Reconnaissance bedrock geologic map for the northern Alaska Peninsula area, southwest Alaska

Including the Dillingham, Iliamna, Lake Clark, Taylor Mountains and the western part of the Kenai and Seldovia 1:250,000-scale quadrangles

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Abstract

The area of this geologic map, nominally called the northern Alaska Peninsula, is a region of transition from the classic magmatic arc geology of the Alaska Peninsula to the accretionary geology of southcentral Alaska, and to the poorly understood, tectonically complex sedimentary basins of southwest Alaska. Physiographically, the map area ranges from the high glaciated mountains of the Alaska-Aleutian Range to the coastal lowlands of the west side of Cook Inlet and northern Bristol Bay. Lower glaciated mountains and the finger lakes of the west side of the map area show strong effects from Pleistocene and Holocene glaciation. Structurally, the map area is cut by a number of major faults and postulated faults. Most important of these are the Bruin Bay, Lake Clark and Holitna faults. The Bruin Bay fault parallels the coast of Cook Inlet. The Lake Clark fault cuts diagonally from northeast to southwest across the eastern part of the map area. In the extreme northwest part of the map area, the Holitna Fault cuts surficial deposits, indicating it is presently active.

The rocks of this map area consist of distinctive packages assigned to 3 provinces and younger sedimentary and igneous rocks not assigned to a province. The oldest rocks of the map area, the Lime Hills province, occur in the north central part of the map area and largely are Proterozoic and early Paleozoic carbonate rocks. The western part of the map area, the Ahklun Mountains province, consists of Mesozoic and Paleozoic rocks including abundant chert, argillite, and graywacke and lesser limestone, basalt, and tectonic melange. Much of the eastern half of the map area lies in the Alaska-Aleutian Range province. The early Tertiary to Jurassic Alaska-Aleutian Range batholith and derivative Jurassic sedimentary rocks of the Tuxedni Group and younger sequences form the core of this province, which is intruded and overlain by the volcanic rocks of the Aleutian magmatic arc. The most extensively exposed map unit in the area is the Kuskokwim Group, an Upper Cretaceous turbidite sequence that bounds all three provinces in the west-central part of the map area. Widely dispersed latest Cretaceous and (or) early Tertiary granitic rocks intrude most rock units west of the crest of the Alaska-Aleutian Range.

Introduction and Previous work

This geologic map, showing an area nominally called the northern Alaska Peninsula, is located on the west side of Cook Inlet and north of Bristol Bay. It is a region of transition from the classic magmatic arc geology of the Alaska Peninsula to the accretionary geology of southcentral and southwest Alaska, and to the poorly understood, tectonically complex sedimentary basins of southwest Alaska. A wide range of sources were used to construct this map, ranging from the published mapping of Robert Detterman and others in the Iliamna and Kenai quadrangles (Detterman and Hartsock, 1966; Detterman and Reed, 1973; 1980, Magoon and others, 1976) to unpublished mapping of J.N. Platt and E.H. Muller in the Taylor Mountains (J.N. Platt, 1957, unpub. data) and Dillingham quadrangles (J.N. Platt and E.H. Muller, 1958, unpub. data). Field notes of J.M. Hoare and W.H. Condon (1969-1970) were especially useful in the western Taylor Mountains and Dillingham quadrangles. Early mapping by J.B. Mertie and P.A. Davison in the 1930’s (Mertie, 1938) laid the general framework for the region; subsequent mapping by Cady and others (1955) filled in parts of that framework. Re-examination of the field notes of Mertie, Davison, Hoare, Condon, and W.L. Coonrad helped define a number of the map units in the western part of the area. Limited new field mapping was conducted as part of this compilation effort (for example, Blodgett and Wilson, 2001; Wilson and others, 2003) and extensive photo interpretative work has also contributed to this product. W.K. Wallace graciously provided field maps from his work in the region during the 1980’s. Papers on the plutonic rocks by B.L. Reed and his coworkers provided the basis for much of the map in the Alaska-Aleutian Range (Reed and Lanphere, 1969; 1972; 1973). Studies around Redoubt and Iliamna Volcanoes (Till and others, 1993; Waythomas and Miller, 1999) also contributed. However, new mapping underway at the time of this compilation is not included here.

In the course of this project, a photo interpretive surficial geologic map for the region and especially Lake Clark National Park and Preserve was produced (Wilson and Preller, 2003; F.H. Wilson and T.K. Bundtzen, 2006, unpub. data). As a result, areas of apparent bedrock exposure were noted not shown on available bedrock maps. In the lowlands of the western Lake Clark quadrangle, it appears that not all of these were examined during the resource assessment studies of Nelson and others (1983). In general, our assignment of a bedrock rock unit to these previous unmapped in the Lake Clark quadrangle is based on extrapolation of the outcrop patterns of Nelson and others (1983) and Eakins and others (1978) maps as well as data from W.K. Wallace (Wallace and others, 1989; Wallace, written commun., 2003), and additional interpretation by the authors of this map. In the Taylor Mountains and Dillingham quadrangle, previously unmapped apparent bedrock exposures, where appropriate, are assigned to map units based on outcrop patterns from Hoare and Coonrad (1978) as well as the unpublished mapping of J.N. Platt and E.H. Muller of the USGS dating from the 1950’s (J.N. Platt, 1957, unpub. data and J.N. Platt and E.H. Muller, 1958, unpub. data).

In 1998, the USGS published a geologic compilation of central or Interior Alaska (Wilson and others, 1998) that brought together mapping of 25 1:250,000-scale quadrangles in a preliminary manner. Later, digital data for a modern geologic map of the Alaska Peninsula was released (Wilson and others, 1999). This Alaska Peninsula map (Wilson and others, in press) represents the compiled results of a concerted 10-15 year mapping effort on the Alaska Peninsula (see Detterman and others, 1996). The present map has been constructed in part, with the intention of providing a join between these previous two maps. Every effort has been made to provide consistent and coherent geologic units and interpretation such that geologic units are carried across the boundaries between these three maps without break. Due to the quality of mapping, this correlation was easiest with the Alaska Peninsula map; the reconnaissance nature of much of the mapping in the southwest part of the central Alaska map (Wilson and others, 1998) means that the correlations are more general.

Geographic, Geologic, and Physiographic Framework

Physiographically, the map area ranges from the high glaciated mountains of the Alaska-Aleutian Range to the coastal lowlands of the west side of Cook Inlet and northern Bristol Bay. Lower glaciated mountains and the finger lakes of the west side of the map area also show extensive terrain modification from Pleistocene and Holocene glaciation. In particular, the finger lakes of Wood-Tikchik State Park are well-developed landlocked fjords. Extensive glacial deposits provide abundant evidence for the glaciers and the two ice caps that are thought to have covered much of eastern and western parts of the map area and probably coalesced in the early Pleistocene on the Bristol Bay lowlands. North of the lowlands, the west central part of the map area consists of heavily vegetated rolling hills that may be covered by local accumulations of eolian deposits including loess. Originally interpreted as never glaciated (see for example, Pèwè, 1975), extensive evidence from air-photo interpretation suggests the past presence of local alpine glaciers, small ice-caps and large ephemeral glacial lakes, most likely of pre-Late Wisconsin age and probably of pre-Wisconsin age (F.H. Wilson, unpub. data; Wilson, 2006). Glacial erratics that suggest an extremely old and areally extensive glaciation are found on many ridges in the eastern Taylor Mountains and Dillingham 1:250,000-scale quadrangles (M.L. Miller, personal commun., 2005; F.H. Wilson, 1999-2006, unpub. data).

Prominent physiographic features in the map area are the volcanoes of the modern Aleutian arc; Iliamna and Redoubt Volcanoes are the highest mountains in the map area, Augustine Volcano, though much smaller, is distinctive because it is an island. Other volcanic centers, such as Double Glacier Volcano (Reed and others, 1992) and the reported center named “Black” near Black Peak (Coats, 1950) are also part of the modern arc but do not form prominent features. In fact, Black is yet to be located following Coats’ (1950) report. But, the dominant geologic feature of the eastern part of the map area is the Alaska-Aleutian Range batholith of Reed and Lanphere (1973) which forms the backbone of the Alaska-Aleutian Range in the map area. The volcanoes are emplaced on top of this backbone and young volcanic rocks represent only a small fraction of the bedrock even in the immediate vicinity of these volcanoes. Bedrock east of the batholith along the Cook Inlet coast consists of the Talkeetna Formation and overlying Jurassic sedimentary rocks of the Tuxedni Group and other sedimentary rock units as young as Tertiary (Detterman and Hartsock, 1966; Detterman and Reed, 1980; Nelson and others, 1983). The rocks of the Alaska-Aleutian Range at this latitude are characteristic of the Alaska Peninsula terrane (Wilson and others, 1985; Wilson and others, in press; 1999) where the batholith and roof pendants form the Iliamna sub-terrane and the sedimentary rocks are typical of the Chignik sub-terrane.

Immediately west of the batholith is a poorly defined sequence(?) of Mesozoic sedimentary and igneous rocks intruded by latest Cretaceous and early Tertiary granitic plutons and locally overlain by early Tertiary volcanic rocks (Nelson and others, 1983; Wallace and others, 1989; Wilson and others, 2003). These rocks have been variously associated with the Southern Kahiltna terrane of Wallace and others (1989), the Kuskokwim Group (Decker and others, 1994), and the Kahiltna flysch of central Alaska (Wilson and others, 1998). On this map, these rocks are included in the informally defined Jurassic and Cretaceous Koksetna River sequence of Wallace and others (1989), which gives way to rocks confidently mapped as the Kuskokwim Group. However, the exact location of this transition is difficult to place with available data. Eakins and others (1983) mapped two Cretaceous-Jurassic clastic units (KJs and KJsh), which correspond well with the Kuskokwim Group and Koksetna River sequence (of Wallace and others, 1989) rock units as shown by W.K. Wallace (written communication, 2004). Also widely distributed west of the batholith are latest Cretaceous and early Tertiary granitic plutons (Wilson, 1977; Wilson and others, 2003), some of which have been shown to be peralkaline.

The westernmost part of the map area consists of a complex assemblage of Paleozoic and Mesozoic volcanic and sedimentary rocks and melange traditionally assigned to the Gemuk Group. Originally somewhat loosely defined in the 1950’s in the northwestern Taylor Mountains quadrangle and southward (Cady and others, 1955), the Gemuk Group was subsequently extended areally (Hoare and Coonrad, 1959a, b, 1961; J.N. Platt, 1957, unpub. data and J.N. Platt and E.H. Muller, 1958, unpub. data) so as to become a catch-all unit for many rocks in southwest Alaska ranging in age from Paleozoic to Cretaceous. Wilson and Coonrad (2005) discussed the history of usage of the term Gemuk Group and formally abandoned the Gemuk Group as a stratigraphic unit and term; rocks that were traditionally included in this unit were assigned to the Togiak-Tikchik Complex. Within this map area, rocks ranging in age from early Paleozoic to Cretaceous are included in the Togiak-Tikchik Complex, a structural assemblage of a variety of rock units; rudimentary sub-division of these rocks into informal rock units is made here on the basis of available data, especially the field notes of J.M. Hoare and W.H. Condon.

In the north central part of the map area, lower Paleozoic carbonate rocks, assigned to the Farewell terrane of Decker and others (1994), extend into the map area from the Lime Hills and Sleetmute quadrangles to the north (Blodgett and Wilson, 2001; Blodgett and others, in press). Immediately south of these rocks is a narrow belt of Late Triassic to Jurassic siliciclastic carbonate rocks of the same age as, but having a distinct faunal signature relative to the Kamishak Formation and overlying clastic rocks (R.B. Blodgett, 2005, unpub. data).

Structurally, the map area is cut by a number of major faults and postulated faults, in addition to many faults mapped only locally. The Lake Clark fault (Detterman and others, 1976) is an important feature cutting diagonally from northeast to southwest across the eastern part of the map area; available data does not indicate its fate southwest of Lake Clark. Haeussler and Saltus (2005) postulated 26 km of right-lateral offset since late Eocene time along the Lake Clark fault on the basis of offset magnetic anomalies. They also postulate 11 km of right-lateral offset on a fault they name the Telequana fault that lies about 35 km northwest and strikes parallel to the Lake Clark fault.

In the extreme northwest part of the map area, the Holitna Fault, has long been considered an extension of the Denali Fault system of central Alaska. Field maps of J.M. Hoare and W.H. Condon (1969, 1970, unpub. data) indicate northwest side up and right-lateral offset. Cady and others (1955) indicated that a high-angle reverse sense of motion. The fault trace cuts surficial deposits and indicates it is presently active (F.H. Wilson, 2006, unpub. data). Offset along this fault is traditionally considered to have a right-lateral sense of motion (see for example Decker and others, 1994); however, a recent aeromagnetic survey (Saltus and Milicevic, 2004) could be interpreted to indicate left-lateral displacement.

The so-called Mulchatna fault lies between the Lake Clark and Holitna faults (Beikman, 1980). However, other than a topographic linear, there is little solid geologic evidence to support its existence or to indicate offset across the trace of the linear. Mohadjer and others (2006) examined available geologic and geophysical data in the vicinity of the fault and found little evidence to support the existence of a fault along the topographic linear. However, the gravity data, as well as mapping by Wallace and others (1989) support the existence of a low-angle, west-dipping contact, which Wallace and others (1989) map as a thrust fault, between the rocks of the Kuskokwim Group and the Koksetna River sequence of Wallace and others (1989). The aeromagnetic data for the Lake Clark quadrangle (Case and Nelson, 1986), in combination with recently completed aeromagnetic surveys of the Dillingham and Taylor Mountains quadrangles (U.S. Geological Survey, 2002; Saltus and Milicevic, 2004) show a definitive magnetic discontinuity along the topographic linear, however the measured magnetic susceptibility of the exposed rocks do not match the survey data, suggesting a buried strong magnetic source west of the trace.

