DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 94-194
PAMPHLET

INTRODUCTION, TECTONIC DEFINITIONS, ACKNOWLEDGMENTS, DESCRIPTION OF STRATIFIED MAP UNITS, REFERENCES, AND STRATIGRAPHIC COLUMNS FOR TECTONOSTRATIGRAPHIC TERRANE AND OVERLAP ASSEMBLAGE MAP OF ALASKA

By Warren J. Nokleberg, Elizabeth J. Moll-Stalcup, Thomas P. Miller, David A. Brew, Arthur Grantz, John C. Reed, Jr., George Plafker, Thomas E. Moore, Steven R. Silva, and William W. Patton, Jr.

With contributions on specific regions by
Robert B. Blodgett, Stephen E. Box, Dwight C. Bradley, Thomas K. Bundtzen, Cynthia Dusel-Bacon, Bruce M. Gamble, David G. Howell, Helen L. Foster, Susan M. Karl, Marti L. Miller, and Steven W. Nelson

INTRODUCTION

This pamphlet contains an introduction, tectonic definitions, acknowledgments, descriptions of post-accretion stratified rocks, and descriptions for tectonostratigraphic terranes, and references for the companion tectono-stratigraphic terrane and overlap assemblage map of Alaska. The companion map describes and depicts the tectono-stratigraphic terranes and major overlap assemblages, except for the Aleutian Islands. In Alaska the major overlap assemblages consist mainly of upper Mesozoic sedimentary rocks, and Upper Cretaceous and Cenozoic sedimentary and volcanic and plutonic rocks of Alaska that were deposited on, or intruded into adjacent terranes after tectonic juxtaposition or accretion.

A tectonostratigraphic terrane is define as a fault-bounded geologic entity or fragment that is characterized by a distinctive geologic history that differs markedly from that of neighboring terranes (Jones and others, 1983; Howell and others, 1985). Tectonostratigraphic terranes (hereafter referred to as "terranes") are mainly fault-bounded, stratigraphically coherent assemblages that formed before accretion to adjacent terranes or to a continental margin. A few terranes are fault-bounded structural complexes formed in subduction zones or in accretionary prisms. Terranes are bounded by faults or fault zones some of which are referred to as sutures. Some sutures are inferred beneath areas of overlap assemblages or from juxtaposition of contrasting geologic sequences. Paleontologic, stratigraphic, and paleomagnetic evidence suggests that some terranes were originally widely separated from one another, and (or) from cratonal North America by distances of up to thousands of kilometers. In contrast for other terranes, paleontologic, stratigraphic, and paleomagnetic evidence suggests that they are displaced from one another, or from another loci on the same continent by distances that are greater than the dimensions of terranes to
greater than hundreds of kilometers. Definitions of tectonic terms are discussed and defined below.

Inferred tectonic environments of terranes are defined below and depicted on the map. These environments are: (1) cratonal margin; (2) passive continental margin; (3) metamorphosed continental margin; (4) continental margin arc; (5) island arc; (6) turbidite basin; (7) oceanic crust, sea mount, and ophiolite; (8) accretionary wedge and subduction zone; and (9) metamorphic. For terranes with varying geologic history, the chosen tectonic environment indicates the dominant tectonic environment interpreted for the older sequences of rocks in the terrane. The tectonic environments inferred for plutonic rocks are described in relation to associated accretionary events. These environments are pre- and post-accretion.

Upper Mesozoic sedimentary rocks and Upper Cretaceous and Cenozoic sedimentary and volcanic rocks are also shown. These rocks are products of magmatism and sedimentation that occurred mainly after accretion of many terranes in the late Mesozoic or Cenozoic. Some of the Late Cretaceous and early Cenozoic igneous and sedimentary rock units, as well as fragments of terranes, are offset as much as 400 km by movement along post-accretion faults. Rock units that occur as overlap assemblages on two or more adjacent terranes provide minimum ages on the timing of accretion of terranes. For simplicity, the map does not depict some post-accretion, mainly Cenozoic age faults that occur within terranes, such as the Hines Creek and Tozitna faults. The time scale used in this report is that of Palmer (1983).

The basic outcrop pattern and distribution of tectonostratigraphic terranes for the map are from Beikman (1980), Jones and others (1987), Monger and Berg (1987), Dusel-Bacon (1991), Grantz and others (1991), Gehrels and Berg (1992), Moore and others (1992), Reed and others (written commun., 1993), cited references, and the authors and contributors. The outcrop pattern and age classification of Cenozoic and older igneous rocks is modified from T.P. Miller (written commun., 1991), D.A. Brew (written commun., 1989, 1990, 1991), Dusel-Bacon (1991), Moll-Stalcup (1990), and E.J. Moll-Stalcup (written commun., 1991).

TECTONIC DEFINITIONS

The following definitions, arranged in alphabetical order, are adapted from Coney and others (1980), Jones and others (1983), Howell and others (1985), Monger and Berg (1987), and Wheeler and McFeely (1991), with modifications by the authors.

Accretion. Tectonic juxtaposition of two or more terranes, or tectonic juxtaposition of a terrane(s) to a continental margin.

Accretionary-wedge terrane. Fragment of a mildly to intensely deformed complex of turbidite deposits and variable amounts of oceanic rocks. Divided into units composed dominantly of turbidites or of oceanic rocks. Formed adjacent to zones of thrusting and subduction along the margin of a continental or an island arc. Commonly associated with subduction zone terranes. May include large, fault-bounded units with coherent stratigraphy. Examples are the Chugach and Prince William terranes.

Craton margin. Late Proterozoic up through Jurassic sedimentary rocks deposited on a continental shelf or slope. Locally has, or is inferred to have had, an Archean and Early Proterozoic craton basement. Consists dominantly of platform successions.

Cratonal terrane. Fragment of a craton. An example is the Kilbuck terrane.

Continental-margin arc terrane. Fragment of an igneous belt of coeval plutonic and volcanic rocks, and associated sedimentary rocks that formed above a subduction zone dipping beneath a continent. Inferred to have a sialic basement. Examples are the Aurora Peak and Maclaren terranes.

Island (intraoceanic) arc terrane. Fragment of an igneous belt of plutonic rocks, coeval volcanic rocks, and associated sedimentary rocks that formed above an oceanic subduction zone. Inferred to possess a simatic basement. An example is the Wrangellia composite terrane.

Metamorphic terrane. Fragment of a highly metamorphosed and (or) deformed assemblage of sedimentary, volcanic, and (or) plutonic rocks that cannot be assigned to a single tectonic environment because original stratigraphy and structure are obscured. Includes highly deformed structural melanges that contain intensely-deformed pieces of two or more terranes. Examples are the Behm Canal, Broad Pass, and Windy terranes.

Metamorphosed continental-margin terrane. Fragment of a passive continental margin, sometimes highly metamorphosed and deformed, that cannot be linked with certainty to the nearby craton margin, but may be derived from a distant site from the nearby craton margin, or from elsewhere. Examples are the Coldfoot, Ruby, Seward, and Yukon-Tanana terranes.

Oceanic crust , seamount, and ophiolite terrane. Fragment of part or all of a suite of eugeoclinal, deep-marine sedimentary rocks, pillow basalts, gabbros, and ultramafic rocks that are interpreted as oceanic sedimentary and volcanic rocks, and upper mantle. Includes both inferred offshore ocean and marginal ocean basin rocks, minor volcaniclastic rocks of magmatic arc derivation, and major marine volcanic accumulations formed at a hot spot, fracture zone, or spreading center. Mode of emplacement onto continental margin uncertain. Examples are the Angayucham and Seventymile terranes.

Overlap assemblage. A post-accretion unit of sedimentary and (or) igneous rock units deposited on, or intruded into two or more adjacent terranes. The sedimentary and volcanic parts depositionally overlie, or are interpreted to have originally depositionally overlain two or more adjacent terranes, or terranes and the craton margin. Plutonic rocks, in some areas, are coeval and genetically related to overlap volcanic rocks, and weld or stitch together adjacent terranes, or a terrane and a craton margin. The major overlap assemblages in Alaska are mainly Late Jurassic and younger sedimentary, volcanic, and plutonic assemblages that formed during or after the Mesozoic accretion of most of these terranes. An example of an overlap assemblage is the Cenozoic igneous rocks of the Aleutian arc that overlap the Chugach and Peninsular terranes.

Passive continental-margin terrane. Fragment of a craton margin. An example is the Nixon Fork terrane.

Post-accretion rock unit. Suite of sedimentary, volcanic, or plutonic rocks that formed in the late history of a terrane, after accretion. May occur also on an adjacent terrane(s) or on craton margin as an overlap assemblage unit. A relative time term denoting rocks formed after tectonic juxtaposition of one terrane to an adjacent terrane.

Pre-accretion rock unit. Suite of sedimentary, volcanic, and (or) plutonic rocks that formed in the early history of a terrane, before accretion. Constitutes the stratigraphy and igneous geology inherent to a terrane. A relative time term denoting rocks formed before tectonic juxtaposition of one terrane to an adjacent terrane.

Seamount and oceanic plateau. Major marine volcanic accumulations formed at a hot spot, fracture zone, or spreading center.

Subduction-zone terrane. Fragment of variably to intensely deformed oceanic crust and overlying units, oceanic mantle, and lesser turbidite and continental margin rocks that were tectonically juxtaposed in a zone of major thrusting of one lithosphere plate beneath another. Divided into units composed dominantly of turbidites or of oceanic crustal rocks. Many subduction zone terranes contain fragments of oceanic crust and associated rocks that exhibit a complex structural history, occur in a major thrust zone, and possess blueschist facies metamorphism. Commonly associated with accretionary wedge terranes. May include large, fault-bounded blocks with coherent stratigraphy. An example is the McHugh Complex in the northern Chugach terrane.

Subterrane. Fault-bounded unit within a terrane that exhibits a similar but not identical geologic history relative to another fault-bounded unit in the same terrane.

Superterrane. An aggregate of terranes that is interpreted to share either a similar stratigraphic kindred or affinity, or a common geologic history after accretion (Moore, 1992). An approximate synonym is *composite terrane* (Plafker, 1990).

Terrane. A fault-bounded geologic entity or fragment that is characterized by a distinctive geologic history that differs markedly from that of adjacent terranes (Jones and others, 1983; Howell and others, 1985). Constitutes a physical entity, i.e., a stratigraphic succession bounded by faults, inferred faults, or an intensely-deformed structural complex bounded by faults. Some terranes may be interpreted as faulted facies equivalents of the same or other terranes with the original intervening facies changes having been removed during faulting.

Turbidite-basin terrane. Fragment of mainly orogenic forearc, backarc, or tectonic basin of terrigenous-clastic basin deposits. Includes continental-slope and rise-turbidite deposits, and submarine-fan turbidite deposits deposited on oceanic crust. May include minor epiclastic and volcaniclastic deposits. An example is the Manley terrane.

ACKNOWLEDGMENTS

We thank our many colleagues over the years for their many discussions of Alaskan geology: J.N. Aleinikoff, H.C. Berg, W.P. Brosge, R.M. Chapman, Michael Churkin, Jr., P.J. Coney, Bela Csejtey, Jr., R.L. Detterman, J.H. Dover, J.A. Dumoulin, J.T. Dutro, Jr., G.E. Gehrels, W.G. Gilbert, C.S. Gromm• , J.W. Hillhouse, Travis Hudson, D.L. Jones, M.A. Lanphere, R.A. Loney, W.C. McClelland, E.M. MacKevett, Jr., J.W.H. Monger, J.C. Moore, T.L. Pavlis, B.L. Reed, D.H. Richter, S.M. Roeske, N.J. Silberling, T.E. Smith, D.B. Stone, I.L. Tailleur, A.B. Till, W.K. Wallace, F.H. Wilson, and G.R. Winkler. We thank A.B. Till and J.A. Dumoulin for providing unpublished data on the Seward and York terranes on the Seward Peninsula, and J.H. Dover for providing unpublished data and interpretations for east-central Alaska. We also thank J.P. Calzia and N.J. Silberling for their constructive and thoughtful reviews, and J.A. Nokleberg for coloring of the map.

DESCRIPTION OF STRATIFIED MAP UNITS
POST-ACCRETION SEDIMENTARY ROCKS

Qs **Sedimentary rocks (Quaternary)Ñ**Chiefly Quaternary continental sedimentary rocks and lesser volcanic rocks, and unconsolidated silt, sand, and gravel. Depositionally overlie older overlap assemblages and terranes. Locally folded and faulted

Ts **Sedimentary rocks (Tertiary)Ñ**Chiefly Tertiary continental sedimentary rocks and lesser volcanic rocks. Depositionally overlie older overlap assemblages and terranes. Locally folded and faulted

Czs **Sedimentary rocks (Cenozoic)Ñ**Chiefly Tertiary continental sedimentary rocks and lesser volcanic rocks, and Quaternary (including Holocene) sedimentary rocks and unconsolidated silt, sand, and gravel. Depositionally overlie older overlap assemblages and terranes. Locally intensely folded and faulted

Ks **Sedimentary rocks (Cretaceous)Ñ**Chiefly deep marine shale and minor conglomerate deposited by turbidity currents. Local coarse-grained sandstone, and fine-grained sedimentary rocks deposited in deep-marine conditions to shallow-marine to nonmarine conditions. Local interlayered volcanic rocks chiefly rhyolite, dacite, and andesite tuff, flows, and breccia. Depositionally overly older Mesozoic overlap assemblages, and terranes. Locally intensely folded and faulted. In southwestern Alaska, consists chiefly of Upper Cretaceous Kuskokwim Group (Cady and others, 1955; Box and Elder, 1992) that is mainly shale and fine- to medium-grained sandstone, and lesser siltstone and conglomerated that formed as deep-water marine turbidites with abundant, immature, lithic-rich components. Kuskokwim Group forms major overlap assemblage on Dillinger, Goodnews, Nixon Fork, Ruby, Tikchik, and Togiak terranes. In west-central Alaska in the Yukon-Koyukuk basin unit consists mainly of Lower Cretaceous, deep-marine turbidite deposits and Upper Cretaceous, shallow marine and non-marine deltaic sedimentary rocks that overlie Angayucham, Nixon Fork, and Ruby terranes (Nilsen, 1989)

GN **Gravina-Nutzotin overlap assemblage (mid-Cretaceous to Late Jurassic)Ñ**Chiefly argillite, graywacke, and conglomerate, with lesser andesitic and basaltic volcanic, and volcaniclastic rocks of the Chisana Formation, Douglas Island Volcanics, and similar unnamed volcanic units. Sedimentary rocks range from deep marine turbidites to shallow-water and nonmarine deposits. In eastern-southern Alaska, coarse clastic rocks in Nutzotin part of assemblage derived locally from the underlying Wrangellia terrane and from unknown metamorphic source terranes. In southeastern Alaska, coarse clastic rocks in Gravina part of assemblage derived from stratigraphically underlying Alexander and Wrangellia terranes mainly to west, but may also have been derived in part from the Stikinia, Wrangellia, and Yukon Tanana terranes to the east. Nutzotin and correlated Gravina parts of assemblage apparently deposited in separate basins. Gravina-Nutzotin overlap assemblage correlated with the Kahiltna overlap assemblage to west. Locally intensely faulted and folded. Intruded by mid- and Late Cretaceous granitic, gabbroic, and ultramafic rocks, part of Chisana, Chitina, and Glacier Bay-Chichagof arcs, and by younger granitic rocks. In southeastern Alaska, Gravina part of unit forms an extensive overlap assemblage that overlies Alexander and Wrangellia terranes, and is locally overthrust by the Yukon Prong and Behm Canal terranes to the east. **REFERENCES**: Berg and others, 1972; Richter, 1976, Barker, 1987; Brew and Karl, 1988a, b, c; Ford and Brew, 1988; Gehrels and others, 1990; McClelland and others, 1991; Haeussler, 1992

KA **Kandik River overlap assemblage (Early Cretaceous, Jurassic, and Late Triassic)Ñ**Chiefly Upper Triassic, Jurassic, and Lower Cretaceous shelfal shale and quartzite (Glenn Shale, Keenan Quartzite) overlain by mainly flyschoid graywacke and non-marine molasse strata that are recycled foreland basin deposits (Biederman Argillite, and Kathul Graywacke). Generally broadly folded with local, small isoclinal folds. Kandik overlap assemblage thrust onto miogeoclinal margin of western North America along northwest-dipping thrusts. Isoclinally folded and with low-grade regional metamorphism. Kandik River overlap assemblage interpreted as a faulted overlap assemblage originally deposited on Porcupine terrane to northwest, and possibly also deposited on North American craton margin. Structurally overlain by Angayucham and Porcupine terranes along northwest-dipping thrusts. **REFERENCES:** Brabb and Churkin, 1969; Churkin and others, 1982; Howell and Wiley, 1987; Dover, 1990; Howell and others, 1992

KH **Kahiltna overlap assemblage (Cretaceous and Late Jurassic)Ñ**Chiefly deep marine, partly volcaniclastic, flyschoid graywacke and argillite, with minor amounts of chert, limestone, conglomerate, and andesite. Mainly Early Cretaceous age, but includes rocks ranging in age from Late Jurassic to early Late Cretaceous (Cenomanian). Structurally-disrupted and intensely folded and faulted. Metamorphic grade mainly lower greenschist facies, but ranges from zeolite to amphibolite facies. Occurs north of Peninsular terrane and interpreted to depositionally overlie Peninsular terrane on Alaska Peninsula. Thrust over Wrangellia terrane in central Alaska Range. May comprise part or all of Maclaren Glacier metamorphic belt of the Maclaren terrane in eastern Alaska Range. In southwestern Alaska, Kahiltna overlap assemblage interpreted to be depositionally overlain by Upper Cretaceous marine sedimentary rocks of Kuskokwim Group to north. Local Late Cretaceous (Turonian) strata in poorly mapped areas may represent gradation into Upper Cretaceous Kuskokwim Group. Correlated with Gravina part of Gravina-Nutzotin overlap assemblage to east and southeast. Contains several, small terranes including Broad Pass, Chulitna, Susitna, and West Fork terranes. Former Kahiltna terrane of Jones and others (1981, 1987). **REFERENCES**: Jones and others, 1981, 1987; Wallace and others, 1989; Csejtey and others, 1992

POST-ACCRETION CENOZOIC AND LATE CRETACEOUS VOLCANIC ROCKS

(Note: Felsic includes Siliceous and intermediate igneous rocks.)

QTv f **Felsic volcanic rocks (Quaternary and late Tertiary)Ñ**Younger than 30 Ma. Chiefly andesite, dacite, and rhyolite of the eastern Aleutian arc and the Wrangell volcanic field. In southeastern Alaska, includes Kuiu-Etolin bimodal volcanic belt.

