and minor sandstone; and (2) Permian (Selennyakh Range) and Early Jurassic (Nera River) radiolarian chert and tuff. Terrane is interpreted as a deep-sea-fan complex that contains interbedded continental rise and marginal sea pelagic deposits that formed between the passive margin of the Siberian continent (North Asian Craton Margin) and terranes to the east. Terrane is weakly to highly metamorphosed and deformed, and exhibits lower greenschist and locally epidote-amphibolite facies. Terrane is locally deformed into gently inclined appressed and superposed folds and is overlapped by the Middle Jurassic to Early Cretaceous Indigirka-Oloy sedimentary-volcanic-plutonic assemblage. Terrane is separated from the Verkhoyansk foldbelt to the west by the Adycha-Taryn fault.

REFERENCES: Dagis and others, 1979; Parfenov and Trushchelev, 1983; Parfenov and others, 1988, 1989; Bychkov and Kiseleva, 1990.

KO Khor terrane (Island arc) (Early Paleozoic?) (Southern Russian Far East)

Occurs in a narrow, fault-bounded wedge along the Cretaceous sinistral-slip Central Sikhote-Alin fault. Terrane is surrounded by the Samarka terrane and consists of gneiss, quartzite, and pelitic schist that are metamorphosed to amphibolite and greenschist facies. Also in the terrane are plagiogranite and leucogranite. The gneiss has a Rb-Sr isotopic age of 227 Ma. The Khor and companion Anui terranes are interpreted as parts of a single microcontinent that collided with the eastern margin of Asia at the beginning of the Cretaceous. The Khor terrane may correlate with the Sergeevka terrane.

REFERENCES: Zmievsky, 1980; Martynyuk, Mikhalev, and Popeko, 1986.

KOZ Kozhukhov terrane (Island arc) (Late Neoproterozoic and Cambrian) (Northern Kuznetsk Alatau)

Occurs in a small wedge-like block adjacent to the large Kuznetsk-Alatau strike-slip fault. Three units are recognized. (1) Vendian(?)-Early(?) Cambrian Contrasting volcanic rocks and tuff, clastic rocks, limestone, chert, and siliceous shale (Kozhukhov and Chumai suites) with unclear relations to older deposits are unclear. (2) Early Cambrian conglomerate, gravelstone, sandstone, mafic tuff, and limestone with archaeocyata (Karacharov suite). This sequence overlie the older deposits with conformity, the others – with unconformity and interruption. Middle Cambrian (Amgaian) andesite and andesite-basalt porphyry and tuff intercalated with volcaniclastic rocks, sand-siltstone, sandy-shale, and limestone. The age is inferred from correlation with the Berikul suite of the eastern Kuznetsk Alatau. Terrane is overlapped by Early-Middle Ordovician marine molasse (Taimen, Vasiliev and Bukhtai suites), Devonian sedimentary-volcanogenic units of the South Siberian volcanic-plutonic belt, and Jurassic-Cretaceous deposits of the West Siberian basin. Terrane is intruded by Early Cambrian island-arc granitoids (Lavernov complex), Cambrian-Ordovician collisional granite (Martaiga complex), and Middle-Late(?) granite and granosyenite (Chebula complex) that may have formed in an active continental margin.

REFERENCES: Resolutions, 1979; Alabin, 1983; Grigor'yev, 1988.

Kolyma-Omolon superterrane (Yakutia)

Consists of a large number of cratonal, passive continental margin, island arc, accretionary-wedge, and minor oceanic crust, and ophiolite terranes. The superterrane is overlain by mainly Middle Jurassic to Early Cretaceous Indigirka-Oloy sedimentary-volcanic-plutonic assemblage that is interpreted as a pre-accretion marginal island arc assemblage. The superterrane was accreted to the North Asian craton and the North Asian Craton Margin during the Late Jurassic and Early Cretaceous. The suture (Adycha-Taryn thrust fault) between the Kolyma-Omolon

superterrane and North Asian Craton Margin is intruded by the Late Jurassic and Early Cretaceous Verkhoyansk collisional granite belt. The eastern margin of the superterrane is locally extensively overlapped by the Cretaceous and Paleocene Okhotsk-Chukotka volcanic-plutonic belt.

KMN Munilkan terrane (Oceanic) (early Paleozoic) (Yakutia)

Consists chiefly of the early Paleozoic(?) Kalgyn ophiolite that consists of serpentinized harzburgite, dunite, cumulate gabbro, amphibolite, and metabasalt with an Ar-Ar actinolite isotopic age of 415 Ma for metamorphism of the amphibolite. Terrane consists of several tectonic sheets that structurally overlie the early to middle Paleozoic carbonate deposits of the Omulevka terrane.

REFERENCES: Shishkin, 1980; Dolgov and others, 1983; Arkhipov, 1984; Oxman, 1989; Parfenov and others, 1989; Layer and others, 1993.

KOV Omulevka terrane (Passive continental margin) (late Neoproterozoic through Triassic) (Yakutia)

Consists chiefly from base to top of five units: (1) Late Precambrian(?) marble, schist, and metavolcanic rocks; (2) an unconformably overlying thick unit (up to 1700 m thick) of boulder conglomerate with pebbles of native and exotic rocks, and Middle and Late fossiliferous Cambrian marble, schist, metarhyolite, and quartzite; (3) a thick sequence of Ordovician through Early Carboniferous fossiliferous carbonate rocks including limestone, dolomite, and marl, and sparse sandstone, siltstone, and mudstone; (4) Carboniferous and Permian fossiliferous tuff, chert, shale, limestone, siltstone, and sandstone; and (5) Triassic fossiliferous siltstone, mudstone, marl, and shaley limestone. Along the southeast border of the terrane is a unit of Givetian calcareous sandstone that contains marine trachybasalt flows. The deep-water siltstone, argillite, and chert that prevail in Famennian-Early Triassic section are interlayered with subordinate andesite and basalt tuff, and limestone. Except for the Late Permian, the late Paleozoic units contain numerous diabase sills that were cofolded with the host rocks. For paleomagnetic determinations, high-quality paleomagnetic directions from sedimentary rocks exist for two localities, one of Late Jurassic age, and the other of Middle Jurassic age. These determinations indicate a southward displacement with respect to the Siberian platform of $20^{o}\pm10^{o}$ for the older locality, and about $15^{o}\pm40^{o}$ for the younger locality. The Omulevka terrane is overlain by Jurassic volcanic rocks and intruded by coeval Jurassic granitic rocks of the Uyandina-Yasachnaya volcanic-plutonic belt (part of the Indigirka-Oloy sedimentary-volcanic-plutonic assemblage).

REFERENCES: Merzlyakov, 1971; Bulgakova, 1986; Natapov and Surmilova, 1986; Parfenov, 1991; Neustroev and others, 1993.

KPD Polousnyi-Debin terrane (Accretionary wedge, type A) (Jurassic) (Yakutia)

Includes units in the the Polousnyy and In'yali-Debin synclinoria located along the northwestern and southeastern margins of the Kolyma-Omolon superterrane, respectively.

The Polousnyy synclinorium extends sublatitudinally for 500 km and ranges from 50-100 km wide. It is separated by thrusts from the Nagondzha and Omulevka terranes that occur to the south. To the west, the synclinorium borders on the Kular-Nera terrane along the thrust faults and, to the north, the synclinorium is overlain by Late Cenozoic rocks of the Primorsk lowland. The Polousnyy synclinorium consists of Jurassic turbidite deposits that range up to 5000 m thick. The lower part consists of interlayered shale and sandstone with endolistostrome horizons. The middle part consists of siltstone and sandstone. The Late Jurassic rocks in the northern part of the synclinorium are shale rich with rare sheets of andesite, andesite basalt, and basalt. Within the Primorsk lowland large positive gravity and magnetic anomalies exist and are interpreted as covered ophiolites. The Polousnyy synclinorium exhibits a fold-and-thrust structure, with related recumbent and inclined folds, and tectonic melange is widely, with greenschist facies metamorphism.

The In'yali-Debin synclinorium extends in a narrow (70-100 km) arc for 800 km along the southwestern margin of the Kolyma-Omolon superterrane. The southwestern boundary of the In'yali-Debin synclinorium is the Charky-Indigirka thrust and other faults. The In'yali-Debin synclinorium consists of turbidite deposits up to 4,000 m thick. The Middle Jurassic rocks consist of interlayered siltstone, mudstone, and sandstone with endolistostrome horizons. The Late Jurassic rocks consists of siltstone, clay shale, and polymictic and calcareous sandstone, with horizons of tuffaceous siltstone and sandstone and intraformational conglomerate. In the southern part of the In'yali-Debin synclinorium a tectonic sheet of ultramafic and mafic rocks occurs within the Jurassic sedimentary rocks. These rocks were previously described as the Debin ophiolite fragment. The base of the sheet consists of peridotite serpentinite, olivine, and hypersthene gabbro-norite, and anorthosite, whereas the upper part consists of banded two-pyroxene gabbro and gabbro-diorite. Petrochemistry of the gabbros indicates their formation from tholeiitic magma at various depths. The rocks of the In'yali-Debin synclinorium are deformed into compressed folds, including isoclines that are associated with high-angle, southwest-verging thrusts. The thrusts and folds are intruded by granitoid plutons that have 40Ar-39Ar isotopic ages of 139-143 Ma.

REFERENCES: Chekhov, 1976; Gusev, 1979; Spector and others, 1981; Arkhipov, 1984; Oxman and others, 1995; Layer and others, in press.

KNG Nagondzha terrane (Continental margin) (Carboniferous through Late Triassic) (Yakutia)

Extends in a narrow band for 450 km and up to 100 kim wide to the north and west of the Ulakhan-Tas, Selennyakh, and Tas-Khayakhtakh blocks of the Omulevka terrane. Consists of repeatedly deformed, late Paleozoic and early Mesozoic rocks in packets of tectonic sheets and lenses of variable thickness. The oldest Carboniferous-Permian rocks form a series of small tectonic lenses and sheets along the eastern boundary of the terrane and consist of hemipelagic volcanic-terrigenous-siliceous and carbonate-terrigenous rocks with fragments of chert and pillow basalt. Ladinian and early Late Triassic sedimentary rocks contain a relatively homogeneous argillaceous composition and thin parallel bedding, with thin and pinching beds of calcareous sandstone and floating pebble sandstone that grade into rhythmically interlayered Late Triassic-Early Jurassic units of cross-bedded siltstone, shale, and calcareous sandstone. The section is topped with Bathonian-Callovian sedimentary rocks, including rhythmically interlayered calcareous sandstone, siltstone, and mudstone with olistostrom fragments of which grade along strike into conglomerate. A fold-and-thrust structure formed in at least three stages of deformation. The amount of horizontal shortening of stratigraphic section caused by thrusting is estimated at 35-40%, as based on balanced sections. Dextral and sinistral strike-slip faults are prevalent in the northeast and southwest parts of the terrane, respectively. The largest Setakchan thrust extends for 100 km as a band of melange and broken rocks. The Triassic rocks of the tectonically overlap Jurassic sedimentary rocks of the Polousnyy anticlinorium along the Setakchan thrust. The amount of horizontal displacement on the fault is estimated at a few tens of km.

REFERENCES: Tarabukin and others, 1997; Rudenko and others, 1998.

KPR Kyushu-Palau terrane (Island arc) (Paleocene) (Western Pacific Ocean)

Consists of Paleogene island arc volcanic rocks forming ridge that was rifted away from the Izu-Bonin arc during opening of Shikoku basin in Oligocene and Miocene. Ridge forms a linear escarpment up to 2000 m high and bounded by normal faults along boundary between the Shikoku Basin and ridge.

REFERENCES: Ingle and Karig, 1975; Shiki and others, 1984; Yamazaki and Yuasa, 1998.

KR Kara terrane (Continental margin turbidite) (Late Neoproterozoic) (northern part of Taimyr Peninsula)

Extends in a northeastern direction for 700 km long and ranges up to 100 km wide. Consists chiefly of rhythmically alternating sandstone, siltstone, and pelite, Riphean acritarchs, that was deposited along a continental slope and foot. Terrane metamorphosed from low grade of greenschist facies to amphibolite facies during intrusion autochthonous granite and migmatite. Rb-Sr and K-Ar metamorphism isotopic age is 270 and 277 Ma. The U-Pb isotopic age of autochthonous granite is 306 Ma, and Sm-Nd isotopic model age of the crust is 1.0-1.2 Ga. Terrane is intruded by Permian two-mica and biotite-amphibole granite and granodiorite along discordant contacts. Adjacent to the granites is a distinct metamorphic zoning from unmetamorphosed rocks to muscovite and amphibole hornfels facies. A U-Pb isotopic age of these granites and granitoids is 264 Ma; Rb-Sr and Ar-Ar isotopic ages are 252-258 Ma, and a Sm-Nd model age of the crust is 850-1075 Ma. Terrane is interpreted as a microcontinent or passive margin of Kara paleocontinent.

REFERENCES: Makhlaev, Korobova, 1972; Zabiyaka, 1974; Bezzubtsev and others, 1986; Uflyand and others, 1991; Vernikovsky and others, 1995, 1998; Vernikovsky, 1996.

KRT Kurtushiba terrane (Accretionary wedge, type B) (Late Neoproterozoic and Early Cambrian) (Southern West Sayan)

Consists of a Vendian-Early Cambrian accretionary wedge exposed in a package of tectonic sheets that are thrust to the northwest over the early Paleozoic continental margin turbidites of the West Sayan terrane. Several tectonostratigraphic units are recognized. (1) An upper sheet of 7 km thickness occurs in the southeastern part of the terrane and consists of a lower ophiolite section, locally disturbed, of serpentinized harzburgite, banded dunite-harzburgite complex, gabbro, a sheeted-dike diabase complex, and pillow lava and tuff. (2) Underlaying is the sedimentary-volcanogenic part of the ophiolite with total thickness over 5-6 km (Chingin suite). The lower part is mainly pillow lava, tuff, diabase sills and dikes, and the upper part is siliceous shale, graphite siliceous shale, shale, graywacke, and carbonate rocks. A Vendian age is suggested by oncolite and catagraphite. Several sheets of Early Cambrian island-arc rocks of andesite basalt, sandstone, gravelstone, conglomerate, and limestone with archaeocyata (Tereshkin suite) also occur. The volcanic rocks are characterized by low Ti and Fe/Mg ratios and high Al. (3) Structurally below is a broken belt of metamorphic schist that forms the northwestern margin of the terrane. The matrix of metamorphic rocks consists of tuffaceous sedimentary rocks with subordinate basalt (Akkol suite) and are the sedimentary part of the Vendian-Early Cambrian accretionary wedge. The metamorphic schist contains glaucophane, crossite and winchite. The metamorphic schist of the Kurtushiba terrane may correlate with those of the Dzhebash and Amil terranes.

Zones of serpentinitic melange separate the tectonic sheets of upper ophiolite and metamorphic schist. The melange includes the clasts of surrounding rocks, such as glaucophane schist, the lower ophiolite, and exotic rocks including garnet amphibolite and limestone. The Vendian-Early Cambrian units are structurally overlain by the Late Silurian motley, shallow-water marine molasse with interlayered limestone with brachiopods and corals. The molasse fills various fault-bounded syncline structures. Within some depressions the Silurian deposits are unconformably overlain by the Early Devonian continental sedimentary-volcanogenic deposits. The terrane is interuded by Early Devonian granitoid bodies that occur in the Late Silurian and Early Devonian synclines.

REFERENCES: Zonenshain, 1963; Eremeev, Sibilev, 1969, 1974; Isakov, Korobeinikov, 1970; Sobolev and Dobretsov, 1977; Kheraskov, 1979; Melyakhovetsky and Sklyarov, 1985.

KT Khemchik-Tapsa terrane (Accretionary wedge, type A) (Cambrian through Ordovician) (Tuva)

Occurs along the northern margin of the Tannuola and Ondum island-arc terranes and consists of the eastern Tapsa and western Khemchik parts. The eastern Tapsa part consists of a tuffaceous siliceous-terrigenous sequence, with flysch in the upper part (Tapsa and Bayankol suites). The sequence contains olistostrome horizons with olistoliths of carbonate rocks, and lesser volcanogenic, siliceous, and other sedimentary rocks. Ophiolitic tectonic sheets also occur. The western Khamchik part occurs in the core of ridge-like anticlines with complicated faults and is overlain by Ordovician-Silurian deposits. The pre-Ordovician rocks occur in odd tectonic lenses are associated with the following rock units for which the stratigraphic section is not clear. (1) Fragments of an ophiolitic section of possibly Vendian-Early Cambrian age containing ultramafic rocks, basalt, and siliceous rocks. The fragments

consist of oceanic island basalt and small blocks of carbonate rocks; (2) turbidites of variable grain size derived from basalt and siliceous rocks; (3) Early Cambrian ophiolitic olistostromes; (4) tuffaceous carbonate-terrigenous deposits with Early Cambrian trilobites and archaeocyata; and (5) terrigenous deposits that vary from coarse-clastic to sandy clay with horizons of polymictic olistostrome. The sandstone and shale matrix of olistostromes contains Middle Cambrian trilobites. The first four units are interpreted as part of an accretionary wedge; the sixth unit is interpreted as a forearc basin. The forearc trough deposits are underlain by the Ondum island arc terrane. In the western part, the boundary between the forearc and volcanic arc units overlain by middle and late Paleozoic deposits of the Tuva trough.

REFERENCES: Amgaian, 1971; Berzin, 1979; 1987; Bukharov, 1979.

KTN Kaitanak terrane (Accretionary wedge, type B) (Early Paleozoic or older) (Southern Gorny Altai)

Occurs in the Charysh-Terekta strike-slip fault zone and consists of two packages. (1) The lower (northern) package consists of high-pressure/low-temperature metamorphosed mafic volcanic rocks, siliceous deposits, and sandstone-shale deposits (Uimon suite). The high-pressure minerals are glaucophane, crossite, winchite, and piedmontite. K-Ar isotopic ages are 455-400 Ma. And (2) overlying ophiolitic sheets, forming erratic tectonic blocks that are separated by serpentinitic melange zones. The sheets are composed of serpentinized ultramafic rocks, gabbro, a sheeted-dike complex(?), siliceous rocks, mafic volcanic rocks, and lesser metaterrigenous and carbonate rocks. Unlike the lower package, the upper package is metamorphosed at low-pressure. Terrane is intruded by small bodies of middle Paleozoic granite of the Altai volcanic-plutonic belt.

REFERENCES: Duk, 1982; Dobretsov and others, 1991; Buslov, 1992, 1998.

KU Kurai terrane (Island arc) (Early Cambrian) (Eastern Gorny Altai)

Consists of tectonic sheets separated by the zones of serpentinitic melange. Two Vendian-Early Cambrian sedimentary-volcanogenic units, formed in two stages of island arc evolution, exist. (1) A primitive island arc containing a rhyolite-basalt assemblage (Balkhash suite) that is overlapped or partly laterally replaced by siliceous tuff, volcanoclastic rocks, black shale, and carbonate rocks (Tydtueryk suite). Island-arc tholeiitic basalt is characterized by low Ti, Al, K, and P, low total alkalinity under Na dominating over K, and high Mg/Fe ratio. Some volcanic rocks are compositionally close to boninite. The unit is intruded by plagiogranite-gabbro-pyroxenite bodies of the Meshtueryk complex. And (2) a normal island arc assemblage (Kurai suite) unconformably overlying the first unit and consists of calc-alkaline volcanic rocks (tuff, tephritoids, andesite, andesite basalt), tuffaceous terrigenous, terrigenous and carbonate rocks with an Early Cambrian fauna. The volcanic rocks are intruded by gabbro-diabase (Tadjilin complex). Terrane is unconformably overlain by Early-Middle Devonian volcanic-sedimentary units of the Altai volcanic-plutonic belt.

REFERENCES: Gusev, 1991; Simonov, 1991; Simonov and Kuznetsov, 1991; Shokalsky and others, 1997.

KUV Kuvai terrane (Accretionary wedge, type A) (Neoproterozoic) (Northwestern Eastern Sayan)

Occurs in the Main Fault strike-slip zone and ranges up to 30-40 km to the northwest, narrows to the southeast, and splits into several tectonic lenses. Chiefly composed of Late or Middle Riphean volcanogenic, carbonate, and sanddy-shale metamorphosed to greenschist facies (Kuvai series and analogues). The northwestern part of the terrane is a fragment of the north-northwest-striking imbricated volcanic arc, that is thrust over an adjacent west backarc(?) sedimentary basin. The volcanic arc consists of mainly mafic lava and pyroclastic rocks of with local siliceous and andesite volcanic rocks (Kuvai and Kershul suites). The volcanogenic rocks are interlayered with carbonaceous limestone and siliceous shale, indicating a relatively deep-water environment. In the upper part this volcanic-sedimentary sequence are lahars, motley and red tuff-breccia, and dolomite interbeds, indicating shallow-water and continental deposition. Upward, the Kuvai suite grades into dolomites and submarine-landslide rocks, shallow-water sand-clay-carbonate sedimentary rocks (Angaloy suite) that contains variable size clasts of limestone, dolomite and tuff.

Also occurring are terrigenous-shale sedimentary rocks including sandy shale sequences with subordinate carbonate deposits (Urman suite), and carbonate sequences with lesser sandy shale sedimentary rocks (Mana suite).

The sand-shale sequences range up to 2 km thick and consist of fine-grained sandstone, siltstone, siliceous, carbonaceous-siliceous and carbonaceous-siliceous-chlorite shale, and thin limestone.

Also occurring are carbonate sequences that range up to 1500 m thick and consist of dark carbonaceous limestone, often with interlayered clay and sand, and carbonaceous-siliceous-carbonate shale. Thin horizons of submarine-landslide conglomerate with the clasts of host rocks or Kuvai (Kershul) volcanic rocks occur locally.

In the southeastern part of the terrane are fragments of ophiolite and various volcanogenic rocks. The ophiolite occurs in separate sheets and boudins that are composed of serpentinized dunite, harzburgite, and a layered lherzolite-wehrlite-pyroxenite-gabbro-diorite complex. The volcanogenic deposits consist of low- and high-Ti tholeiitic metabasalt and andesite-dacite (Inzhigei suite). Several blocks contain Late Riphean or, possibly, Vendian-Early Cambrian carbonate deposits up to 3 to 4 km thick (Mirichun suite and analogues). Also present are numerous layered and stock-like bodies of titaniferous gabbro-pyroxenite, gabbro and gabbro-diabase (Lysan complex) and sporadic dike-like and lens-like bodies of serpentinized ultramafic rocks (Akshep complex) that are gabbro-pyroxenite cumulates. The Kuvai terrane includes pre-oceanic rift-related, oceanic crust, and island-arc units, and exotic, lens-like blocks of Archean-Proterozoic metamorphic rocks of which the largest is the Kansk terrane. The smaller terranes, not shown in the map (Arzybei, Dzhuglym and others), occur adjacent to the Derba terrane, and consist of sialic fragments that were detached from the craton in the Riphean. These fragments were accreted to the craton, together with other tectonic units, during large early and middle Paleozoic displacements.