The Bruin Bay fault, another major fault system, is sub-parallel to the Cook Inlet coast east of the Alaska-Aleutian Range batholith and separates the batholith from sedimentary rocks derived from erosion of the batholith and overlying volcanic rocks of the Talkeetna magmatic arc. The sense of motion on the Bruin Bay fault is high-angle reverse and may have left-lateral offset (Detterman and Hartsock, 1966). It was a growth fault during deposition of the Jurassic sedimentary sequence and has approximately 3 km of stratigraphic throw (Detterman and Hartsock, 1966).

Geologic discussion

The rocks of this map area consist of a number of distinctive packages or terranes. For presentation and discussion they are divided here into 3 provinces, separated by mostly younger rocks and extensive surficial cover. From west to east, these provinces are the Ahklun Mountains province along the western margin of the map, the Lime Hills province, near the western part of northern margin of the map, and the Alaska-Aleutian Range province, constituting the eastern half of the map. These provinces are not to be confused with tectonostratigraphic terranes; in broad extent outside the map area, each may constitute multiple terranes (see Decker and others, 1994, and Plafker and others, 1994). The geology of each of the provinces consists of distinctive stratigraphic units; however, the nature of the boundaries between the provinces is not known. There are also a number of map units that either occur in all of the provinces, or in the case of the Kuskokwim Group flysch, seem to overlie all three provinces.

A number of distinctive Lower Jurassic and Triassic carbonate rock units occur within the map area. Most of these units also have associated chert. The Kamishak Formation, of Late Triassic, Norian age is the best described and has the most extensive area of exposure on the east side of the map area. Associated with the Chilikadrotna Greenstone of the central Lake Clark quadrangle are thin slivers of a similar age limestone, which is shown on this map as part of the Kamishak Formation. However, these rocks are faunally distinct from the Kamishak Formation. Along the periphery of the Paleozoic carbonate rocks of the Farewell terrane of Decker and others (1994) in the northeast Taylor Mountains quadrangle are Lower Jurassic and Triassic carbonate and chert units intercalated with Paleozoic rocks. In the northwestern Taylor Mountains quadrangle, Triassic carbonate rocks are associated with mafic volcanic rocks formerly assigned to the Gemuk Group and now part of the Togiak-Tikchik Complex. Finally, in the southern exposures of the Togiak-Tikchik Complex in the southwestern Taylor Mountains and northwestern Dillingham quadrangle are small exposures of Triassic limestone associated with the Paleozoic chert of the Tikchik Lakes region. All of these units, but the Lower Jurassic one, contain Triassic faunas of Norian age; however, the faunas differ between the units, suggesting different depositional environments or points of origin (R.B. Blodgett, unpub. data).

Ahklun Mountains province

The Ahklun Mountains province consists of Mesozoic and Paleozoic rocks variously assigned to multiple terranes (Box and others, 1993; Decker and others, 1994). These rocks were originally mapped as the now abandoned Gemuk Group (Cady and others, 1955; Hoare and Coonrad, 1959a, 1959b, 1961a, 1961b, J.N. Platt, 1957, unpub. data and J.N. Platt and E.H. Muller, 1958, unpub. data). The name Gemuk Group was abandoned by Wilson and Coonrad (2005) and the assemblage of lithologies re-described and renamed the Togiak-Tikchik Complex, recognizing that the rock units constitute a structural assemblage of poorly known lithologic packages. In the map area, these rocks include abundant chert and graywacke and lesser limestone, basalt, and other volcanic and sedimentary rocks. We have subdivided these rocks on the basis of field notes by J.M. Hoare, W.L. Coonrad, and W.H. Condon dating from 1953 through 1970[1]. Hoare and Coonrad (1978) placed these rocks in the southwestern Taylor Mountains and northwestern Dillingham quadrangles, as well as the western Goodnews Bay quadrangle, in their MzPz unit to which they gave an age range of early Ordovician to Early Cretaceous and included a wide range of lithologies. We have attempted to subdivide it here into lithologic packages; in general, the nature of the boundaries between the lithologic units is not known and clarification of this awaits further mapping. One of the lithologic packages is a melange that includes blocks of the same lithologies in the other subdivisions. Due to the reconnaissance nature of the data, presentation of the lithologic packages as shown in the vicinity of the Tikchik Lakes has to be considered at best schematic.

Lime Hills province

The oldest rocks of the map area occur in the Lime Hills province of the north central part of the map area. These consist of Proterozoic and early Paleozoic carbonate rocks of the Farewell terrane (Decker and others, 1994) best exposed in the Sleetmute and Lime Hills quadrangles north of the map area (Wilson and others, 1998; Blodgett and others, in press [SM A-2]). Proterozoic and Paleozoic rocks of this section extend a short distance into the Taylor Mountains quadrangle. In the northeast Taylor Mountains quadrangle, these rocks are of Neoproterozoic to Silurian age (Blodgett and Wilson, 2001) and contain fossils of Siberian affinity (Palmer and others, 1985; Blodgett, 1998; Blodgett and others, 1999; Blodgett and others, 2002; Dumoulin and others, 2002). Southwest of these rocks, across an abrupt transition that is modified by imbricate thrust faults, Triassic and early Jurassic carbonate and siliciclastic rocks occur in a narrow (~500 m wide) belt, about 15-km-long, trending northwest to southeast. Within the exposure area of the Silurian algal boundstone (map unit Sab), slivers of the Jurassic siliciclastic rocks are thrust imbricated; however, this imbrication occurs at a scale too small to show on this map or the inset map. Lithologically and faunally similar Triassic siliceous carbonate rocks have

[1] Accompanying the digital files of this report is a database which includes the descriptions from the field notes and the unit we assigned to the sample site.

been found on the north shore of Lake Iliamna in the Iliamna quadrangle. In the past (Detterman and Reed, 1980), the rocks at Lake Iliamna were referred to the Kamishak Formation. However, the faunas present at these localities are different (Blodgett and others, 2000) than those typical of the Kamishak Formation in the type area along Cook Inlet and Shelikof Strait.

Alaska-Aleutian Range province

Along the eastern margin of the map area, the plutonic rocks of the Tertiary to Jurassic Alaska-Aleutian Range batholith and the derivative Jurassic sedimentary rocks of the Tuxedni Group and younger sequences constitute the bulk of the bedrock exposures. The batholithic rocks show a rough age progression from older to younger, east to west. The older rocks are Middle to Late Jurassic in age, succeeded by limited areas of middle Cretaceous granitic rocks and finally Eocene granitic rocks. Country rock of the batholith ranges from Triassic carbonate and cherty rocks of the Kamishak Formation and associated basaltic rocks, to arc volcanic rocks of the Talkeetna Formation of early Jurassic age and derivative sedimentary rocks ranging in age from Middle Jurassic to latest Jurassic. In the map area, an unconformity spans nearly the entire Cretaceous on the east side of the batholith. West of the main mountain mass and the batholith are exposures of Jurassic and Tertiary volcanic rocks. Where mapped separately, the Jurassic rocks were assigned to the Talkeetna Formation (Detterman and Reed, 1980). The Tertiary rocks are of Eocene and early Oligocene age, based on limited radiometric dating, and are equivalent to the Meshik magmatic arc of the Alaska Peninsula (Detterman and Reed, 1980; Wilson, 1985). The western margin of this province consists of volcaniclastic sedimentary rocks of the Koksetna River sequence of Wallace and others (1989) ranging in age from Late Jurassic to Early Cretaceous. During the time of deposition of the Jurassic volcaniclastic rocks of the Koksetna River sequence of Wallace and others (1989), sediments on the east side of the batholith, the Naknek Formation, were derived from erosion of plutonic rocks.

Map units not assigned to a province

By far, the most extensively exposed map unit in the area is the Kuskokwim Group, an Upper Cretaceous flysch deposit. Widely distributed throughout southwest Alaska, in the Taylor Mountains, Dillingham, and Lake Clark quadrangles it consists largely of marine turbidites (Box and Elder, 1992) with minor nearshore facies rocks in the vicinity of the Proterozoic(?) and Paleozoic carbonate rocks (J.N. Platt, 1957, unpub. data). However, an enigmatic aspect of these nearshore facies rocks is the absence of carbonate clasts, even where in contact with carbonate rocks (F.H. Wilson, 1999, unpub. data). Intruding the Kuskokwim Group are widely dispersed latest Cretaceous and (or) early Tertiary granitic rocks. Some of these plutons have associated gold, such as at Taylor Mountain and in the Shotgun Hills (Rombach, 2000), tin prospects (Sleitat, Burleigh, 1991), and somewhat distantly, mercury deposits (Marsh Mountain, Sainsbury and MacKevett, 1965). In the northeastern Dillingham quadrangle, a large peralkaline plutonic complex having an associated ignimbrite deposit is present; locally these rocks are overlain by a bimodal sequence of olivine basalt and rhyolite (Wilson and others, 2003; Iriondo and others, 2003).

An outstanding problem is the relation of four Jurassic and Cretaceous map units. In the center of the map area, at the join of 4 quadrangles, map trends suggest that the volcaniclastic sedimentary rocks of the Koksetna River sequence of Wallace and others (1989, KJkr herein), the Graywacke of Kulukak Bay of Hoare and Coonrad (1978, Jkw herein), the Jurassic to Cretaceous volcanic and sedimentary rock sequence of Hoare and Coonrad (1978, KJvs herein), and the Kuskokwim Group (Kk herein) come together. Wilson and others (2003) mapped the latter three units in the northeast Dillingham quadrangle; Wallace and others (1989) showed only their Koksetna River sequence in this vicinity on their sketch map. The description of the Koksetna River sequence by Wallace and others (1989) does not indicate the presence of volcanic rocks or tuff within the section, yet rocks of this type do occur in the central part of the map interlayered with sedimentary rocks. These interlayered sedimentary and volcanic rocks were assigned to map unit KJvs by Wilson and others (2003) and are shown within that unit herein. Volcaniclastic sandstone in the northeast Dillingham quadrangle lithologically and on the basis of fossil collections could be assigned to either map unit KJkr or Jkw; neither unit has been sufficiently studied to determine whether they are truly different map units. Although assigned to different provinces here, inferences with respect to depositional environment and inferred transport directions by Wallace and others (1989) and Box (1985) could be interpreted to indicate a single depositional system.

Digital data

This map and accompanying digital files represent part of a systematic effort to release geologic map data for the United States in a uniform manner (see for example, Wilson and others, 1998; Wilson and others, 2005a, 2005b, 2005c, Stoeser and others, 2005, Nicholson and others, 2005). This map presents a compilation of the best available geologic map data in an integrated fashion; meaning that all of the various sources have been merged to produce as uniform as mapping style as possible. This also means that underlying digital data (Wilson and others, [OFR data release of this report]) is uniformly structured and coded to facilitate production of derivative products. It is presented for use at a nominal scale of 1:500,000, although individual digital datasets may contain data suitable for use at larger scales. The metadata associated with the release will provide more detailed information on sources and appropriate scales for use. Associated attribute databases accompany the spatial database of the geology and are similarly uniformly structured for ease in developing regional- and national-scale maps.

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Geologic units of the northern Alaska Peninsula

Unconsolidated deposits and rocks not assigned to a province

Qs Surficial deposits, undivided (Quaternary)—Unconsolidated, poorly to well-sorted, poorly to moderately well-stratified deposits; consist predominantly of alluvial, colluvial, glacial, marine, lacustrine, eolian, and swamp deposits. Also, locally includes reworked volcanic debris as well as block and ash flows

Qsb Scoured bedrock (Quaternary?)—Areas of glacially scoured unexposed bedrock covered by a thin(?) mantle of unconsolidated surficial deposits; air-photo interpretation. Where shown, bedrock type is indeterminate from available data

bu Bedrock unknown—Areas of known or apparent bedrock exposures. Bedrock type unknown. In the Taylor Mountains quadrangle, a number of the areas shown as bedrock unknown are in areas mapped as largely Kuskokwim Group; however, on air-photos these areas appeared distinctive in some and therefore are highlighted here for examination by future workers

Kk Kuskokwim Group, undivided (Cretaceous, Campanian? to Albian?)—Sandstone, siltstone, shale, and conglomerate (Cady and others, 1955). Sandstone is fine- to medium-grained, commonly micaceous gray graywacke or silty graywacke which is occasionally crossbedded, or contains siltstone partings. Rare argillite pebbles. Originally described by Cady and others (1955), this rock unit is widespread in southwestern Alaska and although largely a flysch deposit, represents a range of local depositional environments. Cady and others (1955) assigned an early Late Cretaceous age to the unit, but acknowledged collections outside their map area that might indicate an age older than Late Cretaceous and as young as Tertiary. Hoare and Coonrad (1959a) reported an Albian to Coniacian age based on fossil collections in the Bethel quadrangle, west of the map area, whereas Box and others (1993) assigned a late Cenomanian to early Turonian age based on new collections and re-examination of existing fossil collections from the same area (see also Elder and Box, 1992). Other age assignments have ranged as young as Santonian (Decker and others, 1995) or Campanian (based on interbedded tuff, Miller and Bundtzen, 1994). The age range for the Kuskokwim Group throughout its extent is not well constrained due to the scarcity of fossils; however, reexamination of available fossil collections (Elder and Box, 1992) indicates most fossils are of Cenomanian and Turonian age including all inoceramid collections from within the map area as shown by Elder and Box (1992). Wallace and others (1989) reported an Albian(?) microfossil fauna in the Mulchatna River region. Within the map area, data is not always sufficient to distinguish these rocks from the Koksetna River sequence of Wallace and others (1989) or the Argillite and graywacke (map unit KTrag) of the Togiak-Tikchik Complex. As a result, this map unit may well include rocks that in fact belong in those units and vice versa, or to other units yet to be recognized. Locally subdivided into:

Kkn Kuskokwim Group, nearshore facies (Cretaceous)—Sandstone, siltstone, shale, and conglomerate as mapped by J.N. Platt (1957, unpub. data) in the northeastern Taylor Mountains quadrangle. This informal sub-division of the Kuskokwim Group was originally defined by J.N. Platt (1957, unpub. data). Miller and Bundtzen (1994) also described a nearshore facies in the Iditarod quadrangle to the north. In the Taylor

Mountains quadrangle, this unit was particularly noted in the vicinity of the Taylor Mountain pluton and eastward along the southern periphery of the Paleozoic carbonate rocks

Kkv Kuskokwim Group?, volcanogenic rocks (Cretaceous?)—Volcanogenic sedimentary rocks and tuff. Contains some cherty argillite, minor limestone, and locally, dikes. Unit defined on the basis of field notes of J.M. Hoare and W.H. Condon (U.S. Geological Survey, 1969 and 1970). Unit occurs in the northwestern part of the Taylor Mountains quadrangle, north and northeast of Flattop Mountain, as well as in the west central part of the Taylor mountains quadrangle east of the Gemuk River. An age of 70 ± 0.4 Ma was obtained on basalt provisionally assigned to this unit (J.R. Riehle, unpublished data, 2001; Table 1 herein). Correlated with unit Kkt of Miller and Bundtzen (1994) in the Iditarod quadrangle

Ahklun Mountains province

Sedimentary rocks

KJvs Volcanic and sedimentary rocks (Lower Cretaceous to Middle Jurassic)—Thick marine unit consisting of low-grade metamorphic or contact metamorphosed volcanic and sedimentary rocks (Hoare and Coonrad, 1978). This rock unit was mapped by Hoare and Coonrad (1978) in the western Dillingham and adjacent Goodnews Bay quadrangles. According to Hoare and Coonrad (1978), "* * * the volcanic rocks range in composition and type from mafic pillow basalts to more abundant andesitic and trachytic flows, tuff, and breccia. Interbedded with the volcanic rocks are tuffaceous siltstone, tuffaceous chert, and massive or thin-bedded argillite." Radiolaria of Late Jurassic to Early Cretaceous age and fragmentary ammonites of Jurassic age have been collected from this unit in the Goodnews Bay quadrangle to the west (Hoare and Coonrad, 1978). The unit was mapped in the northeastern Dillingham quadrangle by Wilson and others (2003). In this area, altered volcanic breccia is relatively abundant; however, locally unit consists largely of vertically standing beds of contact-metamorphosed shale, siltstone, and lesser sandstone and also locally includes fresh-appearing fragmental volcanic rocks. Contact metamorphism evidenced in outcrop by recrystallization where weathered surfaces show textures and structures but fresh surfaces appear aphanitic. In thin-section, mafic minerals are largely replaced by chlorite and feldspars and altered in part to sericite. Wallace and others (1989) included these rocks in their Koksetna River sequence (KJkr, herein); however, the presence of volcanic rocks is not characteristic of the Koksetna River sequence as defined. The map presented by Wallace and others is highly generalized, the small area of these rocks should not be expected to show on their sketch map. Locally subdivided into:

KJv Olivine basalt and fragmental volcanic rocks (Cretaceous or Jurassic)—Olivine basalt flows and fragmental mafic volcanic rocks. Apparent range in composition is from andesite to basalt. Unit is contact metamorphosed by nearby latest Cretaceous and early Tertiary plutonism. Part of unit KJvs volcanic and sedimentary rocks; mapped separately only locally in the northeastern Dillingham quadrangle

Jkw Graywacke of Kulukak Bay (Middle to Upper Jurassic)—A thick marine sedimentary unit consisting of very hard dark-green or gray, massive graywacke and siltstone containing local conglomerate horizons. Typically consists of sandstone, although coarse pebble conglomerate is locally present. According to Hoare and Coonrad (1978) sandstone composition varies from quartz- and plagioclase-rich wackes to quartz-poor volcanic wackes. These rocks are correlated with a thick marine sedimentary unit referred to as the "Weary graywacke" by Hoare and others (1975) and later referred to as the "Graywacke of Kulukak Bay" by Hoare and Coonrad (1978). This unit is widely exposed in the southern Goodnews Bay and the Nushagak Bay quadrangles as well as the southwestern Dillingham quadrangle (Hoare and Coonrad, 1978). Rocks in the map area correlated with this unit were also correlated with rocks in the adjacent Iliamna quadrangle (Detterman and Reed, 1980, unit KJs); however, on this map those rocks have been assigned to map unit KJkr, the Koksetna River sequence of Wallace and others (1989). In the Goodnews Bay and Nushagak Bay quadrangles, *Buchia*, *Inoceramus*, belemnites, and rare ammonite fragments ranging from Middle to early Late Jurassic age have been found. Wilson and others (2003) assigned volcaniclastic graywacke mapped in the northeastern Dillingham quadrangle to this unit in keeping with the correlation with the adjacent Iliamna quadrangle (Detterman and Reed, 1980, unit KJs). However, on this map, those rocks are also assigned to map unit KJkr. The relationship between this map unit, Jkw, and the Koksetna River sequence of Wallace and others (1989), KJkr, is uncertain; although they do not overlap in age, for both units age control is sparse. Lithologically they are similar and therefore may be equivalent units in part. Paleocurrent indicators suggest that the sediments of unit Jkw were derived from the west (Box, 1985), paleocurrent indicators for the Koksetna River sequence of Wallace and others (1989) suggest sediment transport to the northeast (Wallace and others, 1989), possibly indicating they had a common and long lasting depositional system

Structural assemblage

Togiak-Tikchik Complex (Lower Cretaceous to Lower Paleozoic)—Formerly called the Gemuk Group (Cady and others, 1955), this unit consists of a wide variety of rock types in a structural collage of blocks. Locally, it has an internal stratigraphy, but overall it is unlikely that the entire assemblage represents a stratigraphic package. It, as originally defined as the Gemuk Group, consisted chiefly of dense, dark, massive siltstone having interbeds of chert, volcanic rocks, limestone, graywacke and breccia. The name Gemuk Group was formally abandoned and the assemblage was subsequently redefined as the Togiak-Tikchik Complex recognizing its structural character (Wilson and Coonrad, 2005). Included rock packages are:

Mzm Melange (Mesozoic?)—Located in the southwest Taylor Mountains and northwest Dillingham quadrangles, this unit consists of two or more rock types in close proximity, typically tightly folded, sheared, and/or altered, including pillowed and massive basalt, chert, gabbro, graywacke, shale, siltstone, limestone, and dolostone. An individual outcrop area was described by Hoare (1969 field note) as consisting of dark calcareous siltstone and fine-grained dirty limestone pinched into boudins, sugary gray chert, fine-grained biotite intrusive rocks, contorted massive gray dolomitized limestone and altered green phyllitic volcanic rocks and red phyllitic argillite. This unit appears to include rocks from KTrag, Mrc, Pzc, Pcs, and MDv units in a siltstone matrix. Description of this map unit is largely based on the 1969 and 1970 field notes of J.M. Hoare and W.H. Condon and limited fieldwork by F.H.

Wilson and M.L. Miller in 2001. Corresponds generally to map unit MzPz of Hoare and Coonrad (1978) and correlates with map unit TrPzm of Box and others (1993)

KTrag Argillite and graywacke (Lower Cretaceous to Upper Triassic)—Gray to gray-green argillite, cherty argillite, graywacke, and minor mudstone, tuffaceous sandstone, and chert. Unit description is largely derived from the field notes and field maps of J.M. Hoare, W.H. Condon (1969-1970), and W.M. Cady (1943-1944). These rocks primarily occur in the northwest part of the map area and were originally defined as constituting a major proportion of the type area of the now abandoned Gemuk Group. This map unit is distinguished from the Kuskokwim Group because of the presence of argillite, cherty argillite, and chert. Map unit also includes limited areas of multi-colored chert and gray to gray-green argillite or argillite, graywacke and mudstone. The presence of tuff or tuffaceous sedimentary rocks is not universal and relative to similar age rocks to the south in the Dillingham quadrangle, the absence of volcanic rocks is conspicuous. Locally, may include areas of Kuskokwim Group (map unit Kk) where data is insufficient to distinguish these units, for example in outcrops shown at the east end of Lake Chauekuktuli and those north of Tikchik Lake, as well as outcrops in the vicinity of map unit Mzmi in the north-central Dillingham quadrangle. Cady and others (1955) reported Lower Cretaceous fossils from this unit in the Sleetmute quadrangle, north of the map area and Box and others (1993) reported poorly preserved radiolarians of Early Cretaceous and Jurassic age from rocks correlated with this unit in the adjacent Bethel quadrangle. Cady and others (1955) and Sainsbury and MacKevett (1965) reported Triassic (Norian and Carnian) fossils from this unit in the vicinity of Cinnabar Creek in the northwestern Taylor Mountains quadrangle. Miller and others (2005) reported data on a number of new fossil collections and detrital zircon studies, providing new age control on the unit. Radiolarians from siltstone and chert yielded Jurassic ages ranging from Hettangian to Oxfordian, whereas graywacke yielded detrital zircons as young as 130 Ma, Early Cretaceous

KTragi Argillite and graywacke, cut by dike swarms (Cretaceous to Triassic)—Rocks of map unit KTrag and possibly other map units apparently cut by felsic dike swarms or shallow intrusions. Host rocks are primarily calcareous argillic graywacke and cherty argillite

Jms Sedimentary rocks (Lower Jurassic)—Marine unit of micaceous, fine-grained black graywacke, siltstone, and slate, and gritty limestone. Contains *Weyla* pelecypods of Early Jurassic age. Cropping out along the Allen River area near where it drains into Lake Chauekuktuli, these rocks occur between exposures of Paleozoic rocks on the adjacent ridges and are structurally lower than the surrounding Paleozoic rocks

JTrp Phyllite and chert (Lower Jurassic and Upper Triassic?)—Gray to black cherty phyllitic shale, highly contorted thin-bedded siliceous argillite and local cherty dark calcareous phyllite outcropping along the western margin of the Taylor Mountains quadrangle in association with greenstone of map unit MDv. The phyllite is occasionally sulfide-bearing along fault zones. Unit appears to be an extension of map unit JTrp of Box and others (1993). Distribution based on the 1969 field notes of J.M. Hoare and W.H. Condon. Unit also includes apple green tuff and chert in the extreme northwest part of the Taylor Mountains quadrangle thought to be Jurassic or Triassic by J.M. Hoare and W.H. Condon (1970 field notes)

Trcg Triassic limestone (Upper Triassic)—Marine unit consisting of chert, tuffaceous cherty rocks, argillite, siltstone, volcanic wacke, conglomerate, limestone, and mafic flows and breccias. Limestone is generally white to cream colored and recrystallized, however locally it is dark gray and only finely crystalline. Occurs in possibly fault bounded occurrences along the south shore of Nuyakuk Lake in the northwest Dillingham quadrangle. Also occurs in the vicinity of the Cinnabar Creek mine in the northwestern Taylor Mountains quadrangle (Sainsbury and MacKevett, 1965; J.M. Hoare and W.H. Condon, unpublished data, 1970). Triassic (Norian) fossils reported by Mertie (1938) and others in written communications cited in Hoare and Coonrad (1978). This is map unit Trvs of Hoare and Coonrad (1978) and as mentioned by them, it is only shown on the northwest Dillingham portion of the map "… in the vicinity of fossil localities because the rocks resemble other rocks of Paleozoic and Mesozoic ages with which they are tectonically associated." (Hoare and Coonrad (1978)

Trv Volcanic rocks (Upper Triassic)—Volcanic rocks comprising at least 5 separate flows, locally as much as 200 feet thick interbedded with cherty siltstone. Associated with sparsely distributed Triassic limestone in the Cinnabar Creek area which yielded *Monotis* and *Halobia* fossils of Late Triassic (Norian) age. Restricted to the northwest edge of the Taylor Mountains quadrangle, including at Cinnabar Creek (Sainsbury and MacKevett, 1965). In the Cinnabar Creek area, occurs near the top of now abandoned Gemuk Group section (Wilson and Coonrad (2005). Correlates with map unit Trb of Box and others (1993) in the adjacent Bethel quadrangle

TrPzrc Rainbow chert (Triassic? to Paleozoic?)—Mostly highly deformed white, gray, red, minor green, or black, thin-bedded to massive, chert. Locally banded or brecciated and interbedded with minor red siliceous shale, argillite, dolomitic limestone, graywacke, and rare red volcanic rocks and agglomerate. Hoare and Jones (1981) reported Paleozoic(?) radiolarians in rocks of this unit along the shore of Chikuminuk Lake, as well as Permian megafossils in associated and presumably overlying limestone. One of their localities on the shore of Chikuminuk Lake yielded Triassic radiolaria, which is yet to be explained due to lack of map data, but may be due to the structural inclusion of slivers of younger rocks. East of Chikuminuk Lake, apparently overlain by rocks of the Kuskokwim Group (Kk). Mertie (1938) considered these rocks to be Mississippian(?) in age; clearly a Mississippian age is highly speculative. Similarly described varicolored chert and limestone (Patton and others, 1979) or chert and argillite (Chapman and Patton, 1979) units have been mapped in the Medfra and Ruby quadrangles to the north; these yield Carboniferous and Devonian ages. Patton and others (in press) included these rocks in a chert, argillite and volcaniclastic rocks unit they to which they assigned an age range of Triassic(?) to Devonian