QTvm **Mafic volcanic rocks (Quaternary and late Tertiary)Ñ**Younger than 30 Ma. In western Alaska, the Bering Sea shelf, and the Bering Sea Islands, chiefly widespread alkali olivine and tholeiitic basalt and minor basinite and nephelanite of the Bering Sea volcanic belt. In eastern Alaska, chiefly alkalic and tholeiitic basalt of the Yukon-Porcupine Flats, and small basanite and basalt cinder cones erupted throughout the Yukon-Tanana terrane. In southern Alaska, chiefly basalt and basaltic andesite of the eastern Aleutian arc and Wrangell volcanic field. In southeastern Alaska, chiefly calc-alkalic Edgecomb volcanic field and the Behm Canal basalts

mTv f **Felsic volcanic rocks (middle Tertiary)**ÑBetween 30 and 55 Ma. Chiefly andesite and dacite flows and tuffs, and minor basalt and rhyolite that were erupted along the southern margin of Alaska as part of an older pulse of Aleutian magmatism. In western interior Alaska, chiefly small rhyolite bodies with ages of about 40 Ma age that are associated with more mafic rocks. Unit forms the Interior Alaska, West-Central, and Saint Lawrence Island volcanic belts

mTvm **Mafic volcanic rocks (middle Tertiary) Ñ**Between 30 and 55 Ma. Chiefly basalt and basaltic andesite erupted during an earlier pulse of magmatism in the eastern Aleutian arc. Also includes a small field in western Alaska of basalt and alkali rhyolite erupted at the end of subduction-related magmatism at about 55 Ma

TKv f **Felsic volcanic rocks (early Tertiary and Late Cretaceous)**ÑBetween 55 and 76 Ma; locally as old as 93 Ma in east-central Alaska. Chiefly rhyolite, dacite, and andesite tuffs and flows comprising a widespread, continental-margin magmatic arc in western, southwestern, and southern Alaska. In interior and southern Alaska, unit forms felsic volcanic part of the Alaska Range-Talkeetna Mountains, Kuskokwim Mountains, and Yukon-Kanuti volcanic-plutonic belts

TKvs **Siliceous volcanic rocks (early Tertiary and Late Cretaceous)**ÑBetween 55 and 76 Ma; locally as old as 93 Ma in east-central Alaska. In western and southern Alaska, chiefly rhyolite and dacite tuffs and flows comprising the most chemically-evolved part of a widespread, continental-margin magmatic arc. In east-central Alaska, chiefly rhyolite and dacite tuffs and flows. In interior and southern Alaska, unit forms silicic volcanic part of the Alaska Range-Talkeetna Mountains, Kuskokwim Mountains, and Yukon-Kanuti volcanic-plutonic belts

TKvi **Intermediate volcanic rocks (early Tertiary and Late Cretaceous)**ÑBetween 55 and 76 Ma. Chiefly andesite and dacite with subordinate rhyolite flows and tuffs comprising a widespread, continental-margin magmatic arc in western, southwestern, and southern Alaska. In interior and southern Alaska, unit forms intermediate, volcanic part of the Alaska Range-Talkeetna Mountains, Kuskokwim Mountains, and Yukon-Kanuti volcanic-plutonic belts

CRATON MARGIN AND OCEANIC ROCK UNITS

NAM **North AmericaÑ**Undisplaced stable craton margin. Late Proterozoic shelfal sedimentary and volcanic strata, chiefly sandstone, shale, argillite, limestone, dolomite (Tindir Group) deposited under paralic to glacial margin conditions. Grades upward into lower and middle Paleozoic carbonate rocks, shale, and chert (Funnel Creek Limestone, Adams Argillite, Hillard Limestone, Road River Formation, McCann Hill Chert, Nation River Formation, and Ford Lake Shale) deposited during a major marine transgression and foundering of continental margin after rifting at about 570 Ma. Younger, upper Paleozoic through mid-Cretaceous shallow-marine to shelfal deposits (Calico Bluff Formation, Tahkandit Limestone, and Glenn Shale). Structurally underlies Kandik River assemblage along northwest-dipping thrusts. Includes the shallow-marine platform deposits of Yukon Territory and Mackenzie District that depositionally onlap the crystalline rocks of the Canadian Shield. Northwest extension of nuclear North America craton margin. **REFERENCES**: Jones and others, 1981; Howell and Wiley, 1987; Dover, 1990; Howell and others, 1992

PAC **Pacific plateÑ**Late Eocene to late Miocene oceanic crust 7 to 10 km thick overlain by as much as 2.5 km of Eocene to Holocene pelagic, hemipelagic, continental-rise, and glacio-marine deposits. Seismic refraction data indicate that oceanic mantle is overlain layer 3 about 5 km thick, layer 2 about 1 to 1.5 km thick, and layer 1, from less 200 m thick in areas distant from the continent, to more than 2 km thick near the continental margin. Outside of map area, contains chains of sea mounts (Gilbert, Kodiak, and Patton), fracture zones (Aia, Blanco, Sila, Sedna, Surveyor, Sovano), and oceanic spreading ridge (Juan de Fuca) south of southeastern Alaska. **REFERENCES**: Atwater, and Severinghaus, 1991; Grantz and others, 1991; Kirschner, 1988

TECTONO-STRATIGRAPHIC TERRANES

[Arranged alphabetically by map symbol; inferred tectonic environment in parentheses]

Arctic Alaska superterraneÑ Consists of Endicott Mountains, De Long Mountains, Hammond, North Slope, and Tigara terranes. North Slope terrane occurs along northern margin of Arctic Alaska, Endicott Mountains, De Long Mountains, and Hammond terranes occur generally successively to south. Tigara terrane occurs in western Arctic Alaska. Coldfoot terrane (Moore, 1992; Moore and others, 1992) designated as separate terrane in this study. Arctic Alaska superterrane generally overlain by Jurassic and Cretaceous marine sedimentary rocks, and by Cenozoic marine and continental sedimentary rocks. Various terranes of Arctic Alaska terrane are interpreted as originally forming in a passive continental margin environment that subsequently was substantially tectonically imbricated during major Mesozoic thrusting followed by local to substantial extension along southern margin (Moore, 1992; Moore and others, 1993)

AAD **De Long Mountains terrane (passive continental margin)Ñ**Occurs along length of Brooks Range and consists of at least four allochthonous sequences that are composed of Upper Devonian or Lower Mississippian to Lower Cretaceous sedimentary rocks and that are distinguished by various stratigraphic characteristics. Terrane typically consists of: (1) Upper Devonian carbonate rocks (Baird Group, part); (2) Lower Mississippian shallow- to deep-marine clastic rocks and black shale (Kayak Shale of Endicott Group); (3) Lower Pennsylvanian through Triassic chert and argillite (Etivluk Group), and (or) Mississippian carbonate platform rocks (Lisburne Group); and (4) Upper Jurassic and Lower Cretaceous (Neocomian) flysch (Okpikruak Formation). Individual allochthonous sequences distinguished by: (1) presence or absence of Upper Devonian and Mississippian arkosic debris (Nuka Formation) containing 2.06 Ga clastic zircons; (2) Mississippian and Lower Pennsylvanian shallow-marine carbonate platform deposits (Lisburne Group); (3) abundant Permian(?) diabase sills intruding upper Paleozoic strata; and (4) proportion of clastic material within siliceous Permian, Triassic, and Lower Jurassic deposits (Etivluk Group). De Long Mountains terrane structurally overlies Endicott Mountains terrane and is interpreted as a displaced fragment of the late Paleozoic and early Mesozoic Arctic continental margin of North America. **REFERENCES**: Jones and others, 1981, 1987; Dumoulin and Harris, 1987; Mayfield and others, 1988; Karl and others, 1989; Moore and Mull, 1989; Moore and others, 1992

AAE **Endicott Mountains terrane (passive continental margin)Ñ**Occurs along length of northern Brooks Range and consists of: (1) Upper Devonian marine shale and sandstone (Hunt Fork Shale, Noatak Sandstone, part) grading upwards into thick coarse-grained uppermost Devonian and lowermost Mississippian(?) fluvial deposits (Kanayut Conglomerate), and capped by transgressive marine shale (Kayak Shale) that comprise Endicott Group and represent a fluvial-deltaic clastic wedge shed from a northern and eastern source area using present-day coordinates; (2) Mississippian and Pennsylvanian continental-margin carbonate platform deposits (Lisburne Group), and Mississippian and Pennsylvanian shale, chert, dolomite, and sparse marine keratophyre flow and tuff (Kuna Formation); (3) Permian to Jurassic siliceous argillite, chert, and silicified limestone (Siksikpuk and Otuk Formations); and (4) Jurassic to Lower Cretaceous (Neocomian) shale (Ipewik unit) containing a thin, but extensive *Buchia* coquina unit. Overlap units are Neocomian (Okpikruak Formation) and Albian (Fortress Mountain and Torok Formations) flysch and lutite. Terrane displays chlorite-grade greenschist facies metamorphism of Mesozoic age at base. Terrane structurally overlies Hammond and North Slope terranes and underlies De Long Mountains terrane. Endicott Mountains terrane interpreted as displaced fragment of the Paleozoic and early Mesozoic Arctic continental margin of North America. Includes Kagvik terrane of Churkin and others (1979). **REFERENCES**: Dutro and others (1976); Churkin and others, 1979;

Jones and others, 1981, 1987; Mull and others, 1982; Nokleberg and Winkler, 1982; Mayfield and others, 1978, 1988; Nilsen, 1981; Karl and others, 1989; Moore and Mull, 1989; Moore and others, 1992

AAH **Hammond terrane (passive continental margin)Ñ**Occurs along length of central and southern Brooks Range in four complexly imbricated assemblages: (1) Late(?) Proterozoic quartz-mica schist, quartzite, marble, calc-schist, metabasalt, and phyllite metamorphosed generally at lower greenschist facies; (2) metamorphosed Cambrian to Silurian and older carbonate rocks (Skajit Limestone and undifferentiated Baird Group); (3) Devonian phyllite, metasandstone, metaconglomerate, metatuff, metabasalt, and limestone (Beaucoup Formation) and upper Paleozoic (Mississippian) conglomerate and black shale (Kekiktuk and Kayak Formations); (4) sparse Mississippian and Pennsylvanian(?) carbonate platform rocks (Lisburne Group); and (5) sparse siltstone of Permian(?) and Triassic(?) age (Saddlerochit(?) Group). Older two assemblages locally intruded by Late Proterozoic and Devonian gneissic granitic rocks. Hammond terrane characterized by widespread presence of the second assemblage and a strong structural fabric overprinting relict primary sedimentary structures. Oldest assemblage exposed in local structural highs. Upper Paleozoic sequence correlative with coeval stable shelf deposits of the North Slope terrane. Hammond terrane displays mainly chlorite-grade greenschist facies metamorphism and relatively older blueschist and amphibolite facies metamorphism. Hammond terrane interpreted as a composite of several terranes displaced from unknown early Paleozoic carbonate platforms and clastic basins along the North American(?) and (or) Siberian(?) continental margins. Hammond terrane structurally underlies Endicott Mountains and Coldfoot terranes. **REFERENCES**: Tailleur and others, 1977; Dillon and others, 1980, 1987; Jones and others, 1981, 1987; Dumoulin and Harris, 1987; Dillon, 1989; Karl and others, 1989; Moore and Mull, 1989; Moore and others, 1992

AAN **North Slope terrane (passive continental margin)Ñ**Occurs in North Slope subsurface, northeastern Brooks Range, and Doonerak structural window and consists of three major sequences: Franklinian sequence (pre-Mississippian), Ellesmerian sequence (Mississippian to Early Cretaceous), and Brookian sequence (mid-Cretaceous and Cenozoic).

Franklinian assemblage is complexly deformed, stratigraphically complicated, and may be a composite of several terranes. The best studied part (illustrated in stratigraphic column) occurs in Sadlerochit Mountains, on the north flank of the northeastern Brooks Range, and consists of a carbonate platform to basin assemblage composed of: (1) Katakturuk Dolomite (Proterozoic), Nanook Limestone (Proterozoic(?) or lower Cambrian to Ordovician); and (2) Mount Copleston Limestone (Lower Devonian). Pre-Mississippian rocks elsewhere in terrane consist of Late Proterozoic through Silurian slate, phyllite, chert, graywacke, carbonate rocks, mafic and intermediate volcanic and volcaniclastic rocks, and the Neruokpuk Quartzite. Franklinian sequence contains sparse Devonian metagranitic plutons.

Ellesmerian sequence unconformably overlies Franklinian sequence and consists of: (1) transgressive unit of Mississippian nonmarine conglomerate and marine shale (Kayak Shale and Kekiktuk Conglomerate of Endicott Group); (2) Mississippian to Permian carbonate platform deposits (Lisburne Group); (3) Permian and Triassic marine shale, sandstone and conglomerate (Echooka Formation and Ivishak Formation of Sadlerochit Group); (4) Triassic black shale, limestone and quartz-rich sandstone (Shublik Formation) and Jurassic and Lower Cretaceous black shale and sparse fine-grained sandstone (Kingak Shale).

Brookian sequence disconformably to unconformably overlies the Ellesmerian sequence and consists of: (1) mid- to Upper Cretaceous condensed basinal deposits (pebble shale unit and the Hue Shale); and (2) northeast-prograding fluvial deltaic deposits of mid-Cretaceous age (Fortress Mountain Formation, Torok Formation, Nanushuk Group, and of Early Cretaceous and Tertiary age (Canning Formation, Colville Group, Sagavanirktok Formation). Prograding deltaic deposits separated by regional Cenomanian disconformity.

North Slope terrane structurally overlain by Endicott Mountains and De Long Mountains terranes. Base not exposed. North Slope terrane interpreted as a displaced fragment of the Paleozoic and early Mesozoic Arctic continental margin of North America. **REFERENCES**: Brosg• and others, 1962; Brosg• and Tailleur, 1970; Jones and others, 1981, 1987; Mull and others, 1982; Bird, 1985, 1988; Blodgett and others (1986, 1988, 1992; Mayfield and others, 1988; Moore and Mull, 1989; Grantz and others, 1990; Moore and others, 1992

AAT **Tigara terrane (passive continental margin)Ñ**Occurs on Lisburne Peninsula in northwestern Alaska, and on western tip of Seward Peninsula in western Alaska and consists of orogenic deposits unconformably overlain by stable shelf deposits. These deposits are: (1) Ordovician and Silurian slaty argillite, graptolitic shale, and graywacke turbidites of the Iviagik Group (Martin (1970) that is more than 1,500 m thick; (2) unconformably overlying, Lower Mississippian, intercalated marine and nonmarine argillite, lutite, quartzite, and coal of the Kapaloak sequence that is more than 600 m thick; (3) Upper(?) Mississippian marine shale (similar to Kayak Shale) and Lower Mississippian to Pennsylvanian carbonate rocks of the Nasorak, Kogruk, and Tupik Formations of Lisburne Group that is about 2,000 m thick; (4) Pennsylvanian to Jurassic argillite, siliceous shale, and argillaceous chert of the Etivluk Group that is about 200 m thick; and (5) Upper Jurassic(?) to Neocomian marine graywacke turbidite and marine mudstone of the Ogotoruk, Telavirak, and Kismilok Formations that together are more than 5,100 m thick. Tigara terrane inferred to be overlapped by Colville Basin deposits, including marine turbidite sandstone and mudstone that may be part of the Albian Fortress Mountain Formation. Tigara terrane resembles in part North Slope terrane, and in part Endicott Mountains terrane (Jones and others, 1987). Tigara terrane may extend offshore to at least part of the adjacent Herald Arch of the central Chukchi Sea. In western Brooks Range, terrane may be thrust over Cretaceous sedimentary rocks to east; in western Seward Peninsula, thrust over York terrane to east. Tigara terrane interpreted as a fragment of the displaced Paleozoic and early Mesozoic Arctic continental margin of North America. **REFERENCES**: Campbell, 1967; Martin, 1970; Jones and others, 1981, 1987; Murchey and others, 1988; Grantz and others, 1983, 1991; Moore and others, 1992

AM **Angayucham terrane (subduction zone - dominantly oceanic rocks)Ñ**Occurs in east- and west-central, and southwestern Alaska, along southern flank of Brooks Range, and in large klippen in western Brooks Range. Divided into lower (Slate Creek), middle (Narvak), and upper (Kanuti) thrust panels.

Lower (Slate Creek) thrust panelÑChiefly phyllonite, melange, and sedimentary broken formation. Sedimentary part consists mainly of thin-bedded, quartz-rich and chert-rich graywacke turbidites of continental derivation, chert, phyllite, slate. Local tectonic blocks of volcanic rocks, chert, limestone turbidite, chert-pebble conglomerate, and shallow marine clastic deposits. Contains palynomorphs, conodonts, radiolarians, brachiopods and plant fragments ranging in age from Devonian to Early Jurassic. Locally to pervasively deformed and metamorphosed to lower greenschist facies in Mesozoic time, particularly along northern margin where phyllonite is common. Slate Creek thrust panel includes both Prospect Creek, Slate Creek, and Venetie terranes of Grantz and others (1991) and Moore and others (1992); interpreted as a tectonic unit that separates structurally underlying, regionally metamorphosed and deformed rocks of Coldfoot, Endicott, Hammond Mountains, and Ruby terranes from overthrust oceanic rocks of Narvak thrust panel. **REFERENCES**: Jones and others, 1987; Murphy and Patton, 1988; Moore and Mull, 1989; Moore and Murphy, 1989; Patton and others, 1989, 1992; Dover, 1990; Grantz and others, 1991; Patton, 1992a, b; Moore and others, 1992.

Middle (Narvak) thrust panelÑ Chiefly structurally interleaved diabase, pillow basalt, tuff, chert, graywacke, argillite, minor limestone, and volcanogenic sandstone, conglomerate, and tuff. Locally abundant gabbro and diabase. Cherts range in age from Late Devonian to Early Jurassic. Limestones mainly Carboniferous. Devonian corals, brachiopods, and graptolites from shale and limestone beds in extreme eastern Alaska. Major accumulations of late Carboniferous and Late Triassic basaltic volcanism; however, many volcanic sequences are not yet well dated. Basalts interpreted as oceanic island or plateau basalt based on associated sedimentary facies and trace-element discriminant patterns. Includes Tozitna, Innoko, and Woodchopper Canyon terranes of Jones and others (1981, 1987) and Grantz and others (1991), and Rampart Group of east-central Alaska.

Narvak thrust panel structurally and stratigraphically complex; generally highly faulted and locally folded. Metamorphosed to greenschist facies and locally blueschist facies, as indicated by glaucophane, at base of thrust panel. Narvak thrust panel structurally overlies Coldfoot terrane to north and Ruby terrane to south; structurally overlain by Koyukuk terrane, and locally in southwestern Alaska, protolith forms stratigraphic basement to Koyukuk terrane. Narvak thrust panel depositionally overlain by Cretaceous clastic deposits of Yukon-Koyukuk Basin, and by Late Cretaceous and early Tertiary Yukon-Kanuti and Kuskokwim Mountains igneous belts. Narvak thrust panel interpreted as a subduction zone complex composed chiefly of oceanic crust and seamounts. Locally in southwestern Alaska, Narvak thrust panel may be stratigraphically overlain by rocks of Koyukuk terrane. **REFERENCES**: Brosg• and others, 1969; Murchey and Harris, 1985; Barker and others, 1988; Jones and others, 1988; Pallister and Carlson, 1988; Pallister and others, 1989; Patton and others, 1977, 1989, 1992; Patton, 1992a, b.

Upper (Kanuti) thrust panelÑ Chiefly serpentinized pyroxenite, harzburgite, dunite, wehrlite, and gabbro with cumulate and tectonic structures, and intrusive gabbro and diabase. Basal contact of ophiolite locally marked by amphibolite metamorphosed at the time of structural emplacement in the Middle Jurassic (Boak and others, 1987). Includes Misheguk Mountain terrane of Grantz and others (1991) and other isolated klippen of ultramafic and mafic rocks structurally overlying Narvak thrust panel. Kanuti thrust panel interpreted as part of an ophiolitic assemblage emplaced during Middle or Late Jurassic onto an apparently unrelated middle (Narvak) thrust panel of basalt and oceanic sedimentary rocks that constitute the root of an island arc, possibly the tectonically suprajacent Koyukuk terrane. **REFERENCES**: Patton and others, 1977, 1989; 1992; Wirth and others, 1986; Boak and others, 1987; Loney and Himmelberg, 1985, 1989; Mayfield and others, 1988; Karl, 1992; Patton, 1992a, b

AP **Aurora Peak terrane (continental margin arc)Ñ**Occurs in eastern and central Alaska Range and consists of Silurian through Triassic metasedimentary rocks, and Late Cretaceous and early Tertiary metagranitic rocks. Older metasedimentary rocks consist mainly of fine- to medium-grained and polydeformed calc-schist, marble, quartzite, and pelitic schist. One conodont fragment from marble indicates a Silurian to Triassic age. Protoliths for metasedimentary rocks include marl, quartzite, and shale. Correlated with Kluane Schist in southwest Yukon Territory. Younger metaplutonic sequence (unit Kpf) consists of regionally metamorphosed and penetratively deformed schistose quartz diorite with granodiorite, granite, and sparse amphibolite derived from gabbro and diorite. U-Pb zircon and Rb-Sr whole-rock isochron isotopic analyses of the metaplutonic rocks indicate emplacement ages of 71 and 74 Ma. Isotopic analysis of lead from samples of metagranitic rocks show moderate radiogenic values, and derivation from a source of about 1.2-Ga age.