Intrusion of Cambrian (Malaya Biryusa complex) and Ordovician-Silurian (Bugulma complex) gabbro and granite is interpreted as forming during collisional events and strike-slip faulting. Early Devonian rifting is interpreted as forming subalkaline granite and syenite (Ognit complex). Terrane is covered by terrigenous-carbonate deposits of the Mana basin, that is interpreted as the marginal continental facies of a Vendian through Middle Cambrian back-arc basin, Cambrian-Ordovician continental molasse, and Devonian continental rift sedimentary-volcanogenic units.

REFERENCES: Semikhatov, 1965; Berzin, 1967; Berzin, Gibsher, Postnikov, 1982; Khomentovsky and others, 1978; 1980; Abramovich and others, 1989; Yaroshevich and others, 1995.

KV Kamyshovy terrane (Island arc) (Late Jurassic through Late Cretaceous) (Southern Russian Far East)

Occurs on Sakhalin Island and consists chiefly of: (1) oceanic basalt and chert with Late Jurassic to Early Cretaceous radiolarian; and (2) an overlying thick sequence of mid-Cretaceous basalt, andesite, argillite, sandstone, and conglomerate (Pobedinskaya sequence) that contain Albian to Cenomanian Inoceramus.

REFERENCES: Geology of the U.S.S.R., Sakhalin Island, 1970; Simanenko, 1986.

KW Kwanmo terrane (Granulite-paragneiss) (Paleoproterozoic) (Korea)

Consists of metamorphic rocks of the Mach'ollyong Supergroup including: (1) Songjin Group composed of biotite-, sillimanite-, cordierite, and garnet-gneiss and migmatite; (2) Pukdaech'on Group composed of marble and dolomite marble with schist and migmatite interlayers; and (3) Namdaech'on Group composed of micaceous schist and quartzite. The Mach'ollyong Supergroup is intruded by Late Permian granite of the Tumangang Complex, the Jurassic Daebu granite, and Late Cretaceous Bulgugsa granite that are interpreted as forming in active continental margins. Tertiary overlap assemblages consist of epicontinental terrigenous deposits and volcanic rocks of the Ch'ilbosan and Myongchong Groups.

REFERENCES: Geology of Korea, 1993.

KY Kotel'nyi terrane (Passive continental margin) (Late Neoproterozoic through Late Triassic) (Taimyr Peninsula)

Consists of following units. (1) A Ordovician through Early Carboniferous unit (several km thick) of shallow-marine limestone, dolomite, coquina, marl, and limestone breccia of age that is interlayered with local conglomerate, mudstone, siltstone, and sandstone. Unit contains an abundant and diversified coral, ostracod, brachiopod, and gastropod fauna similar to that of the Siberian platform. (2) In the southwest part of the terrane are Late Devonian and Early to Middle Carboniferous turbidites composed of deep-water mudstone, siltstone,

sandstone, and limestone. (3) In the northern and central parts of the terrane are Early to Middle Carboniferous and Early Triassic sedimentary rocks. The Carboniferous and Permian deposits consist of thin conglomerate, siltstone, and sandstone beds. A stratigraphic hiatus occurs at the base of the Triassic units. And (4) an conformably overlying Jurassic unit (up to 2000 m thick) of black shale that contains interlayered fossiliferous limestone with pelecypods, ammonites, foraminifers, crinoids, wood detritus, plant spores, and pollen. The southern part of the terrane contains only Late Triassic units and relationships with the Paleozoic units are not clear. Recent studies suggest that thrusts may be widespread and that the Paleozoic units structurally overly Mesozoic units (G. Aulov, written commun., 1992). The Paleozoic and Mesozoic deposits are codeformed into northwest-trending folds with steep axial surfaces. The age of folding is interpreted as Carboniferous. Postaccretionary units consist of: (1) Jurassic overlap units revealed by drilling in the Fadeev and Novaya Sibir' Islands; and (2) unconformably overlying, flat-lying Aptian mudstone, siltstone, sandstone, silicic tuff, and coal, and Late Cretaceous dacite. Aeromagnetic data indicate abundant mafic and ultramafic plutonic rocks at depth. The southwest boundary of the terrane is drawn along a linear positive gravity anomaly between the Kotel'nyi and Stolbovoy Islands (L.A. Savostin, written commun., 1992). The eastern boundary of the terrane is defined from geophysical data that imply a late Paleozoic and Mesozoic sequence (3 to 5 km thick) of clastic deposits.

REFERENCES: Zhizhina, 1959; Volnov and others, 1970; Churkin, 1973; Vinogradov and others, 1974; Volnov, 1975; Kos'ko, 1977; Avetisov, 1983; Kos'ko and others, 1990; Fujita and Cook, 1990.

KZ Kuzeev terrane (Granulite-orthogneiss) (Paleoproterozoic) (Yenisey Ridge)

Occurs in elongated submeridional-trending plates in the central part of the South Yenisey Ridge with a length of 200 km and ranging up to 30-40 km wide. Consists mainly two-pyroxene-plagioclase gneiss, metamorphosed gabbro-norite, mafic schist derived from andesite and basalt, and local charnockite. High-aluminous biotite-garnet gneiss derived from primarily pelite and psammite sedimentary rocks. The Zemoveynyi massif contains the largest group of gabbro-norite. Terrane was metamorphosed to granulite facies. U-Pb zircon isotopic studies indicate a metamorphic age of 1840 to 1920 Ma ().

REFERENCES: Zhizhina, 1959; Volnov and others, 1970; Churkin, 1973; Vinogradov and others, 1974; Volnov, 1975; Kos'ko, 1977; Volobuev and others, 1980; Avetisov, 1982; Fujita and Cook, 1990; Kos'ko and others, 1990; Bibikova and others, 1993.

LA Laoling terrane (Island arc) (Late Ordovician through Silurian) (Northeastern China)

Consists chiefly of (1) Late Ordovician metamorphic marine deposits and siliceous volcanic-volcaniclastic rocks (over 2,000 m thick) metamorphosed to quartz schist, mica-schist, metamorphic intermediate-siliceous volcanic rocks, marble, slate and sandstone (Shifen Formation) with *Sinkiangolasma, Leolasma and Rouscria*. (2) Early Silurian volcaniclastic deposits and sedimentary rocks (over 3000 m thick) metamorphosed to slate, siltstone, phyllite, tuff, siliceous lava, and sandstone (Taoshan Formation) abundent graptolites. (3) Middle Silurian sandstone, siltstone and tuff (Zhangjiatun Formation), Late Silurian shale, siltstone, graywacke and limestone (Erdaogou Formation); and (4) local unconformably overlapping Middle Devonian limestone, siltstone, limestone and sandstone (Wangjiajie Formation), and local unconformably overlapping Carboniferous and Permian sedimentary rocks and Mesozoic and Cenozoic sedimentary rocks. Terrane is intruded by Silurian plutons and Hercynian plutons with a K-Ar isotopic age of 408 Ma. Terrane is strongly discontinuously latitudinal stretching and intensely deformed by widespread, mainly Hercynian plutons. Faults bounding terrane are covered.

REFERENCES: Tang Kedong and others, 1995; Zhao Chunjin and others, 1996; Bureau of Geology and Mineral Resources of JilinProvince 1989; Sun Jiapeng and others, 2000.

LG Laoyeling-Grodekov superterrane (Island arc) (Late Carboniferous and Permian) (Northeastern China, Southern Russian Far East)

In northeastern China consists chiefly of: (1) discontinuous Early Silurian sedimentary and volcaniclastic rocks composed of tuff, chert, shale, slate, and siltstone that are intruded by Silurian plutons; (2) Late Carboniferous(?) and Early and Late Permian carbonate, terrigenous and intermediate-felsic volcanic, and volcaniclastic rocks, (Qinggouzi, Kedao, Miaoling, Dashangou, and Shanxiuling Formations) composed of limestone, siltstone, sandstone, conglomerate, tuff, rhyolite, andescite; and (3) Mesozoic and Cenozoic overlap sedimentary

assemblages. Terrane is strongly intruded by Late Permian plutons. Terrane strike approximately east-west. Western boundary not well exposed.

REFERENCES: Zhang Qinglong and others 1989, 1996; Zhao Chunjin and others, 1996; Khanchuk, A.I. and others, 1996; Jilin GMRB, 1989; Tang Kedong and others, 1995; Sun Jiapeng and others, 2000.

In Russian Southeast, consists chiefly of the following units. (1) A lower tectonic melange unit contains fragments of Early Silurian granite-pebble-bearing conglomerate, sandstone, siliceous mudstone and lesser interbedded basalt, andesite, rhyolite, and tuff. Sedimentary rocks locally contain brachiopods and graptolites, and are locally intensely deformed and metamorphosed to middle amphibolite facies. The melange structural thickness is about 1,500 m. And (2) an upper unit contains Permian basalt, andesite, rhyolite, conglomerate, sandstone, mudstone, and shale, and lesser interbedded limestone lenses with Late Permian Tethyan fusulinids. The structural thickness is about several thousand meters. Permian rocks are intruded by zoned dunite-clinopyroxenite-gabbro intrusions that form Alaskan-type plutons, and local tonalite and plagiogranite. Permian igneous rocks are interpreted as part of a Permian volcanic arc. Younger, collision-related, Late Permian granitic plutons intrude the terrane and are co-magmatic with Permian volcanic rocks in the Khanka superterrane. This relation suggests that accretion of the Laoelin-Grodekovsk terrane and Khanka superterrane occurred at the end of the Paleozoic. The Laoelin-Grodekovsk terrane is overlapped by: (1) Triassic plant-bearing conglomerate and sandstone; and (2) to the west in China by Late Triassic continental rhyolite, Late Jurassic rhyolite, and Late Jurassic subduction-related granitic plutons.

REFERENCES: Evlanov, 1971; Shcheka and others, 1973; Nazarenko and Bazhanov, 1986; Izosov and others, 1988; Khanchuk and others, 1988.

LK Lake terrane (Island arc) (Late Neoproterozoic and Cambrian) (Western Mongolia)

Occurs vast areas of the Valley of Lakes and foothills of Mongolian Altay and Hangay Mountain Range in western Mongolia. Extends for 1000 km and ranges up to 200 km wide. Consists of Late Precambrian to Cambrian Troodos-type ophiolites, island arc and backarc basin volcanic-sedimentary rocks, and plutonic rocks of different compositions. The well-known intact Han Tayshir ophiolite contains Alpine-type ultramafic rocks, a layered mafic complex, an upper gabbro unit, sheeted dikes, basalt pillow lava, and deep marine siliceous sedimentary rocks. A plagiogranite U-Pb zircon age is 568±4 Ma. The island arc rocks include calc-alkalic volcanic rocks, reef limestone, graywacke, and olistostrome of the Late Vendian to Amgin stage of the Early Cambrian. A basalt Sm-Nd isotopic age is 522± 13Ma. The island arc complex contains small intrusions and sills of layered gabbro with Sm-Nd isotopic ages of 527 to 531Ma (Kovalenko and others, 1996, and is intruded by Middle Cambrian(?) I-type granite of the Togtohynshil complex. Terrane is moderately to intensely folded and thrust faulted, and contains melange, olistostomes, and large allochthonous ophiolites including the Taishir, Naran, Bayannuru, and and ophiolites. Terrane is overlain by Ordovician, Silurian marine sedimentary rocks, Devonian volcanic rocks, Early Carboniferous marine sedimentary rocks, and Permia and Jurassic non-marine deposits. A stitching complex is a Middle to Late Cambrian S-type granite. Terrane is interpreted as a Vendian and Cambrian island arc system that contained several island arc, backarc, and forarc basin units.

REFERENCES: Zonenshain and Kuzmin, 1976; Zonenshain and Kuzmin, 1976; Dergunov, 1989; Tomurtogoo, 1989, 1997, Rhuzentsev and Burashnikov, 1995; Khain and others, 1994; Kovalenko and others, 1996; Windley and others, 2000.

LN Lan terrane (Continental margin turbidite) (Devonian through Triassic) (Southern Russian Far East)

Consists chiefly of Middle Devonian, Carboniferous, Permian, and Triassic turbidites with olistostrome horizons (Dzhegdalinsk, Ustarteksk, Arteksk, Torbosk, Alukansk, Lansk, and Deloesk suites). Inclusions in the olistostromes consist of mafic volcanic rocks, chert, and limestone. Major olistostrome units are: (1) a Middle Devonian olistostrome composed of limestone with Early Cambrian archaeocyatheans with North Asian platform affinity; (2) the Late Carboniferous Alukansk suite of spilite, diabase, sandstone, and silicic volcanic that in interpreted as forming adjacent to a volcanic island arc; and (3) a Late Triassic olistostrome that contains Triassic fossils that are exotic to the Russian Southeast. The Middle Devonian, Visean-Moscovian, and Late Permian macrofossils of the terrane constitute a Boreal fauna. The Late Permian unit contains a Boreal fauna contrasts sharply with the Tukuringra-Dzhagdi terrane that contains a Tethyan fauna. Overlapping the Lan terrane are Early and Middle

Jurassic shallow-marine clastic rocks and tuff that also overlap the Baladek terrane. Regional tectonic analysis suggests that these Jurassic deposits formed in the forearc basin of the Uda volcanic-plutonic belt that occurs along the Stanovoy block of the North Asian craton.

REFERENCES: Kirillova and Turbin, 1979, Brudnitskaya, 1990.

MB Mogen-Buren terrane (Oceanic) (Late Neoproterozoic and Early Cambrian) (Southeastern Gorny Altai)

Consists of Vendian and Early Cambrian volcanic-sedimentary rocks metamorphosed to greenschist facies. The lower horizons consist of greenstone volcanic rocks and tuff with subordinate terrigenous rocks, and local serpentinite and gabbro. The upper horizons are composed chiefly of terrigenous and tuffaceous terrigenous rocks. The lower part of the terrane is interpreted as forming in an oceanic environment, whereas the upper is interpreted as forming in a fore-arc environment. Terrane intruded by early Paleozoic subalkaline granite and middle Paleozoic alkaline and plumasite granite. Terrane bordered by imbricated-thrust structures and strike-slip faults, and is interpreted as a series of turbidite and related deposits that formed along an early Paleozoic continental margin.

REFERENCES: Dergunov, 1967; Avrov , 1980.

MC Mino Tamba Chichibu terrane (Accretionary wedge, type B) (Permian through Early Cretaceous) (Japan)

Consists chiefly of sandstone, mudstone, siliceous shale, chert, limestone, and basalt. Sandstone, mudstone, and siliceous shale are of Jurassic are Cretaceous. Chert includes radiolarians ranging from Permian to Early Jurassic age. Limestone yields Carboniferous to Permian fusulinids and is intimately associated with pillow basalt. The various lithologies are interpreted as derived from oceanic crust ranging in age from Carboniferous to Early Cretaceous that were iincorporated into a melange. Terrane was amalgamated with Hida terrane in middle Cretaceous. Both termanes are unconformably overlain by Cretaceous felsic volcanic rocks and are intruded by Late Cretaceous to Paleogene granite.

REFERENCES: Wakita, 1988; Adachi and others, 1992.

MG Magan terrane (Tonalite- trondhjemite-gneiss) (Paleoproterozoic) (Yakutia)

Consists of a lower structural unit of homogeneous biotite and biotite-amphibole orthogneiss derived from tonalite-granodiorite-adamellite composition, and an upper structural unit of garnet-bearing and highly aluminous gneiss and carbonate rocks (Late Anabar Group). The tonalite-granodiorite-adamellite complex is similar to the Amitsok augen gneiss and Uivak II gneiss. Average Sm-Nd model age for the Magan terrane substratum is 2.94$\pm$0.09 Ga. Terranne metamorphosed to granulite facies. Terrane characterized by poorly-defined structures, a mosaic magnetic field, and very low gravity anomaly values relative to the neighbouring terranes.

REFERENCES: Vishnevskiy, 1978; Oxman, 1989; Lutz and Oxman, 1990; Rosen and others, 1999.

MK Malokhingansk terrane (Accretionary wedge, type B) (Neoproterozoic and Cambrian) (Western part of Russian Southeast)

Consists chiefly of the Neoproterozoic and Early Cambrian units that form a continuous sequence of shale, siliceous schist, chert, and limestone (Ditursk, Iginchinsk, Murandavsk, Rudnosnsk, and Londokovsk Suites). The Neoproterozoic and Cambrian rocks are zonally metamorphosed from green shale to amphibolite faces. Cherts include interlayers of oceanic ferromanganese and manganese minerals. The Neoproterozoic and Cambrian sequence is intruded by granitic rock of the Birsk and Birobidzhan Complexes that yield K-Ar isotopic ages of 301 Ma. Uncomformably overlying, post-accretion units are Devonian, Permian, and Triassic shallow-marine, clastic rocks, including Devonian limestone in the Niransk, Pachansk, and Osakhitinsk Suites. The clastic rocks were deposited in a narrow, fault-bounded belt along southeastern boundary of the terrane, and contain abundant fauna that is similar to other zones of Central Asia. The Permian Osakhinsk Suite contain Kolyma Boreal pelcypods whereas the Permian deposits of the Badzhal terrane contains Tethyan fusulinids. Various Jurassic clastic units, which formed in individual basins, overlap the terrane. Overlapping the Malokhingansk, Badzhal, Ulban, and Nilan terranes is the Cretaceous Khingan-Okhotsk volcanic-plutonic belt (unit ko).

REFERENCES: Krasny, 1966, Martynyuk and others, 1983; Kozlovsky, 1988.

MM Mamyn terrane (Passive continental margin) (Archean?) (Southern Russian Far East)

Consists chiefly of two major metamorphic units. (1) an older Early Archean(?) unit that consists of garnet-cordierite-sillimanite gneiss and schist, granite-gneiss, gabbro, and amphibolite metamorphosed to granulite facies; and (2) an assumed younger sequence of Proterozoic(?) greenschist, metasandstone, marble, quartzite, felsite, sandstone, and siltstone. Metamorphic units are poorly exposed among the extensive Paleozoic granitic rocks of the Kiviliysk complex that have a minimum K-Ar isotopic age of 495 Ma. Overlapping the metamorphic rocks of the terrane are: (1) Early Cambrian limestone and dolomite with archaeocyathids and Silurian clastic rocks (Mamynsk suite), and abundant quartz-rich sandstone and siltstone; (2) Middle Devonian siltstone, sandstone, and limestone (Oldoisk and Imchansk suites) that, along with the Silurian units, are gently folded; (3) Early Cretaceous volcanic rocks (Peremykinsk and Taldansk suites) of the Umlekan-Ogodzhin volcanic-plutonic belt; and (4) terrestrial clastic rocks of the Amur sedimentary basin. These overlap assemblages link together the Mamyn, Gonzha, Oldoi, and Turan terranes.

REFERENCES: Shilo, 1982, Kozlovsky, 1988.

MN Mandah terrane (Accretionary wedge, type A) (Devonian) (Southern Mongolia)

Occurs in narrow, fault-bounded lens, between the Gurvansayhan and Mandalovoo and consists chiefly of a strongly folded and faulted assemblage of undated metavolcanic and metasedimentary rocks, and melange containing blocks of basalt, andesite, tuff, Devonian coral-bearing limestone, minor amphibolit, and gabbro. Matrix for the melange contains mainly sheared serpentinite, and fine-grained sandstone and siltstone, and locally contains olistostrome with blocks of limestone and sandstone. Postaccretionary complex are Middle to Late Carboniferous volcanic-plutonic rocks. Terrane is interpreted as an accretionary wedge that was tectonically paired to the Gurvansayhan arc terrane.

REFERENCES: Suetenko, 1973; Tomurtogoo, 1984, Ruzhentsev and others, 1985.

MO Mandalovoo-Onor terrane (Island arc) (Middle Ordovician through Early Carboniferous) (Southern Mongolia, Northeastern China)

In Mongolia, forms a narrow up to 50 km wide, about 1800 km long belt in northern margin of southern Mongolia. Consists of a complexly-deformed, but partly coherent, long-lived stratigraphic succession of : (1) Middle to Late Ordovician sandstone, siltstone, minor conglomerate, and lenses of limestone with corals and brachiopods; (2) Silurian sandstone, siltstone, argillte, minor conglomerate, massive limestone with corals and brachiopods including Tuvaella fauna of Siberian affinity; (3) Early Devonian conglomerate, sandstone, and minor felsic tuff; (4) Early to Middle Devonian fossil-rich limestone, sandstone, and ash tuff; (5) Middle to Late Devonian massive and pillow basalt, andesite basalt, andesite, rhyolite, tuff, volcaniclastic sandstone, siltstone, chert with radiolarians and conodonts, and sparse limestone with brachiopods and corals; and (6) Early Carboniferous sandstone, siltstone, chert, and tuff that contains conodonts and megafossils. Spiderdiagrams for the Devonian basalt display a pattern that most similar to volcanic arc basalt. Preaccretionary granitic rocks include Middle to Late Devonian small plutons of diorite and granodiorite. Terrane is overlain by Middle to Late Carboniferous, Early Permian volcanic rocks (unit mn), Late Permian sedimentary rocks, and Early Cretaceous volcanic rocks. Stitching complexes include Middle to Late Carboniferous and Early Permian granite. Provenance data from the Ordovician and Silurian sandstone suggested that the source material for these sandstone may have been either an uplifted continental block or the eroded, exposed roots of volcanic arc. Paleomagnetic determinations from Devonian andesite basalt suggest about 40^0 northward motion and 75^0 clockwise rotation. Terrane is interpreted as a displaced fragment of a Devonian island arc that is underlain by thick sedimentary rocks derived from an older island arc.

REFERENCES: Suetenko and others, 1977; Ruzhentsev and others, 1987; 1984, Badarch, 1990; Voznesenskaya and Badarch; 1991, Didenko, 1992; Lamb and Badarch, 1997, 2001.

In northeastern China, terrane extends in a northeast direction and consists of: (1) slate, phyllite, metatuffaceous siltstone, metatuffaceous sandstone, and metasandstone with trilobites, brachiopods, and anthozoa; (2) late Silurian metasandstone, slate and limestone with Gondwana brachiopods; (3) overlapping Devonian strata containing radiolaria, brachiopods, anthozoa, and marine fossils, chert, spilite, keratophyre, quartz keratophyre,

andesite basalt and the terrigenous clastic rocks with intercalated intermediate-siliceous volcanic rocks with Early Carboniferous marine and limnic fossils. Terrane intruded by syntectonic ultramafic and granitic plutons with Rb-Sr isotopic age of 354 Ma. Terrane unconformably overlapped by Permian volcanic rocks and terrigenous clastic rocks.

REFERENCES: Bureau of Geology and Mineral Resources of Inner Mongolian, 1991; Bureau of Geology and Mineral Resources of Heilongjiang, 1993; Ye Mao, 1994; Xu Wenliang, 1994.

MR Maralikha terrane (Accretionary wedge, type A) (Middle Devonian or older) (Northwestern Gorny Altai)

Consists of a monotonous unit (Maralikha suite) (over 3 km thick) of gray and greenish fine-grained sandstone, siltstone, and sericite-siliceous shale that are generally finely and rhythmically interbedded, and several boudins of marble-like limestone with crinoids. The limestone may be part of the sandy shale deposits, or olistoliths. Hosting the carbonate lenses are possibly distal facies turbidites. Terrane is intruded by Late Devonian calc-alkaline and plumasite granite with U-Pb zircon ages of 362 to 371 Ma, and by Late Permian and Early Triassic REE granite. Terrane is overlapped by Cenozoic deposits of the West Siberian sedimentary basin.