Pv Volcanic rocks (Permian?)—Predominantly dark-green to black, altered mafic volcanic rocks having abundant amygdules. Volcanic breccia, calcareous tuff, and pillow lava constitute lower beds, pillow lavas in middle, and phyllitic calcareous tuff and tuffaceous limestone constitute upper beds. Primarily located along the north shore of Chikuminuk Lake at the western edge of the map area and extends into the Goodnews Bay quadrangle (Hoare and Coonrad (1978)

Pls Limestone (Permian)—Lenses of thin-bedded to massive, light- to dark-gray limestone either interbedded or intercalated with clastic and volcanic rocks in the vicinity of the Tikchik and Wood River lakes. Locally is gritty conglomeratic, contains siliceous interbeds, or has a fetid odor. *Atomodesma* sp., crinoid stems, brachiopods, pelecypods, and possible bryozoans reported. Fossil reports (see www.alaskafossil.org) note that fossils were commonly deformed by stretching. Description of this map unit is largely based on the 1969 and 1970 field notes of J.M. Hoare and W.H. Condon and mapping of it from their field maps, augmented by air-photo interpretation. Rocks of this unit are associated with many of the older(?) rock units of the Togiak-Tikchik Complex, yet the nature of the association is rarely clear. In some areas it is clearly a structural intercalation, elsewhere the association may be stratigraphic

Pcs Clastic rocks (Permian?)—Fine to coarse-grained, locally conglomeratic or brecciated, light gray, greenish-gray, or black streaky, slaty, phyllitic, micaceous or silty bedded to massive graywacke. Cigar sized and shaped pits, boudins, or slightly contact metamorphosed in some areas. Intercalated with minor gray to black slaty siltstone having graded bedding, thin argillite, phyllite, limestone, dolomite, and black chert. Unit is associated with limestone yielding Permian age fossils as well as yielding Permian fossils in the vicinity of Lake Chauekuktuli (see www.alaskafossil.org)

MDv Greenstone and schist (Mississippian? and (or) Devonian?)—Fine- to coarse-grained, massive green to purple altered greenstone, occasionally calcareous or schistose, rarely interbedded with green chert, argillite, and tuff. Greenschist with occasional chert boudins is a minor part of unit as is shale-chip agglomerate. Greenstone is locally cut by quartz and calcite veins containing epidote and copper sulfides. This map unit occurs north of Chikuminuk Lake on the west edge of the map area and extends into the adjoining Bethel quadrangle (Box and others, 1993). Phyllite of map unit JTrp may overlie this map unit. Description of this map unit is largely based on the 1969 and 1970 field notes of J.M. Hoare and W.H. Condon and correlation with similar rocks in the adjoining Bethel quadrangle (Box and others, 1993). Age is inferred protolith age based on fossils in an overlying unit in the Bethel quadrangle (Box and others, 1993)

Pzc Black chert (lower Paleozoic?)—Predominantly black and gray chert, but also includes rare white, buff, red, or green bedded to massive chert. Occasionally vitreous, banded, or fractured. Interbedded or structurally interleaved with minor amounts of limestone, amygdaloidal basalt, and thin pitted calcareous graywacke. Occurs in the vicinity of Nuyakuk Lake and Lake Chauekuktuli at the west central margin of the map. This map unit is distinguished found the rainbow chert (unit TrPzrc) of this map by the dominance of black and gray chert and as, abased on Hoare and Condon field notes, the uncommon red and green chert, which is much more common in the rainbow chert unit. Hoare and Jones (1981) reported lower Paleozoic (Devonian? and pre-Devonian) and Paleozoic(?) radiolarians in the area shown for this unit as well as Permian megafossils. The limited geologic information provided in Hoare and Jones (1981) does not indicate the nature of the occurrence of the Permian fossils and we suggest that these locations may be due to inclusion of fault-bounded blocks or slivers of the mélange (Mzm) or units Pls and Pcs that can't be resolved with the available map data. Based on lithology and crude age, the black chert may correlate with the Ordovician chert and phyllite of the Medfra quadrangle (Patton and others, in press; Wilson and others, 2005)

Lime Hills province (see inset map on Plate 2)

Sedimentary rocks

Mesozoic

Jssc Chert, sandstone, and siltstone (Lower Jurassic)—Medium-gray to yellowish-gray weathering, medium to thick-bedded, dominantly chert and sandstone unit with locally abundant phosphatic nodules developed in more cherty phases (R.B. Blodgett, 2005, unpub. data). These rocks are exposed along the periphery of and intercalated with the Paleozoic limestone of the Farewell terrane in the northeastern Taylor Mountains quadrangle. Sandstone beds dominate in lower part of section, chert-rich beds dominant upper part of unit. Contains megafauna (most bivalves and belemnites) of undifferentiated Early Jurassic age (R.B. Blodgett, 2004, unpub. data) and radiolarians of undifferentiated Early Jurassic age (internal report of Emile Pessagno to M.L. Miller; also earlier report of C.D. Blomé to F.H. Wilson). Minimum estimated thickness of unit is 100 m. Contact with underlying Trlc unit is conformable where observed

Trlc Limestone, silty limestone, and chert (Upper Triassic - Norian)—Cream colored to dark-gray, limestone, silty limestone and chert. Divisible into two subunits: (1) a lower subunit of massive- to thick-bedded, light-gray to cream colored limestone with common scleractinian corals, spongiomorphs, and lesser brachiopods (Blodgett and others, 2000), minimum thickness 50 m, grading into (2) an upper subunit of thinner bedded platy limestone, silty limestone, and minor chert containing locally well-developed silicified megafauna (brachiopods, bivalves, gastropods) of late Norian age (see McRoberts and Blodgett, 2002; Blodgett and others, 2000). Upper subunits represents slightly deeper, more offshore environment than underlying subunit. Minimum thickness estimated at 100 m. Many of the gastropods present in upper subunit [i.e., *Chulitnacula alaskana* (Smith), *Andangularia wilsoni* Blodgett] also known from coeval rocks of the Alexander terrane of southeastern Alaska. The relations of the chert to other parts of this subunit uncertain, may be structurally interleaved. Contact of the Trlc with next oldest regionally exposed unit, the Silurian Algal Boundstone (Sab) unit, is uncertain, but is probably structural in some places. Overlain conformably by Jssc unit

Paleozoic

DZn Farewell terrane, Nixon Fork subterrane of Decker and others (1994), undivided (Devonian(?) to Proterozoic)—The map units described here come largely from the unpublished work of R.B. Blodgett and co-workers. Subdivided into:

Sab Algal boundstone (Upper Silurian, Ludlovian and Pridolian)—Thick to massive bedded, light gray algal boundstone, locally dolomitized; composed primarily of spongiostromate algal heads (including abundant oncoid forms). Rock unit represents a barrier reef complex on the outer or seaward margin of the Silurian carbonate platform (Blodgett and Clough, 1985). Contains scattered pockets of brachiopods, mostly belonging to the superfamily Gypiduloidea. Locally abundant are aphrosalppingid sponges (Rigby and others, 1994) which are known elsewhere only from the Ural Mountains of Russia and the Alexander of southeastern Alaska. Equivalent to Sl unit of Gilbert (1981)

Sls Lime mudstone (Upper Silurian, late Llandoverian to Wenlockian)—Primarily thin- to medium-bedded, laminated, dark gray to dark brown, platy lime mudstone, having strong petroliferous odor (Blodgett and Wilson, 2001). Coarse-grained limestone debris-flows having clasts of algal boundstone reef material common in uppermost part of unit; immediately below contact with overlying Sab unit. Age control comes from graptolites and conodonts, see Blodgett and Wilson (2001). Equivalent to uOll unit of Gilbert (1981) and Paradise Fork Formation of Dutro and Patton (1982)

Olss Tcherskidium-bearing limestone (Upper Ordovician, Ashgillian)—Brown, medium- to thick-bedded skeletal lime packstone to wackestone (Blodgett and Wilson, 2001). Contains abundant pentameroid brachiopods (*Tcherskidium*, *Eoconchidium* (or *Proconchidium*), and new genus (smooth) aff. *Tcherskidium*)

Os Shale (Ordovician)—Extremely poorly exposed brown and dark gray ‘chippy’ shale, silty shale and minor silicified limestone (Blodgett and Wilson, 2001). Outcrops in Taylor Mountains D-1 1:63,360-scale quadrangle consist only of frost-boil exposures, however, one rubble outcrop in Taylor Mountains D-2 1:63,360-scale quadrangle (NE1/4 sec. 12, T9N, R42W) is better exposed and contains numerous diplograptid graptolites

Oab Algal boundstone and lime mudstone (Lower Ordovician)—Medium- to thick-bedded, dark-gray to brown algal thrombolites (boundstone) interbedded with light-gray weathering thin- to medium-bedded lime mudstone (Blodgett and Wilson, 2001). Trilobites and a conodonts (identified by N.M. Savage, written commun. 1985), including fossils of the trilobite genus *Hystricurus* indicate an Early Ordovician age (Blodgett and Wilson, 2001)

Ols Lime mudstone (Lower Ordovician)—Thin- to medium-bedded, yellow-gray weathering, dark-gray fresh, burrow mottled lime mudstone (Blodgett and Wilson, 2001). Peloidal mudstone locally common. Age control based on poorly preserved low-spired gastropods and conodonts including *Drepanoistodus?* Sp., *Fryxellodontis?* n. sp. and other conodonts (Blodgett and Wilson, 2001)

Cls Limestone (Middle Cambrian)—Two separate Middle Cambrian limestone subunits are included in this unit in the adjoining Sleetmute A-2 1:63,360 scale quadrangle where it is best developed and exposed (Blodgett and others, in prep). The upper and thicker overlying subunit, exposed in the Taylor Mountains quadrangle is composed of medium- to thick-bedded, commonly light-gray to dark-gray, rarely pink weathering (light-gray fresh) lime mudstone having locally abundant, well developed wavy styolites. Minor green-gray shale intervals present locally. Trilobites locally abundant and diverse in this subunit and are indicative of a Mayan (late Middle Cambrian in terms of Siberian Platform nomenclature) age (Palmer and others, 1985; Babcock and Blodgett, 1992; Babcock and others, 1993; St. John, 1994; St. John and

Babcock, 1994 and 1997). Thickness of Mayan limestone subunit is at least 15 m. The lower subunit is poorly exposed (not yet observed in the Taylor Mountains 1:250,000 scale quadrangle) and consists only of scattered rubble crop of coquinoid limestone (lime wackestone to packstone) containing an abundant and diverse trilobite fauna (agnostids notably common), and ancillary acrotretid brachiopods, hyoliths, and cap-shaped fossils of Amgan (early Middle Cambrian in terms of Siberian Platform nomenclature) age. Trilobites from this subunit are discussed by Palmer and others (1985), Babcock and Blodgett (1992), Babcock and others (1993), Kingsbury (1998), Kingsbury and Babcock (1998), and Kingsbury and others (2003). Thickness of this subunit is uncertain, but probably at least 5 m. Faunas from both subunits are most closely allied biogeographically with coeval faunas from the Siberian Platform. Contact with underlying Cs unit is covered

Cs Clastic and carbonate rocks (Lower Cambrian)—This unit is quite heterogeneous and consists of dark-gray (weathering light-gray) orthoquartzite, locally having well-developed parallel laminations; light-gray (weathering white), thin- to medium-bedded lime mudstone having abundant trilobites (observed in cross-section) and tube-like fossils (possibly *Salterella*); orange-yellow (light-yellow weathering) dolomudstone, locally having weakly developed parallel laminations; medium- to dark-gray chert forming rubble crop, and red-orange to maroon weathering siltstone and chippy shale also forming rubble crop Total thickness of interval uncertain, but minimally 100 m. This unit is poorly exposed in both the Sleetmute A-2 and Taylor Mountains D-2 1:63,360 scale quadrangles, and exposures consist mainly of frost boils in tundra as well as rarer large rubble crops and small isolated limestone outcrops. The Early Cambrian age is inferred by its stratigraphic position immediately beneath Middle Cambrian limestone (Cls unit) and above the underlying Zs unit correlative with Upper Proterozoic(?) strata in the McGrath quadrangle (Blodgett and others, 1994). An early Cambrian age is also indicated by the presence of the *Salterella*-like fossils, a problematic tube-like fossil restricted to the Lower Cambrian. Trilobites were collected from this unit in the Taylor Mountains D-2 1:63,360-scale quadrangle, but a fossil report has not yet been received on this collection. Exact nature of contact with overlying Cls and underlying Zs units uncertain due to extensive tundra cover

Proterozoic

Zs Dolostone, limestone, orthoquartzite, and minor chert (Neoproterozoic?)—Medium-bedded, medium-gray, orange weathering dolostone, limestone, orthoquartzite, and minor chert. Dolostone has locally abundant floating quartz grains, is locally trough cross-stratified, but also has well developed parallel laminations, low domal stromatolites, and local paleokarst intervals. Total thickness of unit uncertain, but minimally is at least 300 to 400 m in thickness. Several repeated sedimentary cycles observed in unit. Unit is best exposed in adjoining Sleetmute A-2 1:63,360-scale quadrangle (R.B. Blodgett and others, 2005, unpub. data). Age of unit is thought to be Upper Proterozoic based on closely similar to identical distinctive lithologies, shared with units of presumed Late Proterozoic age exposed to the northeast in the McGrath 1:250,000-scale quadrangle (Babcock and others, 1994; Blodgett and others, in prep.)