Minimum structural thickness of terrane several thousand meters. Terrane is twice ductily metamorphosed and deformed. Core of terrane exhibits older, upper amphibolite facies metamorphism and associated mylonitic schist. Upper amphibolite facies metamorphism probably occurred during syntectonic intrusion of the Late Cretaceous metagranitic rocks. Margin of terrane exhibits younger middle greenschist facies metamorphism and formation of blastomylonite along an intense, younger schistosity. Younger greenschist facies minerals and younger intense schistosity occur mainly along the margins of the terrane, adjacent to bounding Denali and Nenana Glacier faults. Aurora Peak terrane interpreted as a displaced fragment of a North American continental-margin arc that was tectonically separated from the Kluane Schist and the Ruby Range batholith in southwestern Yukon Territory. **REFERENCES**: Brewer, 1982; Nokleberg and others, 1985, 1989a, 1992; Aleinikoff and others, 1987

BC **Behm Canal (metamorphic)Ñ**Occurs in eastern southeastern Alaska and consists of structurally interleaved thrust slices of Gravina-Nutzotin overlap assemblage, Alexander, Wrangellia, Stikinia, and Yukon-Tanana terranes, Alava sequence of Rubin and Saleeby (1991), Kah Shakes sequence of Saleeby and Rubin (1990) and Rubin and Saleeby (1991), and Ruth assemblage of McClelland and Gehrels (1990). Chiefly mica schist, granitic orthogneiss, calc-silicate rocks, siliceous paragneiss, minor marble and amphibolite. Alava sequence consists of crinoidal and argillaceous marble, carbonaceous phyllite, argillite, mafic flows, pillow breccia, tuff, and quartzite of late Paleozoic and Middle and Late Triassic age that are correlated by Rubin and Saleeby (1991) with rocks of the Stikinia terrane. Behm Canal terrane metamorphosed to greenschist- to amphibolite-facies in the Late Cretaceous and Early Tertiary, after accretion. Intruded by middle and Late Cretaceous granitic, gabbroic, and ultramafic rocks, and by Late Cretaceous and Early Tertiary intermediate plutonic rocks. Includes part of the former Taku terrane of Monger and Berg (1987). Locally structurally overlain by the lower Paleozoic Kah Shakes sequence and an early Paleozoic Behm Canal gneiss complex that are both interpreted as part of the Yukon Prong terrane in southeastern Alaska. Behm Canal terrane interpreted as a series of interleaved fault slices of various adjacent terranes. **REFERENCES**: Saleeby and Rubin, 1990; Rubin and Saleeby, 1991

BP **Broad Pass terrane (metamorphic)Ñ**Occurs in central Alaska Range as a structural melange composed chiefly of chert, argillite, phyllite, bedded tuff, limestone, and flysch including graywacke, argillite, and chert-pebble and polymictic conglomerate. Chert contains Late Devonian(?) to Mississippian radiolarians, and limestone blocks contain Silurian and Devonian fossils (Jones and others, 1980). Poorly exposed and structurally complex. One of several mini-terranes enclosed in highly-deformed flysch of the Kahiltna overlap assemblage. Broad Pass terrane interpreted as a structural melange of diverse metasedimentary rocks that formed during Cretaceous deformation of enclosing Kahiltna overlap assemblage. **REFERENCES**: Jones and others, 1982; Csejtey and others, 1992

Chugach terrane (accretionary wedge and subduction zone)Ñ Composite terrane in Chugach Mountains between Border Ranges and Contact faults in southern Alaska. In southern Alaska consists of: (1) a northern unit of blueschist and greenschist; (2) a central unit of McHugh Complex and correlative units; and (3) a southern unit of the Valdez Group and correlative units. These three units have counterparts in southeastern Alaska

Blueschist and greenschist (subduction zone, dominantly oceanic rocks)Ñ Chiefly narrow, fault-bounded units of blueschist and interlayered greenschist too small to depict on map (schists of Liberty Creek, Iceberg Lake, Seldovia, and Raspberry Strait). Blueschist and greenschist unit occurs in narrow, intensely-deformed, fault-bounded lenses mainly along northern or inboard margin of McHugh Complex and correlative units. Metamorphosed from blueschist to transitional greenschist-blueschist facies. Early Jurassic U-Pb sphene, Ar-Ar, and Rb-Sr mineral isochron metamorphic ages. Interlayered blueschist and greenschist units interpreted as discontinuous remnants of a subduction zone assemblage associated with formation of Jurassic Talkeetna arc to the north

CGM **McHugh Complex and correlative units (subduction zone, dominantly oceanic rocks)Ñ**Chiefly a Mesozoic subduction zone melange composed of mainly Late Triassic, Jurassic, and Early to mid-Cretaceous argillite, basalt, graywacke, radiolarian chert, and limestone, with sparse conglomerate, pillow basalt, mafic tuff, volcanic rocks, and plutonic rocks, and with exotic blocks of ultramafic rocks, and limestone. Includes McHugh and Uyak Complexes, Kelp Bay

Group, and unnamed chert and basalt of Kachemak Bay previously interpreted as the Kachemak terrane by Jones and others (1987). Some limestone blocks contain Permian Tethyan fusulinids. Metamorphosed from prehnite-pumpellyite to lower greenschist facies. McHugh Complex and correlative units intruded by Middle Cretaceous trondhjemite and by early and middle Tertiary granitic plutonic rocks in outcrops that are too small to depict on map. McHugh and correlative units interpreted as disrupted oceanic crust, sea mount, and (or) trench fill assemblages. Subduction linked to Early and middle Jurassic Talkeetna arc, and to Late Jurassic and Early Cretaceous Chitina and Chisana arcs to north

CGV **Valdez Group and correlative units (accretionary wedge - dominantly turbidites)Ñ**Chiefly an accretionary complex composed of Upper Cretaceous (Campanian to Maastrichtian) flysch, mainly graywacke and slate of Valdez Group, Kodiak and Shumagin Formations, Sitka Graywacke, and unnamed metamorphic equivalents. Sparse megafossils. Local thick metabasalt sequence along southern margin. Generally exhibits lower greenschist metamorphism. Complexly folded and faulted. Metamorphic grade increases to upper amphibolite facies in the informally named Chugach metamorphic complex of Hudson and Plafker (1982) in eastern Chugach Mountains. In this area, granitic intrusive rocks of Sanak Baranof plutonic belt (50-65 Ma), and associated aureoles of amphibolite facies metamorphism weld Chugach terrane to the adjacent northern Prince William terrane by early Eocene. Elsewhere locally, early Tertiary plutons are truncated by Contact fault between the Chugach and Prince William terranes. In southern Alaska, bounded to north by Border Ranges fault and Peninsular and Wrangellia terranes. Bounded to south and west by Contact fault and Prince William terrane. Valdez Group and correlative units interpreted as trench deposit derived from a Cretaceous magmatic arc to the north and east (present-day coordinates), and partly as an intraoceanic accreted primitive arc. **REFERENCES**: Connelly, 1978; Connelly and Moore, 1979; Decker and others, 1980; Hudson and Plafker, 1982; Johnson and Karl, 1985; Brew and others, 1988; Roeske and others, 1989; Plafker and others, 1989b; Sisson and others, 1989; Karl and others, 1990; Lull and Plafker, 1990; Bradley and Kusky, 1992; Nelson, 1992

CH **Chulitna terrane (ophiolite)Ñ**Occurs in central Alaska Range and consists of four major units: (1) Late Devonian ophiolite composed of serpentinite, gabbro, pillow basalt, and red radiolarian chert; and Mississippian chert; (2) Permian volcanic conglomerate, limestone, chert, and argillite; (3) Lower Triassic limestone; (4) Upper Triassic redbeds, including red sandstone, siltstone, argillite, and conglomerate, and pillow basalt, limestone, sandstone, and shale; and (5) Jurassic argillite, sandstone, and chert. Depositional contacts and (or) reworked clastic detritus form underlying rocks indicate a continuous stratigraphic sequence. Ammonites from Lower Triassic limestone show strong affinities with faunas from California, Nevada, and Idaho, but differ from assemblages in Canada. Terrane moderately to intensely folded and thrust-faulted and structurally overlies highly deformed upper Mesozoic argillite and graywacke of the Kahiltna overlap assemblage to west, and West Fork terrane to east. Chulitna terrane interpreted as an allochthonous fragment of an ophiolite and overlying igneous arc and sedimentary sequence. **REFERENCES**: Nichols and Silberling, 1979; Jones and others, 1980; Csejtey and others, 1992

CO **Coldfoot terrane (metamorphosed continental margin)Ñ**Occurs along southern margin of Brooks Range and consists of two major units: (1) a structurally high sequence Late Proterozoic(?) to Cambrian(?) quartz-mica schist, quartzite, mica schist, and minor metamorphosed felsic and mafic volcanic rocks; and (2) a structurally low sequence of calc-schist and marble with local Silurian and Devonian conodonts, and locally the Devonian Ambler sequence forms in central and western Brooks Range composed of metamorphosed rhyolite and basalt volcanic flows, tuff, and breccia with stratiform massive sulfide deposits interlayered with chlorite schist, marble, calcschist, and graphitic schist. Terrane contains local metagabbro and metadiabase dikes and sills of middle Paleozoic(?) age. In central Brooks Range younger unit exposed in local structural windows beneath older unit. Terrane locally intruded by Devonian and Late Proterozoic granitic plutons metamorphosed to orthogneiss. Terrane informally named the *schist belt*.

Polymetamorphosed and deformed in Late Mesozoic and older(?) time. Terrane exhibits relict regional Mesozoic blueschist facies minerals overprinted by pervasive lower to middle greenschist facies minerals. Local areas of Late Proterozoic(?) amphibolite facies metamorphism. Local intense retrogressive metamorphism and deformation with formation of phyllonite at structural top adjacent to structurally overlying Angayucham terrane. Structurally overlies Hammond terrane to north, structurally overlain by Angayucham terrane to south. Coldfoot terrane correlated with Seward terrane to southwest. Coldfoot terrane interpreted as an intensely metamorphosed and deformed, displaced fragment of the North American craton margin. **REFERENCES**: Armstrong and others, 1986; Hitzman and others, 1982; Till and others, 1988; Dillon, 1989; Karl and others, 1989; Moore and Mull, 1989; Gottschalk, 1990; Karl and Aleinikoff, 1990; Moore and others, 1992; Patton and others, 1992

CW **Clearwater terrane (island arc)Ñ**Occurs in east-central Alaska and consists of a structurally complex assemblage of argillite, greenstone (pillow basalt), marble derived from shallow-water limestone, and metarhyolite. Marble contains Late Triassic (late

Norian) fossils. Contains fault-bounded pluton of Cretaceous(?) granodiorite. Weakly metamorphosed and penetratively deformed at lower greenschist facies. Terrane occurs as a narrow fault-bounded lens along Broxson Gulch thrust between Maclaren terrane to north and Wrangellia terrane to south. Because of the assemblage of basalt and rhyolite volcanic rocks, and shallow-water sedimentary rocks, Clearwater terrane interpreted as a shallow-level fragment of an island arc. **REFERENCES**: Nokleberg and others, 1985, 1989a, 1992; Csejtey and others, 1992

CZ **Crazy Mountains terrane (passive continental margin)Ñ**Occurs in east-central Alaska in two displaced fragments and consists of two major sequences: (1) maroon and green slate, and grit, and black limestone with floating quartz grains with trace fossil *Oldhamia* of probable Cambrian age in slate; and (2) younger sequence of Early Devonian or older mafic volcanic rocks, agglomerate, chert, and clastic rocks, fossiliferous Lower to Middle Devonian limestone, and Upper Devonian chert-pebble conglomerate. Crazy Mountains terrane interpreted as a displaced fragment of the early Paleozoic continental margin of North America. **REFERENCES**: Churkin and others, 1982; Dover, 1990

DL **Dillinger terrane (passive continental margin)Ñ**Occurs as a major unit in west-central Alaska, south of Denali fault, and in a smaller fragment along branches of the fault. Within branches of fault, terrane composed mainly of lower and middle Paleozoic carbonate and lesser clastic rocks that consist of: (1) Cambrian and Ordovician basinal limestone, banded mudstone, and silty limestone turbidites; and (2) Upper Silurian through Middle Devonian, unnamed, shallow-water limestone and dolomite. Structurally and (or) stratigraphically overlain by Mystic terrane. Unconformably overlain by Upper Cretaceous Kuskokwim Group. Stratigraphic column for area within branches of Denali fault. South of Denali fault, terrane consists chiefly of: (1) Cambrian(?) to Ordovician calcareous turbidite, shale, and minor greenstone; (2) Lower Ordovician to Lower Silurian graptolitic black shale and chert; (3) Lower to Middle Silurian laminated limestone and graptolitic black shale; (4) Middle to Upper Silurian sandstone turbidites and shale; and (5) Upper Silurian to Lower Devonian limestone, limestone, breccia, sandstone, and shale. Dextrally offset along Denali fault in southwestern Alaska Range; locally structurally and possibly stratigraphically overlain by Mystic terrane. Complexly folded and faulted. Interpreted as lower to middle Paleozoic, basinal facies equivalent to lower and middle Paleozoic rocks of Nixon Fork terrane. Dillinger terrane interpreted by R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr. (written commun., 1991), along with Minchumina, Mystic, and Nixon Fork terranes, as part of the larger, composite Farewell terrane. Dillinger terrane interpreted as a displaced fragment of the Paleozoic and early Mesozoic continental margin of North America. **REFERENCES**: Jones and others, 1982; Bundtzen and Gilbert, 1983; Gilbert and Bundtzen, 1984; Blodgett and Clough, 1985; R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr., written commun., 1991

GD **Goodnews terrane (subduction zone - dominantly oceanic rocks)Ñ**Occurs in southwestern Alaska and consists of a disrupted assemblage of pillow basalt, diabase, gabbro, chert, argillite, minor limestone, volcanogenic sandstone, and ultramafic rocks. Ordovician, Devonian, Mississippian, Permian, and Triassic fossils in limestones. Mississippian, Triassic, and Jurassic fossils in cherts. Metamorphic grade of terrane ranges from prehnite-pumpellyite to greenschist to blueschist facies. Blueschist facies minerals occur in two geographically separated belts. Southern belt, south of Goodnews Bay, intruded by pre-186 Ma diorite to gabbro plutons, yields Late Triassic K-Ar blue amphibole age. Northern belt, near Kilbuck terrane, is structurally adjacent to greenschist facies unit that yields Late Jurassic K-Ar amphibole age. Goodnews terrane unconformably overlain by Lower Cretaceous marine sandstone and conglomerate derived from Kilbuck and Togiak terranes, and by Upper Cretaceous sedimentary rocks of Kuskokwim Group, and intruded by Late Cretaceous and early Tertiary plutonic rocks of Kuskokwim Mountains plutonic belt. Goodnews terrane interpreted as subduction zone complex for the Togiak island arc terrane. **REFERENCES**: Hoare and Coonrad, 1978; Murphy, 1987; Box, 1985a, b; Box and others, 1992; Dusel-Bacon and others, 1992; Patton and others, 1992

KI **Kilbuck-Idono terrane (cratonal)Ñ**Occurs in two fault-bounded fragments about 330 km apart in southwestern and west-central Alaska. Chiefly metamorphosed diorite, tonalite, trondhjemite, and granite orthogneiss, subordinate amphibolite, and minor metasedimentary rocks, mainly quartz-mica schist, marble, and garnet amphibolite of the informally named Kanektok metamorphic complex of Hoare and Coonrad (1979). Metaplutonic rocks yield Early Proterozoic (2.06 to 2.07 Ga) U-Pb zircon ages of emplacement. Nd-Sm isotopic analyses indicate 2.5 Ga (Archean) crustal component. Terrane metamorphosed to amphibolite facies with retrograde greenschist facies metamorphism, possibly in Late Mesozoic. Southern fragment constitutes Kilbuck terrane of Box and others (1990); northern fragment constitutes Idono Complex of Miller and others (1991). Unconformably overlain by Upper Cretaceous sedimentary rocks of Kuskokwim Group. Kilbuck-Idono terrane interpreted as highly-displaced cratonal fragment; no known correlative cratonal rocks in North America. Possibly displaced from North Asian craton. **REFERENCES**: Hoare and

Coonrad, 1978, 1979; Turner and others, 1983; Box and others, 1990; Miller and others, 1991

KY **Koyukuk terrane (island arc)Ñ**Occurs in northern and southern sequences within Yukon-Koyukuk basin in west-central Alaska. Northern sequence, north of Kaltag fault, chiefly basalt, voluminous Lower Cretaceous (Neocomian) andesite flows, tuff, breccia, conglomerate, tuffaceous graywacke, mudstone, and bioclastic limestone. Fossil and isotopic ages of Late Jurassic through Early Cretaceous (Berriassian to Aptian). Southern sequence, south of Kaltag fault, consists of Middle and Late Jurassic tonalite and trondhjemite plutonic rocks that intrude Angayucham terrane basement of Koyukuk terrane. Upper Jurassic to Lower Cretaceous volcanic and related rocks associated with, and unconformably overlie tonalite-trondhjemite plutonic rocks and locally an older suite of units, similar to Angayucham terrane, with microfossil ages that range from Pennsylvanian to Triassic. Volcanic and plutonic rocks constitute Middle Jurassic to Early Cretaceous Koyukuk arc. Terrane is depositionally overlain by Lower Cretaceous marine sedimentary rocks of Yukon-Koyukuk basin, and by volcanic rocks of Yukon-Kanuti igneous belt. Terrane structurally underlain by Angayucham terrane. Koyukuk terrane and nearby Nyac and Togiak terranes are interpreted as a group of broadly coeval Jurassic and Early Cretaceous island arc terranes. **REFERENCES**: Patton, 1973; Box and Patton, 1989; Patton and others, 1989; Patton, 1991

LG **Livengood terrane (oceanic crust)Ñ**Occurs in east-central Alaska and consists of a structurally deformed and poorly-exposed assemblage of: (1) serpentinized harzburgite, minor dunite, and Cambrian diabase, gabbro, and diorite; (2) Ordovician ribbon chert with graptolitic shale (Livengood Dome Chert); (3) undated (Silurian(?) to Late Proterozoic(?)) silicified dolomite with lesser chert, limestone, argillite, basalt, and volcaniclastic rocks (Amy Creek and Lost Creek units); and (4) Late Silurian limestone debris flows interbedded within siliciclastic strata; and (5) unconformably overlying Middle Devonian turbidites composed of conglomerate with clasts of mafic and ultramafic rocks, and sandstone and mudstone with minor limestone. (Cascaden Ridge unit). Terrane occurs as one of several, narrow, east-northeast trending terranes in region. Faulted against Crazy Mountains, Ruby, and Angayucham terranes to northwest. Thrust under Manley terrane to southeast. Livengood terrane interpreted as a fragment of a Cambrian ophiolite and oceanic crust with overlying Cambrian to Silurian pelagic and continental rise and slope deposits, and Devonian turbidite deposits. **REFERENCES**: Churkin and others, 1980; Weber and others, 1985; Jones and others, 1986; Loney and Himmelberg, 1988; Dover, 1990; Grantz and others, 1991; Blodgett 1992; Blodgett and others, 1988; Weber and others, 1992

MA **Manley terrane (turbidite basin)Ñ**Occurs in east-central Alaska as three distinct flysch sequences: (1) Upper Triassic or Upper Jurassic unfossiliferous, carbonaceous, slate, argillite, phyllite with sparse chert- and quartzite-pebble conglomerate, and minor chert intruded by gabbro (Vrain unit); (2) Upper Jurassic to Lower Cretaceous quartzite and pebble conglomerate (Wolverine unit); and (3) Albian and Upper Cretaceous shale, siltstone, graywacke, and polymictic conglomerate (Wilber Creek unit) probably derived from a magmatic arc and from sedimentary and volcanic rocks of White Mountains and Livengood terranes. Intruded by mid-Cretaceous granitic rocks. Terrane structurally overlies Livengood terrane and structurally overlain by White Mountains terrane. Manley terrane interpreted as displaced fragment of a Mesozoic overlap assemblage, possibly originally deposited on Livengood terrane. Possible offset equivalent of Kandik River overlap assemblage. **REFERENCES**: Jones and others, 1981, 1986; Weber and others, 1985, 1988; Gergen and others, 1988; Dover, 1990; Grantz and others, 1991

MK **McKinley terrane (sea mount)Ñ**Occurs between branches of Denali fault in central Alaska Range and consists chiefly of a strongly folded and faulted structural complex assemblage of: (1) fine-grained Permian flysch, mainly graywacke, argillite, and minor chert; (2) Triassic chert; (3) a thick sequence of Upper Triassic (Norian) pillow basalt; (4) Upper Jurassic(?) to Cretaceous flysch, mainly graywacke, argillite, minor conglomerate and chert; and (5) Late Jurassic(?) to Cretaceous gabbro and diabase. Also included are Mississippian to Upper Triassic chert (Red Paint subterrane) that is thrust over, and folded with the upper Mesozoic flysch. McKinley terrane interpreted as a fragment upper Paleozoic deep-sea sedimentary rocks and one or more Late Triassic seamounts. One of several terranes in tectonic lenses along Denali fault. **REFERENCES**: Jones and others, 1981, 1982, 1987; Gilbert and others, 1984

ML **Maclaren terrane (continental margin arc)Ñ**Occurs in a narrow, east-west-striking lens between the Denali fault and the Broxson Gulch thrust in eastern Alaska Range. Consists of Maclaren Glacier metamorphic belt to the south and East Susitna batholith to the north. Maclaren Glacier metamorphic belt contains three fault-bounded sequences of: (1) Upper Jurassic or older argillite, flysch, and sparse andesite and marble; (2) phyllite and metagraywacke; and (3) pelitic schist and amphibolite. Protolith for Maclaren Glacier metamorphic belt may be older part of Kahiltna ovrlap assemblage. Progressively metamorphosed from lower greenschist facies to upper amphibolite facies. Higher metamorphic-grade units, adjacent to East Susitna batholith, structurally overlie lower-grade units to south. East Susitna batholith (unit TKpi) chiefly mid-Cretaceous to early Tertiary regionally metamorphosed and penetratively deformed granitic plutonic rocks.