REFERENCES: Iwata, and others, 1997; Vladimirov and others, 1997.

MS Muya terrane (Metamorphic) (Late Archean? and Paleoproterozoic?) (Transbaikalia)

Southern part of terrane contains an Early Archean metamorphic complex (Kindikansky series) consisting of amphibole-, garnet-amphibole-, biotite-amphibole-, and garnet-biotite- (with hyperstene, diopside, disthen, sillimanite) gneiss and schist with contains lenses of garnet ultramafic rocks and eclogite. These units display relatively older high-pressure stage, and relatively younger diaphtoric metamorphisms. In the central part of the terrane, with a unclear relatin, the Late Archean Ileirsky and Ljunkutsky suites contain gneiss and schist with clinopyroxene, plagioclase, hornblende, garnet and biotite metamorphosed to eclogite facies, and two younger diaphtoric stages. In the northern part of terrane, the Ileirsky contains gneiss and schist with garnet, mica and hornblende, amphibolite and marble, and lenticular bodies of eclogite. Outcrops are controlled by blastomylonite zones and overthrust slabs with Sm-Nd rock and minerals isochron ages of 653 Ma ago. Seismic data suggest these units form a large slab that gently dips northeast to a depth 20 km.

In the northern part of the terrane, the Ileirsky suite is concordantly overlapped by gneiss, schist, and marble of the Ljunkutsky suite. Both are metamorphosed to garnet-kyanite-biotite-orthoclase and garnet-sillimanite-biotite-orthoclase subfacies, with younger diapthorisis at greenschist facies conditions. The Ljunkutsky suite is unconformably overlain by the PaleoproterozoicParamsky series containing carbonate-terrigenous rocks that are metamorphosed to greeschist facies conditions. Terrane is intruded by Paleoproterozoic(?) granite bodies of the Ileirsky complex and deformed into as folds with northeastern to submeridional strikes. In the Riphean the Muya terrane was a massif with relatively rigid internal structural framework. Accretion of the Muya terrane and the adjacent Riphean island arc terrane to the craton is interpreted as occuring in the Riphean with formation of granite bodies with Nd-Sm isotopoic model ages of 789 and 784 Ma. The terrane is overlapped by Vendian-Cambrian terrigenous-carbonate sedimentary rocks of the Upper Angara sedimentary basin, and is intruded late Paleozoic granite batholiths.

REFERENCES: Bolonev and others, 1983; Bulgatov 1983, 1988; Bozhko and others, 1999; Dobretsov and others, 1989; Doronina, Sklyarov, 1995; Shatsky and others, 1996; Rytsk and others, 1999.

MT Matveevka terrane (Metamorphic) (Archean? or Proterozoic?) (Southern Russian Far East)

Occurs north of Lake Khanka consists of Precambrian crystalline rocks: (1) diopside-calcite, less common forsterite-calcite, and calcite-dolomite graphite-bearing marble interlayered with gneiss (Ruzhinsk Formation, over 1000 m thick) at the base of visible section; overlying biotite-sillimanite and garnet-biotite-cordierite gneiss, and hypersthene-magnetite and fayalite quartzite interlayered with marble (Matveevsk Formation, about 3000 m thick) with a moderate pressure assemblage of garnet-cordierite and orthoclase-biotite; and (3) an section of biotite-amphibole schist and gneiss, amphibolite, and marble (Turgenevsk Formation, about 4300 m thick).

REFERENCES: Khanchuk and others, 1996.

NA Nadanhada terrane (Accretionary wedge, type B) (Middle Triassic through Middle Jurassic) (Northeastern China)

Consists chiefly of: (1) Middle and Late Triassic pelagic chert with *pseudoheliodiscus* and pillow lava; (2) Early and Middle Jurassic pelite and siliceous mudstone; (3) Late Jurassic turbidite deposits; and (4) unconformbly overlying Late Jurassic and Early Cretaceous sandstone and mudstone with *Buchia*.

REFERENCES: Zhang Qinglong and others, 1989; Shao Jian and others, 1991, 1992; Tang Kedong and others, 1995; Khanchuk and others, 1996; Sun Jiapeng and others, 2000.

NAB Nabilsky terrane (Accretionary wedge, type B) (Late Cretaceous through Paleogene) (Southern Russian Far East)

Consists chiefly of a melange unit with a matrix of late Campanian to early Paleogene(?) turbidite and Campanian chert olistostromes that enclose bodies of Late Jurassic and Early Cretaceous radiolarian chert and basalt and guyot fragments. Guyots are capped by Late Jurassic to Early Cretaceous limestone that contains Tethyan reef corals. The melange also locally contains ophiolitic fragments, including large harzburgite and lherzolite bodies, and sparse cumulative gabbro and sheeted dikes. Geochemical data indicate both MORB and seamount basalt occurs in melange. The southern part of the terrane also include a large allochthon (1.5 x 8 km) that consists of medium-grade metamorphic rocks with K-Ar white mica ages of 130 to 148 Ma. The Nabilsky terrane is tectonically linked to the East-Sikhote-Alin volcanic-plutonic belt.

REFERENCES: Geology of the U.S.S.R., Sakhalin Island, 1970; Raznitsin, 1982; Rozhdestvensky, 1983; Rikhter, 1986; Khanchuk and others, 1988.

ND Nora-Sukhotin-Duobaoshan terrane (Island arc) (Neoproterozoic through Early Carboniferous) (Mongolia, Northeastern China, Russian Far East)

In eastern Mongolia, forms a narrow northwest-trending belt in Mongolia and consists of: (1) Middle and Late Riphean(?) gneiss, schist, stromatolitic marble, and limestone; (2) Early and Middle Cambrian sandstone, siltstone, minor conglomerate, and olistostrome; (3) Middle to Late Ordovician sandstone, siltstone, phyllite, minor conglomerate, and limestone with corals; (4) Silurian sandstone, siltstone, argillite, minor coral-bearing limestone; and (5) thick Early to Middle Devonian sandstone, siltstone, argillite, minor basalt, andesite, tuff, conglomerate, and limestone with brachiopods and corals. Units (1-4) are metamorphosed to greenschist facies and contain disrupted lenses of serpentinite and gabbro.Terrane is intruded by Silurian granite and granodiorite, and minor quartz diorite with K-Ar isotopic ages of 419 to 435 Ma. Terrane overlain by Early Carboniferous shallow-marine sedimentary rocks, Middle to Late Carboniferous and Permian subalkalic and alkalic volcanic and volcaniclastic rocks, and stitched by Middle to Late Carboniferous and Permian granite and leucogranite, and Triassic and Early Jurassic REE granite. Terrane is correlated with the Dong Ujumqin belt and interpreted as an early Paleozoic active continental margin or island arc.

REFERENCES: Geology MPR, 1973; Tang, 1990; Hsu and others, 1991, Badarch and Orolmaa, 1998.

In Northeast China, consists of: (1) Cambrian metasandstone and phyllite with intercalated, lenticular limestone; (2) Ordovician and Silurian metabasalt, metaandesite, metadacite, and volcanic breccia with the intercalated marble; (3) Early Devonian shale, tuff, spilitic keratophyre; and (4) Middle and Late Devonian sandstone, shale, and limestone. Terrane is overlapped by Lower Carboniferous molasse formation with fossils and flora. Terrane intruded by subduction-related granodiorite and adamellite in the Late Carboniferous.

REFERENCES: Xie Guolun, 1980; Cui Ge, 1983; Bureau of Geology and Mineral Resources of Heilongjiang Province, 1993; Zhang Dequan, 1998.

In Russian Southeast, occurs in a mostly concealed region beneath Cenozoic sedimentary rocks of the Amur-Zersk basin and stratigraphic sequence reconstructed from isolated outcrops. Consists of two units: (1) mafic greenstone, mica schist, marble, metasandstone, and quartzite (Dagmarsk and Neklinsk suites) of presumed Neoproterozoic to early Paleozoic age, with greenschist-facies metamorphism; and (2) several sequences of Silurian through Early Carboniferous andesite, sandstone, siltstone, greenschist, limestone, conglomerate, shale, and diabase that locally are variably metamorphosed to greenschist facies. The Late Silurian through Early Carboniferous units

contain a marine fauna and an Angara flora. Terrane is unconformably overlapped by Permian sandstone, shale, conglomerate, tuff, and intermediate volcanic rocks that contain an Angara flora. The unconformity postdates the late Paleozoic amalgamation of the Nora-Sukhotin terrane with the Bureya superterrane. The Nora-Sukhotin terrane is interpreted as a middle Paleozoic island arc that formed on an older metamorphosed accretionary wedge complex.

REFERENCES: Sorokin, 1972; Shilo, 1982; Martynyuk, 1983.

NK Nakhimovka terrane (Metamorphic) (Archean? or Proterozoic?) (Southern Russian Far East)

Occurs north of Lake Khanka and consists of Precambrian crystalline rocks: (1) biotite- and biotite-amphibole gneiss with lenses of marble and amphibolite occur at the lower part of the section (Nakhimovsk Formation, over 1000 m thick); and (2) overlying biotite-, diopside-, and muscovite-graphite schist (Tatyanovsk Formation, about 2500 m).

REFERENCE: Khanchuk and others, 1996.

NL Nilan terrane (Accretionary wedge, type B) (Devonian through Permian) (Southern Russian Far East)

Terrane consists of a series of nappes and composed of: (1) tectonically-mixed Missisipian and Early Pennsylvanian deep-marine siliceous and hemipelagic sedimentary and volcanic deposits; (2) Early Devonian, Middle Pennsylvanian and Permian turbidite and basalt; (3) in the western part of the terrane, intensely metamorphosed middle and late Paleozoic rocks; Paleozoic(?) gabbro, gabbro-amphibolite (Zlatoustovsk complex), and late Paleozoic quartz diorite, granodiorite, and plagiogranite (Ingagli complex) a K-Ar isotopic age of 235-230 Ma. Overlapping sedimentary, volcanic-sedimentary assemblages, and stitching plutonic assemblages are: (1) Early Cretaceous granitoids (Kharga complex), and andesite (Umlekan-Ogodzhin volcanic-plutonic belt); (2) Late Cretaceous granitoids and siliceous volcanic rocks of Khingan-Okhotsk volcanic-plutonic belt; and (3) Neogene and Quaternary non-marine clastic deposits and basalt.

REFERENCES: Martynyuk and others, 1990; Krasni and others, 1996.

NN Nankai terrane (Accretionary wedge, type A) (Miocene through Quaternary) (Western Pacific Ocean, Central Japan)

Consists of sandstone, mudstone, and conglomerate and is subdivided into an accretionary prism and forearc basin deposits. Accretionary prism formed by the subduction of the Philippines Sea Plate along the Nankai trough, and thick forearc basin strata (Miura Group) were deposited during the Miocene to early Pliocene. The Nankai terrane also includes Quarternary trench fill sedimentary rocks that consist of turbidite and hemi-pelagic mudstone. Terrane contains a large number of active thrusts that parallel are to strike of trench and that dip gently towards Japanese islands arc. The thickness of sedimentary rocks in Nankai Trough ranges from 500 m to 2,000 m. Rate of convergence ranges from 3 to 4 cm per year. The age of subducting oceanic plate ranges from 15 to 30 Ma.

REFERENCES: Ogawa and Taniguchi, 1988; Wakita and others, 1992; Hanamura and Ogawa, 1993.

NO North Margin terrane (Accretionary wedge, type B) (Carboniferous and Early Permian) (Northeastern China)

Consists chiefly of: (1) pillow lava and ultramafic rocks; (2) a western part of mainly carbonate and silicate interlayered siliceous shale; and (3) an eastern part of turbidite and olistostromal deposits. Turbidte is derived from both granitic and ophiolite units and contains microfossils of *Monodiexodina, Verbeekina and Kahlerina,* and plant fossils of *Emplectopteris triangularis and Taeniopteris.* Terrane is deformed by appressed folds and thrust faults and intruded by Late Permian and Late Jurassic granitic plutons. Terrane is interpreted as an accretionary wedge that was tectonically accretionary to the Laoling terrane.

REFERENCES: Bureau of Geology and Mineral Resources of Jilin 1989; Guo Shenzhe and others, 1992; Shao Jian and others, 1995; Tang Kedong and others, 1995; Krasnyi, L.I.and others, 1996; Zhao Chunjin and others, 1996; Sun Jiapeng and others, 2000.

NR Nechera terrane (Granulite-paragneiss) (Archean(?) and Proterozoic) (Transbaikalia)

Consists Archean units of: (1) a lower unit of hypersthene-, amphibole-, biotite-, and garnet-gneiss and schist with minor enderbite and charnockite (Chepoksky suite of the Nechera series) that exhibit amphibolite facies diaphtoresis; (2) concordantly overlying biotite-, garnet-biotite-, and amphibole-biotite plagiogneiss with layers of crystalline marble calciphyres, and quartzite metamorphosed, all metamorphosed to amphibolite facies (Olongdisnky suite); (3) Paleoproterozoic Ilinaksky suite (Kevaktinsky series) composed of quartzite, metasandstone, plagiogneiss, micaceous; and graphite-cordierite schist; and (4) Paleoproterozoic Khodokansky suite (Kevaktinsky series) composed of metasandstone, metaaleurolite, and carbonaceous-micaceous schist. Units (3-4) are metamorphosed to biotite and garnet zones, locally to staurolite zone. Intruding these units are granitoids of the Chuya-Nechera complex with U-Pb zircon ages of 1850 Ma and 2114 Ma, and Early Riphean(?) gabbro-diabase and diabase dikes. Metamorphic rocks are multiply deformed with sparse relic Paleoproterozoic domal structures. During Intruding during Late Riphean accretion of cratonal and Riphean terranes to the North Asian Craton were stocks and dikes and granite porphyry and granodiorite-poprhyry (Yazovsky complex) with a U-Pb zircon age 730 of Ma. Post-accretionary granite batholiths (Konkudero-Mamakan complex) have U-Pb zircon ages of 350-300 Ma.

REFERENCES: Neimark and others, 1990; Bukharov and others, 1992; Ivanov and others, 1995.

NRS North Sayan terrane (Island arc) (Neoproterozoic through Early Cambrian) (Northwestern Sayan)

Terrane exhibits a complicated structure and consists of tectonic blocks, lenses, and sheets. Four units are recognized. (1) The Kizas-Oisk (Izykh) ophiolitic belt that extends along the southern margin of the terrane for over 500 km and consists of a melange zone with ultramafic rock, gabbro, basalt and tuff, graywacke, chert, siliceous shale, shale, and limestone. These oceanic crust rocks comprise the basement of an island arc. (2) Volcanic island arc rocks with magmatic arc, fore-arc, and back-arc basin facies. The basal part of the magmatic arc consists of basalt-andesite-rhyolite and graywacke, jasper, and chert. The volcanic rocks consist of bimodal units and local boninitic dikes. The upper part of the magmatic arc consists of differentiated, calc-alkaline, basalt-andesite-dacite-rhyolite with thick tuff and coarse-clastic rocks, and reef limestone with Early Cambrian archaeocyata and trilobites. Local limestone bodies occur in olistostrome-like horizons. (3) Forearc basin trough units occurring in the western part of the terrane (Arbat series and analogues) consist mainly of turbidite with dominating shale and siltstone in a lower part, and sandstone and siltstone in the upper part, with less abundant volcanogenic, siliceous, and carbonate rocks with Early Cambrian archaeocyata and Middle Cambrian trilobites in the upper part. Olistostrome-like horizons with limestone olistoliths are common. And (4) back-arc basin units occur in the eastern part and consist of volcanomictic sand-silt-clay sedimentary rocks and lesser limestone, coal shale, hematite-bearing jasperoid, basalt, rhyolite, and conglomerate (Kolpin suite). The limestone contains Early Cambrian archaeocyata and trilobites. The carbonate rocks define the flanks and inner uplifts of a marginal sea (Balakhtison suite). Terrane is intruded by Early Cambrian tholeiitic plagiogranite in the magmatic arc core, and Ti- and Pt-bearing layered gabbro that formed in back-arc areas(?). The eastern part of the terrane is intruded Middle Cambrian through Early Ordovician(?) granitic batholiths of the collisional Tonnuola belt and Early Devonian granitoids of the rift-related South Siberian belt.

REFERENCES: Zonenshain, 1963; Berzin, 1979; Berzin, Kheraskov, 1979; Simonov and others, 1994; Kungurtsev, 1996.

OD Olokit-Delunuran terrane (Accretionary wedge, type A) (Paleoproterozoic through Neoproterozoic) (Transbaikalia)

Consists of two fragments, the Olokit and Delunuran fragments that are separated by the Baikal-Muya island arc terrane. The Olokit fragment forms a narrow band trending from the southwest (Lake Baikal area) to the northeast (Vitim River area), and consists of small pre-Riphean blocks of gneissic granite, Riphean shale and basalt, and melange lenses of alpine-type ultramafic rocks. A U-Pb zircon isotopic age of the gneissic granite is 2,040 to 1,700 Ma. The shale and basalt sequence (Tyisky suite) occurs in narrow bands and wedges, and the basalt is N-MORB and E-MORB type with a Sm-Nd whole-rock isochron age of 1050 Ma. The Tyisky suite is concordantly overlain by a carbonaceous-sandy shale sequence with polymetallic and iron quartzite ore bodies (Avkitsky Suite). The sedimentary rocks in these suites are regionally metamorphosed from greenscist facies to amphibolite facies, kyanite-sillimanite subfacies. The Olokit fragment is deformed into northeast-striking linear steep folds.

The Delunuran fragment occurs between the North-Asian Craton and the Baikal-Muya terrane, and consists of Riphean metamorphosed sedimentary rocks consisting, from bottom to top of: gneiss and schist (Danninsky Suite); schist and calcareous rocks (Ust-Uriakh and Watershed Suites); and schistose siltstone (Rodionovsky Suite). These units are regionally metamorphosed to greenschist and amphibolite facies with assemblages of staurolite-biotite-kyanite-muscovite, and garnet-kyanite-biotite-muscovite (epidote-amphibolite and amphibolite facies of kyanite-sillimanite type). The Delunuran fragment is deformed into northwest-striking folds.

In the Olokit fragment, the Synnyrsky basin forms a major accretionary structure and is 150 km long, and varies from 12 to15 km wide. The basin contains: (1) a lower subaerial unit of variegated basalt, picrobasalt, and tuff (Synyrsky suite); (2) shallow-water shaly sandy calcareous dolomite (Protivo-Davan suite); and (3) conglomerate, shale, and silty-sandstone (Avgolsky suite) that contain Late Riphean stromatolites, microphytolites and micro-fossils; and (4) marine basalt, siltstone, and hyaloclastic sedimentary rocks. The basalt exhibits a Rb-Sr isotopic age of 670 Ma. The coeval Dovyren dunite-troctolite-gabbrointrusive massif exhibits a Rb-Sr and Sm-Nd isotopic ages from 740 to 700 Ma. The sedimentary rocks of the Synnyrsky basin are deformed into inclined folds striking northeast to north-south, monoclines dipping gently, or bedding that dips gently to horizontally. Vendian overlap assemblage units, formed along a passive margin, are terrigenous sedimentary rocks (Kholodninsky suite) in the Upper Angara sedimentary basin. Terrane is intruded by late Paleozoic intrusion of granite batholiths (Mama complex) with a U-Pb zircon age of 354 Ma, and by a syenite massif (Synnyrsky complex) with Rb-Sr whole rock isotopic ages of 287 and 292 Ma. Accretion of the terrane to the North-Asian Craton is interpreted as occurring in the Late Riphean.

REFERENCES: Tugarinov and others, 1976; Manuilova, Zarubin, 1981; Bolonev and others, 1983; Bulgatov, 1983; Buldygerov and others, 1988; Kislov and others, 1989; Dolnik and others, 1990; Neimark and others, 1990; Konnikov and others, 1994; Andreev and others, 1991; Pokrovsky and Zhidkov, 1993; Rytsk and Shalaev, 1998.

OG Ogcheon terrane (Accretionary wedge, type B) (Proterozoic) (Korea)

Consists of pelitic, psammitic, calcareous sedimentary rocks, and mafic rocks of the early Paleozoic Ogcheon Group, with pelitic rocks being dominant. Also occurring are sparse pammitic rocks that are intercalated with pelite, quartzite, metafeldspathic sandstone, and pepple-bearing phyllite, along with local calcareous sedimentary and mafic rocks. Metamorphism ranges from greenshist through transitional greenshist-amphibolite to amphibolite facies. Shale with pebbles and blocks of terrigenous, carbonate, and rarely chert are dominate. Carbonate rocks contain an early Paleozoic fauna. The late Paleozoic and early Mesozoic sedimentary rocks of the Pyeongnang Group contain numerous granitoid and metamorphic rocks fragment. The Ogcheon Group is probably a late Paleozoic and early Mesozoic olistrostrome formed in a subduction zone. Metamorphism occurred during intrusion of Late Permian-Triassic and Jurassic granite. Younger, northeast-striking overlap pull-apart basins consist of epicontinental terrigenous deposits of the Sindong and Hayan Groups and are interpreted as forming along an Early Cretaceous transform margin. In the Late Cretaceous, volcanic rocks of the Yuchon Group and the Bulgugsa granite intrusion are interpreted as forming in a continental margin arc.

REFERENCES: Geology of Korea, 1993.

OH Okhotsk terrane (Cratonal) (Archean through Jurassic) (Yakutia)

Occurs adjacent to the southern termination of the North Asian Craton Margin (Verkhoyansk foldbelt), and in ascending order consists of a long-lived succession of units: (1) large blocks of Archean to Paleoproterozoic gneiss and schist with a U-Pb zircon age of 3.7 Ga; (2) gently-dipping, shallow-marine Middle and Neoproterozoic clastic and carbonate rocks; (3) Early Cambrian limestone, marl, and sandstone; (4) Early Ordovician conglomerate, limestone, marl, and sandstone with macrofossils; (5) unconformably overlying Middle Devonian limestone, sandstone, shale, and conglomerate, and Late Devonian rhyolite, ignimbrite, andesite, dacite, and tuff that are interlayered with nonmarine sandstone, siltstone, and conglomerate; and (6) mainly nonmarine, rarely marine, clastic rocks of Carboniferous, Permian, Late Triassic, and Early and Late Jurassic age. The ages are determined by rare macrofossils and flora. Terrane contains local facies changes and stratigraphic gaps, and unconformities occur at the base of the Late Triassic and the Late Jurassic units.

Paleomagnetic determinations, moderate-quality data from Precambrian (Riphean) sedimentary rocks and stromatolitic limestone yields a southerly displacement with respect to the Siberian platform of $41^{o}\pm6^{o}$. The Okhotsk terrane is mostly overlapped by Neocomian and Albian to Late Cretaceous nonmarine volcanic rocks of the Uda

volcanic-plutonic belt, and the Okhotsk-Chukotka volcanic-plutonic belt. The Okhotsk terrane is correlated with the Omolon terrane of the Kolyma-Omolon superterrane of the Russian Northeast, and with the Kilbuck-Idono terrane of Alaska.