Alaska-Aleutian Range province

Sedimentary rocks

Tertiary

Ts Sedimentary rocks (Tertiary, Pliocene or Miocene)—Consists mainly light- to medium-gray and light-tan, fine- to medium-grained tuffaceous feldspathic to arkosic wacke and siltstone containing scattered pebbles and lenticular beds of pebble conglomerate (Detterman and Reed, 1980). Micaceous clay and silt having moderately abundant glass shards constitutes 40 to 60 percent of this moderately indurated rock unit. Rock and pumice fragments as well as a few volcanic bombs were reported from the wackes. Plant debris and carbonaceous material is common but, largely unidentifiable or nondiagnostic. J.A. Wolfe (reported in Detterman and Reed, 1980) identified *Picea* sp. suggesting it indicated a possible middle or late Tertiary age. The rocks of this map unit occur only in a small area of the Iliamna quadrangle, west of the batholith on the south shore of eastern Lake Iliamna. Detterman and Reed (1980) suggested a possible correlation with lithologically similar rocks in the Seldovia quadrangle (Detterman and Hartsock, 1966) on the west side of Cook Inlet that they assigned to the Kenai Formation (now Group). Later work by Calderwood and Fackler (1972) and Kirschner and Lyon (1973) resulted in the assignment the Seldovia quadrangle rocks to the West Foreland Formation, as shown here

Ttyh Kenai Group, Tyonek Formation and Hemlock Conglomerate undivided (Tertiary, Miocene and Oligocene)—Sandstone, conglomerate, and siltstone. Known within the map area only in the vicinity of Harriet Point in the Kenai quadrangle, these rocks are inferred from the description in Detterman and others (1976) to consist of fluvial conglomeratic sandstone and conglomerate with minor interbeds of siltstone, shale, coal. Magoon and others (1976) did not distinguish the individual formations at this locality; Detterman and others (1976) assigned these rocks to the Hemlock Formation (now, Hemlock Conglomerate)

Twf West Foreland Formation (Tertiary, early Eocene and late Paleocene)—Tan to light-yellow-brown cobble conglomerate interbedded with lesser sandstone, laminated siltstone, and silty shale (Detterman and Hartsock, 1966). Thin coal beds are interbedded with the siltstone and shale. The clasts in the conglomerate are mainly rounded to sub-rounded quartz diorite, volcanic rocks, argillite, sandstone, siltstone, quartzite, tuff, and coal fragments. Intrusive and volcanic rock fragments each make up about 35 percent of the clasts in the conglomerate. Medium- to coarse-grained arkosic sandstone forms the matrix of the conglomerate as well as distinct lenticular beds. The siltstone and shale interbedded with the conglomerate is a very fine-grained sub-arkosic equivalent of the sandstone. Originally mapped as the Kenai Formation by Detterman and Hartsock (1966), Calderwood and Fackler (1972) subdivided the redefined Kenai Group into a number of units and these rocks were assigned to the West Foreland Formation. The West Foreland was assigned an Oligocene age by Kirschner and Lyon (1973) and later an early Eocene and late Paleocene age (Magoon and others, 1976). Recent dating of zircon from an included tuff north of the map area yielded a 43 Ma (middle Eocene) age (P.J. Haeussler and D.W. Bradley, oral commun., 2005). The West Foreland was removed from the Kenai Group because it was separated by a major unconformity from the overlying Hemlock Conglomerate (see Magoon and Egbert, 1986). The lower contact of these rocks was described as an angular unconformity with the Upper Jurassic Naknek Formation (Detterman and Hartsock, 1966); subsequent work by Magoon and others (1980) showed there to be a nonmarine Upper Cretaceous sedimentary unit between the rocks of the West Foreland and Naknek Formations. Those Cretaceous rocks are shown here as map unit Ksm

Tcl Copper Lake Formation, undivided (Tertiary, Eocene and Paleocene?)—Thick clastic nonmarine sedimentary rock unit consisting of an upper and lower conglomerate member bounding a middle sandstone and siltstone member (Detterman and Reed, 1980; Detterman and others, 1996) at the east end of Lake Iliamna. Upper conglomerate unit consists of red-weathering pebble-cobble conglomerate consisting mainly of volcanic rock clasts and containing minor tuff. Member may be agglomerate rather than conglomerate; ranges from 50 to 100 percent fresh-appearing volcanic rock. Clasts of quartzite, schist, greenstone, rose quartz, limestone, and granitic rocks are present in lower parts of this member. Sandstone and siltstone member is chiefly fine- to medium-grained medium- to greenish-gray, lithic graywacke containing locally abundant tuffaceous and carbonaceous material. Grains in the sandstone include abundant quartz, schist, volcanic, and granitic rock fragments. Interbedded siltstone is similar in color and composition to the sandy facies whereas claystone interbeds are mainly micaeous clay containing a small amount of montmorillonite. Lower conglomerate member is red-weathering pebble-cobble conglomerate consisting mainly of volcanic rock clasts and containing minor tuff. Volcanic clasts constitute about 25 percent and appear to be derived from the Talkeetna Formation and not fresher-appearing Tertiary volcanic units. Age control is from a fossil megaflora collected from within the middle member which indicates an early Eocene age (Detterman and others, 1996). Detterman and others (1996) correlates the Copper Lake Formation with the Tolstoi Formation of the southwest Alaska Peninsula where an early Eocene megaflora was collected from a sandstone and siltstone section overlying a basal conglomerate containing a late Paleocene flora and underlying beds containing a middle Eocene flora. By analogy, a Paleocene(?) to early Eocene age was assigned to the Copper Lake Formation by Detterman and others (1996)

Mesozoic

Ksm Saddle Mountain section of Magoon and others (1980) (Upper Cretaceous, Maastrichtian)—Nonmarine sandstone, conglomerate, and minor siltstone and coal found in the northeast of Chinitna Bay in a section 83 m thick (Magoon and others, 1980). Consists dominantly of fine- to medium-grained sandstone that fines upward and is generally massive with some crossbedded units. It is soft and friable except where calcite cemented. Conglomerate contains volcanic and plutonic rock boulders as much as 30-cm in diameter in a sandy matrix. Coal beds, which tend to occur in the upper part of the section are as much as 2.7- m-thick and locally has underclay (“undersoils”, Magoon and others, 1980). Siltstone is most abundant in the middle part of the section. Sporomorphs indicate a Maastrichtian age. This unit was included in the Kaguyak Formation by Bradley and others (1999), but is separated here because of its distinct difference in lithology and depositional environment from the Kaguyak Formation. This map unit overlies the Jurassic with angular unconformity and is in turn overlain by rocks of the West Foreland Formation with angular unconformity

Kkg Kaguyak Formation (Upper Cretaceous, Maastrichtian and Campanian)—Consists of a measured thickness of more than 1,200 m of dark-gray to pale-brown, typically thin-bedded, shale, siltstone, and fine-grained sandstone Detterman and others, 1996). However, only a small area of outcrop occurs within the map area on the south side of Kamishak Bay. Proportion of sandstone in unit increases up-section. Load and flute casts are common; in upper part of unit, graywacke is graded with numerous rip-up clasts. Overall depositional environment of formation is near mid-fan within multi-channeled system; however, uppermost part of unit may have been deposited in upper-fan regime (Detterman and others, 1996). In general, fossils are sparse; however, in lower part of unit they are locally abundant. Ammonites are most common and may range in size to as much as 1-m across. Fossils allow age assignment of latest Campanian and early Maastrichtian. Within the map area, the Kaguyak Formation unconformably overlies rocks of the Naknek Formation, no units overlie the Kaguyak within the map area. South of the map area, the Kaguyak Formation is unconformably overlain by rocks of the Copper Lake Formation or younger units

KJkr Koksetna River sequence of Wallace and others (1989) (Lower Cretaceous, Valanginian to Upper Jurassic, Kimmeridgian)—Complexly deformed volcanic-lithic turbidites. Consists of a thick monotonous sequence of thin sandstone (<4 cm) beds interbedded with pelagic shale. Locally fining upward sequences of sandstone beds reach thicknesses of 1.5 m and have scoured bases and rippled or contorted tops (Wallace and others, 1989). Westward and northeastward, the proportion of sandstone decreases and most of the unit is siltstone, shale, and thin sandstone interbeds. Paleocurrent indicators suggest transport to the northeast; interpretation of depositional environments suggests regional sediment transport was to the north or northwest (Wallace and others, 1989). Coarse, unsorted and chaotic matrix-supported conglomerate occurs sporadically in the unit. Provenance was a magmatic arc province consisting dominantly of "* * *volcanic rocks, but with local exposures of plutonic rocks, fine-grained clastic rocks, dynamothermally metamorphosed rocks, and contact-metamorphosed rocks." (Wallace and others, 1989, p. 1393). Age control is quite limited for this map unit; Wallace and others (1989) reported 4 fossil localities, all containing *Buchia*, specifically *Buchia mosquensis* of Late Jurassic (late Kimmeridgian) age and *Buchia sublaevis* of Early Cretaceous (Valanginian) age. In the northeastern Dillingham quadrangle, the unit contains rare fragmentary fossils; a sample collected in 2001 yielded fragments of *Buchia*, suggesting a Late Jurassic or Early Cretaceous age (R.B. Blodgett, 2002, unpub. data). An unpublished report indicating Jurassic(?) fossils found by Unocal in 1959 in the northeastern Dillingham quadrangle appears to have erroneous sample locations; the sample description suggests that the samples may have actually come from the southeastern Taylor Mountains quadrangle. Within the map area, this unit may be a partial stratigraphic and lithologic equivalent of the Middle and Upper Jurassic graywacke of Kulukak Bay of Hoare and Coonrad (1978) and the Jurassic to Cretaceous volcanic and sedimentary rock sequence also mapped by Hoare and Coonrad (1978); both units were tentatively extended as far east as the east boundary of the Dillingham quadrangle (Wilson and others, 2003), but are assigned to this unit on this map. Distinction between these three units, KJkr, KJvs, and Jkw will have to be resolved by future study

Jn Naknek Formation (Upper Jurassic; Tithonian to Oxfordian)—Originally named Naknek Series by Spurr (1900, p. 169-171, 179, 181) for exposures at Naknek Lake on the Alaska Peninsula. Largely consists of sandstone, conglomerate and siltstone having a primarily plutonic provenance. This rock unit is widespread in southern Alaska, ranging in a long belt from southcentral Alaska (Wilson and others, 1998) to the southwest end of the Alaska Peninsula (Wilson and others, 1999); about 1,150 km (Detterman and others (1996). The aggregate thickness of the unit members exceeds 3,000 m, though the average thickness the formation is more typically 1,700 to 2,000 m (Detterman and others (1996). Megafossils, particularly the pelecypod *Buchia* (Detterman and Reed, 1980, p. B38; J.W. Miller, written commun., 1982-88), are common, and the fauna, which also includes ammonites, indicate an age range of Oxfordian to late Tithonian (Late Jurassic). Detterman and others (1996; see also, Detterman and Hartsock, 1966; Martin and Katz, 1912) have subdivided unit into members of which the following appear in the map area:

Jnp Pomeroy Arkose Member (Upper Jurassic; Kimmeridgian and Oxfordian?)—Massive light-gray, medium- to coarse-grained arkose containing many interbedded thin beds of dark-gray to brownish siltstone and pebble conglomerate (Detterman and Hartsock, 1966). The sandstone is rich in quartz (40-45 percent) and sodic feldspar (30-35 percent) and also contains 15-20 percent hornblende and tourmaline. Volcanic lithic fragments make up 2-3 percent of the rock. Grains are sub-angular to sub-rounded. The matrix is generally clay, but locally, is tuffaceous. The siltstone is mineralogically distinctive from the arkose and resembles the graywacke of older units according to Detterman and Hartsock(1966); we interpret this to indicate it contains a higher proportion of volcanic- and sedimentary-sourced components. Detterman and Hartsock (1966) indicated that most sections of the Pomeroy Arkose Member have a 70-350-foot-thick (21 to 113 m) gray, medium-bedded to massive, arenaceous siltstone horizon, usually in the lower part of the member. The Pomeroy Arkose is sparsely fossiliferous, containing *Lytoceras*, *Phylloceras*, and *Buchia concentrica*, suggesting an age no younger than early Kimmeridgian. Detterman and Hartsock (1966) suggested that the nearby Jurassic part of the Alaska-Aleutian Range batholith was the source for this unit and the subangular character of the easy-to-destroy grains (hornblende, tourmaline, and feldspar) indicate short transport and rapid burial

Jnst Snug Harbor Siltstone Member (Upper Jurassic; Kimmeridgian and Oxfordian)—Dominantly massive to thin-bedded, dark-gray to black siltstone; calcareous gray sandstone beds are minor part of the unit (Detterman and Hartsock, 1966). Hard gray limestone concretions and lenses are locally abundant; rare thin layers of volcanic ash and tuff are found locally (Detterman and Hartsock, 1966). Deposited in moderately deep water, well below wave base and above carbonate compensation depth, in a basin having restricted circulation (Detterman and others, 1996). It is the lowest abundantly fossiliferous member of the Naknek; main fossils present are *Buchia*, including *Buchia concentrica* as well as the ammonites *Amoeboceras*, *Phylloceras*, and *Perisphinctes*