Maclaren terrane also includes Nenana terrane of Jones and others (1981, 1987). Maclaren terrane thrust over Wrangellia terrane to south and interpreted as a offset fragment of Cretaceous continental-margin arc formed in southeastern Alaska and southwestern Yukon Territory (Kluane Schist and Ruby Range batholith). **REFERENCES**: Smith, 1981; Nokleberg and others, 1985, 1989a, 1992; Csejtey and others, 1992; Davidson and others, 1992

MN **Minchumina terrane (passive continental margin)Ñ**Occurs in central Alaska and consists of a complexly folded assemblage of: (1) Cambrian(?) limestone, dolomite, phyllite, and argillite; (2) Ordovician argillite, quartzite, grit, and chert; (3) Ordovician chert, argillite, shaley limestone, and siliceous siltstone; and (4) Middle to Upper Devonian limestone and dolomite. Minchumina terrane interpreted by R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr., written commun. (1991), along with Mystic, and Nixon Fork terranes, as part of the composite Farewell terrane. Minchumina terrane designated as separate terrane by Patton and others (1989) and in this study, and interpreted as a sequence of deep-water deposits that formed along a continental margin adjacent to the lower Paleozoic platform carbonate rocks of the Nixon Fork terrane to west. Both terranes interpreted as displaced fragments of the Paleozoic and early Mesozoic continental margin of North American. **REFERENCES**: Jones and others, 1981; Patton and others, 1989; R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr., written commun., 1991

MNK **Minook terrane (turbidite basin)Ñ**Occurs in east-central Alaska and consists chiefly of flysch composed conglomerate, sandstone, siltstone, and shale. Conglomerate consists mainly of chert pebble and lesser quartz, slate, and sandstone fragments in a sandy and locally calcareous matrix. Shales contain rare thin argillaceous sandstone and siltstone layers. Early Permian(?) megafossils. Moderately to intensely folded and occurs as east-northeast-trending lens structurally adjacent to Ruby, Livengood, and Manley terranes. Origin of Minook terrane uncertain; may be a fragment of the Nixon Fork, Angayucham, or Tozitna terranes. **REFERENCES**: Chapman and others, 1971; Jones and others, 1981; Dover, 1990; Grantz and others, 1991

MY **Mystic terrane (passive continental margin)Ñ**Occurs in central Alaska, mainly south of Denali fault and consists of a complexly deformed, but partly coherent, long-lived stratigraphic succession of: (1) Ordovician graptolitic shale and associated(?) pillow basalt; (2) Silurian massive limestone; (3) Upper Devonian sandstone, shale, conglomerate, and limestone (informally-named Yentna limestone of Fernette and Cleveland (1984)); (4) uppermost Devonian to Pennsylvanian radiolarian chert; (5) Pennsylvanian siltstone, sandstone, and conglomerate; (6) Pennsylvanian(?) and Permian flysch, chert, argillite, and conglomerate (locally plant bearing); and (7) Triassic(?) pillow basalt and gabbro. Terrane structurally and possibly locally stratigraphically underlain by rocks of Dillinger terrane. Pre-Devonian rocks assigned in part to Dillinger terrane (Gilbert and Bundtzen, 1984; Blodgett and Gilbert, 1992). Mystic terrane interpreted by R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr. (written commun., 1991), along with Dillinger, Minchumina, and Nixon Fork terranes, as part of the composite Farewell terrane. Mystic terrane interpreted as a displaced fragment of the Paleozoic and early Mesozoic continental margin of North America. **REFERENCES**: Reed and Nelson, 1980; Gilbert and Bundtzen, 1984; Blodgett and Gilbert, 1992; R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr., written commun., 1991

NX **Nixon Fork terrane (passive continental margin)Ñ**Occurs in several fault-bounded fragments in central and west-central Alaska and consists of a long-lived stratigraphic succession of: (1) Late Precambrian basement of mainly pelitic and calcareous schists with minor marble, quartzite, and felsic metavolcanic rocks; (2) overlying unmetamorphosed sedimentary rocks consisting of dolograinstone and laminated dolomudstone; (3) overlying unmetamorphosed sedimentary rocks of probable Late Proterozoic age consisting of two units (interbedded sandstone, siltstone, and carbonate), and two dolostone units (Babcock and others, 1993); (4) Middle Cambrian limestone and chert; (5) Upper Cambrian to Lower Ordovician platy limestone (possibly part lower part of Novi Mountain Formation); (6) Lower Ordovician thick and platy limestone (Novi Mountain Formation); (7) Ordovician to Middle Devonian carbonate platform rocks (Telsitna, Paradise Fork, and Whirlwind Creek Formations, and Cheeneetnuk Limestone (R.B. Blodgett, written commun., 1993); and (7) Permian, Triassic, and Cretaceous fossiliferous sedimentary rocks, mainly calcareous sandstone, siltstone, conglomerate, and sparse chert. Proterozoic stratified rocks intruded by Middle Proterozoic metagranitic rocks with U-Pb zircon age of 1.27 Ga, and capped by Late Proterozoic metavolcanic rocks with U-Pb zircon age of 850 Ma. Middle Paleozoic strata grade laterally into deep-water strata equivalent to Dillinger terrane. Permian strata contain clasts of basement rocks.

Nixon Fork terrane is stratigraphically overlain by unnamed Triassic and Lower Cretaceous clastic rocks and by Upper Cretaceous Kuskokwim Group, and locally structurally overlain by Angayucham terrane. Nixon Fork terrane interpreted by R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr., written commun. (1991), along with Dillinger, Minchumina, and Mystic terranes, as part of the larger, composite Farewell terrane. Nixon Fork terrane is designated as separate terrane by Patton and others (1989) and in this study; interpreted as one of several displaced fragments of the Paleozoic and early Mesozoic continental margin of North America. **REFERENCES**: Patton and others, 1980, 1989, Blodgett and Gilbert, 1983; Blodgett and Clough, 1985; Clough and Blodgett, 1985; Palmer and others, 1985; R.B. Blodgett, T.K. Bundtzen, and J.B. Decker, Jr. written commun., 1991; Babcock and Blodgett, 1992

NY **Nyac terrane (island arc)Ñ**Occurs in southwest Alaska and consists chiefly of andesite and basalt flows, breccia, tuff, and interbedded shallow-marine volcaniclastic rocks with Middle and Late Jurassic (Bajocian and Tithonian) fossils. Terrane intruded by Early Cretaceous gabbroic and granitic rocks and depositionally overlain by Late Cretaceous and early Tertiary volcanic rocks of the Kuskokwim Mountains igneous belt. Nyac and nearby Koyukuk and Togiak terranes are interpreted as a group of several broadly coeval Jurassic and Early Cretaceous island arc terranes. **REFERENCES**: Hoare and Coonrad, 1978; Box, 1985a, b; Box and others, 1992

PC **Porcupine terrane (passive continental margin)Ñ**Occurs in northern east-central Alaska and consists of a long-lived stratigraphic succession of: (1) Precambrian (Proterozoic?) phyllite, slate, quartzite, marble, greenstone (metabasalt) rocks; (2) thick, structurally and stratigraphically complex assemblage of Cambrian(?) to Upper Devonian shallow-water limestone, dolomite, and minor chert minor shale (including Salmontrout Limestone); (3) upper Paleozoic sandstone, siltstone, argillite, massive quartzite, conglomerate, and minor limestone; and (4) Permian Step Conglomerate. Jurassic ammonite-bearing strata occur in two places in the northern part of the terrane. Terrane thrust over Kandik River assemblage to southeast, locally overthrust by Angayucham terrane, and depositionally overlain by now faulted Kandik River assemblage. Porcupine terrane interpreted as a displaced fragment of the Paleozoic and Mesozoic continental margin of North America. **REFERENCES**: Brosg• and Reiser, 1969; Imlay and Detterman, 1973; Howell and Wiley, 1987; Howell and others, 1992; Lane and Ormistron, 1979

PN **Pingston terrane (turbidite basin)Ñ**Occurs in discontinuous, narrow, fault-bounded lenses along Denali fault in central Alaska Range. Chiefly a weakly metamorphosed, strongly folded, and faulted sequence of: (1) Early Pennsylvanian and Permian phyllite, minor marble, and chert; (2) Upper Triassic thin-bedded, laminated dark limestone, black sooty shale, calcareous siltstone, and minor quartzite; and (3) locally numerous bodies of post-Late Triassic gabbro, diabase, and diorite. Terrane contains a single slaty cleavage that parallels axial planes of locally abundant isoclinal folds. Terrane also occurs in a small lens of thin-bedded dark limestone, sooty shale, and minor quartzite in eastern Alaska Range (W.J. Nokleberg and D.H. Richter, unpub. data, 1987). Most widespread, Upper Triassic part of terrane interpreted as a turbidite-apron sequence deposited from deep-water turbidity currents that flowed from a cratonal source, such as the Yukon-Tanana terrane to the north, onto upper Paleozoic continental slope-rise deposits. **REFERENCES**: Jones and others, 1981, 1982; Gilbert and others, 1984

PW **Prince William terrane (accretionary wedge - dominantly turbidites)Ñ**Occurs in southern Alaska and consists chiefly of a complexly folded and faulted, thick assemblage of graywacke, argillite, minor conglomerate, pillow basalt, and basaltic tuff, sills, and dikes, and ultramafic rocks (Orca Group, Sitkalidak Formation, and Ghost Rocks Formation). Includes Late Cretaceous and early Tertiary Ghost Rocks terrane of Jones and others (1987). Rare mega- and microfossils of Paleocene and Eocene age

Terrane bounded to north by Contact fault and Chugach terrane, to south by Aleutian megathrust or late Cenozoic accretionary prism, and to east by Yakutat terrane. In central and western parts of Prince William Sound, large areas occur without fossil control on either side of Contact fault that in this area may be a gradational accretionary zone. Sandstone petrologic studies indicate local gradational contact between Prince William and Chugach terranes (Dumoulin, 1987, 1988). In eastern part of Prince William Sound, east of Valdez and Cordova, singly deformed Orca Group of Prince William terrane is thrust under doubly-deformed and metamorphosed rocks of Valdez Group of southern Chugach terrane (Plafker and others, 1989b).

One early Tertiary granitic pluton of Sanak-Baranof plutonic belt (50-65 Ma) and local adjacent amphibolite facies metamorphism welds the northern Prince William terrane to the southern Chugach terrane. Early Tertiary zeolite to greenschist facies metamorphism. Local ophiolite exposed on Resurrection Peninsula and on Knight Island; interpreted as slabs of oceanic basement. Prince William terrane overlain by assemblages of marine clastic rocks and local continental coal-bearing rocks of post-middle Eocene age. Prince William terrane interpreted as early Tertiary oceanic lithosphere, seamounts, and deep-sea fan assemblage that was tectonically imbricated into an extensive accretionary wedge complex. **REFERENCES**: Tysdal and Case (1979), Moore and others, 1983; Nelson and others, 1985; Dumoulin, 1987, 1988; Plafker and others, 1989b; Nelson, 1992

RB **Ruby terrane (metamorphosed continental margin)Ñ**Occurs in northern west-central Alaska and consists chiefly of a structurally complex assemblage of quartz-mica schist, quartzite, calcareous schist, mafic greenschist (metabasalt), quartz-feldspar schist and gneiss, and marble. Sparse Silurian and Devonian fossils occur in metasedimentary rocks. Local granitic gneiss with Devonian and Early Cretaceous U-Pb zircon age. Generally metamorphosed to greenschist facies and local amphibolite faces, with sparse relict blueschist facies metamorphic minerals. Ruby terrane is overthrust by Angayucham terrane, is unconformably overlain by Lower Cretaceous sedimentary rocks of Yukon-Koyukuk basin and by Upper Cretaceous Kuskokwim Group, and is extensively intruded by mid-Cretaceous granitic plutons. Ruby terrane interpreted as a highly metamorphosed and deformed, displaced fragment of the North American craton margin. **REFERENCES**: Patton and others, 1987, 1989

SD **Seward terrane (metamorphosed continental margin)Ñ**Occurs on Seward Peninsula in western Alaska and consists chiefly of a structurally complex assemblage of mica schist, micaceous calc-schist, metavolcanic rocks, and carbonate rocks. Consists of informally-named Nome Group composed of pelitic schist, marble, quartz-graphite schist, and mafic schist (rift-related metabasalt, calc-schist, and chlorite-albite schist). Metasedimentary rocks contain Cambrian through Silurian conodonts and megafossils. Part of terrane may be Proterozoic in age. Associated carbonate rocks occur in poorly-exposed area in eastern part of terrane and range in age from Lower Cambrian to Middle Devonian. Regionally metamorphosed at blueschist facies, and retrograded to greenschist facies. Penetratively deformed. Terrane includes a small pluton (informally named Kiwalik Mountain orthogneiss of A.B. Till and J.A. Dumoulin, written commun., 1991) that yields U-Pb zircon age of 381 Ma. Central part of terrane consists mainly of Kigluaik Group that contains: (1) upper unit of pelitic and calcareous schist, marble, and lesser amphibolite and quartz-graphite schist metamorphosed up to upper amphibolite facies, and interpreted as a higher-grade counterpart of the Nome Group; and (2) lower unit of marble gneiss, mixed gneiss, and gneissic granitic rocks, metamorphosed up to granulite facies. Locally intruded by large Cretaceous plutons. Correlated with Coldfoot terrane to northeast. Seward terrane interpreted as a highly metamorphosed and deformed, displaced fragment of the North American craton margin. **REFERENCES**: Armstrong and others, 1986; Hudson, 1977; A.B. Till and J.A. Dumoulin, written commun., 1991; Patton and others, 1992

SM **Seventymile terrane (subduction zone - dominantly oceanic rocks)Ñ**Occurs in east-central Alaska as scattered remnants of three highly-deformed and locally folded thrust sheets. Structurally overlies Yukon-Tanana and Stikinia terranes.

Lower thrust sheet composed chiefly structural melange of undated metasandstone, metagraywacke, and metaconglomerate, and metaandesite. Pervasively metamorphosed to lower greenschist facies in Mesozoic time. Lower thrust sheet interpreted as a fragment of an island arc.

Middle thrust sheet composed chiefly structural melange of pillow basalt, basalt, mafic tuff, chert, argillite, and limestone. Cherts and limestones contain Mississippian, Permian, and Late Triassic radiolarians or conodonts. Locally, limestone contains assemblage of giant *Parafusulina,* indicating tropical depositional environment (C.S. Stevens, written commun. to D.G. Howell, 1990) that also occurs in similar oceanic and (or) ophiolite terranes in the Canadian Cordillera, Klamath Mountains, and northwest Mexico. Pervasively metamorphosed to lower greenschist facies in Mesozoic time. Sparse relict glaucophane in pillow basalt. Middle thrust sheep interpreted as subduction zone melange of late Paleozoic and early Mesozoic oceanic crust and sea mounts.

Upper thrust sheet composed chiefly harzburgite, peridotite, and minor clinopyroxenite, and gabbro, and diabase with local amphibolite sole. Upper thrust sheet interpreted as possible roots to a Jurassic(?) island arc. Lower and middle thrust sheets pervasively metamorphosed to lower greenschist facies in Mesozoic time. **REFERENCES**: Keith and others, 1981; Foster and others, 1987

ST(?) **Stikinia(?) terrane - east-central Alaska (island arc)Ñ-**Occurs in eastern east-central Alaska and consists chiefly of metasedimentary rocks intruded by large Late Triassic to Early Jurassic granitic plutons of Taylor Mountain batholith. Metasedimentary rocks mainly biotite-hornblende gneiss, marble, amphibolite, quartzite, pelitic schist, quartz-feldspar schist, and metachert. Protoliths of metasedimentary rocks interpreted as forming in an oceanic or marginal basin. Stikinia(?) terrane intensely deformed. and metamorphosed to amphibolite and epidote-amphibolite facies at high temperatures and pressures, with local kyanite, during Early to Middle Jurassic. Structurally overlies Yukon-Tanana terrane and is structurally overlain by Seventymile terrane. Stikinia(?) terrane interpreted as part of an extensive early Mesozoic oceanic igneous arc. **REFERENCES**: Foster and others, 1987; Dusel-Bacon and Hansen, 1992

ST **Stikinia terrane - southeastern Alaska (island arc)Ñ**Occurs in southern southeastern Alaska and consists of: (1) basal sequence consists of Late Proterozoic(?), Devonian(?), Carboniferous, and Permian andesitic, basaltic, and minor rhyolitic volcanic and volcaniclastic rocks with interbedded marine limestone and clastic sedimentary rocks; and (2) Upper Triassic to Upper Jurassic marine sedimentary clastic rocks, minor limestone, and various volcanic rocks (Hazelton and Stuhini Formations of Souther (1971) and Anderson (1989) that are locally intruded by Late Triassic and Early Jurassic granitic rocks, and by middle Tertiary intermediate plutonic rocks. Stikinia terrane is interpreted as occurring structurally or stratigraphically above Yukon-Tanana terrane. Stikinia terrane interpreted as part of an extensive early Mesozoic oceanic igneous arc. **REFERENCES**: Monger and Berg, 1987; Monger and others, 1982; Bevier and Anderson, 1991; Evenchick, 1991

SU **Susitna terrane (sea mount)Ñ**Occurs in northern part of the Talkeetna Mountains and consists of thick piles of pillow basalt, deep-marine tuffaceous sedimentary rocks, sandstone, and tuff. Late Triassic (Norian) *Monotis subcircularis* and *Heterastridium* sp. locally abundant in argillite interbedded with volcanic rocks. Terrane forms rootless nappe in highly-deformed Mesozoic flysch of the Kahiltna overlap assemblage. The upper contact of basalt with flysch originally may have been depositional, but relations now obscured by subsequent shearing along the contact. Susitna terrane interpreted as possible fragment of an oceanic seamount and (or) fragment of the Peninsular terrane, possibly lithologically equivalent to the Cottonwood Bay or Chilikadrotna Greenstones, that was tectonically decoupled from its basement and faulted into the Kahiltna overlap assemblage of flysch during the mid- or Late Cretaceous. **REFERENCES**: Jones and others, 1980, 1982

SW **Southern Wrangellia terrane (island arc)Ñ**Occurs in southern Alaska along southern margin of Wrangellia terrane and consists mainly of two sequences: (1). Older sequence composed of a fault-bounded assemblage of generally highly-deformed and metamorphosed sedimentary and volcanic rocks of late Paleozoic and older age (stratified part of metamorphic complex of Gulkana River and Strelna Metamorphics of Plafker and others (1989b)). Metasedimentary and metavolcanic rocks mainly chlorite schist derived from andesite, metabasalt, metatuff, calc-schist, pelitic schist, metachert, and marble that locally contains Early Pennsylvanian conodonts. (2) Younger sequence composed of metamorphosed and deformed late Paleozoic and Late Jurassic metaplutonic rocks (plutonic part of metamorphic complex of Gulkana River and Uranatina River metaplutonic unit and Chitina Valley batholith of Plafker and others (1989b)). Paleozoic metaplutonic rocks, with U-Pb ages of 308 to 312 Ma, consist of schistose hornblende diorite and gabbro, metagranodiorite, metagranite, and orthogneiss. Late Jurassic metaplutonic rocks, with an U-Pb zircon age of 153 Ma, consist mainly of hornblende diorite and tonalite. Southern Wrangellia terrane generally intensely deformed and regionally metamorphosed from greenschist facies to amphibolite facies near metaplutonic rocks. Local mylonite zones occur adjacent to, and within syntectonic Late Jurassic metaplutonic rocks.