REFERENCES: Korol'kov and others, 1974; Vel'dyaksov and Umitbaev, 1976; Avchenko, 1977; Chikov, 1978; Verzkhovskaya and Krichevets, 1987; Pavlov, 1993.

OI Orhon-Ikatsky terrane (Continental margin arc) (Late Neoproterozoic through Silurian) (Mongolia, Transbaikalia)

In Transbaikalia, terrane strikes north-northeast and has dimensions about 650 by 170 km. The geology of the terrane is reconstructed from scattered fragments in the Barguzin-Vitim granitoid batholith. Terrane primarily composed of terrigenous-carbonate, carbonate and sedimentary-volcanogenic formations of Vendian-Cambrian, and, to a smaller extent, of Ordovician and Silurian age. Also includes highly metamorphosed rocks (Garginsky Suite) that are an uplift of an early Precambrian basement. The Vendian-Cambrian sedimentary rocks include fossiliferous limestone and dolomite. In the lower of the carbonate section (Kurminsky, Tilimsky, Orochensky suites) are Early Cambrian archeaocyates, chyolites, spucules of sponges. The overlying carbonate sequences with shale interbeds (Ikatskyt and Yakshibsky Suites, Panovsky Series) contain Early and Middle Cambrian trilobites. Older sedimentary-volcanogenic sedimentary rocks (Balbagarsky and Itantsinsky Suites) occur in the southern part of terrane and consist of mafic and intermediate volcanic rock, chert-carbonate, and siliceous shale. The sedimentary rocks are intruded by mafic intrusions of the Atarkhansky and Ikatsky Complexes. Also occurring are small lenticular bodies of dunite and harzburgite that are commonly serpentinized. A larger area of flyschoid and terrigenous-volcanogenic rocks with sparse fossils may constitute a younger Ordovician through Devonian assemblage. The youngest unit is a Devonian variegated molassoid sequence (Bogdarinsky Suite). Terrane is intruded bvy granitoids of the Barguzin-Vitim batholith.

REFERENCES: Belichenko, 1969, 1977; Osokin and others, 1989; Butov 1996.

In northern Mongolia, terrane occurs in the Hangay Upland and Basin along the Orhon River. Terrane extends for 1200 km and ranges from 30-50 km wide. Consists of late Riphean Early Cambrian volcanic and sedimentary rocks that are subdivided into two complexes: (1) a lower greenschist complex (Darhad Formation) that consists of quartz-chlorite and quartz-biotite schist with metabasalt and porphyritic volcanic rock, and lesser quartzite and stromatolitic limestone lenses; and (2) an upper carbonate and schist complex (Buuraltay and Uldzitgol Formations) that consists of siliceous slate, carbonaceous schist, phyllite, and dolomitic limestone with Vendian to Early Cambrian stromatolites and microphytolites. Units are zonally contact metamorphosed to high temperature amphibolite facies, and contain sparse ultramafic rock and gabbro bodies that probably are part of an Early Cambrian layered complex. Terrane stitched by Bayangol calc-alkalic granite complex with K-Ar isotopic age of 520 Ma, and by Devonian and Permian volcanic and plutonic rock.

REFERENCES: Geology of Mongolian People's Republic, 1973, Tomurtogoo, 1997, Badarch and others, 1999; Badarch and Bor-ming Jahn, 2000.

OL Oldoy terrane (Passive continental margin) (Silurian through Early Carboniferous) (Southern Russian Far East)

From base to top consists chiefly of: (1) Silurian quartzose sandstone, siltstone, conglomerate, and minor limestone and Early Devonian siltstone, sandstone, and conglomerate (Bolsheneversk and Omutninsk suites); (2) Middle Devonian (Eifelian) limestone, sandstone, and siltstone (Imchansk suite); and (3) Middle to Late Devonian (Givetian-Fransian) sandstone, siltstone, and limestone, Late Devonian (Fransian-Famennian) siltstone, sandstone, and limestone, and Early Carboniferous (Tournaisian-Visean) sandstone, siltstone, conglomerate, and limestone (Tiparinsk, Teplovsk, and Oedoisk suites). The Devonian deposits contain abundant macrofossils including brachiopods, corals, and bryozoans. The Early Carboniferous brachiopods and bryozoans are Boreal. Silurian deposits are locally metamorphosed to lower greenschist facies. Middle Paleozoic deposits are intruded by granodiorite, granite, and diorite with K-Ar isotopic ages of 204 to 257 Ma and Rb-Sr isotopic age of 256±7.35 Ma. Unconformably overlying overlap assemblages are: (1) the Jurassic and Early Cretaceous Bureya sedimentary basin that formed after amalgamation of the Oldoi and Gonzha terranes; and (2) Early Cretaceous intermediate and silicic volcanic rocks, flora-bearing nonmarine clastic rocks, and coeval granite and granodiorite of the Umlekan-Ogodzhin volcanic-plutonic belt that also overlaps the Oldoi, Gonzha, Mamyn, and Turan terranes.

REFERENCES: Krasny, 1966, 1973; Shilo, 1982; Martynyuk and others, 1990. Krasnyi and others,1996.

OM Ondum terrane (Island arc) (Late Neoproterozoic through Ordovician) (Southern Tuva)

Consists of two units. (1) A differentiated andesite-dacite-rhyolite unit with tuff, breccia-lava, and subvolcanic rocks (Ondum suite) of possible Vendian-early Cambrian age. Dacite and rhyolite varieties are prevalent with minor basalt, and spares chert, jasperoid, and sandy limestone. (2) A volcanic-sedimentary unit composed of coarse-clastic tuffaceous terrigenous rocks at the base and carbonate rocks at the top (Ilchir suite). The carbonates contain Early Cambrian archaeocyata. Terrane also contains Middle-Cambrian through Early Ordovician(?) granite of the Tonnuola collisional belt; and smaller bodies of Early Devonian subalkaline granitoids of the rift-related South Siberian belt.

REFERENCES: Zaikov, 1976; Bukharov, 1979, 1981.

ON Olenek terrane (Greenschist) (Paleoproterozoic) (Yakutia)

Consists of metasandstone, metasiltstone, metapelite, and metavolcanic rocks (Aekit Series) that consists of metamorphosed rhyolite and dacite (at the base), and basalt, andesite-basalt, and tuff (at the top). Metamorphic grade varies from prehnite-pumpellyite to greenschist facies. Primary sedimentary structures, such as bedding, rhythm, and ripples are locally well preserved. Terrane is deformed into linear isoclinal folds with axial planes dipping steeply southwest, and is intruded by siliceous and intermediate dikes, potassic granite stocks, and gabbro, diorite and granodiorite plutons. Muscovite from granite exhibits a K-Ar whole rock isotopic age of 2,000 to 1,950 Ma, and a biotite isotopic age of 2,080 to 1,846 Ma. Terrane is exposed in Olenek uplift and is overlain by flat-lying Riphean deposits of the Siberian Platform.

REFERENCES: Vishnevskiy and Krasil'nikov, 1963; Shpount and others, 1979; Rosen and others, 1994.

OS Ononsky terrane (Accretionary wedge, type B) (Neoproterozoic? or Silurian?) (Transbaikalia, Mongolia)

In Transbaikalia, terrane, that extends about 2000 km and has a maximum width of 150 to 200 km, defines the Mongol-Okhotsk suture zone of central Mongolia and eastern Transbaikalia. Consists of several major units from oldest to youngest. (1) Volcanic-sedimentary sequences (Kulindinsky and Ononsky suites) metamorphosed to greenschist, blueschist, and locally to epidote subfacies of amphibolite facies. The Kulindinsky suite contains large ophiolite fragments with tectonic wedges of metabasalt, blocks of massive and layered metagabbro, lenses and slabs of alpine type ultramafic rocks. The metabasalt is derived from N-MORB, E-MORB and OIB basalt, and has a Sm-Nd isotope model age of 583 Ma for the basalt protolith (S. Dril, unpublished data, this report.). Metasedimentary rocks are mostly derived turbidites with lesser deep-water chert metamorphosed to micro-quartzite. The Ononsky suite is mainly terrigenous metasedimentary rocks with metamafic rocks rapidly decreases from bottom to top. The age may be either Late Riphean, based on poorly preserved microfauna of in schist, or Silurian on the basis of structural position. (2) Early and Middle Devonian sedimentary rocks of the Chindantsky and Ust-Borzja suites consist mainly of terrigenous sedimentary rocks, often of turbidite origin, OIB type metavolcanic rocks, and minor limestone and chert. The age of suites is defined from fauna remains (Rutshtein and Chaban, 1997). (3) Discordantly overlapping Late Devonian and Early Carboniferous sedimentary and volcanic rocks (Makarovsky and Zunshiveisnky suites) contain dacite, rhyolite, and siliceous tuff. The sedimentary rocks contain Carboniferous brachiopods, byozoans, and crinoids. The sedimentary rocks consist of non-metamorphosed terrigenous rocks, mainly turbidite (Chironsky series) with abundant brachiopods, bivalves, gastropods, and bryozoans. And (4) the youngest unit consists of Late Triassic terrigenous sedimentary rocks (Mogoituy series) with *Monotis.*

Overlap and stitching complexes are the Trans-Baikalian-Daxinganling sedimentary-volcanic plutonic that consists of Middle Jurassic continental clastic sedimentary rocks (Karbachinsky series), and Early Cretaceous rift-related volcanic-sedimentary formations (Turginsky suite), and Middle and Late Jurassic granite (Kukulbey, Konduysky and Shakhtaminsky complexes). These units define a time of accretion of terrane to the North Asian Craton as pre- Middle Jurassic. Thrust and strike-slip fault displacements along the Mongol-Okhotsk fault during accretion resulted in local greenschist facies metamorphism.

REFERENCES: Okuneva and Konditerov, 1964; Kotlyar and Popeko, 1974; Dolganev, 1963; Neelov, Milkevich, 1979; Gusev and Peskov, 1993; Dril and others, 1994; Popeko, 1996; Rutshtein and Chaban, 1997; Rutshtein, 1997; Zorin and others, 1998a, 1998b.

In northeastern Mongolia, terrane occurs in a narrow, up to 30-70 km wide and 1250 km long belt along the boundary of the Hangay and Hentiy Uplands, along the southern border of the Hentey Upland. Terrane contains fragments of Hangay-Dauria terrane and forms a large duplex structure with southwest vergence. Terrane separated from Argunsky terrane by Middle Mongolian Tectonic Line. Terrane consists chiefly of: (1) schist and ophiolite in the central part; and (2) volcanic-carbonate slate and flysch units near the Onon, Jargalant, and Duch Rivers with Permian to Early Triassic fossils. The volcanic-carbonate slate units (Upper Onon Complex) in the Onon River basin consist of metabasalt, siliceous slate, and limestone with problematic fossils, and quartzite interbeds. Complex was, previously dated as PreCambrian to Early Cambrian but may be correlative with similar, fossil-bearing Early to Middle Devonian units in the Tukuring fragment of the Argunsky terrane. Metamorphic complexes occur in western and central parts of terrane and consist of a greenschist complex in the west and black shale to the east. Greenschist complex contains sandstone and siltstone, and minor mafic volcanic rock and quartzite that are probably correlative to Upper Onon Complex. The black shale consists of interbedded black shale (carbonaceous schist), quartz-chlorite-sericite schist and mudstone with quatrzite beds, and deformed lenses jasper that may be an olistolith. Local Late Permian radiolarian occur in the jasper. The possible ophiolite complex occurs along the Adaatsag melange zone, and consists of serpentinized ultramafic rock, pyroxenite, and gabbro, with a diabase dike and sill swarm, and variolitic tholeiitic basalt with a backarc basin geochemical signature. The ophiolite age may be middle Paleozoic. The terrane contains imbricated fault slices, thrusts, and duplex structures that are overturned to the north and northeast. Stitch complex consists of Triassic to Jurassic granite.

REFERENCES: Geology of Mongolian People's Republic, v. 1, 1973, Tectonics of Mongolian People's Republic, 1974, Tomurtogoo, 1989, 1997, Badarch and others, 1999; Parfenov and others, 1999.

OT Onot terrane (Granite-greenstone) (Middle Archean? or Paleoproterozoic?) (Eastern Sayan)

Forms a wedge among blocks of Sharizhalgay terrane, extends for 100 km long, and ranges up to 30 km wide. Basal part consists of plagiogneiss and tonalite- trondhjemite granitoids with relices of biotite and biotite-hornblende migmatitic plagiogneiss and amphibolite forming includions in plagiogranite. Plagiogneiss derived from high-alumina tonalite-trondhjemite, and amphibolite derived from tholeiite basalt. Plagiogranite exhibits a U-zircon isotopic age of 3.25 Ga. Upper part of terrane consists of metavolcanogenic and metasedimentary rocks, mainly biotite and amphibole-biotite gneiss and amphibolite with layers of talc-serpentinite, metagraywacke, marble, and quartzite (Kamchadal suite and Sosnovo-Baits suite). Metasedimentary rocks are intruded by gabbros of the Arbansky complex. Near the terrane margin are rapakivi-like granitoids (Shumikhinsky complex) with a Rb-Sr isotopic age of 1.983±0.048 Ba. Terrane is overlapped by terrigenous Late Riphean sedimentary rocks (Ushakovsky suite) of the North Asian Craton.

REFERENCES: Bibikova and others, 1981; Belichenko and others, 1988; Nozhkin, 1997.

OZ Orogen-Zalantun terrane (Metamorphic) (Proterozoic) (Mongolia, Northeastern China)

Extends to the northeast and consists of: (1) Paleoproterozoic biotite-amphibole-plagioclase-gneiss, hornblendite, quartz-schist, marble, and mica-schist that are metamorphosed to lower amphibolite facies; (2) Neoproterozoic sericite-chlorite-schist, sericite-quartz-schist, marble, ferroan quarzite, plagioclase-gneiss, and other lower greenschist facies metamorphic rocks. Ordovician marine terrigenous rocks and limestone unconformably overlap the terrane.

REFERENCES: Dong Shenbao, 1986; Zhou Yuwen and others, 1993.

PP Poputninsk terrane (Oceanic) (Mesoproterozoic and Neoproterozoic) (Yenisey Ridge)

Occurs in the central part of the Yenisey Ridge and overthrust to the east onto the Central Angara terrane. Terrane extends for 150 km long and ranges up to 10-15 km wide. Consists mainly of a mafic-ultramafic rock complex. Locally along the basal contact are green quartz-feldspar-actinolite schist derived from andesic-mafic tuff, pyroxenit and gabbro on differentiated sills, diabase dike complexes, siliceous rocks, picrite, and ophiolite-clastic

conglomerate and gritstone. The middle and upper parts consist of altered pillow-basalt and greenschist derived from tuff and hyaloclastite with local basalt pillows. Basalt is similar to island arc and margin sea tholeiite in terms of oxide and trace-element geochemistry. Terrane overlapped by Late Riphean terrigenous-carbonate sedimentary rocks, and intruded by calc-alkaline granite of the Tataka-Ayakhta complex with a U-Pb zircon age of 760 Ma.

REFERENCES: Kornev and others, 1998; Kheraskova, 1999.

PR Predivinsk terrane (Island arc) (Late Neoproterozoic) (Yenisey Ridge)

Occurs in the southwestern Yenisey Ridge along the right bank of the Yenisey River, extends in a submeridional direction for 70 km and ranges up to 20 km wide, and is thrusted onto the Yenisey amphibolite-gneiss terrane to the west. Consists of the Late Riphean and Vendian metavolcanogenic and metrasedimentary rocks. The metavolcanic rocks are mainly calc-alkaline basalt, andesite-basalt, andesite, dacite, and rhyolite metamorphosed to greenschist facies. From mafic to siliceous rocks, Sr decreases, K, Rb, Ba, and Th increase, and concentration of high-field-strength elements distinctly increases. These geochemical features, the prevalence of Na over K, the content of high-field-strength elements in basalt close to MORB, and increased Fe indicates an island arc formation. Gabbroc and gabbro-diorite-plagiogranite massifs are associated with the volcanic rocks. Thrust plates of paleooceanic rocks, including serpentinized harzburgite, gabbro, and near-MORB tholeiite basalt occur in the eastern and central parts of the terrane. Metabasalt occurs in overturned, northeast-striking folds, and is the most deformed unit in the terrane. Ultramafic rocks form zones of serpentinite melange, and metasedimentary rocks, mainly quartzite, schale, and tuffaceous sandstone are less abundant than volcanic rocks. A U-Pb zircon isotopic age for calc-alkaline metarhyolite is 637±5.7 Ma. The western terrane margin is overlapped by Middle Jurassic sandstone and shale with coal layers.

REFERENCES: Zablotsky and others, 1987; Vernikovsky and others, 1999.

QT Qinghe-Tsel terrane (Metamorphic) (Mesoproterozoic and Neoproterozoic) (Northwest China, Mongolia)

In Northwest China, strikes east-west and consists of two parts: (1) Mesoproterozoic migmatite, schist, amphibolite, and migmatite intercalated with marble containing remains of ancient micro-plants and alga. (2) Low-grade metamorphosed Paleoproterozoic fine-grained clastic rocks, mainly sandstone, siltstone, and mudstone. Unconformably overlapping are Ordovician, Silurian and Devonian sedimentary rocks.

REFERENCES: Bureau of Geology and Mineral Resources of Xinjiang Uygur Aut. Reg.(Xinjiang GMRB), 1990; Chen Zefu, 1997.

In southwestern Mongolia, terrane occurs in three separate small blocks that occur on the southern margin of the Mongolian Altai and northwestern side of the Gobi Altai Ranges. Blocks occur along the Bulgan and Transaltai fault systems. Consists of polymetamorphosed and polydeformed tonalite gneiss, amphibolite, schist with relics of granulite, syntectonic granodiorite, and granite withU-Pb zircon isotopic ages of 370 and 385 Ma, respectively (Mitrofanov and others, 1981; Kozakov, 1986; Bibikova and others, 1992). The protolith age of metamorphic rocks and granulite-amphibolite facies metamorphism is uncertain. Kozakov (1986) obtained Pb-Pb zircon ages ranging from 250 to 1120 Ma and 2200 Ma from gneiss. Intruding the terrane are the Gashuun Nuur mafic dike complex, with Sm-Nd isotopic ages of 320 and 321 Ma (Baykova and others, 1994) and Permian granite. Terrane interpreted as a displaced fragment of pre-Altaid continental crust, or fragments of Gondwana, or an accretionary wedge that presumably contains an inverted metamorphic complex.

REFERENCES: Kozakov, 1986, Mitrofanov, 1986, Coleman 1991, Bibikova and others, 1993; Dobretsov and others, 1995.

RA Rudny Altai terrane (Island arc) (Late Silurian through Early Carboniferous) (Rudny Altai Upland)

Bounded by the Irtysh and Northeast strike-slip fault zones. Composed chiefly of middle and late Paleozoic sedimentary and magmatic units formed in varying geodynamic environments. Oldest units are pre-Emsian greenschist that occur in two large anticlines (Alei, Sinyushin, Irtysh, and Zyryanov areas) consist mainly of Late

Silurian and Early Devonian age carbonate, sandstone, and shale with local fauna. Older, early Palozoic units may exist. Units are interpreted as forming in a convergent-transform margin along the North Asian Craton.

Unconformably overlying are less metamorphosed sequences with marine fault that occur in asymmetric brachiform folds that are complicated by the shearing and large-scale faulting. The sequences consist of several sequences of Emsian through Early Carboniferous shallow-water marine sedimentary-volcanogenic rocks. (1) The lower sequence of Emsian sedimentary rocks contain a pebbly basal conglomerate with abundant granitic pebbles, Eifelian-Early Givetial volcanic-sedimentary rocks with mainly bimodal calc-alkaline volcanic rocks with subordinate basalt, locally with pyroclastic and tuffaceous terrigenous facies. The volcanogenic rocks are interbedded with sedimentary rocks. These units are interpreted as forming along active continental margin consisting of a region of convergent-transform interaction between oceanic and continental plates that was accompanied by magmatism. (2) The next sequence consists of unconformably overlying Late Givetian-Late Devonian island-arc bimodal volcanic rocks with significant basalt and tuff. The volcanic rocks range from basalt to rhyolite with mainly andesite and dacite. In the Late Givetian-Late Devonian volcanic rocks decreased eastwards and volcanomictic deposits increased. These deposits are interpreted as a back-arc marine basin. (3) The next sequence consists of Tournaisian-Early Visean terrigenous and carbonate rock (Tarkhan, Bukhtarma and Ulbin suites) and overlying Middle-Late Visean volcanic and sedimentary rocks (Larikhin and Ramanikhin suites). Volcanic rocks are mainly andesite and basalt porphyry and lesser dacite, rhyolite, and tuff. These units mark the end of the island-arc. (4) The next sequence is Middle-Late Carboniferous molasse (Maloulbin suite) that locally overlies the Devonian and Early Carboniferous sequences and consists of basal andstone and conglomerate succeeded by siltstone and shale with coal beds with plant fossils, sparse basalt porpohyry, and mafic and siliceous tuff. Coeval granodiorite-tonalite batholiths (Zmeinogorsk complex) also occur. (5) The youngest sequence is unconformably overlying Late Carboniferous-Early Permian continental volcanogenic molasse and occur in a small area in the central part of the terrane. The volcanic rocks vary from andesite through dacite to rhyolite and are intruded by leucogranite and granosyenite (Leninogorsk complex) with isotopic ages of 277 to 266 Ma.

REFERENCES: Nekhoroshev, 1958; Kuzebny, 1975; Rotarash and others, 1982; Zonenshain and others, 1990; Dubatolov, 1994; Yolkin and others, 1994; Kozlov, 1995; Berzin and Kungurtsev, 1996.

SA Sangilen terrane (Passive continental margin) (Paleoproterozoic or Neoproterozoic) (Southeastern Tuva, Mongolia)

In northern Mongolia, consists of lower Proterozoic(?) marble, amphibolite, schist, orthogneiss, and metapelite intruded by Ordovician granodiorite and granite and Devonnian subalkalic granite. Overlain by Permian non-marine subalkalic volcanic rocks and volcaniclastic rocks. The Han Huhey block, that occurs on the southwestern margin of terrane, east of Agardag fault, consists of (1) Archean gneiss and migmatite with granulite inclusions; (2) Paleoproterozoic graphite marble and quartzite; (3) Riphean metasandstone and dolomite intruded by lower Paleozoic granite, granodiorite, diorite, and adamellite, and by Devonian and Permian subalkalic and alkalic granitic rocks. Terrane is interpreted to be a passive margin terrane, formed along the Sangelin? cratonic block.

REFERENCES: Mitrofanov and others, 1981; Kozakov, 1986; Fedrovskii and others, 1995.