Jnn Northeast Creek Sandstone Member (Upper Jurassic; Oxfordian)—Arkosic sandstone and graywacke. Called the “lower sandstone member” by Detterman and Hartsock (1966), they considered this unit to have only local significance. Later work on the

Alaska Peninsula (Detterman and others, 1996) showed that the lateral equivalent of this unit, the Northeast Creek Sandstone Member, is present along the entire length of the Alaska Peninsula. The member is light-gray, thin-bedded to massive arkosic sandstone, graywacke, and siltstone. According to Detterman and Hartsock (1966), some beds have a tuffaceous matrix, zones of small pebbles, as well as thin beds of arenaceous siltstone. Fossils are most common in the lower part of this unit and include ammonites, particularly *Cardioceras*, but also include *Phyllocreas* and *Lytoceras*. Detterman and Hartsock (1966) assigned an uppermost Callovian and lower Oxfordian age to this unit based on the presence of *Cardioceras martini* in the lower part of the member and its association with *Cardioceras distans*, which then without *Cardioceras martini* continues to the top of the member. Detterman and others (1996) assigned only an Oxfordian age to the unit. Pelecypods including *Pleuromya*, *Quenstedtia*, *Oxytoma*, *Thracia*, and *Astarte* are present but not common as are gastropods, echinoids, and belemnites (Detterman and Hartsock (1966). Lower contact of member intertongued with the Chisik Conglomerate Member. Upper contact is gradational with the overlying Snug Harbor Siltstone Member

Jnc Chisik Conglomerate Member (Upper Jurassic)—Consists of massive to thick-bedded conglomerate and interbedded, crossbedded, quartzose sandstone. Clasts, as large as 2 m, are mainly granitic rocks, but up to 20 percent metamorphic and volcanic rocks are present (Detterman and others, 1996). The unit is mainly restricted to the area adjacent to Iniskin Bay and Tuxedni Bay in the map area. A quartz diorite cobble yielded a protolith age of 156.6 Ma (Detterman and others, 1965; Table 1 herein)

Chinitna Formation (Middle Jurassic, Callovian)—Massive gray arenaceous siltstone. Unit is best exposed along the west coast of Cook Inlet subdivided into two members, the upper Paveloff Siltstone Member and the lower Tonnie Siltstone Member (Detterman and Hartsock (1966). This unit is a partial age equivalent of the Shelikof Formation of the Alaska Peninsula (Detterman and others, 1996). Subdivided into:

Jcp Paveloff Siltstone Member—Consists of massive dark-gray arenaceous siltstone in the upper part and a thick sandstone unit at its base (Detterman and Hartsock, 1966). Large ellipsoidal concretions and lenticular beds of limestone occur throughout the unit and thin interbeds of sandstone occur in the siltstone. A few siltstone beds contain abundant finely disseminated pyrite, causing the beds to weather rusty brown. The siltstone is well-indurated and the uppermost part is thin-bedded and fractures into angular fragments. The graywacke sandstone of the lower unit is "…thin bedded to massive, locally lenticularly bedded, fine to coarse grained, gray to greenish gray" (Detterman and Hartsock, 1966, p. 43). Limestone concretions and interbeds are common and on fresh surfaces are very dark-gray, but weather buff to cream colored. Locally the limestone is bioclastic (Detterman and Hartsock (1966). Many non-diagnostic pelecypods and gastropods have been collected from the lower sandstone (Detterman and Hartsock, 1966), whereas a wide variety of ammonites have been collected from the siltstone and limestone concretions higher in the section. Many genera of ammonites, including *Cadoceras, Stenocadoceras,* P*seudocadoceras, Kepplerites, Kheraiceras*, and *Lilloettia,* have been collected from the unit (Detterman and Hartsock, 1966), indicating a Callovian age, although the uppermost zone of the Callovian has not been identified. The Paveloff Siltstone Member is the age equivalent of the Shelikof Formation of the Alaska Peninsula; the Shelikof contains a higher proportion of coarse volcanic debris (Detterman and others, 1996)

Jct Tonnie Siltstone Member—Massive dark-gray to brownish-gray arenaceous siltstone, which weathers brownish-gray to red-brown (Detterman and Hartsock, 1966). Numerous small yellowish-brown weathering limestone concretions occur in parallel bands and randomly throughout the section. Thin fine-grained, greenish-gray sandstone interbeds occur in the siltstone and a more massive sandstone unit is found at the base of the section. The limestone concretions are generally ovoid and as much as 12-13 cm in diameter. They are extremely hard and commonly fossiliferous (Detterman and Hartsock, 1966). The sandstone interbeds are compositionally similar to the siltstone, just coarser grained. The thick (6-30 m) sandstone bed present at the base of the unit is medium-bedded to massive, fine- to medium-grained and grayish-brown. On Chisik Island, a thick (65 m) channel conglomerate consisting mainly of volcanic rock cobbles and boulders is present at the base of the section. "The Chisik Island section also contains numerous thin beds of volcanic ash (Detterman and Hartsock, 1966, p. 41)." The Tonnie Siltstone is abundantly fossiliferous, yielding many mollusks, particularly ammonites. *Paracadocreas*, *Pseudocadoceras*, *Phyllocreas*, *Lilloettia*, *Kheraiceras*, *Kepplerites*, and *Xenocephilites* are among the collections as are numerous pelecypods and rare belemnites, gastropods and brachiopods (Detterman and Hartsock, 1966) allowing an age assignment of early Callovian

Jt Tuxedni Group (Middle Jurassic, Bathonian to Bajocian)—Light- to dark-gray and green graywacke, conglomerate, siltstone, and shale (Detterman and Hartsock, 1966). Graywacke ranges from feldspathic to lithic, conglomerate composed mainly of volcanic clasts in a graywacke matrix. Unit is locally subdivided into the Red Glacier Formation, Gaikema Sandstone, Fitz Creek Siltstone, Cynthia Falls Sandstone, Twist Creek Siltstone, and Bowser Formation, descriptions of which below are derived from Detterman and Hartsock (1966):

Jtb Bowser Formation (Middle Jurassic, Callovian and Bathonian)—Heterogeneous assemblage of sandstone, conglomerate, shale and siltstone characterized by rapid facies changes (Detterman and Hartsock, 1966). Massive light- to dark-gray sandstone and conglomerate are the dominant lithologic types on the Iniskin Peninsula. The sandstone and the conglomerate matrix are coarse-grained and composed of angular fragments of feldspar and quartz, having biotite, augite, and magnetite as common accessory minerals. The light-gray sandstones are interbedded with the dark-gray sandstone and are commonly calcareous and contain numerous coquina beds composed almost entirely of the pelecypods *Inoceramus* and *Trigonia*. Clasts in the conglomerate are dominantly felsic volcanic rocks and basalt, but include about 10 percent granitic rocks. Siltstone as much as 100 m thick is interbedded with the conglomerate and sandstone and north of Chinitna Bay occurs in units as much as 250 m thick, where it forms the dominant lithology in the Bowser Formation. The siltstone is massive to thin-bedded, medium- to coarse-grained, dark-brownish gray, weathering to light-brown. Lenticular limestone concretions containing ammonites are common north of Chinitna Bay. The formation ranges in overall thickness from 380 to 560 m. Abundantly fossiliferous, containing ammonites and pelecypods, this formation can be divided into two faunal zones which occur on either side of the break between Callovian and Bathonian. The lower faunal zone immediately overlies the unconformity with the Twist Creek Siltstone and contains the ammonites *Cranocephalites*, *Arctocephalites*, *Siemiradzkia*, *Cobbanites*, and *Parareineckia* and is of middle Bathonian in age. The upper faunal zone contains the ammonites *Xenocephalites, Kheraiceras*, and *Kepplerites* of Callovian age

Jtt Twist Creek Siltstone (Middle Jurassic, Bajocian)—Soft, poorly consolidated, thin-bedded to massive siltstone and silty shale as much 125 m thick (Detterman and Hartsock, 1966). The siltstone is dark-gray, weathering to dark-rusty brown and contains many thin beds of volcanic ash that weather a bright orange color. Small limestone concretions commonly fossiliferous and are common throughout the unit. The Twist Creek Siltstone has an abundant ammonite fauna which includes *Oppelia* (*Liroxyites*), *Megasphaerceras*, *Leptoshinctes*, *Lissoceras*, and *Normannites* (*Dettermanites*), but which is restricted to the contained limestone concretions

Jtc Cynthia Falls Sandstone (Middle Jurassic, Bajocian?)—Massive to thick-bedded graywacke sandstone and pebble conglomerate about 200 m thick (Detterman and Hartsock, 1966). The sandstone is medium- to coarse-grained, greenish-gray to dark-green, weathering mottled light-gray due to zeolites and has graded bedding. The sandstone consists mainly of angular fragments of feldspar and volcanic rocks in a compositionally similar silt-size matrix. The pebble conglomerate occurs in thin lenticular beds within the sandstone and is well sorted within individual beds. Clasts consist of “red and green felsitic volcanic rocks, aphanitic igneous rocks, and a few metasedimentary rocks that are primarily dark-gray quartzite” (Detterman and Hartsock, 1966, p. 32). Coarse-grained siltstone is interbedded with the sandstone and the siltstone may contain a few limestone concretions. The siltstone may make of 10 to 15 percent of the formation. Like the underlying Fitz Creek Siltstone and Gaikema Sandstone, the Cynthia Falls Sandstone is coarsest grained in the vicinity of Gaikema Creek and finer grained away from this area. Fossils are relatively uncommon in this unit, thought in part due to rapid deposition in a nearshore environment. The sparse fauna includes the ammonites *Chondroceras* and *Stephanoceras* as well as the pelecypods *Inoceramus* sp. and *Mytilus* sp.

Jtf Fitz Creek Siltstone (Middle Jurassic, middle Bajocian)—Thick sequence (up to 400 m thick) of massive, bluish dark-gray, arenaceous coarse- to fine-grained siltstone that commonly weathers rusty orange and contains many small limestone concretions (Detterman and Hartsock, 1966). Interbedded is fine-grained sandstone and, locally, conglomerate interbeds. In the upper part of the unit the siltstone could possibly be called silty shale. The unit is coarsest in the vicinity of Gaikema Creek and rapidly becomes finer-grained in all directions away from the Gaikema Creek section. This unit is abundantly fossiliferous and is the first unit of the Tuxedini Group where ammonites are more numerous than pelecypods. A few non-diagnostic brachiopods are also present. The ammonites include *Normannites, Teloceras*, and *Chondroceras* and many other genera, pelecypods include *Inoceramus* and *Pleuromya*, both forms distinctly different than lower part of the Tuxedini Group. The *Inoceramus* is specifically identified as *I. ambiguus* Eichwald, different from the common *Inoceramus* of the older rocks

Jtg Gaikema Sandstone (Middle Jurassic, lower middle Bajocian)—Resistant, cliff-forming, massive to thin-bedded graywacke sandstone and cobble conglomerate showing graded bedding 150- to 260 m thick (Detterman and Hartsock, 1966). Conglomerate is confined to the Iniskin Peninsula, clasts in it consist of "red and green felsitic volcanic rocks, aphanitic igneous rocks, and minor metasedimentary rocks" (Detterman and Hartsock, 1966, p. 26), all thought to be derived from the Talkeetna Formation. Rare granitic clasts are the first appear in the Middle Jurassic of rocks presumably derived from the Alaska-Aleutian Range batholith. Siltstone constitutes generally less than 10 percent of the unit, occurring mainly as thin interbeds in sandstone. Siltstone is thin-bedded to massive, generally coarse-grained to sandy, gray to olive-gray, and brownish to rusty brown weathering. Locally siltstone can constitute as much as 40 percent of the formation, though it apparently does not occur in close proximity to the conglomeratic parts of the formation. Fossiliferous throughout, containing pelecypods *Meleagrinella*, *Trigonia*, and *Inoceramus* and ammonites *Witchellia(?), Stephanceras* and locally, *Sonninia (Papilliceras), Lissoceras*, and *Emileia*

Jtrg Red Glacier Formation (Middle Jurassic, lower Bajocian to lower middle Bajocian)—Thin-bedded to massive, red-brown weathering dark-gray to moderate olive-gray siltstone is concentrated in the upper part of the unit and makes up about 40 percent of the Formation (Detterman and Hartsock, 1966). The siltstone is highly arenaceous and locally contains lenticular interbeds and concretions of reddish-gray, dense limestone and very minor coal seams. Underlying this is light-tan to buff arkosic sandstone making up about 25 percent of the unit and a thick black, silty to arenaceous, very fissile, shale constitutes the rest of the unit. Overall thickness ranges from 600 to 2,000 m. The Red Glacier Formation is most abundantly fossiliferous in its upper parts, no fossils are known from the lower 600 m of the unit. Pelecypods include *Meleagrinella*, *Trigonia*, *Inoceramus*, *Camptonectes*, and *Pleuromya*. Ammonites occur in two distinct faunal assemblages. The lower assemblage includes *Erycites*, *Tmetoceras*, and *Pseudolioceras* and this faunal zone from 450 to 1,400 m below the top of the formation. The upper assemblage is in the upper 400 m of the formation and includes *Soninia*, *Emiliea*, *Parabigottes* and in the uppermost 150 meters, also includes *Papilliceras*, *Strigoceras*, *Lissoceras*, *Stephanoceras*, *Stemmatoceras*, and *Skirroceras*