Southern Wrangellia terrane locally structurally overlain or underlain by greenstone and Upper Triassic carbonate sequence inferred to be equivalent of Upper Triassic strata that characterize the Nikolai Greenstone, and Chitistone and Nizina Limestones of the Wrangellia terrane. Late Paleozoic part of terrane interpreted as part of late Paleozoic Skolai arc of Wrangellia terrane. Late Jurassic metaplutonic rocks constitute part of Chitina arc. Southern Wrangellia terrane locally occurs as moderate-size klippen thrust onto northern Chugach terrane during mid-Cretaceous faulting along Border Ranges fault. Southern Wrangellia terrane interpreted either as: (1) a deeper and more metamorphosed equivalent of the Wrangellia terrane to the north; or (2) as a distinct terrane structurally juxtaposed between the Wrangellia terrane to north and Peninsular terrane to south. Equivalent to Strelna terrane of Grantz and others (1991). **REFERENCES**: Plafker and others, 1989b; Nokleberg and others, 1989b; Grantz and others, 1991

TG **Togiak terrane (island arc)Ñ**Occurs in southwestern Alaska and consists of two major sequences: (1) lower ophiolite sequence of Late Triassic mid-ocean-ridge pillow basalt, diabase, gabbro, and ultramafic rocks at southwestern end of unit; and (2) coherent upper stratigraphic sequence of Lower Jurassic to Lower Cretaceous marine volcaniclastic sandstone, conglomerate, shale, tuffaceous chert, and minor argillaceous limestone, and marine to non-marine andesite and basalt flows and flow breccia, and tuff. Depositionally overlain by Upper Cretaceous marine sedimentary rocks of Kuskokwim Group, and by volcanic and plutonic rocks of Kuskokwim Mountains igneous belt. Togiak terrane may depositionally overly Tikchik terrane at northeastern end of unit. Togiak and nearby Koyukuk and Nyac terranes interpreted as a group of broadly coeval Jurassic and Early Cretaceous island arc terranes. **REFERENCES**: Hoare and Coonrad, 1978; Box, 1985a, b; Box and others, 1992

TK **Tikchik terrane (island arc)Ñ**Occurs in southwestern Alaska as structurally complex assemblage of andesite, dacite, and rhyolite volcanic rocks, volcaniclastic rocks, chert, tuffaceous chert, chert-clast sandstone, limestone, dolomite, and argillite that contain microfossils of pre-Late Devonian, Devonian, Mississippian, Permian, and Triassic age. Tikchik terrane depositionally overlain by Upper Cretaceous marine sedimentary rocks of Kuskokwim Group, and intruded by Late Cretaceous to early Tertiary plutonic rocks of Kuskokwim Mountains igneous belt. Tikchik terrane interpreted as possible depositional basement to Togiak (island arc) terrane. **REFERENCES**: Hoare and Coonrad, 1978; Hoare and Jones, 1981; Box, 1985a, b; Box and others, 1992

UM **Ultramafic and associated rocks (oceanic crust?)Ñ**Occurs as narrow, fault-bounded, near-vertical prisms and sparse klippen discontinuously exposed for several hundred kilometers along the Denali fault in the eastern and central Alaska Range. Ultramafic rocks (Mesozoic?) mainly fine- to medium-grained pyroxenite and peridotite, and fine-grained dunite and are largely altered to serpentinite and highly sheared. Associated rocks are amphibolite, hornblende-plagioclase gneiss, marble derived from calcareous sedimentary rocks, and weakly metamorphosed hornblende gabbro, tonalite, and granite. Amphibolite and gneiss enclose ultramafic rocks. Intense strong schistosity that subparallels contacts and enclosing faults. Tonalite and granite intrude ultramafic and associated rocks; form small elongate plutons with moderate schistosity that subparallels contacts. Terrane of ultramafic and associated rocks interpreted as crustal-suture belt composed of fragments of either oceanic lithosphere, an island arc, or less likely deep-level continental lithosphere. Terrane may be derived in part from basement of terranes juxtaposed along the Denali fault. **REFERENCES**: Richter, 1976; Nokleberg and others, 1985, 1989a, 1992; Csejtey and others, 1992; Patton and others, 1992

WF **West Fork terrane (turbidite basin)Ñ**Occurs in central Alaska Range and consists of two sequences: (1) Upper sequence of chert, argillite, and sandstone ranging in age from Early to Late Jurassic; and (2) lower sequence of crystal tuff and volcaniclastic sandstone and argillite that contains an Early Jurassic sandy conglomerate. Terrane occurs structurally below Chulitna terrane to west and is faulted against Broad Pass terrane to east. One of several mini-terranes enclosed in highly deformed flysch of the Kahiltna overlap assemblage. West Fork terrane interpreted as fragment of a turbidite basin or submarine fan formed adjacent to Jurassic volcanic arc. **REFERENCES**: Jones and others, 1982; Csejtey and others, 1992

WM **White Mountains terrane (passive continental margin)Ñ**Occurs as one of several narrow east-northeast trending terranes in east-central Alaska and consists of three units: (1) Ordovician phyllite, slate, chert, and limestone overlain by pillow basalt, basaltic aquagene tuff, and mafic volcanic breccia (Fossil Creek Volcanics) with local volcaniclastic conglomerate containing granitic clasts dated at 560 Ma; (2) Silurian limestone and dolomite (Tolovana Limestone); and (3) undated gray, vitreous quartzite with argillite layers and Mississippian diorite and gabbro sills (Globe quartzite unit of Weber and others (1992)). Terrane moderately to intensely-deformed into east-northeast-trending upright folds and parallel high-angle faults and is similar to upper part of Crazy Mountains terrane to north across Tintina fault. White Mountains terrane structurally overlies Manley terrane to northwest and structurally underlies Wickersham terrane to southeast. White Mountains terrane interpreted as displaced fragment of the early Paleozoic continental margin of North America Cordillera. **REFERENCES**: Churkin and others, 1982; Weber and others, 1985, 1988; Dover, 1990; Aleinikoff and Plafker, 1989; Grantz and others, 1991

Wrangellia superterrane (island arc)Ñ Consists of middle Paleozoic and older Alexander sequence, late Paleozoic and early Mesozoic Wrangellia sequence, and Jurassic Peninsular sequence. Overlain by younger late Mesozoic and Cenozoic sedimentary and volcanic rock assemblages. Equivalent to combined Alexander, Peninsular, and Wrangellia terranes of Jones and others (1987) and Monger and others (1987). Corresponds to Wrangellia composite terrane of Plafker and others (1989b) and Nokleberg and others (in press). Alexander and Wrangellia sequences occur throughout southern and southeastern Alaska. Peninsular sequence occurs mainly on Alaska Peninsula and adjacent areas to northeast. Chief differences between regions underlain by superterrane are notable contrasts in the relative abundances of coeval strata. From east to west, the Alexander, Wrangellia, and Peninsular sequences form successively higher levels of a structural-stratigraphic succession. The dominantly early and middle Paleozoic Alexander sequence, the oldest part of the succession, occurs mainly to the east and southeast in southeastern Alaska; the late Paleozoic and early Mesozoic Wrangellia sequence, the middle part of the succession, occurs mainly to the north and west in southern Alaska; and the middle Mesozoic Peninsular sequence, the youngest part of the succession occurs mainly to the west on the Alaska Peninsula.

Substantial tectonic shortening occurs within the Wrangellia superterrane (Plafker and others, 1989b; Nokleberg and others, in press). The faulted juxtaposition of the Jurassic Talkeetna of the Peninsular sequence in eastern-southern Alaska against the Wrangellia sequence in the Wrangell Mountains requires extensive post-Middle Jurassic tectonic displacement of this part of the Peninsular sequence relative to the Wrangellia sequence. This post-Jurassic displacement resulted in juxtaposition of different facies and, therefore, in the original designation of the Peninsular and Wrangellia terranes as separate units.

WRA **Alexander sequence (island arc)** (**southeastern Alaska)Ñ**Occurs along length of southeastern Alaska and consists of Late Proterozoic to middle Paleozoic volcaniclastic turbidites, siliceous shale, chert, limestone, intermediate to mafic volcanic rocks, local polymictic conglomerate, and early to middle Paleozoic plutonic rocks that are overlain by late Paleozoic and early Mesozoic units of the Wrangellia sequence, and by younger overlap assemblages. Age of exposed units varies from north to south.

In the southern part of southeastern Alaska, late Proterozoic and Early Cambrian Wales Group consists of metamorphosed volcanic, turbidite, and carbonate rocks that are overlain by Ordovician through Mississippian, interlayered volcaniclastic turbidites, carbonate rocks, and volcanic rocks, shallow-water clastic and carbonate rocks, and sparse volcanic rocks. These lithologies occur in the Port Refugio and Karheen Formations, Heceta Limestone, and Descon Formations. In the northern part of southeastern Alaska, the equivalent units, as depicted on stratigraphic column, equivalent units are the Ordovician through Devonian Gambier Bay, Freshwater Bay, and Cedar Cove Formations, Kennel Creek Limestone, and Bay of Pillars, Point Augusta, Hood Bay, Cannery, Saginaw Bay, and Iyoukeen Formations.

Alexander sequence includes abundant early to middle Paleozoic granitic to gabbroic, and minor ultramafic plutons. In southeastern Alaska, the

Alexander sequence and overlying Wrangellia sequence are locally overlain by parts of Gravina-Nutzotin overlap assemblage, including Douglas Island Volcanics and Brothers Volcanics, and Seymour Canal and Gravina Island Formations that are intruded by coeval plutonic rocks of the Muir-Chichagof belt and Gravina arc. Locally unconformably overlain by Tertiary and Quaternary basalt, dacite, rhyolite, sandstone, and minor conglomerate.

In southeastern Alaska, Alexander sequence (and overlying Wrangellia sequence) faulted against Chugach terrane to west and against Behm Canal terrane to east. Alexander terrane interpreted as a displaced fragment of an early through mid Paleozoic island arc. **REFERENCES**: Loney and others, 1975; Turner and others, 1977; Eberlein and others, 1983; Brew and others, 1984; Gehrels and Saleeby, 1986, 1987; Gehrels and others, 1987; Monger and Berg, 1987; Berg and others, 1988; Brew and others, 1991; Gehrels, 1990, 1991; McClelland and Gehrels, 1992; McClelland and others, 1991; D.A. Brew, written commun., 1991

WRA **Alexander sequence - (island arc) (southern Alaska)Ñ**Occurs in eastern Wrangell Mountains, eastern Alaska Range, and northern part of Chugach Mountains. In Wrangell Mountains consists chiefly of early to middle Paleozoic Kaskawulsh metamorphic rocks of Gardner and others (1988), which are equivalent to the Kaskawulsh Group in adjacent parts of Canada (Figure 3) (MacKevett, 1978; Campbell and Dodds, 1982a, b; Gardner and others, 1988). Kaskawulsh metamorphic rocks are mainly a highly deformed sequence of early Paleozoic marble, greenstone, metagreywacke, phyllite, slate, schist, argillite, siltstone, mafic volcanic rocks, and volcaniclastic rocks that are about a few thousand meters thick. Multiply folded and strongly schistose. Metamorphosed from upper greenschist to amphibolite facies. Devonian and older megafossils occur widely in unit in Alaska and in the Yukon Territory to the east. Intruded by Middle Pennsylvanian Bernard Creek pluton composed of granite, syenite, and alkali granite, and by Jurassic and Cretaceous tonalite and granodiorite of Chitina and Chisana arcs. Intrusion of the Middle Pennsylvanian Bernard Creek pluton into both Alexander and Wrangellia sequences indicates either stratigraphic continuity or structural juxtaposition by about the Early Pennsylvanian.

In the eastern Alaska Range in eastern-southern Alaska, Alexander sequence is interpreted to consist of pre-Pennsylvanian units of mica and quartz schist, and relatively younger metagranitic rocks occur as roof pendants in Pennsylvanian granitic rocks that also intrude upper Paleozoic volcanic and related rocks (Nokleberg and others, in press). In northern Chugach Mountains, north of the Border Ranges fault, the Alexander sequence is interpreted to consist of sparse roof pendants of quartz and pelitic schist, and marble (Knik River terrane) that occur in, or are faulted against the adjacent Border Ranges ultramafic-mafic assemblage of the Peninsular sequence, described below (Plafker and others, 1989b; Nokleberg and others, in press). Alexander sequence in southern Alaska interpreted as a displaced fragment of an early and middle Paleozoic island arc. **REFERENCES**: MacKevett, 1978; Campbell and Dodds, 1982a, b; Gardner and others, 1988; Plafker and others, 1989b; Nokleberg and others, in press

WRP **Peninsular sequence (island arc) (southern Alaska)Ñ**Occurs mainly on Alaska Peninsula and adjacent area to northeast, and Kachemak Bay area of the Kenai Peninsula. Consists mainly of an areal extensive Jurassic island arc volcanic and plutonic sequence (Talkeetna arc) and strata. Volcanic and plutonic sequence consists mainly of: (1) Upper Triassic (Norian) and Lower Jurassic andesitic flows, breccias, and volcaniclastic siltstone and sandstone (Talkeetna Formation) (volcanic part of Talkeetna arc); (2) Jurassic batholithic granitic rocks (plutonic part of Talkeetna arc); and (3) Middle Jurassic to Cretaceous arc-derived clastic rocks (Shelikof and Chinitna Formations, Tuxedni Group, Kialagvik Formation, Naknek Formation, Staniukovich and Herendeen Formations), and bioclastic limestone (Nelchina Limestone). Unconformably overlying units are Cretaceous to lower Tertiary, progradational marine and non-marine sandstone, shale, and minor conglomerate (Matanuska, Hoodoo, Chignik, and Kaguyak Formations).

Southern part of Peninsular sequence, adjacent to Denali fault, consists of Early Jurassic Border Ranges ultramafic-mafic assemblage (BRUMA) interpreted as roots of Talkeetna arc (Plafker and others, 1989b; Nokleberg and others, in press). Peninsular sequence probably originally overlain by Kahiltna assemblage along southern part of northwestern margin, but is thrust over Kahiltna overlap along Talkeetna thrust. Peninsular sequence is bounded to southeast by Border Ranges fault and Chugach terrane, and is locally extensively overlain by Cenozoic volcanic rocks of Aleutian arc. Peninsular sequence interpreted mainly as a Upper Triassic and Jurassic oceanic island arc. **REFERENCES**: Jones and others, 1981; Pavlis, 1983; Burns, 1985; Plafker and others, 1989b; Detterman and others, in press; Wilson and others, in press

WRW **Wrangellia sequence (island arc) (Southern and southeastern Alaska)Ñ**Occurs mainly in southern and southeastern Alaska and is inferred to occur to a minor extent in Puale Bay region of Alaska Peninsula. Consists of late Paleozoic and Mesozoic sedimentary, volcanic, and plutonic rocks. In southern Alaska, Wrangellia sequence consists of: (1) Pennsylvanian and Permian island-arc-related volcanic breccias, flows, and volcaniclastic rocks, mainly andesite and dacite, and associated marine sedimentary rocks (Tetelna Volcanics, and Station Creek and Slana Spur

Formations). (2) Permian limestone, pelitic rocks, and chert (Hasen Creek and Eagle Creek Formations). (3) Triassic (Ladinian) black cherty argillite. (4) A thick section of Upper Triassic (Norian) subaerial and marine tholeiitic pillow basalt and lesser argillite (Nikolai Greenstone, up to thousand meters thick). (5) Upper (Norian) Triassic platform and basinal limestone (Chitistone and Nizina Limestones); and (6) Late Triassic and Jurassic basinal, siliceous, argillaceous and calcareous rocks (McCarthy Formation). On northern flank of Wrangell Mountains, unconformably overlying, Upper Jurassic and Lower Cretaceous flysch and andesite volcanic rocks (Gravina-Nutzotin overlap assemblage and Chisana Formation) form part of a major tectonically-collapsed flysch basin that is intruded by coeval granitic plutons. On southern flank of Wrangell Mountains, unconformably overlying, mainly Middle Jurassic to Maastrichtian progradational, volcaniclastic sequences (Root Glacier, Nizina Mountain, Chititu, Moonshine Creek, Schulze, and Kennicott Formations). Overlain by Upper Cenozoic to Holocene volcanic rocks (Wrangell Lava).

Upper Paleozoic sedimentary and volcanic rocks in Wrangellia sequence in eastern-southern Alaska are intruded by coeval metaplutonic rocks of the Skolai island arc. Late Triassic basalt and older rocks are intruded by mafic and ultramafic dikes, sills, and small plutons. Late Triassic basalts and associated plutonic rocks interpreted as products of rifting and (or) oceanic plume activity. Wrangellia sequence locally intruded by extensive Late Jurassic and Early Cretaceous granitic plutons of the Chisana, Chitina, and Glacier Bay-Chichagof arcs. Pervasive weak greenschist facies metamorphism in Early Cretaceous and older rocks. In eastern Wrangell Mountains, Wrangellia sequence welded to northern Alexander sequence by Middle Pennsylvanian granitic plutons of Skolai arc. In southern Alaska, Wrangellia sequence faulted against Yukon-Tanana and Maclaren terranes to north along Denali fault and Broxson Gulch thrust, and to south faulted against southern Wrangellia terrane along Chitina Valley and Paxson Lake faults.

On Alaska Peninsula, Wrangellia sequence consists of upper Paleozoic and lower Mesozoic island arc and oceanic sequences that occur in Puale Bay area and areas to north. Major units are: (1) Pennsylvanian(?) andesite flows and agglomerate; (2) Permian limestone; and (3) Upper Triassic (Norian) basalt, mafic tuff, limestone, and argillite (Kamishak Formation), and correlative units of Cottonwood Bay and Chilikadrotna Greenstones, and informally-named Tlikalika complex of Wallace (1983).

In southeastern Alaska, Wrangellia sequence consists of: (1) late Paleozoic clastic and carbonate rocks; and (2) Late Triassic mafic and lesser siliceous volcanic rocks. Major units are Mississippian, Pennsylvanian, and Early Permian clastic, volcaniclastic, and carbonate rocks of Cannery, Pybus, Ladrones Limestone, and Saginaw Bay, and Klawak Formations, and Late Triassic mafic and lesser siliceous volcanic, and carbonate rocks including the Hyd Group, Keku Volcanics, Goondip Greenstone, Retreat Group (Duttweiler-Kelly, 1990), White Stripe Marble, Chapin Peak Formation, and an unnamed sequence on the Chilkat Peninsula. Overlying Upper Jurassic and Lower Cretaceous flysch of Gravina-Nutzotin overlap assemblage. **REFERENCES**: Richter and others, 1975; Richter, 1976; Jones and others, 1977; MacKevett, 1978; Silberling and others, 1981; Johnson and Karl, 1985; Nokleberg and others, 1985, 1992, in press; Gardner and others, 1988; and Plafker and others, 1989a, b; Barker and others, 1989; Richards and others, 1991

WS **Wickersham terrane (passive continental margin)Ñ**Occurs as one of several narrow east-northeast-trending terranes in east-central Alaska and consists of turbidites comprising two major lithofacies: (1) a structurally lower unit of mainly gray, maroon, and green slate with local quartzose sandstone and granule to pebble conglomerate, with dolomite and dark limestone; (2) an upper unit of mainly thick-bedded quartzose sandstone and pebble conglomerate with local layers of gray slate with local *Oldhamia* trace fossils of probable Cambrian age. Former Beaver terrane of Churkin and others (1982). Southern margin of Wickersham terrane exhibits penetrative metamorphic fabric and lower greenschist metamorphism that parallels fault bounding southern margin. Singly deformed and weakly metamorphosed. Structurally overlies White Mountains terrane to northwest and Fairbanks schist unit of Nokleberg and others (1989a) of Yukon-Tanana terrane to southeast. Wickersham terrane interpreted as displaced fragment of the early Paleozoic continental margin of North America Cordillera. **REFERENCES**: Churkin and others, 1982; Weber and others, 1985, 1988; Pessel and others, 1987; Moore and Nokleberg, 1988; Dover, 1990; Grantz and others, 1992

WY **Windy terrane (metamorphic)Ñ**Occurs as narrow, discontinuous lenses along Denali fault in central and eastern Alaska Range and consists of a structural melange of: (1) small to large fault-bounded lenses of Silurian or Devonian limestone and marl; (2) Upper Triassic limestone; (3) Jurassic(?) basalt and chert; (4) Cretaceous flysch and volcanic rocks, mainly argillite, quartz-pebble siltstone, quartz sandstone, metagraywacke, and metaconglomerate with lesser andesite and dacite; and (5) Cretaceous(?) gabbro and diabase dikes and sills. Flysch contains sparse Cretaceous ammonites. Intensely faulted and sheared with a weak to intense schistosity formed at lower greenschist facies; local phyllonite and protomylonite. Minimum structural thickness of a few thousand meters. Windy terrane interpreted as a structural melange formed during tectonic mixing during Cenozoic dextral-slip movement along the Denali fault. Mesozoic flysch and associated volcanic rocks interpreted as tectonic remnants of the Kahiltna overlap assemblage and Chisana arc. Fragments of Silurian(?) and Devonian limestone and marl may be derived from Dillinger, Mystic, and (or) Nixon Fork terranes. **REFERENCES**: Jones and others, 1981; Nokleberg and others, 1985, 1989a, 1992; Stanley and others, 1990; Csejtey and others, 1992

YA **Yakutat terrane (accretionary wedge - dominantly turbidites)Ñ**Occurs in southern Alaska and northern margin of Gulf of Alaska and consists of an allochthonous composite terrane. Mesozoic Yakutat Group forms eastern part, and Eocene oceanic crust forms western part. Both eastern and western parts overlain by younger Cenozoic sedimentary and volcanic rocks. Yakutat Group divided into: (1) melange facies, chiefly basalt, chert, argillite, tuff, and sandstone of Late Jurassic(?) and Early Cretaceous age, with exotic blocks of Permian and Upper Triassic carbonate rocks, and Middle and Late Jurassic tonalite; and (2) flysch facies, chiefly Upper Cretaceous volcanic sandstone, siltstone, and minor conglomerate with structurally interleaved lenses of disrupted chert, argillite, and volcanic rocks. Yakutat Group metamorphosed from zeolite to lower greenschist facies and intruded by Eocene granitoid plutons. Cenozoic sedimentary and volcanic rocks divided into: (1) Lower and middle Tertiary oceanic basalt, sandstone, siltstone, shale, and conglomerate (Poul Creek, Redwood, Kulthieth, and Tokun Formations) that includes Eocene basalt and shale rich in organic material; and (2) an overlap assemblage of Miocene and younger, shallow marine sandstone, siltstone, diamictite, and conglomerate (Yakataga and Redwood Formations). Terrane thrust under Prince William terrane to north along gently north-dipping Chugach-Saint Elias fault, and to west along subhorizontal Kayak Island fault zone; underthrust by Pacific plate to south along Transition fault. Yakutat terrane interpreted as a fragment of Chugach terrane (Yakutat Group) and Eocene oceanic crust that, together with overlying pre-Miocene sequence, was displaced at least 600 km northward along the Fairweather transform fault since the early Miocene. **REFERENCES**: Jones and others, 1981; Plafker, 1987

YO **York terrane (passive continental margin)Ñ**Occurs on western margin of Seward Peninsula and consists of a weakly metamorphosed, structurally complex assemblage of Ordovician through Mississippian limestone, argillaceous limestone, dolostone, and fine-grained clastic rocks deposited in shallow-marine environment. Ordovician carbonate rocks comprise most of unit and may range up to 3,000 m thick. Late Proterozoic rocks may also occur. Terrane intruded by small, Late Cretaceous granitic stocks, and may correlate with passive continental margin rocks of Hammond terrane to northwest. York terrane interpreted as a displaced fragment of the Paleozoic and early Mesozoic Arctic continental margin.