In the Southern Tuva region, terrane consists of the Sizim, North Sangilen, and South Sangilen blocks that are separated by sinistral strike-slip faults that were later transformed into north-south-trending thrust systems. Terrane consists of two thick, lithologic-petrographic series, the lower Mugur-Teskhem gneiss-schist series, and the upper Sangilen metaterrigenous-carbonate series. The Mugur-Teskhem gneiss-schist series occurs mainly in the western South Sangilen block and consists of gneiss and schist, and lesser marble, quarztite, iron-bearing quartzite, and black shale that are metamorphosed to amphibolite facies. The Sangilen series forms the most of the terrane, occurs in all blocks, and consists of graphite-bearing marble, marble-like limestone, quartzite, metamorphosed sandstone and shale that are about 5000 m thick. The contact between these two series is unclear, and is usually a thrust fault. The Sangilen series is interpreted as Late Riphean, and may be stratigraphically overlain by terrigenous-carbonate deposits with Early Cambrian archaeocyata. The Mugur-Teskhem and Sangilen series comprise a thick terrigenous-carbonate section interpreted as a Late Riphean passive margin of the North Asian Craton. U-Pb isotopic data for metamorphic rocks of the Mugur-Teskhem series show that the series is younger than 1130 Ma, regional metamorphism occurred at about 1100 Ma, and high-temperature zonal metamorphism occurred at about 440 Ma. The Sangilen terrane is locally intruded by possible Cambrian and Ordovician granitic plutons that probably occurred during strong deformation of the margin of the North Asian Craton, during transform interaction of

lithospheric plates. The youngest plutons are of Early Devonian, within-plate plutons of subalkaline granite, and small stocks of late Paleozoic-early Mesozoic rare-metal granite.

REFERENCES: Alexandrov and others, 1981; Terleev and others, 1988; Gibsher and Terleev, 1989, 1992; Il'in, 1982; Lebedev and others, 1991, 1993; Berzin and Dobretsov, 1994.

SAL Salair terrane (Island arc) (Early Cambrian through Early Ordovician) (Salair Ridge)

Consists of three large units. (1) An island-arc volcanic-sedimentary sequence with Early Cambrian-Tremadoc marine fauna fossils. Sedimentary rocks are limestone, sandstone, shale, siliceous shale, and coarse-clastic rocks. Carbonate rocks are mostly Early Cambrian (Gavrilov suite and analogurd) that range up to 2000 m thick, and the latest Cambrian and Early Ordovician (Tolstochikhin suite and analogues) that range up to 350 m thick. Several unconformities occur, a strong deformation obviously occurred in the early Middle Cambrian with deposition of molasse including conglomerate with granitic pebbles and boulders (Bachat suite). (2) An island-arc sequence of localy magmatic rocks that decreases upward. Rhyolite, andesite, basalt, and tuff occur in the lower part of the section in the early Early Cambrian(Ancheshev suite), and basalt and andesite (Pryamushin, Bachat, and Orlinogor suites) occur in the late Early Cambrian. The Middle Cambrian-Early Ordovician units contain sparse to no volcanic rocks, and decrease. Southward. And (3) a sedimentary-volcanic sequence consists of subvolcanaic plaigogranite, plagiogranite-porphyry, diabase and small intrusions of diorite, gabbro-diorite and gabbro. Up section, these rocks exhibit low and moderate alkalinity, increasing K content, increasing Na and lowering Ti.

Overlap assemblage rocks consist mainly of Ordovician, Silurian, Early Devonian, and Eifelian shallow-marine carbonate-terrigenous moSouthlasse. In the southwestern part, the terrane is conformably overlain by carbonate-terrigenous rocks. From east to west, the shallow-water sedimentary rocks are replaced by deeper units in the Ordovician, Silurian and Early Devonian. Deeper marine deposits formed in the Late Devonian and Early Carboniferous after a Late Givetian pause. No essential re-structuring has been fixed. Terrane is intruded by small bodies of late Paleozoic-early Mesozoic, within-plate granitoids.

The Salair terrane was structurally imbricated in the late Paleozoic and early Mesozoic, and thrust over the continental Carboniferous-Permian deposits of the Kuznetsk basin to the east. The northwest Salair terrane is underthrust the Late Devonian and Early Carboniferous marine sedimentary strata of the Kolyvan-Tomsk marine basin.

REFERENCES: Resolutions, 1979; Grigor'yev, 1988; Yolkin and others, 1994; Tokarev and others, 1996.

SE Seluohe terrane (Accretionary wedge, type B) (Neoproterozoic) (Northeastern China)

Occurs at the northern margin of the Archean Jilin-Liaoning-East Shandong terrane of Sino-Korean Craton. Consists of the Neoproterozoic Seluohe group composed of metamorphic rocks. The lower member of the Seluohe Group consists of metamorphosed basalt and andesite tuff and intercalated metamorphosed rhyolitic tuff and local dolomitic marble. The upper member of the Seluohe Group consists of felsic lava and intercalated granulite, biotite-chlorite schist, and amphibolite. Several volcanic eruptive cycles are recognized. Terrane generally exhibits greenschist facies metamorphism. However, recent studies indicate the Seluohe group consists of tectonic sheets of various origins and metamorphic grades and may constitute a melange.

REFERENCES: Bureau of Geology and Mineral Resources of Jilin Province, 1989; Krashyi and others, 1996; Lu Jiansheng and others, 1996.

SG Sergeevka terrane (Island arc) (Cambrian? and Ordovician?) (Southern Russian Far East)

Consists chiefly of a long-lived and complex terrane composed of two major units: (1) An older unit of syntectonic, migmatitic, gneissic gabbro and quartz diorite that contain xenoliths up to several hundred meters in size. The xenoliths are composed of amphibolite, quartzite, marble, and calc-schist. The gneissic structure in the gabbro and diorite parallels the schistosity in the xenoliths. The amphibolite xenoliths are derived from oceanic tholeiite whereas the gneissic gabbro and quartz diorite are derived from a continental-margin arc. U-Pb zircon isotopic analyses exhibit intrusive ages of about 500 to 527 Ma. And (2) a younger unit of the Early Ordovician biotite-muscovite Taphuin Granite with a Ar-Ar muscovite isotopic age of 491 Ma. The granite forms a major thrust overlying gneissic gabbro and associated rocks.

Overlapping units are: (1) Unconformably overlhing Middle and Late Devonian felsic tuff, conglomerate, and sandstone with flora; (2) conformably overlying Early Carboniferous nonmarine conglomerate, flora-bearing sandstone, and felsic tuff; (3) Permian conglomerate, sandstone, mudstone, basalt, andesite, rhyolite, and reef-forming limestone; (4) Late Permian olistostromes; (5) unconformably overlying Middle Triassic to Middle Jurassic shallow-marine marine sandstone and siltstone; and (6) conformably overlying Middle and Late Jurassic, subduction-related(?) rhyolite, andesite, and basalt to the south, and Late Jurassic, extension-related basalt and picrite to the north; and (7) Cretaceous and younger terrestrial coal-bearing deposits. The Sergeevka terrane was amalgamated with other terranes of the Khanka superterrane during the early Paleozoic, and in the Early Cretaceous, the Khanka superterrane was accreted to the eastern margin of Asia. The Late Cretaceous and Paleogene calc-alkalic volcanic rocks of the East Sikhote-Alin volcanic-plutonic belt (unit es) overlap all terranes of the Sikhote-Alin region.

REFERENCES: Krasny, 1966, 1973, Bersenev, 1969, Shilo, 1982; Nazarenko and Bazhanov, 1986; Khanchuk and others, 1988; Sinitsa and Khanchuk, 1991; Natal'in, 1991, 1993; Khanchuk, 1993; Aleinikoff and others, in press.

SH Shalaurov terrane (Accretionary wedge, type B) (Permian and Triassic) (Yakutia)

Occurs on southeast Bolshoy Lyakhov Island and consists serpentinized peridotite, MORB-type pillow basalt with a Sm-Nd isotopic age of 291+62 Ma, and amphibolite with a K-Ar isotopic age of 473 Ma. Units comprise a tectonic sheet that is thrust over the Permian and Triassic flysch to the north that are intruded by granite with K-Ar ages of 100 to 110 Ma. Permian and Triassic rocks terrane may be northernmost fragment of the Kular-Nera slate belt described above.

REFERENCES: Parfenov, 1984; Drachev and Savostin, 1993; Nokleberg and others, 1994.

SHA Sharizhalgay terrane (Tonalite-trondhjemite gneiss) (Archean through Paleoproterozoic) (Transbaikalia, Eastern Sayan)

Occurs to west of Lake Baikal, extends more than 300 km long and ranges up to 50 km wide, and consists of several large blocks comprising an uplifted basement of the Siberian Platform composed of early Precambrian (Archean and Paleoproterozoic?) granulite-gneiss complexes. Terrane consists of: (1) Erminsky Suite consisting of biotite and biotite-hornblende gneiss, schist, and amphibolite; (2) Shumikhinsky Suite consisting of diopside- and hypersthene-hornblende schist and amphibolite; (3) Zhidoysky Suite consisting of biotite-hypersthene, biotite-two-pyroxene gneiss and granulite with interlayered pyroxene, pyroxene-hornblende schist; and (4) Zaginsky Suite consisting of biotite, biotite-pyroxene plagiogneiss, two-pyroxene schist, and ferruginous quartzite. units are metamorphosed to granulite facies. The Kitoy Suite (Sharyzhalgay Series), that differs from underlying suites in composition, type of folding, and metamorphism, contains high-aluminous sillimanite schist, amphibole, garnet-pyroxene-amphibole plagiogneiss with lenses of garnet-biotite and garnet-sillimanite plagiogneiss, marble, and calciphyres. Recent U-Pb, Rb-Sr and Sm-Nd isotopic ages for the Sharyzhalgay Series are 2.42-2.27 Ga (age of protolith for granulite and charnokite), and 1.9-1.8 Ga (age metamorphism and migmatisation). Terrane is overlapped by the Riphean and Paleozoic sedimentary cover of the North Asian Craton.

REFERENCES: Volobuev and others, 1980; Bibikova and others, 1981; Petrova, Levitsky, 1984; Belichenko and others, 1988; Sklyarov and others, 1998; Aftalion and others, 1991.

SHE Shevli terrane (Passive continental margin) (Early Cambrian through Late Devonian) (Northern part of Russian Southeast)

Consists of following deposits from bottom to top: (1) Early Cambriam units, with Sibirian-affinity archeocyats, including Tokhikan suite (red conglomerate, sandstone, siltstone, limestone, and sparese basalt, andesite, and tuff), Malotokhikan suite (basalt, andesite, and sparse conglomerate, sandstone, and limestone), Ust-Tipton suite (sandstone, siltstone, conglomerate, and limestone), and Shevli suite (limestone, dolomite, and marl). Early Cambrian ones; (2) Late Cambrian Rybalka suite (limestone and marl with sandstone and siltstone interbeds); (3) Early Ordovician Ust-Bugali suite (sandstone, siltstone, conglomerate, and limestone); (4) Late Devonian sandstone, and siltstone. Overlapping sedimentary and volcanic assemblages are: (1) Jurassic shallow-marine deposits (Uda sedimentary basin); and (2) Early Cretaceous non-marine clastic deposits (Bokon suite) including andesite and tuff.

REFERENCES: Kirillova and Turbin, 1979; Popeko and others, 1993; Krasni and others, 1996.

SHK Sangun-Hidagaien-Kurosegawa terrane (Island arc) (Silurian through Permian) (Japan)

Consists mainly of various tectonic blocks of low- to intermediate-pressure type metamorphic rocks with Rb-Sr whole-rock isotopic ages of 350 to 400 Ma, Ordovician ophiolite with local highly sheared serpentine matrix, Ordovician through Permian sedimentary rocks, and Mesozoic sedimentary rocks. The middle Ordovician to Devonian sedimentary rocks consist of melange and turbidite, mainly shale and siliceous tuff that are partly metamorphosed to high P/T conditions. The Carboniferous and Permian rocks consist of shallow-marine continental shelf deposits, mainly shale, sandstone, conglomerate and limestone, with a large amounts of Carboniferous pyroclastic rocks.

REFERENCES: Suzuki and others, 1979; Igo, 1990; Nishimura 1990;Yoshikura and others, 1990, Tazawa, 2000.

SHM Shimanto terrane (Accretionarry wedge, type A) (Early Cretaceous through Miocene) (Japan)

Consists mainly of thick coarse-grained flysch tectonically intercalated thin melange zones that occur along north-dipping thrust faults with a reconstructed ocean-plate stratigraphy for melange zone. Minor basaltic rock and chert occur along with predominant clastic rocks. Melange units form thin tectonic slivers in thick, coherent turbidite units. Melange contains varicolored shale, radiolarian chert, red shale, pillow basalt lava, and nannoplankton limestone that all occur in a random manner. Melange was highly sheared during tectonic mixing. Terrane contains four subterranes, from north to south, a Early to mid-Cretaceous, a Late Cretaceous, Eocene, and early Miocene subterranes. The thickness of the Late Cretaceous (Shimanto) subterrane ranges from 500 m to 1,500 m. Terrane contains tight isoclinal folds. Thickness of Tertiary subterranes ranges from 1,000 m to 2,000 m. The rate of convergence ranges from 4 to 6 cm per year. The age of subducting oceanic plate is younger than 10 Ma. Terrane is separated from the Jurassic accretionary complex to the north by a major thrust fault, the Butsuzo tectonic line.

REFERENCES: Taira, 1981, 1988.

SHT Shmidt terrane (Island arc) (Late Jurassic through Late Cretaceous) (Southern Russian Far East)

From oldest to youngest, consists chiefly of three units. (1) Serpentinite melange that consists of harzburgite, cumulate gabbro, high-Ti dikes, basalt, and Late Jurassic to Early Cretaceous radiolarian chert (Tominskia sequence) that is interpreted as a subduction zone complex. (2) Bimodal sheeted dikes and flows and siliceous tuff with mid-Cretaceous (Albian to Cenomanian) radiolarians, and plagiogranite. The bimodal igneous rocks are geochemically similar to primitive island arcs. And (3) an upper unit of basalt, andesite, tuff, argillite, and sandstone with Cenomanian to Santonian *Inoceramus* (Slavyansk sequence).

REFERENCES: Geology of the U.S.S.R., Sakhalin Island, 1970; Raznitsin, 1982; Yurkova, 1991.

SHU Shutkhulai terrane (Metamorphic) (Late Neoproterozoic) (Eastern Sayan)

Occurs in a large lens along the margin of the Tuva-Mongolian superterrane, chiefly consists of mica schist, schist and marble metamorphosed to amphibolite facies, and minor metavolcanic rocks. Age unknown but infered as Late Neoproterozoic. Terrane interpreted as a small fragment of the Riphean passive-continental margin of the North Asian Craton. Structural position is similar to that of the Derba and Sangilen terranes. Terrane intruded by early and middle Paleozoic granitoids of the Tannuola and South Siberian belts.

REFERENCES: Makhin, 1959; Kudryavtsev, 1960; Altukhov, 1986; Polkanov and Obruchev, 1964; Il'in and Parfenov, 1967.

SK South Kitakami terrane (Island arc) (Silurian through Permian?) (Japan)

Consists mainly of Paleozoic to Mesozoic sequences including ophiolite, metamorphic rocks, and granite of early Paleozoic age. Units include clastic and carbonate rocks, calc-alkalic rhyolite to dacite volcanic rocks, and the

early Paleozoic Hikami Granite. Oldest layered rocks contain Silurian fossils. Terrane overlain by Triassic, Jurassic and Early Cretaceous shallow-marine clastic sedimentary rocks and lesser volcanic rocks, unconformably overlapped by Late Cretaceous rhyolite, and intruded by Late Cretaceous Granite.

REFERENCES: Mori and others, 1992.

SL Solon terrane (Accretionary wedge, type B) (Late Carboniferous through Permian) (Northeastern China, Mongolia)

In Chna, occurs on the north of the Solon-Xarmolonhe fault, strikes east-west, and composed mainly of two units: (1) Middle and Late Carboniferous ophiolite, limestone, and chert containing foraminifera, fusulinida, polyp coral, brachiopods, and other marine fossil; (2) a Carboniferous subduction-related ultramafic plutonic mass; and (3) Permian volcanoclastic rocks, andesite, tuffaceous sandstone, and sandstone and conglomerate with brachiopods. Overlapping units are Jurassic volcanoclastic and sedimentary rocks. Terrane is interpreted as forming during subduction of late Paleozoic ocean crust.

REFERENCES: Xie Tonglun, 1980; Cao Congzhou, 1987; Bureau of Geology and Mineral Resources of Inner Mongolian Aut.Reg. (Inner Mongolian GMRB), 1991; Wang Ying, 1991.

In southeastern Mongolia occurs south of the Hutag Uul terrane near the China-Mongolia border. Consists of a structurally complex assemblage of: (1) dismembered Solon ophiolite of presumably Upper Devonian to Lower Carboniferous age; (2) Early Carboniferous sandstone, siltstone and limestone, minor conglomerate; (3) Middle Carboniferous to Early Permian fusulinid-bearing massive limestone, minor conglomerate, and sandstone; (4) Late Carboniferous to Early Permian andesite, dacite, tuff, sandstone, and siltstone, and minor fossiliferous limestone; (5) Late Carboniferous to Early Permian tholeiite pillow basalt, basaltic andesite, chert, tuffaceous sandstone, and siltstone containing olistostrome; and (6) Late Permian conglomerate, sandstone, siltstone, and chert. Terrane also contains undated greenschist to amphiboite facies metamorphic rock that is intruded by gabbro and granodiorite. Terrane overlain by Early Cretaceous conglomerate, sandstone, and volcanic rock, and is intruded by Triassic plutons .Tterrane is interpreted as an accretionary wedge with fragments of island arc, back-arc, and forearc basin sedimentary rock, seamount volcanic rock, and associated rock.

REFERENCES: Tectonics of Mongolian People’s Republic, 1974; Ruzhentsev and others, 1989; Pavlova and others, 1991.

SM Sisim terrane (Island arc) (Cambrian) (Eastern Sayan)

Consists of two units. (1). Early Cambrian metamorphosed basalt, keratophyre, volcaniclastic rocks, and sparse lenses of limestone (Kolpin suite); and (2) an unconformably overlying carbonate-tuffaceous terrigenous unit with a lower part composed of massive and platy limestone and basal conglomerate (Lodochnaya suite), and an upper part composed of interlayered tuff, tuffaceous sandstone, tuffaceous conglomerate, siltstone, and mudstone (Katel suite). Both units contain Middle Cambrian trilobites (Amgaian). Terrane also contains Cambrian, Ordovician and Silurian(?) collisional granite (Tannuola belt) and Early Devonian subalkaline granite of rift-related South Siberian volcanic-plutonic belt. Terrane unconformably overlapped by a Early Devonian sedimentary-volcanogenic complex that grades upward into Middle Devonian and Carboniferous continental molasse.

REFERENCES: Musatov, Nemirovskaya, 1961; Predtechensky, 1967; Amgaian, 1971.

SMA Samarkina terrane (Accretionary wedge, type B) (Late Permian through Middle Jurassic) (Southern Russian Far East)

Occurs along eastern edge of the Khanka-Bureya superterrane and extends northeast from southern coast of Primorye to Amur River, and ranges up to 100 km wide. Consists of rocks that vary widely in lithology, age, and genesis, including: (1) continental-margin deposits (turbidite and accretionary melange), pelagic chert, and siliceous mudstone that occur in various thrust panels and slices, variable-size lumps and blocks; and (2) fragments of seanmounts including basalt, limestone, and ophiolites. The marine formations occur in thrust slices up to 20 km long and range from several tens up to several hundreds meters thick. Chert slices are locally repeated three to five times. Large slices are usually underlain by melange with lumps and blocks of the same units.

Terrane consist of a minimum of five successive tectono-stratigraphic units that are subdivided into Sebuchar and Eldovaka subterranes. Each unit composed of marine rocks that grade smoothly upward into continental-margin terrigenous rocks grade into olistostromes in an accretionary melange. Uppermost structural level is the Sebuchar subterrane that contains accreted fragments of an oceanic plateau with slices and blocks of: (1) middle Paleozoic gabbro-ultramafic rocks (Kalinovka Formation); (2) basalt with overlying Late Devonian(?) and Early Permian chert, Carboniferous and Permian limestone, and Permian black mudstone (Sebuchar Formation); and (3) Late Permian greenish-grey and green sandstone alternating same-colour siltstone (Udeka Formation). The other four tectono-stratigraphic units are the Eldovaka subterrane that forms the middle and lower structural levels of the Samarka terrane. The subterrane consists of chert overlapped by turbidite deposits (Eldovaka Formation) with local basalts underlying some chert slices. Age of chert ranges from Late Permian thorugh Middle Jurassic, whereas the age of turbidite and accretionary melange is Early to Late Jurassic. The structure of the Samarka accretionary prism is a multiple layered cake with relatively younger terrigenous deposits alternating with older marine rocks. The relationship between various formations of the Samarka prism in modern Sikhote-Alin structure are faults. Unconformably overlying units are Valanginian clastic marine rocks and unconformably overlying Albian clastic marine rocks.

REFERENCES: Khanchuk and others, 1988, Kemkin and Khanchuk, 1993a, Kemkin and Philippov, 2000.

SN Saratan terrane (Oceanic) (Late Neoproterozoic and Early Cambrian) (Eastern Gorny Altai)

Consists of two presumably Vendian-Early Cambrian volcanic-sedimentary units. (1) A lower unit (Saratan sequence) chiefly composed of mafic volcanic rocks and tuff that are metamorphosed to epidote-chlorite-actinolite schistm and interlayered metamorphosed siliceous rocks and siliceous shale. The volcanic rocks are high-Ti tholeiitic MORB and OIB types. (2) An upper unit (Karagol sequence), formed in a back-arc island-arc environment, consists of locally occurring basal conglomerate, tuffaceous sedimentary rocks, and minor volcanic rocks that range from basalt to plagiorhyolite. Sedimentary rocks are sandy shale and lesser metachert and limestone. Also occurring are small serpentinite and gabbro bodies; the serpentinite occurs mainly within melange zones of tectonically imbricated units. Granitoids consist of Devonian calc-alkaline and plumasitic granite, and late Paleozoic and early Mesozoic subalkaline and alkaline granite. Overlapping units are Early Devonian and local Early and Middle Carboniferous volcanic-sedimentary rocks. The complicated outlines of terrane are the result of imbricated-thrust and strike-slip faulting. Local blueschist metamorphism with Na amphibole (crossite) and glaucophane.

REFERENCES: Dergunov, 1967; Dong and others, 1985; Gusev, 1991; Maruyama and others, 1996; Shokalsy and others, 1997; Vladimirov and others, 1997.

SP Spassk terrane (Accretionary wedge, type B) (Cambrian and older through Early Silurian) (Northeastern China, Southern Russian Far East)

In northeastern China, consists chiefly of: (1) amphibolite derived from mafic and ultramafic rocks, and calc-schist; and (2) Early Cambrian slate, marble, phyllite, and gneiss containing *Archaeolynthus sibiricus* and *Ajacicyathus sp*. Overlap assemblages are Late Permian conglomerate, sandstone, phyllite, marble, slate, and tuff. Terrane is possibly intruded by the Silurian, late Paleozoic, and Early Cretaceous plutons.

REFERENCES: Bureau of Geology and Mineral Resources of Heilongjiang 1993; Nokleberg and others, 1994; Tang Kedowg and others, 1995; Khanchuk others, 1996; Krasnyi and others, 1996; Sun Jiapeng and others, 2000.