Jtk Talkeetna Formation, undivided (Lower Jurassic)—Bedded volcanic rocks widely distributed in the Iliamna, Lake Clark and Kenai quadrangles. Where undivided, it consists of flows, breccia, tuff, and agglomerate and minor sandstone and shale, often somewhat altered or metamorphosed (Detterman and Hartsock, 1966; Detterman and Reed, 1980). Locally subdivided into:

Jtkh Horn Mountain Tuff Member—Bedded tuff and tuffaceous feldspathic sandstone, locally containing porphyritic andesite flows. Bedded tuff occurs in thin-bedded to massive beds that are fine- to coarse-grained, and tan, red, green, purple, or mottled (Detterman and Hartsock, 1966). Locally, tree stumps occur within the tuff beds, suggesting subaerial deposition. However, thin-bedded laminated units having graded bedding and containing rare belemnite fragments indicate some parts of the unit are marine. Measured thickness is as much as 870 m (Detterman and Hartsock, 1966). The above mentioned belemnites and plant fragments occur near the top of the unit; the fossils are not age diagnostic. In the Talkeetna Mountains area, fossils in the upper part of the Talkeetna Formation, which is considered correlative to the rocks of the Horn Mountain Tuff Member, indicate a late Pliensbachian and Toarcian (Early Jurassic) age (Arthur Grantz, oral commun., 1963, cited in Detterman and Hartsock, 1966)

Jtkp Portage Creek Agglomerate Member—Reddish fragmental volcanic debris, primarily rounded volcanic bomb-like fragments and lapilli tuff (Detterman and Hartsock, 1966). In contrast to the Marsh Creek Breccia Member, this unit grades to fine-grained tuff, clastic sedimentary rocks and flows northward in the map area. Interbedded flows, tuff, and sedimentary rocks are thicker than in the underlying Marsh Creek Breccia Member, suggesting to Detterman and Hartsock (1966) a decrease in violent volcanism in the source area. These rocks are generally more felsic, although commonly described as andesitic (Detterman and Hartsock, 1966), than those of the Marsh Creek Member and their distribution suggests a separate source (Detterman and Hartsock, 1966). The estimated thickness of this unit is between 685 and 870 m. Fossil control is unknown for this map unit

Jtkm Marsh Creek Breccia Member—Massive dark-green to green volcanic breccia having a tuff matrix (Detterman and Hartsock, 1966). Consists of angular fragments of aphanitic pink and green volcanic rocks ranging in size from 1 cm to nearly 1 m. Interbedded flows of andesite and basalt (Detterman and Reed, 1980), thought to be partly submarine (Detterman and Hartsock, 1966), are common and increase in abundance and thickness southward and coarse breccia decreases southward. This member has an estimated minimum overall thickness of 1,000 m no complete section has been measured and the measured section is cut by faulting. No fossils are known from this unit in the map area and its age is only inferred based on correlations with rocks in the Talkeetna Mountains type area

Trk Kamishak Formation, undivided (Upper Triassic; Norian)—Limestone, chert, porcellanite, and minor tuff divided into three formal members, in descending order, the Ursus, an unnamed middle, and Bruin Limestone members by Detterman and Reed (1980). Originally named the Kamishak Chert by Martin and Katz (1912) and renamed the Kamishak Formation by Kellum (1945, as cited in Detterman and Reed, 1980). Unit primarily found along west side of Cook Inlet, east of Alaska-Aleutian Range crest. Fossils found within the unnamed middle and Bruin Limestone members of the Kamishak Formation yield a Norian age (Detterman and Reed, 1980; C.D. Blomé, U.S. Geological Survey, oral commun., 1981). As mapped, unit includes a small area of Triassic limestone and chert associated with the Chilikadrotna Greenstone in the central Lake Clark quadrangle. Cut by abundant dikes and sills related either to the Cottonwood Bay Greenstone or the Talkeetna Formation. Locally subdivided into:

Trku Ursus Member—Thin-bedded, light-gray limestone, locally dolomitic, and minor interbedded gray chert and porcellanite and minor tuff. Limestone is fine-grained biomicrite. Depositional environment was moderate to high-energy, shallow water

Trkm middle Member—Thin- to medium-bedded, dark-gray to black limestone and calcilutite, locally dolomitic, and minor black chert and gray tuff. Limestone is fine-grained microsparite. Calcite is locally altered to chert, suggesting a deep-basin environment

Trkb Bruin Limestone Member—Massive to thin-bedded, light- to dark-gray limestone; coral and echinoid bioherms, banded green and white chert. Environment was apparently high energy, shallow water

Trsh Gray shale and gray volcaniclastic sandstone (Triassic)—Gray shale and gray volcaniclastic sandstone. Unit shown by Eakins and others (1978) in central Lake Clark quadrangle in close proximity to outcrops of the Chilikadrotna Greenstone. Originally thought to be of Silurian age on the basis of an erroneous fossil determination in associated limestone (R.B. Blodgett, 2004, unpub. data)

Structural assemblages

JPk Kakhonak and Tlikakila Complexes (Jurassic, Triassic, and Permian(?) or older(?))—The Kakhonak Complex, defined by Detterman and Reed (1980), and the Tlikakila Complex, defined by Carlson and Wallace (1983), are lithologically diverse and complex assemblages of metamorphosed mafic plutonic, volcanic, and sedimentary rocks. Detterman and Reed (1980) described the unit as largely consisting of roof pendants within the Alaska-Aleutian Range batholith and believed that the Kakhonak Complex represents, in part, the metamorphic equivalent of Upper Triassic and Lower Jurassic rocks of the vicinity. However, quartzite and quartz-mica schist occurring within the Kakhonak Complex have no direct equivalent within the sedimentary rocks of the vicinity, indicating other protoliths may have contributed to the complex. As Permian rocks were known from Puale Bay, south of the map area, a possible Paleozoic age was not excluded by Detterman and Reed (1980). Internal contacts are typically faults, resulting in a tectonic mix of lithologies. The essentially equivalent Tlikakila Complex is lithologically similar. The Kakhonak Complex is defined from the southeastern part of the map area as roof pendants or closely associated with the batholith, the Tlikakila Complex is exposed largely west of the batholith, but still closely associated with it, in the northern part of the map area. Although most of the rocks of these complexes are at greenschist facies, the rocks range from nonmetamorphosed to granulite facies. Age control on the protolith is limited in the Tlikakila Complex to Late Triassic megafossils and conodonts in the included limestone (Wallace and others, 1989), whereas no age control is known from the Kakhonak Complex. Bogar and others (2003) reported ^{40}Ar-^{39}Ar ages ranging from 176.3 to 178.2 Ma on biotite from metasedimentary rocks in the Tlikakila Complex indicating Middle Jurassic metamorphism, coeval with the emplacement of plutonic rocks of the Alaska-Aleutian Range batholith (see Table 1). Detterman and Reed (1980) also mapped a migmatite unit on the east side of the Jurassic batholith at Bruin Bay; we have included that map unit with this unit on the present map

Igneous rocks

Quaternary

Qv Volcanic rocks, undivided (Quaternary)—Andesite, dacite, and basalt lava flows, volcanic breccia, lahar deposits, and debris-flow deposits. Includes air-fall tuff, volcanic dome deposits, block-and-ash-flow deposits, ash-flow tuffs, volcanic-rubble flows, debris flows and hot-blast avalanche deposits. Lava flows and clasts in other volcanic deposits of unit are porphyritic, typically glassy, gray to black, and commonly vesicular. Andesite is dominant composition and probably constitutes 60 percent or more of rocks. Unit typically forms volcanic edifices. Rocks of this unit mapped at Augustine and Iliamna Volcanoes include Holocene rocks. Locally subdivided into:

Hv Volcanic rocks (Quaternary, Holocene)—Andesite and basalt lava flows, and sills. These primarily extrusive rocks typically form the present day edifices of Iliamna and Redoubt Volcanoes. They cap ridges and include massive lava flows, agglomerate, and lahar deposits, primarily associated with Redoubt Volcano and flows from Iliamna Volcano and North and South Twin volcanic center

Qdf Debris-flow deposits (Quaternary, Holocene)—Debris flow deposits from Redoubt Volcano in the Crescent River valley. Includes several small (older?) deposits in the upper valley and a 3,500-year-old debris flow in the lower valley. The older deposits are of multiple debris flows off the west and southwest flanks Redoubt Volcano. Oldest(?) deposit is derived from west flank of Redoubt. Next oldest deposit appears derived from presently glaciated valley draining to the southwest off Redoubt. These deposits are of relatively limited extent. They may have dammed the North Fork of the Crescent River, creating a temporary lake in the valley. Deposits of the youngest, most extensive, and probably most fluid debris flow derived from southwest flank of Redoubt Volcano. Flow was apparently derived from the only presently glacier free valley draining south from Redoubt. This debris flow has been dated at 3,500 yrs. BP (Riehle and others, 1981), young enough to possibly explain lack of glaciers in the source valley, as all surrounding valleys have extensive glaciers and glacial deposits. This debris flow extends to coast of Cook Inlet and back flowed up the main fork of the Crescent River, creating Crescent Lake. Map unit also includes an apparent debris flow deposit in the upper Crescent River valley. These unusual deposits emanate from valley on east side of Crescent River valley. Source valley is along extension of normal fault trending to the northeast and having apparent Holocene motion. These deposits have not been examined on the ground and probably are non-volcanogenic

Qmf Volcanic rubble and mudflows (Quaternary, Holocene)—Volcanic rubble and mudflows on Augustine Volcano (Detterman and Reed, 1980) as well as mudflows in the Drift River valley draining Redoubt Volcano (Till and others, 1993) these deposits are of Holocene age and many are historic including 1963 mudflows on Augustine and 1966 and later flows from Redoubt

Qamp Andesite and dacite domes (Quaternary)—Composite dome complex of Double Glacier Volcano consisting of medium- to coarsely porphyritic hornblende andesite and dacite. Three K-Ar whole-rock ages were determined on these domes, two are considered minimum ages at 627 and 763 ka and one yielded 887 ka. (Table 1) Also, includes the Johnson Glacier dome complex of Iliamna Volcano (Waythomas and Miller, 1999)

Quaternary or Tertiary

QTv Volcanic rocks, undivided (Quaternary, Pleistocene or Tertiary, Pliocene)—Detterman and Reed (1980) mapped two eruptive centers within the Jurassic part of the Alaska-Aleutian Range batholith in the Iliamna quadrangle. Only one of the sites was examined and that only briefly by Detterman and Reed (1980). Scoriaceous olivine basalt at Seven Sisters is thought to represent a volcanic neck and feeder-dike system. The second site, at West Glacier Creek, was thought to consist largely of andesitic tuff and breccia having a smooth to gently rounded topographic expression. No age control exists for either center, Detterman and Reed (1980) suggested the olivine basalt of the Seven Sisters is most closely related to the Intricate Basalt of possible Pliocene age, whereas the andesite(?) at West Glacier Creek seemed more similar to Augustine and Iliamna Volcano products. Also included in this map unit are basaltic andesite porphyry dikes and sills intruding the Jurassic sedimentary rocks between Chinitna and Iniskin Bays

Tertiary

Ti Intrusive rocks, undivided (Tertiary)—Generally consists of fine- to medium-grained granodiorite and quartz diorite, but also includes granite (Nelson and others, 1983). Typically surrounded by well-developed hornfels zones and sporadic hydrothermal alteration in country rocks, includes volcanic necks, sills, and dikes. Dikes, sills, and stock-like masses of felsic to mafic composition including a wide variety of granitic rocks in the Lake Clark quadrangle. Part of the Alaska-Aleutian Range batholith of Reed and Lanphere (1969; 1972). Locally divided into:

Tig Granite and aplite (Tertiary, Oligocene? and younger)—This map unit includes a variety of granite bodies in the Lake Clark quadrangle (Nelson and others, 1983). A multiphase, hypabyssal leucocratic grayish-pink biotite granite outcropping north of the Lake Clark fault system (Ti13 of Nelson and others, 1983) and mall area of fractured biotite granite containing as much as 40 percent potassium-feldspar (Ti18, Nelson and others, 1983) north of this pluton are part of this map unit. Also, includes a light-gray, fine-grained xenomorphic granular aplite stock (Ti19, Nelson and others, 1983)

Tpgr Peralkaline granite—Mostly medium-grained hypidiomorphic granular granite containing subhedral to euhedral perthite (Nelson and others, 1983). Only peralkaline granite associated with Alaska-Aleutian Range batholith and probably not related to calc-alkaline rocks of the batholith. This map unit may correlate with other peralkaline granite bodies in the Dillingham quadrangle (map units TKgr and TKgs) that generally yielded 60-64 Ma ages

Tign Gabbronorite—Small, coarse-grained stock of hornblende and biotite-bearing olivine gabbronorite cutting Mesozoic sedimentary rocks (Nelson and others, 1983). According to Nelson and others, this pluton is most likely related to nearby Tertiary volcanic rocks

Togd Granodiorite and quartz monzodiorite (Tertiary, Oligocene and late Eocene)—A compositionally variable suite of medium-grained, slightly foliated rocks ranging from tonalite to monzodiorite, including quartz diorite and granodiorite (Detterman and Reed, 1980; Nelson and others, 1983). Also, heterogeneous, intensely sheared and locally altered medium- to fine-grained rocks ranging from tonalite to monzodiorite as well as medium-gray, medium-grained hypidiomorphic-granular biotite-hornblende granodiorite (Ti16 of Nelson and others, 1983) that Reed and Lanphere (1972), had assigned to the Merrill Pass sequence but, as a result of additional work (Nelson and others 1983) indicated was no longer a proper assignment. K-Ar ages range between 31.9 ± 0.9 and 39.6 Ma (Table 1)