REFERENCES: Sainsbury, 1969; Hudson, 1977; A.B. Till and J.A. Dumoulin, written commun., 1991

YP **Yukon-Prong terrane (metamorphosed continental margin) (southeastern Alaska)Ñ** Occurs in eastern southeastern Alaska and consists chiefly of Late Proterozoic(?) and (or) early and middle Paleozoic mica schist, granitic orthogneiss, amphibolite, metavolcanic rocks, quartzite, marble, and calc-silicate rocks. Protoliths are quartz-rich and pelitic sedimentary rocks, carbonate rocks, intermediate to mafic volcanic rocks, ultramafic rocks, and sparse metamorphosed middle Paleozoic granitic plutons. Terrane includes lower Paleozoic metasedimentary rocks of Nisling assemblage (marble, metamorphosed quartz sandstone, pelitic schist, and metabasalt), middle Paleozoic metasedimentary and metavolcanic rocks of Ruth assemblage and Kah Shakes sequence (pelitic schist, marble, mafic and felsic metavolcanic rocks, metagranodiorite and orthogneiss) (former Tracy Arm terrane), and the informally named Paleozoic East Behm gneiss complex of metaplutonic rocks of Saleeby and Rubin (1990). Metamorphosed stratified and plutonic rocks correlated with Yukon-Tanana terrane in east-central Alaska. Metamorphosed before Late Triassic to amphibolite-facies

Yukon Prong terrane intruded by Late Cretaceous and Early Tertiary intermediate plutonic rocks, and middle Tertiary intermediate plutonic rocks. Bounded to west by structural complex of Behm Canal terrane. Possibly stratigraphically(?) or structurally overlain by Stikinia terrane. Interpreted as a highly metamorphosed and deformed, displaced fragment of the North American craton margin. **REFERENCES**: Gehrels and others, 1990; Saleeby and Rubin, 1990; Rubin and Saleeby, 1991; McClelland and others, 1991, 1992; Samson and others, 1991; Gehrels and McClelland, 1992

YT **Yukon-Tanana terrane (metamorphosed continental margin) (east-central Alaska)Ñ**Occurs in eastern Alaska and adjoining Yukon Territory of northwestern Canada and consists of an enormous tract of poly-deformed and poly-metamorphosed, middle Paleozoic and older sedimentary, volcanic, and plutonic rocks. Contains three major sequences of metasedimentary, metavolcanic, and metaplutonic rocks that occur in various subhorizontal to gently folded thrust slices. Major sequences are: (1) Mississippian, Devonian, and locally older metasedimentary rocks, mainly pelitic schist, quartz schist, quartz-feldspar schist, and sparse marble (Fairbanks, Birch Hill, and Chena River subterranes, and metasedimentary parts of Jarvis Creek Glacier, Hayes Glacier, Lake George, and Macomb subterranes; Totatlanika Schist, and Keevey Peak Formation); (2) Devonian and Mississippian orthogneiss and augen gneiss (metaplutonic part of Lake George and Macomb subterranes); and (3) Devonian and Mississippian intermediate and siliceous metavolcanic rocks (Butte subterrane, metavolcanic rock parts of Jarvis Creek, Hayes Glacier, and Lake George subterranes; Cleary sequence within Fairbanks schist unit; and Spruce Creek sequence in the Kantishna Hills area). The extrusive metavolcanic rocks and coeval metamorphosed hypabyssal igneous rocks, mainly metamorphosed andesite, dacite, and keratophyre flows and tuffs, are interlayered with the Mississippian, Devonian, and locally older metasedimentary rocks.

U-Pbigneous isotopic analyses indicate Devonian and Mississippian extrusion of intermediate and siliceous metavolcanic rocks (Cleary sequence of Fairbanks subterrane, and Spruce Creek sequence) (Aleinikoff and Nokleberg, 1989; Nokleberg and others, 1989a; J.N. Aleinikoff, T.K. Bundtzen, and W.J. Nokleberg, unpub. data, 1993). Conodont and megafossil ages indicate Mississippian and Devonian ages for metasedimentary rock part of Jarvis Creek Glacier subterrane, and Totatlanika Schist. One known Late Proterozoic metagranitic pluton intrudes metasedimentary rocks in northern part of Chena River subterrane (Nokleberg and others, 1989a), indicating at least part of metasedimentary rocks are pre-Late Proterozoic in age. Locally near Denali fault are abundant Cretaceous(?) metadiabase and metagabbro dikes, sills, and small plutons.

Yukon-Tanana terrane contains an intense subhorizontal to gently dipping structural fabric defined by parallel schistosity and composition layering that are subparallel to major subhorizontal faults that separate major thrust slices. Faults between major thrust slices exhibit both older, early Mesozoic thrust, and younger, mid-Cretaceous extensional displacements. Higher-grade units, with abundant Devonian and Mississippian orthogneiss and augen gneiss, and upper amphibolite to eclogite facies metamorphism, generally occur in deeper structural levels. Lower-grade units, with abundant Devonian and Mississippian volcanic rocks and upper greenschist facies metamorphism, generally occur in higher structural levels. Intense zone of retrogressive metamorphism and mylonitic schists along southern margin of terrane. Major periods of amphibolite to eclogite facies metamorphism in Early Jurassic and mid-Cretaceous time.

Southern margin of Yukon-Tanana terrane faulted against mainly Windy and Wrangellia terranes. Northwestern margin thrust under Wickersham terrane. Southern part of terrane interpreted as structurally underlain in part by Mesozoic flysch of Kahiltna overlap assemblage. Northeastern margin faulted North America craton margin, Kandik River, Angayucham, and Crazy Mountains terranes along Tintina fault. Yukon-Tanana terrane locally structurally overlain by formerly extensive klippen of Seventymile and Stikinia(?) terranes in east-central Alaska. In same area, locally unconformably overlain by Upper Cretaceous and lower Tertiary conglomerate, sandstone, coal, and rhyolite to basalt tuff and flows, and intruded by extensive mid-Cretaceous, Late Cretaceous, and early Tertiary granitic plutons. Yukon-Tanana terrane interpreted as a highly metamorphosed and deformed, displaced fragment of the North American craton margin. Former Yukon Crystalline terrane of Churkin and others, 1982. **REFERENCES**: Foster, 1976; Foster and others, 1987; Nokleberg and others, 1989a, 1992; Stanley and others, 1990; Dusel-Bacon, 1991; Pavlis and others, 1993; Dusel-Bacon and Hansen, 1992

REFERENCES CITED

Aleinikoff, J.N., Dusel-Bacon, Cynthia, Foster, H.L., and Nokleberg, W.J., 1987, Pb-isotope fingerprinting of tectonostratigraphic terranes, east-central Alaska: Canadian Journal of Earth Sciences, v. 24, p. 2089-2098.

Aleinikoff, J.N., and Nokleberg, W.J., 1989, Age of deposition and provenance of the Cleary sequence of the Fairbanks schist unit, Yukon-Tanana terrane, east-central Alaska, *in* Dover, J.H., and Galloway, J.P., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1988: U.S. Geological Survey Bulletin 1903, p. 75-83.

Aleinikoff, J.N., and Plafker, George, 1989, In search of the provenance and paleogeographic location of the White Mountains terrane: Evidence from U-Pb data of granite boulders in the Fossil Creek Volcanics, *in* Dover, J.H., and Galloway, J.P., eds., Geologic Studies in Alaska by the U.S. Geological Survey, 1988: U.S. Geological Survey Bulletin 1903, p. 68-74.

Anderson, R.G.,1989, A stratigraphic, plutonic, and structural framework for the Iskut River map area, northwestern British Columbia, *in* Current Research, Part E, Geological Survey of Canada Paper 89-1E, p. 145-154.

Armstrong, R.L., Harakal, J.E., Forbes, R.B., Evans, B.W., and Thurston, S.P., 1986, Rb-Sr and K-Ar study of metamorphic rocks of the Seward Peninsula and southern Brooks Range, *in* Evans, B.W., and Brown, E.H., eds., Blueschists and Eclogites: Geological Society of America Memoir 164, p. 185-203.

Atwater, Tanya, and Severinghaus, Jeff, 1991, Tectonic map of the north-central Pacific Ocean, in Winterer, E.L., Jussong, D.M., and Decker, R.W., eds., The eastern Pacific Ocean and Hawaii: Geological Society of America, Decade of North America Geology (DNAG), v. N, plate 3.

Babcock, L.E., and Blodgett, R.B., 1992, Biogeographic and paleogeographic significance of Middle Cambrian trilobites of Siberian Aspect from southwestern Alaska [abs.]: Geological Society of America Abstracts with Programs, p. 4.

Babcock, L.E., Blodgett, R.B., and St. John, James, 1993, Proterozoic and Cambrian stratigraphy and paleontology of the Nixon Fork terrane: Proceedings of Circum-Pacific and Circum-Atlantic Terrane Conference, Guanajuato, Mexico, p. 5-7.

Barker, F., 1987, Cretaceous Chisana island arc of Wrangellia, eastern Alaska: Geological Society of America, Abstracts with Programs, v. 19, no. 7, p. 580.

Barker, Fred, Jones, D.L., Budahn, J.R., and Coney, P.J., 1988, Ocean plateau-seamount origin of basaltic rocks,

Angayucham terrane, central Alaska: Journal of Geology, v. 96, p. 368-374.
Barker, Fred, Sutherland Brown, A., Budahn, J.R., and Plafker, G., 1989, Back-arc with frontal arc component origin of Triassic Karmutsen basalt, British Columbia, Canada: Chemical Geology, v. 75, p. 81-102.
Beikman, H.M., 1980, Geologic map of Alaska: U.S. Geological Survey, scale 1:2,500,000.
Berg, H.C., Elliott, R.L., and Koch, 1988, Geologic map of the Ketchikan and Prince Rupert quadrangles, southeastern Alaska: U.S. Geological Survey Map-1807, 2 sheets, 27 p.
Berg, H.C., Jones, D.L., and Richter, D.H., 1972, Gravina-Nutzotin beltÑTectonic significance of an upper Mesozoic sedimentary and volcanic sequence in southern and southeastern Alaska, *in* Geological Survey research 1972: U.S. Geological Survey Professional Paper 800-D, p. D1-D24.
Bevier, M.L., and Anderson, R.G., 1991, Jurassic geochronometry in NW Stikina (56-57¡N), British Columbia [abs.]: Geological Society of America, Abstracts with Programs, v.23, no. 5, p. A191.
Bird, K.J., 1985, The framework geology of the North Slope of Alaska as related to oil-source rock correlations, *in* Magoon, L.B., and Claypool, G.E., eds., Alaskan North Slope oil/rock correlation study:American Association of Petroleum Geologists Studies in Geology, no. 20, p. 3-29.
Ñ1988, Alaskan North Slope stratigraphic nomenclature and data summary for government-drilled wells: U.S. Geological Survey Professional Paper 1399, p. 317-353.
Bird, K.J., and Molenaar, C.M., 1987, Stratigraphy, Chap.5, *in* Bird, K.J., and Magoon, L.B., eds., Petroleum geology of the northern part of the Arctic National Wildlife Refuge, northeastern Alaska:U.S. Geological Survey Bulletin 1778, p. 37-59.
Blodgett, R.B., 1992, Taxonomy and paleobiogeographic affinities of an Early Middle Devonian (Eifelian) gastropod faunule from the Livengood quadrangle, east-central Alaska: Palaeontographica Abteilung A, v. 221, p. 125-168.
Blodgett, R.B., and Clough, J.G., 1985, The Nixon Fork terrane - Part of an in-situ peninsular extension of the Paleozoic North American continent [abs.]: Geological Society of America Abstracts with Programs, v. 17., p. 342.
Blodgett, R.B., Clough, J.G., Dutro, J.T., Jr., Ormiston, A.R., Palmer, A.R., and Taylor, M.E., 1986, Age revisions for the Nanook Limestone and Katakturuk Dolomite, northeastern Brooks Range, *in* Bartsch-Winkler, Susan, and Reed, K.M., eds., Geologic studies in Alaska by the U.S. Geological Survey during 1985: U.S. Geological Survey Circular 978, p. 5-10.
Blodgett, R.B., Clough, J.G., Harris, A.G., and Robinson, M.S., 1992, The Mount Copleston Limestone, a new Lower Devonian formation in the Shublik Moutnains, northeastern Brooks Range, Alaska, *in* Bradley, D.S., and Ford, A.B., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1999, U.S. Geological Survey Bulletin 1999, p. 3-7.
Blodgett, R.B., and Gilbert, W.G., 1983, The Cheeneetnuk Limestone, a new Early(?) to Middle Devonian Formation in the McGrath A-4 and A-5 quadrangles, west-central Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 85, p. 1-6.
Ñ1992, Upper Devonian shallow-marine siliciclastic strata and associated fauna and flora, Lime Hills D-4 quadrangle, southwest Alaska, *in* Bradley, D.C., and Dusel-Bacon, Cynthia, eds., Geologic Studies in Alaska by the U.S. Geological Survey: U.S. Geological Survey Bulletin 2041, p. 106-113.
Blodgett, R.B., Rohr, D.M., Harris, A.G., and Rong, Jia-yu, 1988, A major unconformity between Upper Ordovician and Lower Devonian strata in the Nanook Limestone, Shublik Mountains, northeastern Brooks Range, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic studies in Alaska by the U.S. Geological Survey during 1987: U.S. Geological Survey Circular 1016, p. 18-23.
Boak, J.M., Turner, D.L., Henry, D.J., Moore, T.E., and Wallace, W.K., 1987, Petrology and K-Ar ages of the Misheguk igneous sequence, an allochthonous mafic and ultramafic complex, and its metamorphic aureole, western Brooks Range, Alaska, *in* Tailleur, I.L., and Weimer, Paul, eds., Alaskan North Slope Geology: Los Angeles, Society of Economic Paleontologists and Mineralogists, Pacific Section, and Anchorage Alaska Geological Society, v. 2, p. 737-745.
Box, S.E., 1985a, Geologic setting of high-pressure metamorphic rocks, Cape Newenham area, southwestern Alaska, *in* Bartsch-Winkler, Susan, ed., The United States Geological Survey in Alaska: Accomplishments during 1984: U.S. Geological Survey Circular 967, p. 37-42.
Ñ1985b, Terrane analysis, northern Bristol Bay region, southwestern Alaska, *in* Bartsch-Winkler, Susan, ed., The United States Geological Survey in Alaska: Accomplishments during 1984: U.S. Geological Survey Circular 967, p. 32-36.
Box, S.E., and Elder, W.P., 1992, Depositional and biostratigraphic framework of the Upper Cretaceous Kuskokwim Group, southwestern, Alaska, *in* Bradley, D.C., and Ford, A.B., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1990: U.S. Geological Survey Bulletin 1999, p. 8-16.
Box, S.E., Moll-Stalcup, E.J., Frost, T.P., and Murphy, J.M., 1992, Preliminary geologic map o the Bethel and southern Russian Mission 1¡ x 3¡ quadrangles, southwestern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-_____, scale 1: 250,000.
Box, S.E., Moll-Stalcup, E.J., and Wooden, J.L., 1990, Kilbuck terrane: Oldest-known rocks in Alaska: Geology, v. 18, p. 1219-1222.
Box, S.E., and Patton, W.W., Jr., 1989, Igneous history of the Koyukuk terrane, western Alaska: Constraints on the origin, evolution, and ultimate collision of an accreted island arc terrane: Journal of Geophysical Research, v. 94, p. 15,843-15,867.
Brabb, E.E., and Churkin, Michael, Jr., 1969, Geologic map of the Charley River quadrangle, east-central Alaska:

U.S. Geological Survey Miscellaneous Geologic Investigations Map I-573, 1 sheet, scale 1: 250,000.

Bradley, D.C., and Kusky, T.M., 1992, Deformation history of the McHugh Complex, Seldovia quadrangle, south-central Alaska, *in* Bradley, D.C., and Ford, A.B., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1990: U.S. Geological Survey Bulletin 1999, p. 17-32.

Brew, D.A., 1988, Latest Mesozoic and Cenozoic igneous rocks of southeastern Alaska--a synopsis: U.S. Geological Survey Open-File Report 88-405, 52 p.

Brew, D.A., and Karl, S.M., 1988a, A reexamination of the contacts and other features of the Gravina Belt, southeastern Alaska [abs]: Geological Society of America, Abstracts with Programs, v. 20, no. 7, p. 111.

Ñ1988b, A reexamination of the contacts and other features of the Gravina belt, southeastern Alaska, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic studies in Alaska by the U.S. Geological Survey during 1987: U.S. Geological Survey Circular 1016, p. 143-146.

Ñ1988c, A reexamination of the contacts and other features of the Gravina belt, southeastern Alaska, Supplemental data: U.S. Geological Survey Open-File Report 88-652, 8 p.

Brew, D.A., Karl, S.M., Barnes, D.F., Jachens, R.C., Ford, A.B., and Horner, R., 1991, A northern Cordilleran ocean-continent transect: Sitka Sound to Atlin Lake, British Columbia: Canadian Journal of Earth Sciences, v. 28, no. 6, p. 840-853.

Brew, D.A., Karl, S.M., and Miller, J.W., 1988, Megafossils *(Buchia)* indicate Late Jurassic age for part of Kelp Bay Group on Baranof Island, southeastern Alaska, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic studies in Alaska by the U.S. Geological Survey during 1987 U.S. Geological Survey Circular 1016, p. 147-149.

Brew, D.A., Ovenshine, A.T., Karl, S.M., and Hunt, S.J., 1984, Preliminary reconnaissance geologic map of the Petersburg and parts of the Port Alexander and Sumdum 1:250,000 quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 84-405, 2 sheets, 43 p. pamphlet.

Brewer, W.M., 1982, Stratigraphy, structure, and metamorphism of the Mount Deborah area, central Alaska Range, Alaska [Ph.D. thesis]: Madison, University of Wisconsin, 318 p.

Brosg• , W.P., Lanphere, M.A., Reiser, H.N., and Chapman, R.M., 1969, Probable Permian age of the Rampart Group, central Alaska: U.S. Geological Survey Bulletin 1294-B, 18 p.

Brosg• , W.P., and Reiser, H.N., 1969, Preliminary geologic map of the Coleen quadrangle, Alaska: U.S. Geological Survey Open-File Report OF 69-370, 1 sheet, scale 1:63,360.