In Russian Southeast, consists chiefly of four major units: (1) undated turbidite and olistostrome deposits with Tommotian limestone fragments; (2) limestone, with Atdabanian archaeocyathids, and interlayered chert with a structural thickness of at least 3,000 m; (3) ophiolite-derived ultramafic and mafic rocks, serpentinite melange, and basalt that are overlapped by limestone and interlayered mudstone and that contain Lenian archaeocyathids and trilobites, with a minimum structural thickness of 1,700 m; and (4) conglomerate, sandstone, and siltstone derived from units (2) and (3) with Early and Middle Cambrian trilobites and brachiopods, and Ordovician and Early Silurian conglomerate. Terrane intruded by postaccretion middle Paleozoic, Carboniferous, and Late Permian granitic rocks, and overlain by Devonian, Mississippian, and Permian volcanic and sedimentary rocks that constitute overlap assemblages for the entire Khanka superterrane. Albian granitic rocks are interpreted as forming in a continental margin, transform-margin arc. The Late Cretaceous and Paleogene calc-alkalic volcanic rocks of the East Sikhote-Alin volcanic-plutonic belt overlap the Spassk and all other terranes of the southern Russian Far East.

REFERENCES: Shcheka and others, 1973; Nazarenk and Bazhanov, 1987; Belyaeva, 1988; Natal'in, 1991, 1993; Khanchuk, 1993.

SR Sarkhoy terrane (Island arc) (Late Neoproterozoic) (Northern Mongolia, Eastern Sayan)

In northern Mongolia, forms a north-south trending belt west of Hovsgol Lake, and consists of late Riphean basalt, andesite, dacite, rhyolite, tuff, conglomerate, sandstone, siltstone, dolomite, and limestone. Volcanic rocks are intruded by coeval riebeckite granite with a K-Ar isotopic age of 752 Ma. A granite clast from conglomerate has a K-Ar isotopic ages of 823 and 718 Ma. Volcanic rocks are interpreted as part of a calc-alkaline island arc according to petrochemical and trace element data (Konnikov and others, 1994). The terrane overlain by Vendian to Early Cambrian sedimentary rock, Permian volcanic and sedimentary units, and Jurassic molasse, and are intruded by Middle to Late Cambrian, Devonian, and Permian granite.

REFERENCES: Il'in, 1973; Buyakite and others, 1989; Konnikov and others, 1994; Byamba, 1996.

SS Sosunay-Langeri terrane (Accretionary wedge, type B) (Jurassic through Paleogene) (Southern Russian Far East)

Consists of the Susunay and Langeri metamorphic complexes. The Susunay complex occurs in southern Sakhalin Island and consists of the packet of tectonic nappes. The lower tectonic nappes mainly siliceous and volcanic rocks and the upper nappes contain mainly terrigenous rocks. Units contain Early Triassic through Early Cretaceous conodonts and radiolarians. Volcanic rocks are tholeitic, subalkaline, and alkaline basalt formed in abyssal plates or ocean islands. Overlying units are interbedded siliceous and terrigenous rocks that grade upward into flysch with interlayered tuff and sandstone with carbonate concretions and that contain Late Cretaceous and Paleogene(?) radiolarians. Terrane metamorphosed to greenschist facies with K-Ar metamorphic isotopic ages of 60 to 55 Ma. The foots of tectonic nappes contain serpentinite melange with blocks of ophiolite, eclogite with K-Ar isotopic age of 133Ma, amphibolite with K-Ar isotopic age of 206 and 178 Ma, and glaucophane schist with K-Ar isotopic age of 90 to 95 Ma.

The latter Langeri metamorphic complex occurs in the western foothills of the East Sakhalin Mountains and consists of nappe packets composed of Jurassic and Early Cretaceous volcanic rocks with rare chert interbeds and Late Cretaceous laminite metamorphosed from prehnite-pumpellyite up to low-grade biotite greenschist facies with K-Ar ages of 71-58 Ma. Metamorphism intensifies down structure. Local serpentinite melange in the base of the tectonic nappe packet contains blocks of ultramafic rocks, amphibolite, amphibole- and quartz-mica schist metamorphosed to blueschist facies with K-Ar isotopic age of 92 Ma.

REFERENCES: Rikhter, 1986; Zinkevich and others, 1999.

SU Sugash terrane (Island arc) (Early and Middle Cambrian) (Southern Gorny Altai)

Forms a tectonic sheet in between Kaitanak oceanic terrane and Altai continental-margin turbidite terrane and consists of clastic rocks and basalt, minor plagiorhyolite, and small hypabyssal diorite and gabbro bodies (Sugash suite). Basalt is mainly MORB or island-arc tholeiite type. are present. The Early-Middle Cambrian age is inferred. Terrane is intruded by Devonian granitoids of the Altai volcanic-plutonic belt.

REFERENCES: Shokalsky and others, 1997.

SW Sambagawa terrane (Metamorphic) (Cretaceous) (Japan)

Consists of greenstone, chert, and graphite metapelite. Sedimentary rocks contain Carboniferous, late Triassic, and Late Jurassic microfossils. Metamorphic grade range from high pressure type epidote-amphibolite facies to greenschist facies. Metamorphic ages range from 65 to 120 Ma.

REFERENCES: Miyashiro and Banno, 1958; Banno, 1964.

TA Talitsk terrane (Continental-margin turbidite) (Cambrian through Early Triassic) (Northwestern Gorny Altai)

Chiefly composed of: (1) Cambrian sandstone-siltstone flysch sequence with coarse-clastic interbeds that occurs in windows inbetween plutons; (2) small sheets and tectonic lenses of strongly imbricated Ordovician-Silurian volcanic-siliceous rocks that occur the marginal areas of the terrane; (3) Late Devonian calc-alkaline and plumasitic granite; and (4) Late Permian and Early Triassic REE granite, and. The sequence is correlative with the Charysh and Suetka suite of the Charysh terrane, but unlike the Charysh terrane, contains the Ordovician-Silurian units.

REFERENCES: Iwata and others, 1997; Shokalsky and others, 1997; Vladimirov and others, 1997

TB Tumangang terrane (Island Arc) (Late Carboniferous and Permian) (Korea)

Consists of the Tuman Group that contains: (1) Late Carboniferous(?) and Early Permian Amgi Formation composed of biotite-siliceous shale with interlayered quartzite and limestone; (2) Early Permian Kyorensang Formation composed of basalt and andesite lava and tuff, aleurolite, shale, and limestone; and (3) Late Permian Songsang Formation composed of aleurolite, shale with interlayered siliceous sandstone and volcanic rocks. Terrane intruded by Late Permian granite (Tumangang Complex) and the Jurrassic Daebu granite, and is overlapped by Tertiary epicontinental deposits and volcanic rocks (Hamyon and Obong Groups).

REFERENCES: Geology of Korea, 1993.

TD Tukuringra-Dzhagdy terrane (Accretionary wedge, type B) (Silurian through Permian) (Southern Russian Far East)

Consists chiefly of following fault-bounded units: (1) tectonic lenses or olistoliths of Neoproterozoic limestone with oncolite and catagraphite; (2) Silurian and Devonian mafic volcanic rocks and chert with lesser terrigenous rocks and limestone; (3) Late Carboniferous sandstone, siltstone, shale, and turbidite (Dzheskogon and Nekter suites); (4) Permian flysch, greenstone, chert, and limestone with Tethyan corals and fusulinids (Bochagor suite); and (5) a narrow tectonic lens of ophiolite (Pikansk complex) that occurs along southern margin of terrane, and consists of gabbro, amphibolite, pyroxenite, serpentinite, and plagiogranite. Sparse Early to Middle Devonian corals and crinoids occur in the limestone; and Givetian brachiopods in the siltstone. Late Permian Tethyan fusulinids that in the Bochagor suite are paleobiogeographically distinct from those in adjacent terranes. Terrane generally metamorphosed to schist and microquartzite at greenschist facies. Relic glaucophane schist occurs in western part of the terrane. Six stages of collisional deformation are recognized. During the main, initial stage, north-verging, recumbent and overturned isoclinal folds and thrusts formed. A penetrative ductile, stretching lineation formed during subsequent strike-slip terrane transport. The northern part of the terrane is overlain by Middle to Late Jurassic continental terrigenous deposits; and the southern part is overlain by Early Cretaceous Umlekan-Ogodzhin volcanic-plutonic belt. Terrane is interpreted as tectonically linked to the Uda volcanic plutonic belt that formed part of the Mongol-Okhotsk active continental margin along the Stanovoi block of the North Asian Craton.

REFERENCES: Kirillova and Turbin, 1979; Natal'in and others, 1985; Kozlovskiy, 1988; Natal'in, 1993; Krasni and others, 1996.

TE Tersa terrane (Oceanic) (Late Neoproterozoic) (Central Kuznetsk Alatau, Altai)

Consists of a package of tectonic sheets of back-arc units that gently dip north-northeast and are composed of a tectonically imbricated ophiolite melange. The ophiolite consists of a succession of dunite and harzburgite, dunite and wehrlite and clinopyroxenite, layered gabbro and ampohibolite, and mafic volcanic rocks metamorphosed to greenschist facies, carbonaceous tuffaceous rocks, siliceous shale and carbonate rocks. Terrane possibly interpreted as a fragment of back-arc depression deposited on oceanic crust. Terrane structural elements are separated by thrusts and terrane area is intruded by early Paleozoic gabbro and granite.

REFERENCES: Konovalova and Prusevich, 1977; Goncharenko and others, 1982; Dergunov, 1989; Simonov and others, 1999.

TF Tonod terrane (Greenschist) (Paleoproterozoic) (Transbaikalia)

Consists of sedimentary rocks of the Kevaktinsky series that consists from older to younger of gravelstone, metasandstone, metaaleurolite, phyllite, and carbonaceous phyllite metamorphosed up to biotite stage of greenschist facies. A Pb-Pb isochrone isotopic age of carbonaceous phyllite is 2,467 Ma. Granitoids (Chuya-Nerchinsk complex) intruding large parts of the have U-Pb zircon isotopic ages of 2,114 Ma, and a Rb-Sr isotopic age of 750 and 735 Ma. Amphibolite facies metamorphism and migmatite along the contacts of the granite batholiths. Also occurring are Early Riphean dikes and minor of gabbro-diabase and diabase. The sedimentary rocks of the terrane are folded into linear and domal folds. Accretion of terrane to the North Asian Craton was occurred with intrusion of granite porphyry stocks and granodiorite-porphyry of the Yazovsky complex with U-Pb zircon isotopic age of 730. The northwest and southeast margins of the terrane are bounded by overthrusts, and the southwest and northeast parts of the terrane are discordantly overlapped by Riphean sedimentary rocks of the Patom sedimentary basin.

REFERENCES: Bukharov and others, 1992; Sharov and others, 1992; Ivanov and others, 1995.

TG Tsagaan Uul-Guoershan Terrane (Continental margin arc) (Paleoproterozoic through Permian) (Mongolia, Northwestern China)

In northwestern China, consists of: (1) Precambrian metarhyolite, quartz schist, marble, quartz-plagioclase gneiss with a Rb-Sr whole rock isotopic age of 1,755 Ma; (2) overlapping Middle Ordovician andesite-porphyry and diabase porphyry, volcanoclastic rocks, sandstone, mudstone, and limestone with gastropods, brachiopads and trilobites; (3) Early Silurian graywacke, siltstone, and shale interlayered with limestone containing graptolites; (4) Devonian calcareous sandstone, reef limestone, chert, tuff, sandstone, and limestone with gastropods, brarchipods, trilobites, and anthozoa; and (5) Early and Late Carboniferous sandstone, marble with gastropods, garchipods, and anthozoa, and siltstone, chert, rhyolite, dacite, and tuff. Terrane is intruded by syntectonic anatectic granite and overlapped by Permian terrigerous sedimentary rocks and volcanoclastic rocks.

REFERENCES: Bureau of Geology and Mineral Resources of Inner Mongolian Aut.Reg. (Inner Mongolian GMRB), 1991; Li Wenguo, 1996;

In southern Mongolia consists of (1) Paleoproterozoic(?) schist and migmatite, (2) Early to Middle Ordovician metavolcanic rocks, conglomerate, sandstone, and minor limestone lenses with brachiopods; (3) Middle to Late Ordovician conglomerate, sandstone, and minor coral-bearing limestone; (4) Silurian limestone with brachiopods and corals, and sandstone, siltstone; (5) Devonian pillow basalt, andesite, tuff, sandstone, siltstone, and chert; and (6) Early Carboniferous sandstone, siltstone with brachiopods and bryozoans, minor conglomerate. Terrane is intruded by Middle to Late Devonian granite and granodiorite, and is overlain by Middle to Late Carboniferous andesite, dacite, tuff, and Permian volcanic rocks and fossil-rich limestone.

REFERENCES: Suetenko, 1967; Ruzhentsev and Badarch, 1985.

TH Taukha terrane (Accretionary wedge, type B) (Late Jurassic through Early Cretaceous) (Southern Russian Far East)

Consists of three overlying other tectono-stratigraphic units that are similar in lithology and structure, but differ in rock age. Each unit is composed of oceanic deposits, mainly chert and carbonate that grade upward into terrigenous rocks of continental-margin origin, and overlapping accretionary melange (olistostrome).

The low unit (Erdagou Formation) consists of Late Jurassic to Early Cretaceous (Berriasian) chert and clay-chert overlapped Middle Jurassic (Callovian) basalt (Erdagou suite), and Berriasian-Valanginian turbidite deposits (Silinka suite). Thickness of chert and basalt is about 150 m whereas thickness of terrigenous rocks is about 2,500 m. The turbidites may be tectonically repeated. The turbidite conformably and gradually replaces chert rocks through a section of siliceous mudstone and mudstone. The Valanginian and Barremian accretionary melange also grades from turbidite. The structural thickness the accretionary melange varies from 100 to 400 m.

The middle unit (Gorbousha Formation) consists of Middle to Late Triassic limestone (Tetyukha suite) with high-Ti alkaline basalt at the base (400 to 500 m thick), and Early Triassic to Late Jurassic chert and clay-chert (about 100 m thick) that grad into Late Tithonian to Berriasian turbidite (Gorbousha suite) that grades into a

Berriasian-Valanginian accretionary melange. The thickness of turbidites ranges from 350 to 700 m. The accretionary melange thickness is same as above.

The upper unit (Skalistorechenka Formation) consists of Late Devonian to Late Permian limestone (Skalistorechenka suite) associated with high-Ti alkaline basalt (about 400 m thick), Carboniferous to Middle Jurassic chert and overlapping Late Jurassic turbidite (Pantovyi Creek suite). The thickness of chert and clastic deposits is not clear because of fragmentary outcrops.

Terrane exhhibits an inverted stratigraphy with older marine formations and overlapping terrigenous rocks (including accretionary melange) comprising upper structural levels of terrane whereas younger units occur at the base. However, within each structural unit, the age succession is normal. Terrane is unconformably overlain by Late Albian to Turonian andesite and volcaniclastic rocks of the East Sikhote-Alin volcanic-plutonic belt.

REFERENCES: Khanchuk and others, 1988, Rudenko and Panasenko, 1990, Kemkin and Khanchuk, 1993b, Kemkin and Kemkina, 1998, Kemkin and Kemkina, 1999, 2000, Kemkin and others, 1999.

TK Terekta terrane (Accretionary wedge, type A) (Late Neoproterozoic through Early Cambrian) (Southern Gorny Altai)

Consists of a fragment of a Vendian and Early Cambrian accretionary prism located in the Charysh-Terekta strike-slip zone. Consists of two northwest-verging thrust sheets. (1) The lower sheet, forming most of the terrane, consists of sanddy shale and calcareous rocks with subordinate mafic volcanic rocks and carbonate rocks metamorphosed to greenschist facies (Terekta suite). The upper sheet occurs as a discontinuous band along the southern margin and consists of volcanic rocks metamorphosed to epidote-amphibolite facies (Turgundin metamorphic complex). Amphibolite Ar-Ar isotopic ages are 415±3 to 418±2 Ma. The metamorphic rocks are associated with granite and granitic gneiss. Retrograde greenschist metamorphism also occurs and occurred during strike-slip migration of the terrane. Terrane contains small bodies of Devonian granitoids and unconformably overlapped by Early and Middle Devonian sedimentary and volcanogenic rocks that formed along an active continental margin.

REFERENCES: Dook, 1982; Dobretsov and others, 1991; Buslov, 1992, 1998.

TL Teletsk terrane (Accretionary wedge, type A) (Late Neoprotoerozoic) (Eastern Gorny Altai)

Consists of fine-grained sandstone, siltstone, mafic volcanic rocks, and sparse lenses of marble that are metamorphosed to greenschist facies. Volcanic rocks occur mainly in lower part of the section. Intruded by small late Paleozoic granitoid bodies related to collisional and strike-slip displacement along a continental plate margin. Two types of granite are: (1) alkaline and subalkaline granite, and (2) calc-alkaline and plumasitic granite. K-Ar muscovite isotopic ages are 323±7 and 331±7 Ma for the Altyn-Taus subalkaline granitic massifm and a K-Ar biotite isotopic age for schist along the contact of the massif is 343±7 Ma.

REFERENCES: Dergunov, 1967; Berzin, Buslov, Sintubin, 1995; Kungurtsev, 1996.

TM Tomsk terrane (Metamorphic) (Late Neoproterozoic) (Kuznetsk Alatau, Altai)

Eastern margin of the terrane consists of complexes of Late Riphean rocks occuring in tectonic sheets. A sedimentary and volcanogenic unit occurs at the base (Tersin complex) and includes include metabasalt, siliceous and carbonate rocks, and lenses of serpentinite metamorphosed to greenschist facies. A higher sheet of mafic rocks (Konzhin complex) is metamorphosed to greenschist to epidote-amphibolite facies. Amphibolite exhibits a Sm-Nd isochron isotopic age of 694±43 Ma. The volcanic rocks of the two complexes are derived from MORB and OIB types. Amphibolite facies rocks occur in the western part of the terrane are mainly metapelite derived from primitive crust (Tashelgin complex now metamorphosed into garnet-bearing schist and gneiss intercalated with marble, amphibolite, and quarztite. Terrane intruded by gabbro, diorite, granodiorite, and granite (Sadrin and Tebin complexes) and subalkaline leucocratic gabbro (Luzhbin complex) that stitch the tectonic sheets. U-Pb zircon isotopic ages are 499±19 and 490±19 Ma. Late Permian and Triassic granitoids comprise large areas and include the Tomsk gneissogranite and granite complex with a U-Pb zircon isotopic age of 251-236 Ma, and the alkaline Porozhin monzodiorite, granodiorite, granite, and leucogranite complex a U-Pb zircon isotopic age of 211±4 Ma.

The largest plutons of these younger granites occur in shear zones bounding the western part of the terrane. High-grade, amphibolite facies rocks, with U-Pb isotopic ages of about 300 Ma, occur locally.

REFERENCES: Plotnikov, 1998; Vladimorov and others, 1998.

TN Tokoro-Nemuro terrane (Island arc) (Late Cretaceous through Paleogene) (Hokkaido, NorthernJapan)

Consists chiefly of sandstone, shale, chert, basalt, and ultramafic rocks. Divided into an accretionary complex unit and a forearc unit. Accretionary complex consists of accreted seamounts and sedimentary rocks and is divided into Nikoro, Yubetsu, and Nakanogawa Groups. The forearc unit consists of thick flysch deposits and is divided into Campanian Saroma Group, middle Campanian to middle Eocene Nemuro Group, and the Paleogene Urahoro Group.

REFERENCES: Kiminami and others, 1983, Niida and Kito, 1986.

TO Tannuola terrane (Island arc) (Cambrian and older?) (Southern Tuva and Northern Mongolia)

In the East Tannuola Range, consists of two units. (1) Marine shallow-water and subaerial flows of basalt, andesite, dacite, rhyolite, tuff, sandstone, siltstone, siliceous shale, and limestone (Kadvoi, Serlig, Irbitei, and Shivelig suites). Sedimentary rocks contain Early Cambrian archaeocyata and trilobites. (2) Sandstone and siltstone interbedded with limestone and marl, and lesser tuffaceous sandstone and tuff (Manailyg and Karabulun suites). Sedimentary rocks contain Middle Cambrian trilobites. Terrane intruded by collision-related Late Cambrian and Ordovician granitoid batholiths, unconformably overlain by Ordovician-Silurian marine sedimentary rocks of the Khemchin-Sistigkhem basin, and overlain by continental volcanogenic and sedimentary deposits of the Tuva basin.

REFERENCES: Luchitsky, 1970; Zaikov, 1976; Volkov, 1986; Berzin and Kungurtsev, 1996.

TR Terpeniy terrane (Island arc) (Late Cretaceous) (Southern Russian Far East)

Consists chiefly of a thick tectonic melange composed of Santonian to Campanian deep-marine and terrestrial volcanic and sedimentary rocks (Berozovskaya, Rakitinskaya, and Bogatinskaya sequences). Locally contains *Inoceramus* and radiolarians. Volcanic rocks consist of island-arc tholeiitic, calc-alkalic, and shoshonite rocks. Some basalts are close in composition to oceanic basalt. Local abundant peridotite-pyroxenite-gabbro and gabbro-plagiogranite intrusions are interpreted as having formed in the magmatic chambers of the island arc. Terrane is structurally disrupted and strongly folded.

REFERENCES: Geology of the U.S.S.R.; Sakhalin Island, 1970; Grannik, 1978; Khanchuk and others, 1988.

TS Tasuul terrane (Oceanic) (Neoproterozoic) (Western Mongolia)

Occurs along western edge of Hangay upland and forms narrow (up to 10 km by 300 km long), north-south trending allochtonous, thrust sheet to east of Zavhan terrane. Consists of metamorphosed ophiolite composed of ultramafic tectonite, hornblendite, metagabbro, diabase dike swarm, and tholeiitic metabasalt that are intruded by tonalite and plagiogranite plutons of inferred middle Riphean age.

REFERENCES: Makarychev, 1988; Kravtsev and others, 1989; Tomurtogoo, 1989, 1999.

TT Telbes-Kitat terrane (Island-arc) (Neoproterozoic through Devonian) (Kuznetsk Alatau)

Basal units are carbonate rocks (Kabyrzgin and Kivdin suites), and siliceous sandy mudstone, clay-chert, carbonate rocks, and mafic volcanic rocks (Kamzhelin and Alambai suites) of Late Riphean-Vendian and possibly Early Cambrian age. Metamorphosed to greenschist facies, and adjacent to faults metamorphosed to amphibolite facies. Local lenses of serpentinitic and gabbro melange occur.

Different stratigraphy occurs in northern and southern segments. The northern area Telbes segment consists of three units. (1) Early Cambrian terrigenous-volcanogenic rocks, including mafic-andesite, limestone and reef limestone of Late Aldanian and Lenian age. (2) Unconformably overlying carbonate, volcanic,and terrigenous rocks

with Amgaian fauna (Mundybash suite). The volcanic rocks ranging from high-alkaline basalt to rhyolite. And (3) unconformably overlying Late Cambrian and Ordovician shallow-water marine carbonate, terrigenous, and motley molasse (Gornoshor, Algain, and Amzas suites).