Brosg• , W.P., and Tailleur, I.L., 1970, Depositional history of northern Alaska, *in* Adkison, W.L., and Brosg• , M.M., eds., Proceedings of the geological seminar on the North Slope of Alaska:American Association of Petroleum Geologics Pacific Section Meeting, Los Angeles, p. D1-D18.

Brosg• , W.P., Dutro, J.T., Jr., Mangus, M.D., and Reiser, H.N., 1962, Paleozoic sequence in eastern Brooks Range, Alaska:American Association Petroleum Geologists Bulletin, v. 46, p. 2,174-2,198.

Bundtzen, T.K., and Gilbert, W.G., 1983, Outline of the geology and mineral resources of the upper Kuskokwim region, southwest Alaska, *in* Sisson, Alex, ed., Symposium on energy and mineral resoutces of western Alaska: Alaska Geological Society, v. 3, p. 98-119.

Burns, L.E., 1985, The Border Ranges ultramafic and mafic complex, south-central Alaska: Cumulate fractionates of island-arc volcanics: Canadian Journal of Earth Sciences, v. 22, p. 1020-1038.

Cady, W.M., Wallace, R.E., Hoare, J.M., and Webber, E.J., 1955, The central Kuskokwim region, Alaska: U.S. Geological Survey Professional Paper 268, 132 p.

Campbell, R.H., 1967, Areal geology in the vicinity of the Chariot site, Lisburne Peninsula, northwest Alaska:U.S. Geological Survey Professional Paper 395, 71 p.

Campbell, R.B., and Dodds, C.J., 1982a, Geology of s.w. Kluane Lake map area, Yukon Territory: Geological Survey of Canada Maps 115F and 115G, Open File 829, scale 1:250,000.

Ñ1982b, Geology of the Mount St. Elias map area, Yukon Territory: Geological Survey of Canada Maps 115B and 115C, Open File 830, scale 1:250,000.

Chapman, R.M., Weber, F.R., and Taber, Bond, 1971, Preliminary geologic map of the Livengood quadrangle, Alask: U.S. Geological Survey Open-File Report 71-66, 1 sheet, scale 1:250,000.

Churkin, Michael, Jr., Carter, Claire, and Trexler, J.H., Jr., 1980, Collision-deformed Paleozoic continental margin of Alaska--foundation for microplate accretion: Geological Society of America Bulletin, v. 91, p. 648-654.

Churkin, Michael, Jr., Foster, H.L, Chapman, R.M., and Weber, F.R., 1982, Terranes and suture zones in east central Alaska: Journal of Geophysical Research, v. 87, no. B5, p. 3718-3730.

Churkin, Michael, Jr., Nokleberg, W.J., and Huie, Carl, 1979, Collision-deformed Paleozoic continental margin, western Brooks Range, Alaska: Geology, v. 7, p. 379-383.

Clough, J.G., and Blodgett, R.B., 1985, Comparative study of the sedimentology and paleoecology of middle Paleozoic algal and coral-stromatoporoid reefs in Alaska: Proceedings of the Fifth International Coral Reef Congress, Tahiti, v. 3, p. 184-190.

Coney, P.J., Jones, D.L., and Monger, J.W.H., 1980, Cordilleran suspect terranes: Nature, v. 288, p. 329-333.

Connelly, William, 1978, Uyak Complex, Kodiak Islands, Alaska: A Cretaceous subduction complex: Geological Society of America Bulletin, v. 89, p. 775-769.

Connelly, William, and Moore, J.C.., 1979, Geologic map of the northwest side of the Kodiak and ;adjacent islands, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1047, 2 sheets, scale 1:250,000.

Csejtey, B• la, Jr., Mullen, M.W., Cox, D.P., and Stricker, G.D., 1992, Geology and geochronology of the Healy quadrangle, Alaska: U.S. Geological Survey

Miscellaneous Investigations Series Map I-1961, 2 sheets, scale 1:250,000, 63 p.
Davidson, Cameron, and Hollister, L.S., 1992, Role of melt in the formation of a deep-crustal compressive shear zone: The Maclaren Glacier metamorphic belt, south-central Alaska: Tectonics, v. 11, p. 348-359.
Decker, John, Wilson, F.H., and Turner, D.L., 1980, Mid-Cretaceous subduction event in southeastern Alaska [abs.]: Geological Society of America Abstracts with Programs, v. 12, p. 103.
Dillon, J.T., 1989, Structure and stratigraphy of the southern Brooks Range and northern Koyukuk basin near the Dalton Highway, *in* Mull, C.G., and Adams, K.E., eds., Dalton Highway, Yukon River to Prudhoe Bay, Alaska:Alaska Division of Geological and Geophysical Surveys Guidebook 7, v. 2, p. 157-187.
Dillon, J.T., Harris, A.G., and Durtro, J.R., Jr., 1987, Preliminary description and correlation of lower Paleozoic fossil-bearing strata in the Snowden Mountain area of the south-central Brooks Range, Alaska, *in* Taillerur, I.L., and Weimer, Paul, eds., Alaskan North Slope Geology: Pacific Section, Society of Economic Paleontologists and Mineralogists, Bakersfield, Calif. v. 50, p. 337-345.
Dillon, J.T., Pessel, G.H., Chen, J.H., and Veach, N.C., 1980, Middle Paleozoic magmatism and orogenesis in the Brooks Range, Alaska: Geology, v. 8, p. 338-343.
Dover, J.H., 1990, Geology of east-central Alaska: U.S. Geological Survey Open-File Report 90-289, 96p.
Dutro, J.T., Jr., Brosg• , W.P., Lanphere, M.A., and Reiser, H.N., 1976, Geologic significance of Doonerak structural high, central Brooks Range, Alaska: American Association of Petroleum Geologists Bulletin, v. 60, p. 952-961.
Dumoulin, J.A., 1987, Sandstone composition of the Valdez and Orca Groups, Prince William Sound, Alaska: U.S. Geological Survey Bulletin 1774, 37 p.
Ñ1988, Sandstone petrographic evidence and the Chugach-Prince William terrane boundary in southern Alaska: Geology, v. 16, p. 456-460.
Dumoulin, J.A., and Harris, A.G., 1987, Lower Paleozoic carbonate rocks of the Baird Mountains quadrangle, western Brooks Range, Alaska, *in* Tailleur, I.L., and Weimer, Paul, eds., Alaska North Slope Geology: Pacific Section, Society of Economic Paleontologists and Mineralogists, Bakersfield, California, v. 50, p. 311-336.
Dusel-Bacon, Cynthia, 1991, Metamorphic history of Alaska: U.S. Geological Survey Open-File Report 91-556, 48 p., 2 sheets, scale 1:2,500,000.
Dusel-Bacon, Cynthia and Hansen, V.L., 1992, High-pressure, amphibolite-facies metamorphism and deformation within the Yukon-Tanana and Taylor Mountain terranes, eastern Alaska, *in* Bradley, D.C., and Dusel-Bacon, Cynthia, eds, Geological Studies in Alaska by the U.S. Geological Survey, 1991: U.S. Geological Survey Bulletin 2041, p. 140-159.
Duttweiler-Kelley, Karen, 1990, Interpretation of geochemical data from Admiralty Island, Alaska--Evidence for volcanogenic massive sulfide mineralization, *in* Goldfarb, R.J., Nash, T.J., and Stoerer, J.W., eds., Geochemical Studies in Alaska by the U.S. Geological Survey, 1989: U.S. Geological Survey Bulletin 1950, p. A1-A9.
Eberlein, G.D., Churkin, M., Jr., Carter, C., Berg, H.C., and Ovenshine, A.T., 1983, Geology of the Craig quadrangle, Alaska: U.S. Geological Survey Open-File Report 83-91, 4 sheets, 54 p.
Fernette, Gregory, and Cleveland, Gregory, 1984, Geology of the Miss Molly molybdenum propsect, Toyonek C-6 quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 86, p. 35-41.
Ford, A.B., and Brew, D.A., 1988, The Douglas Island Volcanics; basaltic-rift--not andesitic-arc--volcanism of the "Gravina-Nutzotin belt," northern southeastern Alaska (abs.): Geological Society of America, Abstracts with Programs, v. 20, no. 7, p. 111.
Foster, H.L., 1976, Geologic map of the Eagle quadrangle, Alaska: U.S. Geological Survey Miscellaneous Investigations Map Series I-922, scale 1:250,000.
Foster, H.L., Keith, T.E.C., and Menzie, W.D., 1987, Geology of east-central Alaska: U.S. Geological Survey Open-File Report 87-188, 59 p.
Gardner, M.C., Bergman, S.C., Cushing, G.W., MacKevett, E.M., Jr., Plafker, G., Campbell, R.B., Dodds, C.J., McClelland, W.C., and Mueller, P.A., 1988, Pennsylvanian pluton stitching of Wrangellia and the Alexander terrane, Wrangell Mountains, Alaska: Geology, v. 16, p. 967-971.
Gehrels, G.E., 1990, Late Proterozoic-Cambrian metamorphic basement of the Alexander terrane on Long and Dall Islands, southeast Alaska: Geological Society of America Bulletin, v. 102, p. 760-767.
Gehrels, G.E., 1991, Geologic map of Long Island and southern and central Dall Island, southeastern Alaska: U.S. Geological Survey Map MF-2146, 1 sheet.
Gehrels, G.E., and Berg, H.C., 1992, Geologic map of southeastern Alaska: U.S. Geological Survey Miscellaneous Investigations Series Map I-1867, 1 sheet, scale 1:600,000, 24 p.
Gehrels, G.E., McClelland, W.C., 1992, Geology of the western flank of the Coast Mountains between Cape Fanshaw and Taku Inlet, southeastern Alaska: Tectonics, v. 11, p. 567-585.
Gehrels, G.E., McClelland, W.C., Samson, S.D., Patchett, P.J., and Jackson, J.L., 1990, Ancient continental margin assemblage in the northern Coast Mountains, southeast Alaska and northwest Canada: Geology, v. 18, p. 208-211.
Gehrels, G.E., and Saleeby, J.B.,1986, Geologic map of southern Prince of Wales Island, southeastern Alaska: U.S. Geological Survey Open-File Report 86-275, 33 p.
Gehrels, G.E., and Saleeby, J.B.,1987, Geology of southern Prince of Wales Island, southeastern Alaska: Geological Society of America Bulletin, v. 98, p. 123-137.
Gehrels, G.E., Saleeby, J.B., and Berg, H,C., 1987, Geology of Annette, Gravina, and Duke Islands, southeastern Alaska: Canadian Journal of Earth Sciences, v. 24, p. 866-881.

Gergen, L.D., Decker, J.E., and Plafker, George, 1988, A comparative study of sandstone from the Wilber Creek, Cascaden Ridge, and Wickersham units in the Livengood quadrangle, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic Studies in Alaska by the United States Geological Survey during 1987: U.S. Geological Survey Circular 1016, p. 57-60.

Gilbert, W.G., and Bundtzen, T.K., 1984, Stratigraphic relationships between Dillinger and Mystic terranes, western Alaska Range, Alaska [abs.]: Geological Society of America Abstracts with Programs, v. 16, p. 286.

Gilbert, W.G., Nye, C.J., and Sherwood, K.W., 1984, Stratigraphy, petrology, and geochemistry of Upper Triassic rocks from the Pingston and McKinley terranes, central Alaska Range: Alaska Division of Geological and Geophysical Surveys Report of Investigation 84-30, 14 p.

Gottschalk, R.R., Jr., 1990, Structural evolution of the schist belt, south-central Brooks Range fold and thrust belt, Alaska: Journal of Structural Geology, v. 12, p. 453-469.

Grantz, Arthur and May, S.D., 1983, Rifting history and structural development of the continental margin north of Alaska, *in* Watkins, J.S. and Drake, C., eds., Continental margin processes: American Association of Petroleum Geologists Memoir 34, p. 77-100.

Grantz, Arthur, Moore, T.E., and Roeske, S.M., 1991, North American Continent-Ocean transect A-3: Gulf of Alasa to Arctic Ocean, Geological Society of America Continental/Ocean Transect A-3: Geological Society of America, Boulder, Colorado, 72 p., 3 sheets, scale 1:500,000.

Grantz, Arthur, Tailleur, I.L., and Carter, Claire, 1983, Tectonic significance of Silurian and Ordovician graptolites from the Lisburne Peninsula, northwest Alaska [abs.]: Geological Society of America Abstracts with Programs, v. 15, no. 5, p. 274.

Haeussler, P.J., 1992, Structural evolution of an arc-basin: The Gravina belt in central southeastern Alaska: Tectonics, v. 11, p. 1245-1265.

Hitzman, M.W., Smith, T.E., and Proffett, J.M., 1982, Bedrock geology of the Ambler district, southwestern Brooks Range, Alaska: Alaska Division of Geologic and Geophysical Surveys, Geologic Report 75, 2 pls., scale 1:63,360.

Hoare, J.M., and Coonrad, W.L., 1978, Geologic map of the Goodnews and Hagemeister Island quadrangles region, southwestern Alaska: U. S. Geological Survey Open-File Report 78-9-B, scale 1:250,000.

Ñ1979, The Kanektok metamorphic complex, a rootless belt of Precambrian rocks in southwestern Alaska, *in* Johnson, K.M., and Williams, J.R., eds., The United States Geological Survey in Alaska: Accomplishments during 1978: U.S. Geological Survey Circular 804-B, p. B72-B74.

Hoare, J.M., and Jones, D.L., 1981, Lower Paleozoic radiolarian chert and associated rocks in the Tikchik Lakes area, southwestern Alaska, *in* Albert, N.R.D., and Hudson, Travis, eds., The United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. 44-45.

Howell, D.G., Johnsson, M.J., Underwood, M.B., Huafu, Lu, and Hillhouse, J.W., 1992, Tectonic evolution of the Kandik region, east-central Alaska: Preliminary interpretations, *in* Bradley, D.C., and Ford, A.B., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1990: U.S. Geological Survey Bulletin 1999, p. 127-140.

Howell, D.G., Jones, D.L., and Schermer, E.R., 1985, Tectonostratigraphic terranes of the Circum-Pacific region: Principles of terrane analysis, *in* Howell, D.G., ed., Tectonostratigraphic terranes of the Circum-Pacific region: Circum-Pacific Council for Energy and Mineral Resources, Houston, Texas, p. 3-31.

Howell, D.G., and Wiley, T.J., 1987, Crustal evolution of northern Alaska inferred from sedimentology and structural relations of the Kandik area: Tectonics, v. 6., p. 619-631.

Hudson, Travis, 1977, Geologic map of Seward Peninsula, Alaska: U.S. Geological Survey Open-File Report 77-796-A, scale 1:1,000,000.

Hudson, Travis, and Plafker, George, 1982, Paleogene metamorphism of an accretionary flysch terrane, eastern Gulf of Alaska: Geological Society of America Bulletin, v. 93, p. 1280-1290.

Imlay, R.W., and Detterman, R.L., 1973, Jurassic paleobiogeography of Alaska: U.S. Geological Survey Professional Paper 801, 34 p.

Johnson, B.R., and Karl, S.M., 1985, Geologic map of western Chichagof and Yakobi Islands, southeastern Alaska: U.S. Geological Survey Map I-1506, 1 sheet, 15 p. pamphlet.

Jones, D.L., Coney, P.J., Harms, T.A., and Dillon, J.T., 1988, Interpretive geologic map and supporting radiolarian data from the Angayucham terrane, Coldfoot area, southern Brooks Range, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1993, 1 sheet, scale 1:63,360.

Jones, D.L., Howell, D.G., Coney, P.J., and Monger, J.W.H., 1983, Recognition, character, and analysis of tectonostratigraphic terranes in western North America, *in* Hashimoto, M., and Uyeda, S., eds., Accretion tectonics in the circum-Pacific regions; proceedings of the Oji International Seminar on Accretion Tectonics, Japan, 1981: Advances in Earth and Planetary Sciences, Tokyo, Terra Scientific Publishing Company, p. 21-35.

Jones, D.L., Silberling, N.J., Berg, H.C., and Plafker, George, 1981, Map showing tectonostratigraphic terranes of Alaska, columnar sections, and summary description of terranes: U.S. Geological Survey Open-File Report 81-792, 20 p., 2 sheets, scale 1:2,500,000.

Jones, D.L., Silberling, N.J., Coney, P.J., and Plafker, George, 1986, Collision tectonics in the Cordillera of western North America:examples from Alaska, *in* Coward, M.P., and Ries, A.C., (eds.), Collision Tectonics:Geological Society Special Publication no. 19, p. 367-387.

Ñ1987, Lithotectonic terrane map of Alaska (West of the 141st Meridan): U.S. Geological Survey Map MF-1874-A, 1 sheet, scale 1:2,500,000.

Jones, D.L., Silberling, N.J., Csejtey, B• la, Jr., Nelson, W.H., and Blome, C.D., 1980, Age and structural significance of ophiolite and adjoining rocks in the Upper Chulitna district, south-central Alaska: U.S. Geological Survey Professional Paper 1121-A, 21 p.

Jones, D.L., Silberling, N.J., Gilbert, Wyatt, and Coney, Peter, 1982, Character, distribution, and tectonic significance of accretionary terranes in the central Alaska Range: Journal of Geophysical Research, v. 87, no. B5, p. 3709-3717.

Jones, D.L., Silberling, N.J., and Hillhouse, J.W., 1977, Wrangellia--a displaced terrane in northwestern North America: Canadian Journal of Earth Sciences, v. 14, p. 2565-2577.

Karl, S.M., 1992, Arc extensional basin geochemical and tectonic affinities for the Maiyumerak basalts in the western Brooks Range, *in* Bradley, D.C., and Ford, A.B., eds., Geologic Studies by the U.S. Geological Survey, 1990: U.S. Geological Survey Bulletin 1999, p. 141-155.

Karl, S.M., and Aleinikoff, J.N., 1990, Proterozoic U-Pb zircon age of granite in the Kallarichuk Hills, western Brooks Range, Alaska: Evidence for PreCambrian basement in the schist belt, *in* Dover, J.H., and Galloway, J.P., eds., Geologica studies in Alaska by the U.S. Geological Survey, 1989: U.S. Geological Survey Bulletin 1946, p. 95-100.

Karl, S.M., Brew, D.A., and Wardlaw, B.R., 1990, Significance of Triassic marble at Nakwasina Sound, southeastern Alaska, *in* Dover, J.H., and Galloway, J.P., eds., Geologic studies in Alaska by the U.S. Geological Survey in 1989: U.S. Geological Survey Bulletin 1946, p. 21-28.

Karl, S.M., Dumoulin, J.A., Ellersieck, Inyo, Harris, A.G., and Schmidt, J.M., 1989, Preliminary geologic map of the Baird Mountains quadrangle, Alaska: U.S. Geological Survey Open-File Report 89-551, 65 p., 1 sheet, scale 1:250,000.

Keith, T.E., Foster, H.L., Foster, R.L., Post, E.V., and Lehmbeck, W.L., 1981, Geology of an alpine-type peridotite in the Mount Sorenson area, east-central Alaska: U.S. Geological Survey Professional Paper 1170-A, 9 p.

Kirschner, C.W., 1988. Map showing sedimentary basins of onshore and continental shelf areas: U.S. Geological Survey Miscellaneous Investigations Series Map I-873, 1 sheet, scale 1:2,500,000.

Lane, H.R., and Ormiston, A.R., 1979, Siluro-Devonian biostratigraphy of the Salmontrout River area, east-central Alaska: Geologica et Palaeontologica, v. 13, p. 39-36.

Loney, R.A., Brew, D.A., Muffler, L.J.P., and Pomeroy, J.S., 1975, Reconnaissance geology of Chichagof, Baranof, and Kruzof Islands, Alaska: U.S. Geological Survey Professional Paper 792, 105 p.

Loney, R.A., and Himmelberg, G.R., 1985, Ophiolite ultramafic rocks of the Jade Mountains-Cosmos Hills area, southwestern Brooks Range, *in* Bartsch-Winkler, Susan, ed., The United States Geological Survey in Alaska: Accomplishments during 1984: U.S. Geological Survey Circular 967, p. 13-15.

Ñ1988, Ultramafic rocks of the Livengood terrane, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic Studies in Alaska the United States Geological Survey during 1987: U.S. Geological Survey Circular 1016, p. 62-70.

Ñ1989, The Kanuti ophiolite, Alaska: Journal of Geophysical Research, v. 94, p. 15,869-15,900.

Lull, J.S., and Plafker, George, 1990, Geochemistry and paleotectonic implications of metabasaltic rocks in the Valdez Group, southern Alaska: U.S. Geological Survey Bulletin 1946, p. 29-38.

McClelland, W.C., and Gehrels, G.E., 1990, Geology of the Duncan Canal shear zone: Evidence for Early to Middle Jurassic deformation of the Alexander terrane, southeastern Alaska: Geological Society of America Bulletin, v. 102, p. 1378-1392.