The northern, fault-bounded Zolotokitat segment consists of three units. (1) basalt and andesite-basalt, tuff, clastic rocks, and bedded reef limestone with Early Cambrian fauna (Edinis suite); (2) unconformably overlying Middle Cambrian through Early Ordovician marine carbonate and terrigenous rocks and motley molasse (Bolshekitat, Chernoosipov, Kitat, Taimen, and Alzas suites); and (3) Middle and Late Cambriam mafic volcanic rock and tuff, and Early Ordovician subalkaline and alkaline volcanic rock of variable composition and pyroclastic units.

Terrane includes lens-like bodies of Vendian and early Cambrian(?) gabbro and gabbro-diabase (Kundustuyul complex), in the Kamzhelin suite in Zolotokitat segment. Stitching plutonic rocks are Telbes granodiorite, quartz diorite, plagiogranite and diorite that varies from normal to high-K calc-alkaline series (I type) with a U-Pb isotopic age of 385±15 Ma. Granitoids are part of a Early and Middle Devonian volcanic belt.

Locally occurring are Middle-Late Devonian(?) granite and granosyenite intrusions (Mezen complex) in the southern area, and alkaline granite and syenite (Kiya complex) in the northern area. Terrane is overlapped by middle and late Paleozoic deposits of the Kuznetsk basin.

REFERENCES: Gintsinger and others, 1969; Alabin, 1983; Grigor'yev, 1988; Shokalsky and others, 1997; Vladimirov and others, 1997.

TU Tunka terrane (Island-arc) (Eastern Sayan)

Occurs in southeast part of Eastern Sayan and forms a tectonic nappe about 100 by 50 km Consists of allochthonous sedimentary rocks occurring in the lower Urtagol and upper Toltinsky suites. (1) The Urtagol suite contains terrigenous-volcanogenic sedimentary rocks with a basal melange-olistostrome horizon. The lower part of the suite consists mainly of terrigenous and terrigenous-carbonate sedimentary rocks, in the upper part of the suite contains mainly basalt, andesite basalt, and tuff with local often calcareous units. Suite contains bryozoans that occur in Ordovician and younger rocks. (2) The Toltinsky suite contains mainly carbonate and volcanic-carbonate sedimentary rocks. The carbonate rocks consists of dolomite and limestone, locally siliceous. The volcanogenic rocks primarily consist of calc-alkaline basalt and andesite basalt with a sharp predominance of Na over K, a relatively high silica content, and with a moderate total iron coefficient. Suite also contain olistostrome layers. An Ordovician-Silurian age is defined by conodonts and skoleocodonts. Terrane exhibits polyphase disthene-sillimanite metamorphism adjoining the Khamar-Daban subterrane. A Rb-Sr mineral isochron from garnet-staurolite-two-micac gneiss is 312±20 Ma. Terrane is intruded by subduction-related granitoids, and overlapped by variegated molasse-like sedimentary rocks of the Sagansaray suite that contains siliceous volcanic rocks (rhyodacite, rhyolite, quartz albitophyres) contain Devonian and Early Carboniferous plant fossils.

REFERENCES: Roschektaev and others, 1984; Boos, 1991.

TY Tynda terrane (Tonalite-trondhjemite-gneiss) (Archean and Paleoproterozoic) (Yakutia)

Forms a unit about 700x150 km occurs in the southern Aldan-Stanovoy shield. Consists mostly of various Archean rocks in three complexes, the amphibolite facies Stanovoy complex, the granulite facies Larba complex, and the amphibolite facies Gilyui complex.

The Stanovoy complex consists of diorite-tonalite-trondhjemite gneiss, metamafic rocks, and paragneiss (metagraywacke and metapelite). Metamorphism is high-pressure amphibolite facies and a U-Pb zircons isotopic U-Pb ages for tonalite-trondhjemite gneiss are 2,941±80 to 2,785±5 Ma. The age of marginal zones of zircons from the same tonalite-trondhjemite gneiss and of zircons from metamafic dikes is 1,900 Ma which is interpreted as age of granulite metamorphism.

The Larba complex comprises relatively small tectonic slabs (up to 7,500 sq. km in area) bounded by northwest-striking faults. Tectonic wedges have recently been mapped within the fault zone, which are composed of metamorphosed volcanogenic and sedimentary-volcanogenic rocks of Paleoproterozoic age (Gilyui complex). The wedges are interpreted as fragments of the Mid-Gilyui, Unakha, and Nyukzha greenstone belts. The Larba complex

consists of enderbite and amphibole-biotite gneiss, ultramafic schist interbedded with pyroxene gneiss and kinzigite, calc-silicate rocks, and iron-bearing quartzite. Anorthosite and metagabbro also occur. Metamorphism is at granulite facies of high pressure. The age of zircons from garnet from granite-sillimanite-cordierite gneiss is 2585± 20 Ma and is interpreted as the age of granulite metamorphism or possibly the age of relict zircons from the source rocks.

The Gilyui complex consists mainly of hornblende and biotite-hornblende schist and amphibolite at the base, these lithologies and biotite gneiss in the middle, and mainly biotite and hornblende gneiss at the top. Complex is intruded by numerous concordant diorite and granodiorite bodies. Metamorphism is at epidote-amphibolite facies. Pb-Pb zircons isotopic ages for amphibolite, biotite-hornblende schist, and biotite gneiss are 2,100 Ma and for diorite gneiss are 1,940 Ma.

An additional Paleoproterozoic complex occurs within the Djeltula fault zone and is the Djeltula complex consisting of quartzite, mica schist, metasandstone, metavolcanic rocks, and marble with rare metaconglomerate layers. The complex is metamorphosed to greenschist and epidote-amphibolite facies.

Intruding the Stanovoy and Larba complexes are granite dikes and veins with isotopic ages of 2500 to 2000 Ma, and in the Unakha greenstone belt are stocks of hornblende-biotite granite with an isotopic age of 1830 Ma.

REFERENCES: Kastyrkina, 1983; Bibikova and others, 1986; Godzevich, 1986; Mitrofanov, 1987; Moskovchenko and Kastyrkina, 1989; Nutman and others, 1992; Rosen and others, 1994; Mironyuk and others, 1996; Korsakov, 2000.

TZ Tumanshet terrane (Paragneiss) (Proterozoic) (Eastern Sayan)

Occurs in the northwestern part of the Eastern Sayan region and extends for100 km long and ranges up to 70 km wide. Consists of Early or Neoproterozoic units of: (1) a lower section of quartzite that grades upward into high-alumina staurolite, kyanite, and chloritoid schist interstratifed with garnet-biotite schist and calciphyre; and (2) interlayered two-mica schist and calciphyres that grades upward into interlayered carbonaceous and micaceous schist. Terrane intruded by Sayan granite and unconformably overlapped by Late Riphean terrigenous-carbonate Karagas and Oselok units and the Devonian volcanic-sedimentary units.

REFERENCES: Galimova and Bormotkina, 1983; Sez'ko, 1988.

UB Uniya-Bom terrane (Continental margin turbidite) (Late Triassic and Early Jurassic) (Southern Russian Far East)

Consists chiefly of a tectonic sheet of Late Triassic to Early Jurassic turbidite deposits and interbedded olistostromes (Amkansk, Kurnalsk, Nelsk, and Muyakansk suites). Subdivided on basis of sandstone/mudstone ratios and occurrence of rare fauna of *Monotis* in the Nelsk suite, and on basis of crinoids in the Kurnalsk suite. The Late Triassic Muyakansk suite contains an olistostrome horizon up to 500 m thick. Some limestone lenses contain oncolite and catagraphite similar to those in the Late Precambrian rocks of the North Asian Craton, whereas the other limestone lenses contain Late Permian bryozoans. The turbidite deposits contain lenses of greenstone and microquartzite typical of the Tukuringra-Dzhagdy terrane. The sandstone and conglomerate clasts in the Uniya-Bom terrane are partly derived from the North Asian Craton. The Uniya-Bom terrane is intensely deformed and contains a penetrative ductile stretching lineation that formed during strike-slip tectonic transport. Terrane is interpreted as a forearc basin that is tectonically linked to the Uda volcanic-plutonic belt, part of the Mongol-Okhotsk active continental margin that occurs along the Stanovoy block of the North Asian Craton.

REFERENCES: Kirillova and Turbin 1979; Natal'in and others, 1985; Natal'in, 1993; Krasnyi and others, 1996.

UC Ulus-Cherga terrane (Island arc) (Cambrian) (Gorny Altai)

Forms an imbricated, east-verging thrust structure with various tectonic sheets of the folowing units. (1) A basal unit of basalts and tuff interbedded with graywacke sandstone, siltstone, siliceous shale, jaspers and limestone with a thickness of greater than 2000 m. Upwards, the portion of sedimentary varieties increases. Unit contains Early Cambrian archaeocyata and trilobites. Basalt is close to MORB and partly OIB types. Basal unit interpreted as forming over oceanic crust in a backarc setting. (2) A structurally overlying tectonic sheet composed of Middle Cambrian volcanic rocks, lava breccia, and basalt, and lesser andesite and dacite, tuff with subordinate siliceous

rocks, siltstone, tuffogenic and volcanomictic sandstone. REE geochemistry suggest formation in an island-arc. And (3) structurally overthrust Middle-Late Cambrian fore-arc deposits consisting of polymictic and volcanomictic sandstone, siltstone, siliceous rocks and shale with layers of andesite-basalt tuff, tuff, conglomerate, and olistostrome. An unconformity overlapping unit is the Early-Middle Devonian volcanogenic and sedimentary rocks of the Altai volcanic-plutonic belt.

REFERENCES: Avrov, 1980; Buslov and others, 1993; Volkov, 1966.

UG Ulgey terrane (Island arc) (Neoproterozoic through Devonian) (Mongolia)

Occurs in northwestern part of Altay range and consists of a disrupted assemblages of Vendian and Early Cambrian serpentinite melange, basalt, andesite, tuff, and unconformably overlying Ordovician to Silurian conglomerate, sandstone and siltstone. Terrane overlain by Devonian volcanic and sedimentary rocks and intruded by Middle Devonian granite.

REFERENCES: Dergunov and others, 1980; Demin and Demin, 1993.

UK Urik-Lya terrane (Greenschist) (Proterozoic) (Eastern Sayan)

In Eastern Sayan region extends northwest for more than 200 km long and ranges up to 50 km wide. Consists mainly of inferred Paleoproterozoic terrigenous-sedimentary rocks metamorphosed under moderate pressure-temperature conditions. Sedimentary rocks are composed of quartz sandstone, siltstone with thin to thick layers and lens of black carbonaceous shale that predominate in the lower section. Layered diabase, lava, and tuff-breccia occur in the middle section with terrigenous-sedimentary rocks. Immature oligomictic sandstone and graywacke predominate in the upper section. In the northwestern part of the terrane these units are overlapped by tuff and basalt, andesite, and liparite, tuff, and tuffaceous conglomerate. Terrane intruded by Sayan granite and unconformably overlapped with by inferred Neoproterozoic orogenic Ingashin unit that consists of unmetamorphosed conglomerate, gritstone, sandstone, and siltstone.

REFERENCES: Konnikov and Travin, 1986; Belichenko and others, 1988; Nozhkin, 1999.

In Transbaikalia region, consists of the Bolsherechensky (Ingashinsky) suite composed of quartz-mica, cordierite-, andalusite- and garnet-biotite schist alternating with amphibole schist and amphibolite, metasandstone and phyllite schist, metasandstone, metatuffaceous sandstone with interbeds of amphibolite, and metamorphosed mafic and siliceous extrusive rocks of spilite-diabase formations, gravelstone and conglomerate. Abundance of volcanic rocks increases to the northwest and consist of Paleoproterozoicquartz and felsic porphyry and altered spilite-keratophyre (Subluksky suite). Youngest unit consists of Early Riphean coarse-clastic sedimentary rocks (Ermosokhinsky suite)

REFERENCES: Konnikov and, 1986; Nozhkin, 1999.

UL Uimen-Lebed terrane (Island arc) (Cambrian through Ordovician) (northeastern Gorny Altai)

Consists of the following four units. (1) Sedimentary and volcanogenic rocks (Sarysaz suite) dominated by mafic volcanic rocks, including siliceous and mafic tuff and tuff-breccia, and clastic carbonate rocks. Early Cambrian sandstone, siltstone, gravelstone with limestone layers (Ubin suite) with Aldanian trilobites and archaeocyata occurr locally. Two suites intruded by gabbro and plagiogranite of which the largest is the Sarakokshin massif in the central part of the terrane. (2) Unconformably overlying sedimentary and volcanic-sedimentary units. Both units contain coarse-clastic rocks with pebbles and boulders of volcanic rocks and plagiogranite from the underlying unit, and olistostrome-like horizons with carbonate olistoliths (Tyrgan and Verkhneynyrgin Suites). Volcanogenic rocks consist of tuff, tuff-breccia, and lava with carbonate rocks and marl with Early Cambrian trilobites and archaeocyata. Carbonate blocks with Aldanian fauna occur in possible olistoliths in chaotic horizons. (3) Early Late Cambrian high-alkaline mafic volcanic rocks and tuff occur locally along with minor sedimentary rocks inferred to have formed in back-arc environment. And (4) unconformably overlying Late Cambrian-Ordovician shallow-water marine molasse interpreted as forming during intensive deformation along an active continental margin of the North Asian Craton during oblique or transform displacement of lithospheric plates.

REFERENCES: Gintsinger and others, 1969; Berzin, 1979; Resolutions, 1979; Avrov , 1980; Shokalsky and others, 1997.

UN Ulban terrane (Continental margin turbiditie) (Late Triassic through Middle Jurassic) (Southern Russian Far East)

Consists mainly of Late Triassic and Early-Middle Jurassic turbidite that is tectonicaly mixed with rare sheets of Middle Jurassic chert and basalt. Boudinage, minor asymmetric folds with subhorizontal hinges, and duplex structures occur. South-vergence of subduction-related folds and thrusts occurs in most cases. Overlapping sedimentary, volcanic-sedimentary assemblages and stitching plutonic granitoids are as follows. (1) Early Cretaceous granite of Kharga plutonic complex; (2) Intermediate composition Early Cretaceous volcaniclastic and volcanic rocks; (3) Late Cretaceous bimodal volcanic and volcaniclastic rocks and Late Cretaceous granite of the Khingan-Okhotsk volcanic-plutonic belt; and (4) Paleogene and Neogene nonmarine clastic deposits and Neogene basalt.

REFERENCES: Decision, 1990; Martynyuk and others, 1990; Natal'in, 1993; Krasnyi and others, 1996.

UO Ulugo terrane (Island arc) (Early Cambrian) (Tuva)

Consists of variable-composition units that range up to 8 to 9 km thick. Subdivided into Ottug-Taiga and Syynak suites or Tumat-Taiga and Tapsa suites. Consists consists of three units: (1) a mafic volcanic unit with subordinate siliceous volcanic rocks and tuff, siliceous rocks and black shale, and limestone with Early Cambrian archaeocyata; (2) a siliceous volcanic-tuff unit with subordinate mafic volcanic rocks and siliceous shale; and (3) a tuff and sedimentary rock unit composed of tuffaceous conglomerate, reef limestone, siliceous and mafic volcanic rocks and tuff, sandstone. Siliceous shale occurs in the lower part and sandstone, siltstone, limestone with Early Cambrian archaeocyata, tuff, black shale, siliceous shale, and andesite occur in the upper part. Volcanic and related rocks interpreted as forming in an island-arc setting by the occurrence deep-water of pillow-lava and siliceous sedimentary rocks, and subaerial red sedimentary rocks and. Mafic and siliceous hypabyssal and subvolcanic bodies occur throughout the section. Unconformity overlying are: (1) collisional-related Late Cambrian terrigenous rocks (Tashtygkhem suite) composed of Middle-Late Cambrian collisional granitoids; and (2) Early Devonian rift-related volcanic-sedimentary rocks; and (3) Middle and Late Devonian continental molasse.

REFERENCES: Luchitsky, 1970; Zaikov, 1976; Bukharov, 1979; Berzin and Kungurtsev, 1996.

UR Urmi terrane (Passive continental margin) (Archean through Middle Triassic) (Northeast China, Southern Russian Far East)

Consists of (1) Middle Archean amphibolite, chert, gneiss, quartzite (Amur series); (2) Middle Archean granite, granodiorite, gneiss-granite and migmatite plutonic rocks of ultrametagenous type (Bureya rock complex); (3) Middle Ordovician granite; (4) Early and Middle Devonian marine terrigenous and terrigenous-carbonate rocks with corals, brachiopods, bryozoans, crinoids, trilobites (Niran and Pachan suites); (5) Early Permian rhyolite and tuff; (6) Early to Late Permian shallow marine sandstone, siltstone and conglomerate with mixed Boreal-Tethyan type bryozoans, brachiopods, and Tethyan-type ammonoids (Osakhtin suite); (7) Early and Middle Triassic turbidite; and (8) Late Triassic shallow marine deposits. Overlapping sedimentary an volcanic-sedimentary assemblages are as follows. (1) Early Jurassic (Langary suite) and Middle Jurassic (Budakan and Katon suites) composed of nonmarine sandstone, siltstone with flora. (2) Early-Late Cretaceous nonmarine sandstone, siltstone, and coal (Nabat, Bira, Chuki-Poktoi Bolshechurkin members), and Early-Late Cretaceous andesite, rhyolite, and rhyolite tuff forming a part of the Khingan-Okhotsk volcanic-plutonic belt. (3) Cenozoic sandstone, mudstone, and pebble conglomerate. And (4) stitching plutonic rocks of Late Cretaceous granite and granodiorite of the Khingan-Okhotsk volcanic-plutonic belt.

REFERENCES: Resolutions, 1979; Krasni and others, 1996.

VS Voznesenka terrane (Passive continentalal margin) (Cambrian through Permian) (Southern Russian Far East)

Constitutes southwestern Khanka superterrane. Consists of four major units. (1) Cambrian sandstone, pelitic shale, rhyolite, felsic tuff, limestone with Atdabanian to Lenian archaeocyathidsand, and dolomite ranging up to

several thousand meters thick. Rhyolite exhibits a Rb-Sr whole-rock isotopic age of 512 Ma. Cambrian rocks are intensely deformed and intruded by Ordovician collision-related granitic rocks with a Rb-Sr whole-rock isotopic age of 480 Ma. (2) Ordovician to Early Silurian conglomerate and sandstone according to questionable flora. (3) Early Devonian rhyolite and felsic tuff, and Middle and Late Devonian rhyolite, felsic tuff, and rare basalt with intercalated continental rocks and shallow-marine clastic rocks with limestone lenses, and Early and Middle Carboniferous rhyolite, silicic tuff, siltstone, and limestone lenses with Tethyan forminifera. And (4) Late Permian basalt, andesite, rhyolite, sandstone, and siltstone with plant fossils. Overlapping Mesozoic and Cenozoic volcanic and sedimentary are: (1) Early and Middle Triassic marine clastic rocks; (2) interbedded Late Triassic marine and nonmarine coal-bearing clastic rocks; (3) marine Jurassic deposits with an abundant fauna; (4) Hauterivian and Albian and younger Cretaceous clastic coal-bearing rocks that also unconformably overlie the Laoelin-Grodekovsk and the Sergeevka terranes of the Khanka superterrane; (5) Late Cretaceous and Paleogene calc-alkalic volcanic rocks of the East Sikhote-Alin volcanic-plutonic belt that overlaps all terranes of the southern Russian Far East; and (6) younger Cenozoic deposits including Paleogene and early Neogene epicontinental sedimentary rocks, and late Neogene alkalic basalt of the Sakhalin-Primorye volcanic belt. The Voznesen terrane was amalgamated with other terranes of the Khanka superterrane in the early Paleozoic, and in the Early Cretaceous, the Khanka superterrane was accreted to the eastern margin of Asia.

REFERENCES: Geology of the U.S.S.R., 1966; Goroshko, 1983; Oleinik, 1983; Nazarenko and Bazhanov, 1987; Belyaeva, 1988; Khanchuk and others, 1991; Androsov, 1992; Izosov, 1992.

WAD West Aldan terrane (Granite-greenstone) (Archean) (Yakutia)

Forms a block about 400 km by 350 km and occurs on the western margin of the Aldan-Stanovoy shield.

Terrane consists of Archean rocks of different types metamorphosed under widely ranging temperatures and pressures. Orthogneiss of tonalite-trondhjemite composition predominate and form the Olekma complex that occurs in several large linear blocks separated by four longitudinal belts about 300 km long and 30 km wide. The belts contain tectonic greenstone slabs of the Subgan complex; blastomylonite bounds the belts. The Kurulta granulite complex forms several independent fault-bounded blocks and tectonic slabs. All these blocks and zones may be independent terranes.

The Olekma tonalite-trondhjemite complex consists of compositionally similar biotite, biotite-amphibole, and amphibole plagiogneiss and highly aluminous gneiss. These units are enriched in LREE and have high Sr and low U contents. Associated are mafic schist and amphibolite bodies. The age of tonalite-trondhjemite gneiss is 3.0 to 2.7 Ga. Orthogneiss older than 3.0 Ga also occurs. Units are generally progressively metamorphosed to moderate pressure amphibolite facies. Nearby the greenstone belts, orthogneiss exhibits low-grade amphibolite facies retrograde metamorphism with the formation of heteroblastic, glomeroblastic, and blastomylonite structures.

The Subgan greenstone complex contain varous rock assemblages and metamorphosed at varying degrees. Sedimentary and volcanogenic rocks in the greenstone belts exhibit isotopic ages of 3.2 to 3.0 and 3.0 to 2.7 Ga. Contacts between greenstone belts and the surrounding rocks of the tonalite-trondhjemite complex are generally tectonic or intrusive contacts.

The Tokko-Khani greenstone belt contains small amounts of mafic and ultramafic volcanic rocks in combination with siliceous and intermediate volcanic rocks that are metamorphosed to high grade kyanite-sillimanite type. To the west and east, the Chara-Tokko and Temulyakit-Tungurcha) greenstone belts contain tholeiitic volcanic rocks, banded iron formation, and carbonate-terrigenous rocks (Temulyakit-Tungurcha and Saimagan). Two generations of greenstone belts occur one with ages of 3.3 to 3.0 Ga (Syrylyr tectonic slab) and the other with ages of 3.0 to 2.9 Ga (Olondo synform and Tasmiele wedge).

The Kurulta granulite complex comprises the Olomokit, Chara, and Kalar blocks and consists mainly of orthoenderbite- and charnockite-orthogneiss along with paragneiss, including amphibole- and pyroxene-bearing gneiss and schist, garnet-biotite gneiss, rarely with cordierite and sillimanite. The blocks form relatively thin tectonic slabs overthrusting the tonalite-trondhjemite and greenstone complexes. Scarce isotopic data for the protoliths of garnet-biotite gneiss of the Olomokit block derivation from rocks with a Nd model age of 3.5 Ga; data for the protoliths of two-pyroxene schist formed indicates derivation from rocks with a Nd model age of 3.15 Ga. This suggests that the age of granulite metamorphism is no older than 3.15 Ga. The upper age limit of

metamorphism is constrained by the emplacement of the Charodakan granite complex with an isotopic age of 2.6 Ga.