MacKevett, E.M., Jr., 1978, Geologic map of the McCarthy quadrangle, Alaska: U.S. Geological Survey Miscellaneous Investigations Series Map I-1032, scale 1:250,000.

Martin, A.J., 1970, Structure and tectonic history of the western Brooks Range, De Long Mountains and Lisburne Hills, northern Alaska: Geological Society of America Bulletin, v. 81, p. 3605-3622.

Mayfield, C.F., Tailleur, I.L., and Ellersieck, Inyo, 1988, Stratigraphy, structure, and palinspastic synthesis of the western Brooks Range, northwestern Alaska, *in* Gryc, George, ed., Geology and Exploration of the National Petroleum Reserve in Alaska, 1974 to 1982: U.S. Geological Survey Professional Paper 1399, p. 143-186.

Mayfield, C.F., Tailleur, I.L., Mull, C.G., and Sable, E.G., 1978, Bedrock geologic map of the south half of National Petroleum Reserve in Alaska: U.S. Geological Survey Open-File Report 78-70-B, scale 1:500,000.

McClelland, W.C., and Gehrels, G.E., 1992, Upper Jurassic-Lower Cretaceous basinal strata along the Cordilleran margin: Implications for the accretionary history of the Alexander-Wrangellia-Peninsular terrane: Tectonics, v. 11, p. 832-835.

McClelland, W.C., Gehrels, G.E., Samson, S.D., and Patchett, P.J., 1991, Protolith relations of the Gravina belt and Yukon-Tanana terrane in central southeastern Alaska: Journal of Geology, v. 100, p. 107-123.

Ñ1992, Structural and geochronologic relations along the western flank of the Coast mountains batholith: Stikine River to Cape Fanshaw, central southeastern Alaska: Journal of Structural Geology, v. 14, p. 475-489.

Miller, M.L., Bradshaw, J.Y., Kimbrough, D.L., Stern, T.W., and Bundtzen, T.K., 1991, Isotopic evidence for early Proterozoic age of the Idono Complex, west-central Alaska: Journal of Geology, v. 99, p. 209-223.

Moll-Stalcup, E.J., 1990, Latest Cretaceous and Cenozoic magmatism in mainland Alaska: U.S. Geological Survey Open-File Report 90-84, 80 p.

Monger, J.W.H., and Berg, H.C., 1987, Lithotectonic terrane map of western Canada and southeastern Alaska: U.S. Geological Survey Map MF-1874-B, one sheet, 12 p.

Monger, J.W.H., Price, R.A., and Tempelman-Kluit, D.J., 1982, Tectonic accretion and the origin of the two major metamorphic and plutonic weilts in the Canadian Cordillera: Geology, v.10, p. 70-75.

Moore, J.C., Byrne, T., Plumley, P.W., Reid, M., Gibbons, H., and Coe, R.S., 1983, Paleogene evolution of the Kodiak Islands, Alaska: Consequences of ridge-trench interaction in a more southerly latitude: Tectonics, v. 2, p. 265-293.

Moore, T.E., 1992, The Arctic Alaska superterrane, *in* Bradley, D.C., and Dusel-Bacon, Cynthia, eds., Geologic studies in Alaska by the U.S. Geological Survey, 1991: U.S. Geological Survey Bulletin 2041, p. 238-244

Moore, T.E., and Mull, Gil, 1989, Geology of the Brooks Range and North Slope, *in* Nokleberg, W.J., and Fisher, M.A., eds., Alaskan Geological and Geophysical Transect: Field Trip Guidebook T104, 28th International Geological Congress, p. 107-131.

Moore, T.E, and Murphy, J.M., 1989, Nature of the basal contact of the Tozitna terrane along the Dalton Highway, northeast Tanana quadrangle, Alaska, *in* Dover, J.H., and Galloway, J.P., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1988: U.S. Geological Survey Bulletin 1903, p. 46-53.

Moore, T.E., and Nokleberg, W.J., 1988, Stratigraphy, sedimentology, and structure of the Wickersham terrane in the Cache Mountain area, east-central Alaska, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic Studies in Alaska the United States Geological Survey during 1987: U.S. Geological Survey Circular 1016, p. 75-80.

Moore, T.E., Wallace, W.K., Bird, K.J., Karl, S.M., Mull, C.G., and Dillon, J.T., 1992, Stratigraphy, structure, and geologic synthesis of northern Alaska: U.S. Geological Survey Open-File Report 92-330, 283 p, 1 plate.

Monger, J.W.H., and Berg, H.C., 1987, Lithotectonic terrane map of western Canada and southeastern Alaska: U. S. Geological Survey Miscellaneous Field Studies Map MF-1874-B, 1 sheet, scale 1:2,500,000, 12 p.

Mull, C.G., Tailleur, I.L., Mayfield, C.F., Ellersieck, Inyo, and Curtis, S.M., 1982, New upper Paleozoic and Lower Mesozoic stratigraphic units, central and western Brooks Range, Alaska: American Association of Petroleum Geologists Bulletin, v. 66, p. 348-362.

Murchey, Benita, and Harris, A.G., 1985, Devonian to Jurassic sedimentary rocks in the Angayucham Mountains of Alaska; possible seamount or oceanic plateau deposits [abs.]: Eos, v. 66, p. 1102.

Murchey, Benita L., Jones, David L., Holdsworth, Brian K., and Wardlaw, Bruce R., 1988, Distribution patterns of facies, radiolarians, and conodonts in the Mississippian to Jurassic Siliceous rocks of the northern Brooks Range, Alaska: U.S. Geological Survey Professional Paper 1399, p. 697-724.

0Murphy, J.M., 1987, Early Cretaceous cessation of terrane accretion, northern Eek Mountains, southwestern Alaska, *in* Hamilton, T.D., and Galloway, J.P., eds., Geologic Studies in Alaska by the U.S. Geological Survey during 1986: U.S. Geological Survey Circular 998, p. 83-85.

Murphy, J.M., and Patton, W.W., Jr., 1988, Geologic setting and petrography of the phyllite and metagraywacke thrust panel, north-central Alaska, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic studies in Alaska by the U.S. Geological Survey during 1987:U.S. Geological Survey Circular 1016, p 104-108.

Nelson, S.W., 1992, Ophiolitic complexes for the Gulf of Alaska: U.S. Geological Survey Open-File Report 92-20C, 10 p.

Nelson, S.W., Dumoulin, J.A., and Miller, M.L., 1985, Geologic map of the Chugach National Forest, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1645-B, 16 p., 1 sheet, scale 1:250,000.

Nichols, K.M., and Silberling, N.J., 1979, Early Triassic (Smithian) ammonites of paleoequatorial affinity from the Chulitna terrane, south-central Alaska: U.S. Geological Survey Professional Paper 1121-B, p. B1-B25.

Nilsen, T.H., 1981, Upper Devonian and Lower Mississippian redbeds, Brooks Range, Alaska, *in* Miall, A.D., ed, Sedimentation and tectonics in alluvial basins: Geological Association of Canada Special Paper 23, p. 187-219.

Ñ1989, Stratigraphy and sedimentology of the mid-Cretaceous deposits of the Yukon-Koyukuk basin, west-central Alaska: Journal of Geophysical Research, v. 94, p. 15,925-15,940.

Nokleberg, W.J., Aleinikoff, J.N. Lange, I.M., Silva, S.R., Miyaoka, R.T., Schwab, C.E., and Zehner, R.E., 1992, Preliminary geologic map of the Mount Hayes quadrangle, eastern Alaska Range, Alaska: U.S. Geological Survey Open-File Report 92-594, 1 sheet, scale 1:250,000, 39 p.

Nokleberg, W.J., Foster, H.L., and Aleinikoff, J.N., 1989a, Geology of the northern Copper River Basin, eastern Alaska Range, and southern Yukon-Tanana Basin, southern and east-central Alaska, *in* Nokleberg, W.J., and Fisher, M.A., eds., Alaskan Geological and Geophysical Transect: Field Trip Guidebook T104, 28th International Geological Congress, p. 34 to 63.

Nokleberg, W.J., Jones, D.L., and Silberling, N.J., 1985, Origin, migration, and accretion of Andean-type arc and island arc tectonostratigraphic terranes in the southern Mount Hayes quadrangle and adjacent areas of the eastern Alaska Range, Alaska: Geological Society of America Bulletin, v. 96, p. 1251-1270.

Nokleberg, W.J., Plafker, George, Lull, J.S., Wallace, W.K., and Winkler, G.W., 1989b, Structural analysis of the southern Peninsular, southern Wrangellia, and northern Chugach terranes along the Trans-Alaskan Crustal Transect (TACT), northern Chugach Mountains, Alaska: Journal of Geophysical Research, v. 94, p. 4297-5320.

Nokleberg, W.J., and Winkler, G.R., 1982, Stratiform zinc-lead deposits in the Drenchwater Creek area, Howard Pass quadrangle, northwestern Brooks Range, Alaska: U.S. Geological Survey Professional Paper 1209, 22 p.

Pallister, J.S., Budahn, J.R., and Murchey, B.L., 1989, Pillow basalts of the Angayucham terrane: Oceanic plateau and island crust accreted to the Brooks Range: Journal of Geophysical Research, v. 94, p. 15,901-15,924.

Pallister, J.S., and Carlson, Christine, 1988, Bedrock geologic map of the Angayucham Mountains, Alaska: U.S.

Geological Survey Miscellaneous Field Studies Map MF-2024, 1 sheet, scale 1:63,360.
Palmer, A.R., 1983, The Decade of North American Geology 1983 Geologic Time Scale: Geology, v. 11, no. 9, p. 503-504.
Palmer, A.R., Egbert, R.M., Sullivan, R., and Knoth, J.S., 1985, Cambrian trilobites with Siberian affinities, southwestern Alaska [abs.]: American Association of Petroleum Geologists Bulletin, v. 69, p. 295.
Patton, W.W., Jr., 1973, Reconnaissance geology of the northern Yukon-Koyukuk Province, Alaska: U.S. Geological Survey Professional Paper 774-A,
Ñ1991, Deep crustal composition of the Yukon-Koyukuk basin, Alaska [abs.]: Geological Society of America Abstracts with Programs, v. 23, p. 88.
Ñ1992a, Ophiolitic terrane of western Brooks Range, Alaska: U.S. Geological Survey Open-File Report 92-90D, 8 p.
Ñ1992b, Ophiolitic terrane bordering the Yukon-Koyukuk basin, Alaska: U.S. Geological Survey Open-File Report 92-90F, 8 p.
Patton, W.W., Jr., Box, S.E., Moll-Stalcup, E.J., and Miller, T.P., 1989, Geology of west-central Alaska: U.S. Geological Survey Open-File Report 89-554, 53 p.
Patton, W.W., Jr., Moll, E.J., Dutro, J.T., Jr., Silberman, M.L., and Chapman, R.M., 1980, Preliminary geologic map of Medfra quadrangle, Alaska: U.S. Geological Survey Open-File Report 80-811-A, scale 1:250,000.
Patton, W.W., Jr., Murphy, J.M., Burns, L.E., Nelson, S.W., and Box, S.E., 1992, Geologic map of ophiolitic and associated volcanic arc and metamorphic terranes of Alaska (west of the 141st meridian): U.S. Geological Survey Open-File Report 92-20A, 1 sheet, scale 1:2,500,000.
Patton, W.W., Jr., Stern, T.W., Arth, J.G., and Carlson, Christine, 1987, New U/Pb ages from granite and granite gneiss in the Ruby geanticline and southern Brooks Range, Alaska: Journal of Geology, v. 95, p. 118-126.
Patton, W.W., Jr., Tailleur, I.L., Brosg• , W.P., and Lanphere, M.A., 1977, Preliminary report on ophiolites of northern and western Alaska, *in* Coleman, R.G., and Irwin, W.P., eds., North American ophiolites: Oregon Department of Geology and Mineral Industries Bulletin 95, p. 51-57.
Pavlis, T.L., 1983, Pre-Cretaceous crystalline rocks of the western Chugach Mountains, Alaska: Nature of the basement of the Jurassic Peninsular terrane: Geological Society of America Bulletin, v. 94, p. 1329-1344.
Pavlis, T.L., Sisson, V.B., Foster, H.L., Nokleberg, W.J., and Plafker, George, 1993, Mid-Cretaceous extension tectonics of the Yukon-Tanana terrane, Trans-Alaskan Crustal Transect (TACT), east-central Alaska: Tectonics, p 103-122.
Pessel, G.H., Reifenstuhl, R.R., and Albanese, M.D., 1987, Regional geology, Chapter 2, *in* Smith, T.E., Pessel, G.H., and Wiltse, M.A., eds., Mineral assessment of the Lime Peak-Mt. Prindle area, Alaska, Volume 1, Alaska Division Geological and Geophysical Surveys, Fairbanks, Alaska, p. 2-1 to 2-41.
Plafker, George, 1987, Regional geology and petroleum potential of the northern Gulf of Alaska continental margin, *in* Scholl, D.W., Grantz, Arthur, and Vedder, J.G., eds., Geology and resource potential of the continental margin of western North America and adjacent ocean basins: Circum-Pacific Council for Energy and Mineral Resources Earth Science Seires, v. 6, p. 11/1-11/38.
Ñ1990, Regional geology and tectonic evolution of Alaska and adjacent parts of the northeast Pacific ocean margin: Proceedings of the Pacific Rim Congress 90, Australasian Insitute of Mining and Metallurgy, Queensland, Australia, p. 841-853.
Plafker, George, Blome, C.D., and Silberling, N.J., 1989a, Reinterpretation of lower Mesozoic rocks on the Chilkat Peninsula, Alaska, as a displaced fragment of Wrangellia: Geology, v. 17, p. 3-6.
Plafker, George, Nokleberg, W.J., and Lull, J.S., 1989b, Bedrock geology and tectonic evolution of the Wrangellia, Peninsular, and Chugach terranes along the Trans-Alaskan Crustal Transect in the northern Chugach Mountains and southern Copper River basin, Alaska: Journal of Geophysical Research, p. 4255-4295.
Reed, B.L., and Nelson, S.W., 1980, Geologic map of the Talkeetna quadrangle, Alaska: U.S. Geological Survey Miscellaneous Investigations Map I-1174A, 15 p., scale 1:250,000.
Richards, M.A., Jones, D.L., Duncan, T.A., and DePaolo, D.J., 1991, A mantle plume initiation model for the formation of Wrangellia and others oceanic flood basalt plateaus, Science, v. 254, p. 263-267.
Richter, D.H., 1976, Geologic map of the Nabesna quadrangle, Alaska: U.S. Geological Survey Miscellaneous Investigations Map Series I-932, scale 1:250,000.
Richter, D.H., Lanphere, M.A., and Matson, N.A., Jr., 1975, Granitic plutonism and metamorphism, eastern Alaska Range, Alaska: Geological Society of America Bulletin, v. 86. p. 819-829.
Riehle, J.R., Brew, D.A., and Lanphere, M.A., 1989, Geologic map of the Mount Edgecumbe volcanic field, Kruzof Island, southeastern Alaska: U.S. Geological Survey Miscellaneous Field Investigations Map I-1983, scale 1:63,360.
Roeske, S.M., Mattinson, J.M., and Armstrong, R.L., 1989, Isotopic ages of glaucophane schists on the Kodiak Islands, southern Alaska, and their implications for the Mesozoic tectonic history of the Border Ranges fault system: Geological Society of America Bulletin, v. 101, p. 1021-1037.
Rubin, C.M., and Saleeby, J.B., 1991, Tectonic framework of the upper Paleozoic and lower Mesozoic Alava sequence: a revised view of the polygenetic Taku terrane in southern southeast Alaska: Canadian Journal of Earth Sciences, v. 28, p.881-893.
Sainsbury, C.L., 1969, Geology and ore deposits of the central York Mountains, western Seward Peninsula, Alaska: U.S. Geological Survey Bulletin 1287, 101 p.
Saleeby, J.B., and Rubin, C.M., 1990, The East Behm Canal gneiss complex (southern southeast Alaska) and some insights into basement tectonics along the Insular suture

belt [abs.]: Geological Association of Canada, Program with Abstracts, v. 15, p. A116.

Samson, S.D., Patchett, P.J., McClelland, W.C., and Gehrels, G.E., 1991, Nd and Sr isotopic constraints on the petrogenesis of the west side of the northern Coast Mountains batholith, Alaska and Canadian Cordillera: Canadian Journal of Earth Sciences, v. 28, p. 939-946.

Silberling, N.J., Richter, D.H., Jones, D.L., and Coney, P.C., 1981, Geologic map of the bedrock part of the Healy A-1 quadrangle south of the Talkeetna-Broxson Gulch fault system, Clearwater Mountains, Alaska: U.S. Geological Survey Open-File Report 81-1288, scale 1:63,360.

Silberling, N.J., Jones, D.L., Monger, J.W.H., and Coney, P.J., 1992, Lithotectonic terrane map of the North American Cordillera: U.S. Geological Survey Miscellaneous Investigations Series Map I-2176, 2 sheets, scale 1:5,000,000.

Sisson, V.B., Hollister, L.S., and Onstott, T.C., 1989, Petrologic and age constraints on the origin of a low-pressure/high-temperature metamorphic complex, southern Alaska: Journal of Geophysical Research, v. 94, p. 4392-4410.

Smith, T.E., 1981, Geology of the Clearwater Mountains, south-central Alaska: Alaska Division of Geological and Geophysical Surveys Geologic Report 60, 72 p., 1 sheet, scale 1:63,360.

Souther, J.G., 1971, Geology and mineral deposits of Tulsequah map area, British Columbia, Geological Survey of Canada Memoir 362, 45 p.

Stanley, W.D., Labson, V.F., Nokleberg, W.J., Csejtey, B• la, Jr., and Fisher, M.A., 1990, The Denali fault system and Alaska Range of Alaska: Evidence for suturing and thin-skinned tectonics from magnetotellurics: Geological Society of America Bulletin, v. 102, p. 160-173.

Tailleur, I.L., Mayfield, C.F., and Ellersieck, I.F., 1977, Late Paleozoic sedimentary sequence, southwestern Brooks Range, *in* Blean, K.M., ed., The United States Geological Survey in Alaska: Accomplishments during 1976: U.S.G.S. Circular 751-B, p. B25-B27.

Till, A.B., Schmidt, J.M., and Nelson, S.W., 1988, Thrust involvement of metamorphic rocks, southwestern Brooks Range, Alaska:Geology, v. 10, p. 930-933.

Turner, D.L., Forbes, R.B., Aleinikoff, J.N., Hedge, C.E., and McDougall, I., 1983, Geochronology of the Kilbuck terrane in southwestern Alaska [abs.]: Geological Society of America Abstracts with Programs, v. 15., p. 407.

Turner, D.L., Herreid, Gordon, and Bundtzen, T.K., 1977, Geochronogy of southern Prince of Wales Island: Alaska Division of Geological and Geophysical Surveys Report 55, p. 11-20.

Tysdal, R.G., and Case, J.E., 1979, Geologic map of the Seward and Blying Sound quadrangles, Alaska: U.S. Geological Survey Miscellaneous Investigations Map Series I-1150, scale 1:250,000.

Wallace, W.K., Hanks, C.L., and Rogers, J.F., 1989, The southern Kahiltna terrane: Implications for the tectonic evolution of southwestern Alaska: Geological Society of America Bulletin, v. 101, p. 1389-1407.

Weber, F.R., McCammon, R.B., Rinehart, C.D., Light, T.D., and Wheeler, K.L., 1988, Geology and mineral resources of the White Mountains National Recreation area, east-central Alaska:U.S. Geological Survey Open-File Report 88-284, 234 p., 23 plates.

Weber, F.R., Smith, T.E., Hall, M.H., and Forbes, R.B., 1985, Geologic guide to the Fairbanks-Livengood area, east-central Alaska:Alaska Geological Society, Anchorage, Alaska, 45 p.

Weber, F.R., Wheeler, K.L., Rinehart, C.D., Chapman, R.M., and Blodgett, R.B., 1992, Geologic map of the Livengood quadrangle, Alaska: U.S. Geological Survey Open-File Report 92-562, 1 sheet, scale 1:250,000, 20 p.

Wheeler, J.O., and McFeeley, P., 1991, Tectonic assemblage map of the Canadian Cordillera and adjacent parts of the United States of America: Geological Survey of Canada Map 1712A, 3 sheets, scale 1:2,000,000.

Wirth, K.R., Harding, D.J., Blythe, A.E., and Bird, J.M., 1986, Brooks Range ophiolite crystallization and emplacement ages from $^{40}Ar/^{39}Ar$ data [abs.]: Geological Society of America Abstracts with Programs, v. 18, p. 792.