Stitching assemblages include granite and pegmatite that intrude the Archean metamorphic complexes. The granites form small orthogneiss and migmatite bodies and large plutons up to 2,500 km^2 in size (Charodakan pluton). Chemical analysis indicates a normal granite series with equal amounts of K_2O and Na_2O, and, less frequently, to subalkaline granite with K_2O slightly prevailing over Na_2O. Granite from the eastern margin of the Tasmiele tectonic slab exhibits an isotopic age of 2.7 Ga. The largest of the plutons, the Charodakan, is dated at 2.6 Ga.

Unconformably overlap assemblages are Paleoproterozoic medasedimentary rocks of the Udokan and Uguy series in the Kodar-Udokan, Early Khani, Oldongso, and Uguy graben-like basins. A U-Pb age of volcanogenic zircons from metagraywacke and tuffaceous sandstone of the Udokan series in the Kodar-Udokan basin is 2.18±0.005 Ga. The metasedimentary rocks are intruded by granite of the Kodar complex with an isotopic age of 1.8-1.9 Ga. Metasedimentary rocks in the Early Khani basin are separated from the surrounding orthogneiss by faults and consist of marmorized dolomite, metaquartzite, and oligomictic metasandstone with conglomerate lenses, rhythmically interlayering metapelite and metapsammite, as well as polimictic and oligomictic metasandstone. The total thickness of is 1800 to 2100 m. Also occurring are metadiabase sills ranging up to 150 to 200 m thick. Units are metamorphosed to greenschist facies (biotite zone), and rarely up to low-grade -amphibolite facies with isotopic ages of 1.95±0.11 Ga. Basal deposits are well correlated with the Udokan series in the Oldongso basin, unconformably overlap the Charadokan granite pluton and orthogneiss of the Olomokit granulite block. Basal units include include poorly sorted gravelstone, conglomerate, coarse-grained sandstone, and breccia. Units are metamorphosed up to chlorite-sericite zone of greenschist facies. Sedimentary rocks are intruded by metadiabase sills with isotopic ages of 1.88 Ga. The Udokan series is unconformably overlain by terrigenous rocks of the Uguy series that consists of boulder-pebble conglomerate and grey and rose-grey oligomictic and quartz sandstone, both massive and bedded. Occurring in the sandstone are bands of silty sandstone and local slaty siltstone. Bedding is thin, horizontal and oblique, and cross-wavy.

REFERENCES: Mironyuk and others, 1971; Neelov and others, 1971; Petrov, 1976; Cherkasov, 1979; Kudryavtsev and Nuzhnov, 1981; Rublev and others, 1981;Grabkin, 1982; Beryozkin and others, 1983; Bushmin and others, 1983; Drugova and others, 1983; Aksenov and others, 1985; Beryozkin and Smelov, 1985; Bogomolova and others, 1985; Dook and others, 1986; Sochava, 1986; Levchenkov and others, 1987; Mitrofanov, 1987; Berezhnaya and others, 1988; Drugova and others, 1988; Gorokhov and others, 1989; Smelov and others, 1988;Smelov, 1989; Popov and others, 1990; Kovach and others, 1995b; Smelov, 1996; Stogniy and others, 1996; Smelov and Beryozkin, 1997.

WAG West Angara terrane (Passive continental margin) (Neoproterozoic) (Yenisey Ridge)

Occurs in the central part of the Yenisey Ridge and extends northwest for 450 km and ranges up to 80 km wide. Consists of Middle and Late Riphean metamorphosed terrigenous, terrigenous-carbonate, and carbonate sedimentary rocks of three units that formed along a passive continental margin. High-aluminous kyanite-(andalusite-sillimanite)-staurolite gneiss, quartz-mica schist, quartzite, and marble occur in the lower parts of sections (Teya unit). Interstratal bodies of orthoamphibolite occur in the upper part. The sedimentary rocks of Teya unit are concordantly or unconformably overlapped by terrigenous and terrigenous-carbonate sedimentary rocks of Sukhopit unit that consists of mainly metasandstone, metasiltstone, quartz-chlorite-sericite often carbonaceous schist, rhythmically laminated sedimentary rocks that grade upward into limestone and dolomite. Units are metamorphosed from amphibolite to lower greenschist facies. Autochthonous granite and migmatite of Teya complex occur with gneiss of Teya and Sukhopit units and has an U-Pb zircon isotopic age of 866 Ma. Teya, Sukhopit, and Tungusik units were intruded by calc-alkaline granitoids of Tataka-Ayakhta complex with an U-Pb zircon isotopic age of 760 Ma. Unconformity overlapping is the Late Riphean and Early Cambrian Vorogovka-Chapa sedimentary assemblage.

REFERENCES: Khomentovsky and others, 1972; Kornev and others, 1974; Postel'nikov, 1980; Nozhkin and others, 1998; Vernikovskaya and others, in press.

WB Waizunger-Baaran terrane (Island arc) (Ordovician through Permian) (Northwestern China, southwestern Mongolia)

In northwestern China, consists of: (1) Ordovician limestone with intercalated andesite, terrigenous rocks, intermediate- and mafic-tuff, mafic- and siliceous-volcanic rocks, and muddy limestone with trilobites, pelecypods, and corals; (2) unconformably overlapping Silurian sandstone, conglomerate, pyroclasic rocks, and limestone with corals and brachiopods; and (3) mainly Devonian mafic and intermediate mafic volcanic rocks, and minor siliceous volcanic rocks and tuff, fine-grained sandstone, siltstone, and limestone with trilobites and brachiopods that grade into coal clastic rocks. Overlying are Permian continental volcanic and terrigenous rocks with local coal.

In southwestern Mongolia, consists of: (1) Early Devonian tholeiite pillow basalt, diabase, tuff, sandstone, chert, and minor limestone; (2) Early to Middle Devonian volcaniclastic sandstone, argillite and chert, and minor lenses of limestone with corals; (3) Middle to Late Devonian basalt, andesite, pyroxene porphyry, shoshonite, and quartz latite; (4) Early Carboniferous trachyandesite, quartz latite, trachydacite, rhyodacite, tuff, sandstone, siltstone, and minor limestone with brachiopods. Postaccretion stitch complexes are Middle to Late Carboniferous granodiorite, gabbro, picrite diabase, granosyenite, and Early Permian leucogranite. Rhuzhentsev and others (1989) interpret the terrane as a fragment of a Devonian continental margin arc formed on the thick crust, based on the composition of volcanic rocks. In contrast, Badarch and Orolmaa (1996) and Baofu (1993) interpret the terrane as a combination of a volcanic island arc and backarc basin**.**

REFERENCES: Gavrilova and others, 1975; Dergunov and others, 1980; Badarch and Orolmaa, 1989; Bureau of Geology and Mineral Resources of Xinjiang Uygur Aut. Reg.(Xinjiang GMRB), 1990; Ren Jishun, 1980; Ruzhentsev and others, 1992; Han Baofu, 1992, 1993.

WD Wundurmiao terrane (Accretionary wedge, type B) (Mesoproterozoic through Middle Ordovician) (Northern China, Mongolia)

Extends to east-west and consists of : (1) A lower Mesoproterozoic ophiolite composed of gabbro, diabase, schistose tholeiite with apparent pillow structures and lenses of ferrous, silica-rich rocks, and an upper Mesoproterozoic unit composed of sericite schist, sericite-quartz schist, chlorite schist, two-mica-quartz schist, ferrous quartzite, greenschist, marble, and glaucophane schist that comprise a suite of radiolarian-bearing, pelagic, silica-rich ferrous rocks; (2) Neoproterozoic sericite-quartz schist, chlorite-sericite schist, chlorite-calcite schist, metasandstone, phyllite, and lenses of phyllite-limestone with a U-Pb isotopic age of 1130 Ma ; (3) Early and Middle Ordovician altered andesite, chert, marble-like slate, altered basalt, tuff, and volcanic breccia; tuff contains radiolarian, graptolites and foraminifera. Terrane intruded by granodiorite porphyry with a U-Pb isotopic age of 466 Ma, and is unconformably overlain by Silurian marine terrigenous clastic rock.

REFERENCES: Bureau of Geology and Mineral Resources of Inner Mongolian Aut.Reg. (Inner Mongolian GMRB), 1991; Hu Xiao, 1986; Li Jinyi, 1987; Wang Quan, 1991; Chen Qi, 1992; Zhang and Sklyarov, 1992; Li Weiguo, 1996.

WSA West Sakhalin terrane (Accretionary wedge, type A) (Cretaceous) (Southern Russian Far East)

Consists chiefly of: (1) a basal sequence of Early Cretaceous volcanic rock, jasper, and pelagic rocks (Samokhinskaya, Pobedinskaya, and Tymovskaya sequences); and (2) Late Cretaceous clastic and tuffaceous clastic rocks with *Inoceramus* and ammonites (Arkovskaya and Krasnoyarkovskaya sequences). The Late Cretaceous rocks are interpreted forearc trough deposits and are overlapped by Tertiary conglomerate and sandstone. Terrane deformed into northwest-striking folds and is interpreted as a forearc basin that formed along the igneous arc formed by the East Sikhote-Alin volcanic-plutonic belt. Terrane correlated with Sorachi-Yezo terrane on Hokkaido Island in northern Japan. For paleomagnetic determinations, three Late Cretaceous localities exhibite poor-quality southerly displacements of $5^{o}\pm10^{o}$, $12^{o}\pm7^{o}$ and $20^{o}\pm3^{o}$ with respect to the Siberian platform. Best estimate suggests displacement to the south of about 15^{o}.

REFERENCES: Geology of the U.S.S.R., Sakhalin Island, 1970; Pechersky, 1970; Parfenov, 1984; Zyabrev, 1984; Nevolina and Sokarev, 1986.

WST West Stanovoy terrane (Metamorphic) (Archean through Mesoproterozoic) (Transbaikalia, Mongolia)

In Mongolia, consists of Precambrian(?) gneiss, migmatite, amphibolite, quartzite and marble, minor pegmatite and diabase, and porphyry dikes with K-Ar isotopic ages of 2,650, 2,480, 1200to 2200 Ma. A f oliated granite exhibits a K-Ar isotopic age of 89-129 Ma. Overlap assemblage consists of Permian subalkalic volcanic and volcaniclastic rocks.

REFERENCES: Koval and Smirnov, 1983; Kozakov, 1986; Zorin and others, 1997; Tomurtogoo and others, 1999.

In the Transbaikalia region, consists of several sequences.

Oldest Archean and Paleoproterozoic units are Early Archean Mogocha, Late Archean Nikitkinsky, and Paleoproterozoic Tungirsky metamorphic complexes that consists of schist, gneiss, quartzite-aluminous and carbonate subcomplexes metamorphosed to granulite facies. The granulite metamorphism has a U-Pb zircon isotope age of 1.9 Ma. Intrusive rocks consist of the Early Archean upper Moklinsky complex with a Rb-Sr isotope age of 2.6 to 2.9 Ma, Late Archean Amazar and Early Stanovoy complexes, and Paleoproterozoic Oloshkinsky Late Stanovoy complexes in which granitoids predominate significantly over mafic plutonic rocks. Southwest part of terrane consists of Precambrian(?) gneiss, migmatite, amphibolite, quartzite and marble, minor pegmatite and diabase and porphyry dikes interpreted as a metamorphic core complex formed during early Creataceous continental extension. K-Ar isotopic ages for mylonitic foliated granite are 89 to 129 Ma.

Several younger units also occur. (1) The Middle Riphean Irgainsky suite composed of metabasalt, greenschist, marble, and phyllite with interlayered metasandstone, quartzite, conglomerate; and subconcordant dikes of basalt and andesite. (2) The Cambrian Solontosvsky volcanic-sedimentary sequence contains late Riphean and Cambrian microfossils and consists of sedimentary rocks composed of sandstone, aleuropelite, conglomerate, and marble, and volcanic rocks composed of rhyolite, trachyrhyolite, dacite, andesite, basalt, and intermediate and siliceous tuff. The intrusive equivalents are the layered mafic and spare ultramafic rocks of the Kruchininsky complex, and granitoids of the Krestovsky complexes with an inferred early Paleozoic age. Younger batholith intrusions of quartz-diorite, granodiorite, and granite exhibit a Rb-Sr isotope age of 438±7.6 Ma and are the product of palingenic melting.

Overlap and stitching complexes the Barguzin-Vitim batholith, Selenga sedimentary-volcanic-plutonic belt, and Trans-Baikalian-Daxinganling sedimentary-volcanic plutonic belt that indicate pre-late Carboniferous accretion of the terrane to the North Asian Craton.

REFERENCES: Koval, Smirnov, 1982; Vinogradov and others, 1983; Kozakov, 1986; Bibikova and others, 1993; Anashkina and others, 1997; Zorin and others, 1997; Tomurtogoo and others, 1999; Kazimirovsky and others, 2000.

WSY West Sayan terrane (Continental margin turbidite) (Late Neoproterozoic through Devonian) (Western Sayan and eastern Gorny Altai)

Consists of several large tectonic sheets and lenses ranging up to 50 km or more wide. Sheets are separated by complicated strike-slip and inbricated-thrust zones and constitute subterranes. Terrane may be underlain by Vendian and Early Cambrian ophiolite and accretionary units that are exposed along the terrane periphery and in a tectonic window. The terrane consists mainly of thick Cambrian-Ordovician sand-shale flysch that are overlapped by Silurian shallow-water carbonate-terrigenous shelf deposits, and by Devonian and Early Carboniferous continental volcanogenic and terrigenous rocks. The major units, from oldest to youngest, are as follows. (1) Late Precambrian or Cambrian sandy-silty shale of the Syutkhol and Ishkin suites with typical sparese quartz and plagioclase clasts. The coarse-clastic rocks increase upsection and become more polimictic. (2) Overlapping Cambrian coarse-clastic, polymictic and motley sedimentary rocks, and andesite, granitic pebble conglomerate, and flysch. (3) Ordovician flysch, mainly sandstone and shale (Shignet series). The proportion of sandstone, siltstone, and shale varies greatly. Calcareous rocks, shale, marl, and sandy limestone constitute a major part of the Late Ordovician section. Local brachiopods, corals, and trilobites occur. Also occurring are exoticOrodvician chert, jasper, and quarztite in the northern part of the terrane. (4) Conformable to unconformable overlying Early Silurian rocks are carbonate rocks with reef containing abundant corals, crynoids, brachiopods, and trilobites (Onin and Yaryshkol suites), and terrigenous interbedded motley sandstone, siltstone, and mudstone (Taslin suite). (5) Unconformably overlying in

the southern part of the terrane are Late Silurian motley marine molasse composed of cross-bedded sandstone, siltstone, and conglomerate with unevenly distributed limestone interbeds with brachiopos and corals. And (6) Early Devonian continental terrigeous-volcanic rocks, and lesser Carboniferous through Jurassic coal-bearing molasse that fills fault graben basins.

Most of the terrane is metamorhosed to greenschist and prehnite-pumpeliite facies of. Late Ordovician and Silurian units are less or not metamorphosed. Locally, metamorphism attains amphibolite facies. K-Ar isotopic age of metamorphism granite, migmatite, gneiss, and schist is Devonian and Early Carboniferous. Early Devonian or Early Silurian plutons intrude areas metamorphosed to greenschist facies and consist of a tonalite-granodiorite complex (Bolshoy Porog complex), and a REE subalkaline granite-leucogranitic complex with granosyenite and syenite (Dzhoy complex).

REFERENCES: Zonenshain, 1963; Dergunov, 1967; Kheraskov, 1979; Berzin, Dobretsov, 1994; Buslov, Sintubin, 1995; Zonenshain and others, 1990.

XC Xichangjing terrane (Metamorphic) (Proterozoic) (Northwestern China)

Extends east-west and mainly consists of two suites of metamorphic rocks: (1) Mesoproterozoic, low- and middle-grade metamorphosed clastic rocks interlayered intermediate to ultramafic volcanical rocks; and (2) Neoproterozoic low-grade metamorphosed clastic rocks and interlayered carbonate rocks and chert.

REFERENCES: Zuo Guoquan and others, 1990; Bureau of Geology and Mineral Resources of Inner Mongolian Aut.Reg. (Inner Mongolian GMRB), 1991; Bureau of Geology and Mineral Resources of Gansu province (Gansu GMRB), 1991; He Guoqi and others, 1994.

YN Yenisey terrane (Paragneiss) (Paleoproterozoic?) (Yenisey Ridge)

Extends in a submeridional direction for 200 km long and ranges up to 30 km wide. Consists of in ferred Paleoproterozoic volcanic-terrigenous units metamorphosed to amphibolite facies. From west to the east, metamorphosed terrigenous-carbonate rocks with tholeiite basalt grade into differentiated calc-alkaline rocks ranging from rhyolite to dacite to basalt, and associated mature metasedimentary rocks. Volcanic and sedimentary rocks metamorphosed to gneiss and mica-quartz schist with interlayered quartzite. Units interpreted as a margin basin of an ensialic island arc and associated continental slope and foot deposit.

REFERENCES: Bibikova and others, 1993; Nozhkin, 1999.

ZA Zavhan terrane (Continental margin arc) (Late Neoproterozoic) (Mongolia)

Occurrs in northern and southern segments separated by Hangay fault. The northern segment extends for 450 km and ranges up to 90 km wide, and the southern segment extends longitudunally for 350 km and ranges up to 130 km wide. Consists of Riphean complexes, from east to west, interpreted as forming along an active continental margin: (1) Zavhan-Mandal batholith of calc-alkalic diorite, tonalite and palgiogranite with a K-Ar isotopic age of 840 Ma; (2) Hutul-Hasagt fold- and thrust-belt containing Alpine type ultramafic rocks, a spilite-keratophyre bimodal series, and carbonate-siliceous rocks, and phyllite, (3) Urgamal fold belt containing calc-alkalic basalt, rhyolite, tuffaceous flysch, carbonaceous slate with stromatolites, and limestone; and (4) Buural-Darive imbricated fold zone, containing thick quartzite-carbonite-schist complex with blocks of early Precambrian schist and Riphean(?) Alpine-type ultramafic rocks and mafic volcanic rocks. Most of complexes overlapped by late Late Riphean volcanic molasse (Zavhan formation) occurring in a rift structure. Terrane is overlain chiefly by Vendian to Early Cambrian carbonate- terrigenous sedimentary rocks and stitched by Late Cambrian granitoids.

REFERENCES: Geologic Map., 1987, 1999, Map., 1989, Tomurtogoo, 1989, 1990.

ZN Zhangguangcailing superterrane (Continental margin arc) (Neoproterozoic through Devonian) (Northeastern China)

Extends north-south and consists chiefly of the following units. (1) Paleoproterozoic basement containing schist, quartzite, marble, and gneiss (Xinhuadukou Group). (2) Neoproterozoic tuff, rhyolite dacite, slate, shale, quartzite, marble and metamorphic sandstone (Yimianpe and Dongfenshan Groups). (3) local Neoproterozoic and Early Cambrian siliceous slate, limestone, marble, carbonaceous slate and siltstone (Xilin Group), and local Ordovician

sedimentary deposits and intermediate-mafic volcanic rocks. The Early Ordovician rocks include limestone, conglomerate, lava, and tuff. The Late Ordovician rocks include mafic-intermediate lava (over 530 m in thickness), sandstone, siltstone and slate. (4) local overlapping Devonian carbonate, and terrigenous and felsic rocks (Xiaobeihu, Fuxingtun, Hongchuan, and Heilonggou Formations). And (5) late Paleozoic, Mesozoic, and Cenozoic overlap assemblages. Synorogenic Ordovician and Silurian plutons intrude the superterrane that is extensively intruded by Hercynian and Mesozoic plutons. Local blueschist metamorphism with Na amphibole (crossite) and glaucophane.

REFERENCES: Dong and others, 1985; Heilongjiang GMRB, 1993; Maruyama and others, 1996; Zhao Chunjin and others, 1996; Krasnyi and others, 1996; Sun Jiapeng and others, 2000.

ZO Zoolen terrane (Accretionarry wedge, type B) (Ordovician(?) and Devonian) (Mongolia)

Ranges up to 30 km wide and extends for 700 km in southern Mongolia and consists of several tectonic sheets, slivers, blocks, and melange units of mainly Ordovician(?) to Devonian tholeiite basalt, andesite, tuff, volcaniclastic rocks, and chert metamorphosed to greenschist facies. Also occurring are scattered small ultramafic bodies, and serpentinite melange with blocks of gabbro, peridotite, diorite, diabase, chert, and limestone. Terrane overlain by Carboniferous volcanic rocks and flysch.

REFERENCES: Suetenko, 1967; Zonenshain and others, 1975; Ruzhentsev and others, 1985.

ZRA Zhuravlevsk-Amur River terrane (Continental margin turbidite) (Late Jurassic and Early Cretaceous) (Southern Russian Far East)

Forms a S-shaped unit occurring along a major strike-slip fault system. Southern part consists mainly of: (1) Late Jurassic chert and basalt formed in an upper oceanic crust environment; and (2) a thick continuous sequence of Early Cretaceous shelf and turbidite depo (up to 13,000 m thick) derived from both oceanic and continental units. Source area for turbidited are granitic and metamorphic rocks to the west and east of turbidite basin. Northern part of terrane contains large open folds, whereas appressed folds and thrust faults occur in southern and central parts. Along the Amur River, the northern part of the terrane consists mainly of Neocomian turbidite. Terrane intruded by Early Cretaceous high-alumina granitic rocks with K-Ar ages of 100 to 120 Ma, and by of the Late Cretaceous and Paleogene granite rocks of the East Sikhote-Alin volcanic-plutonic belt. Terrane is interpreted as forming along a transform plate boundary in the Neocomian and as a back-arc basin for the in Kema arc in the Aptian-Albian.

REFERENCES: Krasny, 1966; Bersenev and others, 1969: Martynyuk and others, 1983; Nazarenko and Bazhanov, 1986: Markevich, 1971: Golozubov and Khanchuk, 1995.

ZS Zasurin terrane (Oceanic) (Late Cambrian and Early Ordovician) (Northwestern Gorny Altai)

Forms a folded tectonic sheet surrounded by strongly deformed sedimentary units and consists of chert, shale, jasper, hematite quarztite, sandstone, tuffaceous sandstone, siltstone, tuff-breccia, and mafic pillow-lava (Zasurin suite). Volcanic rocks are associated with diabase and gabbro-diabase bodies and are low-K, oceanic tholeiite and oceanic island basalt. Terrane interpreted as a sedimentary-volcanic layer of oceanic crust. Conodonts and radiolaria defines a Late Cambrian and Early Ordovician age. The Zasurin, Talitsk and Maralikha terranes are intruded by Late Devonian calc-alkaline and plumasitic granitoids with U-Pb zircon ages of 365±5, 364±8, 367±4, 364v16, 371±15 Ma, and by Late Permian and Early Triassic REE metal granite.

REFERENCES: Zonenshain and others, 1990; Iwata and others, 1997; Shokalsky and others, 1997; Vladimirov and others, 1997; Buslov and others, 1999, 2000.