Teg Granite (Tertiary, late Eocene)—Largely granite, but includes lesser granodiorite and quartz monzodiorite (Nelson and others, 1983). This map unit includes a large biotite granite, biotite-hornblende granite and granodiorite pluton in the northeast part of the Lake Clark quadrangle which becomes more heterogeneous to the south. Available K-Ar ages are between 34.6 ± 1.3 and 41.9 ± 1.3 Ma (Table 1)

Tipg Older granite (Tertiary, Paleocene)—Medium-grained composite pluton of granite and granodiorite which forms western border of Alaska-Aleutian Range batholith from Little Lake Clark southwestward into the Iliamna quadrangle. Age inferred; however, a single K-Ar age (Reed and Lanphere, 1972; Table 1 herein) yielded 43.9 Ma on biotite. The biotite was very low in potassium (Reed and Lanphere, 1972, sample 66Ale 23), possibly indicating alteration

Tigd Granodiorite (Tertiary, Paleocene)—Medium- to fine-grained, equigranular hornblende-biotite granodiorite plutons, but ranges from granite to quartz monzodiorite (Nelson and others, 1983). Intrudes Jurassic and Cretaceous rocks of Alaska-Aleutian Range batholith. Concordant K-Ar ages of 61.0 and 62.8 Ma (Reed and Lanphere, 1969, 1972; Nelson and others, 1983; Table 1 herein)

Tvig Ignimbrite (Tertiary, Paleocene)—Crystal tuff containing variable amounts of biotite and feldspar crystals in a tuffaceous matrix (Wilson and others, 2003). Unit is widespread in the Stuyahok Hills in the northeast Dillingham quadrangle and varies in general appearance from crystal tuff to porphyritic plutonic rock. However in all cases, the groundmass is tuff. The proportion of tuff seems to decrease east to west. Wallace and others (1989) reported K-Ar ages of 57.9 ± 1.7 (hornblende) and 58.6 ± 1.8 (biotite, Table 1) for this unit. New ^{40}Ar-^{39}Ar age determinations on biotite indicate a tight age range between 59.25 ± 0.05 and 59.69 ± 0.05 Ma (Iriondo and others, 2003, Table 1 herein)

Cretaceous and Jurassic

KJg Mafic granitic rocks (Cretaceous and (or) Jurassic)—Medium-gray, medium-grained, hypidiomorphic granular hornblende-biotite quartz monzodiorite containing variable amounts of clinopyroxene. Flow structures locally present and hornblende and plagioclase is aligned in a north-northeast direction. Two samples yielded strongly discordant K-Ar biotite and hornblende ages between 58.8 and 97.5 Ma (Nelson and others, 1983; Table 1 herein). Part of the Alaska-Aleutian Range batholith of Reed and Lanphere (1969; 1972)

Jurassic

Alaska-Aleutian Range batholith (Jurassic phase)—Subdivided into:

Jtr Trondhjemite (Late Jurassic)—Medium- to coarse-grained, seriate, leucocratic trondhjemite containing 10 percent muscovite and about 5 percent interstitial, perthitic potassium feldspar. This is a large body in the central part of the batholith west of Chinitna Bay. A single K-Ar age on muscovite was 148 Ma (Reed and Lanphere, 1972; Table 1 herein)

Jla Lamprophyre and basalt dikes—Shown only locally in the join area between the Iliamna and Kenai quadrangles (Detterman and Hartsock, 1966) these dikes intrude map unit Jqd

Jqm Granodiorite and quartz monzonite—Whitish-gray, medium-grained, biotite granodiorite, minor hornblende and accessory primary muscovite. Medium-grained, light-gray with a pinkish cast quartz monzonite, locally may include quartz diorite and trondhjemite. This unit is largely exposed only on the eastern margin of the Jurassic batholith. Detterman and Reed (1980) reported ages of 170 ± 4.0 and 174 ± 4.0 (Table 1 herein) Ma, which were replicates of a single sample

Jqd Quartz diorite, tonalite, and diorite—Medium-grained quartz diorite and tonalite, which are locally foliated. This is by far the dominant map unit of the Alaska-Aleutian Range batholith. Hornblende is the dominant mafic mineral, biotite increases in proportion to the presence of quartz and potassium feldspar. Detterman and Reed (1980) reported that the rocks of this unit grade to diorite but they did not observe it grading into granodiorite or quartz monzonite. Potassium-argon ages generally range from 146 ± 4.3 to 183 Ma; a number of samples yielded younger ages which were considered suspect or reset by younger plutonism (Table 1). Two small exposures of gabbro and diorite included in unit

Jmu Mafic and ultramafic plutonic rocks (Early Jurassic)—Small areas of gabbro, hornblende gabbro, hornblendite, and pyroxenite in the Jurassic batholith of Detterman and Reed (1980). K-Ar ages of 160 and 183 Ma reported (Reed and Lanphere, 1972; Table 1 herein)

Triassic

Trc Cottonwood Bay Greenstone and Chilikradrotna Greenstone (Triassic)—Largely dark-gray to dark-green porphyritic to amygdaloidal basaltic flows altered to greenstone (Detterman and Reed, 1980; Nelson and others, 1983; Wallace and others, 1989). Locally includes andesite, chert, limestone, and tuffaceous sedimentary rock, all weakly metamorphosed. About 60 percent of unit is metabasalt. The Cottonwood Bay Greenstone occurs either as roof pendants of or east of the Alaska-Aleutian Range batholith in the Iliamna quadrangle. The Chilikradrotna Greenstone occurs well west of the batholith in the Lake Clark quadrangle. In the Dillingham quadrangle, an area of fine-grained, mildly altered basaltic volcanic rocks is included in this unit; however this is mainly based on an inferred lithologic correlation (Wallace and others, 1989). Basal beds of the Bruin Limestone Member of the Kamishak Formation contain volcanic rocks similar to the Cottonwood Bay Greenstone and with this evidence Detterman and Reed (1980) assigned a Late Triassic age to Cottonwood Bay Greenstone. As the Kamishak Formation is of Norian age, Detterman and Reed (1980) stated that the Cottonwood Bay Greenstone is probably older than Norian. Eakins and others (1978) described dark-gray limestone associated with the Chilikadrotna Greenstone. Originally, the fossils in this limestone were identified as Silurian (Eakins and others, 1978, Nelson and others, 1983); re-collection indicated the limestone was of Triassic age (Wallace and others, 1989), it is shown as Kamishak Formation on this map

Metamorphic rocks

MzPzu Metamorphic rocks, undivided (Mesozoic and (or) Paleozoic)—Biotite-feldspar-quartz schist, locally actinolite-feldspar-quartz schist or garnet-feldspar-quartz schist (Eakins and others, 1978). Unit occurs west of Lake Clark

MzPzb Metamorphosed mafic volcanic and sedimentary rocks (Mesozoic and (or) Paleozoic)—Metamorphosed mafic volcanic rocks, phyllite, schist, quartzite, marble, calc-silicate rocks, serpentinite, gabbro, and chert (Nelson and others, 1983). Mixed unit of varying affinity, protolith, and metamorphic age. Dominant rock type of unit is metamorphosed mafic volcanic rock which may be stratigraphically equivalent to the Chilikradrotna Greenstone or the Talkeetna Formation. Unit also includes nonmetamorphosed siltstone and sandstone near west margin of the map unit, which Wallace and others (1989) assigned to their Koksetna River sequence. A K-Ar date on biotite from schist near the western margin of this unit yielded a data of 63.2 ± 1.9 Ma (Wallace and others, 1989; Table 1 herein). Wallace and others (1989) considered this schist to be the metamorphosed equivalent of their Koksetna River sequence; however, the abundance of metamorphosed mafic volcanic rocks indicates the significant inclusion of another protolith

Igneous rocks, all provinces

Although many of the rock units in this group are primarily exposed in the Alaska-Aleutian Range province, representatives of each group occur throughout the map area.

Tertiary

Tvu Volcanic rocks, undivided (Tertiary)—Andesite, basalt, and dacite lava flows, tuff, lahar deposits, volcanic breccia, and hypabyssal intrusions. Widely scattered throughout the map area, they are most apparent in the Lake Clark quadrangle where they are a subdivision of the Tvf map unit of Nelson and others (1983). In part mapped by air-photo correlation with areas of known volcanic rocks of unit Tv of Detterman and Reed (1980) having similar outcrop and erosion patterns. Locally subdivided into:

Tb Basaltic volcanic rocks (late Tertiary)—Olivine basalt lava flows as much as 10 m thick and locally diabasic intrusive rocks in the northwest corner of the Taylor Mountains quadrangle. These columnar-jointed flows, which form a large tilted plateau, yielded K-Ar ages of 4.62 and 4.72 Ma (Reifenstuhl and others, 1985a, Table 1, herein). Map unit also includes the Intricate Basalt of Detterman and Reed (1980), a glassy to porphyritic black to dark-green olivine-augite basalt, largely in the vicinity of Intricate Bay, but also occurring south of Gibraltar Lake, as well as mafic dikes not shown here. Detterman and Reed (1980) reported K-Ar dates of 4.4 ± 0.5 and 5.1 ± 1.0 Ma on an olivine basalt dike that cuts the Naknek Formation. An outcrop of olivine basalt at Kazik Hill in the northeast Taylor Mountains quadrangle is undated

Tpg Gibraltar Lake Tuff (Tertiary, Pliocene? to Oligocene?)—Defined by Detterman and Reed (1980), it is divided into a lower welded member and an upper nonwelded member. The upper member consists of light-gray to white crystal ash-flow tuff having a maximum thickness of 152 to 182 m. It is locally capped by basalt flows of the Intricate Basalt. Lower member is at least 300 m thick and consists of light- to medium-gray and tan rhyolitic crystal and lithic welded tuff and, locally, interbedded porphyritic rhyolite flows. It unconformably overlies older Tertiary basalt and andesite. Detterman and Reed (1980) had little age control on this unit; however based on geomorphic grounds and comparison with other Tertiary age units, they suggested that the age was more likely Pliocene than Oligocene

Tvr Felsic volcanic rocks (Tertiary)—Rhyolitic breccia, ash-flow tuff, flows, and intrusive rocks and subordinate mafic and intermediate flows. Unit is thought to encompass entire Tertiary and may include Jurassic rocks of the Talkeetna Formation. Much of this unit was included in map unit Tv of Nelson and others (1983), however, those that we believe correspond in age with the Oligocene to Eocene Meshik Arc (Wilson, 1985) were placed within map unit Tmv here. In the Dillingham quadrangle, this unit includes the larger of scattered occurrences of felsic hypabyssal rocks which occur as dikes and small plugs. In the Taylor Mountains quadrangle, includes felsic porphyritic rocks in the northwest corner and along the southeastern margin

Tmv Volcanic rocks, undivided (Tertiary, Oligocene and Eocene)—Ranges from rhyolitic breccia, ash-flow tuff, and flows to dark-gray to green, coarse andesitic and basaltic volcanic rubble, lahar deposits, glassy to porphyritic basaltic andesite and andesite lava flows. Includes minor volcaniclastic sedimentary rocks and hypabyssal felsic porphyry. As described by Detterman and Reed (1980), in many cases eruptive centers can be identified, as volcanic necks of eroded volcanoes or as caldera complexes. Limited age determinations for the unit and sub-divisions range from approximately 41 to 54 Ma; dates reported by Thrupp (1987) were 31.3 ± 0.9 and 33.8 ± 6.8 Ma (Table 1). Inferred to represent the northern extension of the Meshik Arc of the Alaska Peninsula (Wilson, 1985). Most likely correlative, in part, with volcanic rock units Tmf and Tmba, below. As mapped in the Lake Clark quadrangle by Nelson and others (1983), this map unit may also include rocks of the Talkeetna Formation. Locally subdivided into:

Tmf Tuffaceous felsic volcanic rocks—Cream, light-gray, green, and purple bedded lithic, crystal, and vitric tuff; light-gray to tan welded crystal and lithic tuff most common (Detterman and Reed, 1980). Also includes distinctive light colored horizons of felsic tuff interlayered with olivine basalt in the northeast Dillingham quadrangle (Wilson and others, 2003). This tuff is largely altered glass and very fresh phenocrysts of plagioclase in layers approximately 10 to 30 m thick. A ^{40}Ar-^{39}Ar age determination yielded 45.1 ± 0.19 Ma (sample 01AWs 67B, Table 1). A sample from this unit collected by J.H. Curran (USGS) along the Alagnak River in the southern Dillingham quadrangle yielded a ^{40}Ar-^{39}Ar age of 41.62±0.18 Ma (sample AL00, Table 1), both of which are consistent with the Meshik Arc (Wilson, 1985). However, these ages are not necessarily applicable to all the tuffs within this map unit

Tmba Basalt and andesite—Dark-gray to green glassy to porphyritic basaltic andesite and andesite lava flows. Also includes andesite to basalt plugs, volcanic rubble and breccia, including some agglomerate; may include deposits of lahars (Detterman and Reed, 1980). Includes two areas of massive columnar-jointed olivine basalt flows in the northeast Dillingham quadrangle (Wilson and others, 2003). The younger of these consists of flows ranging from 3 to 10 m thick interbedded with felsic tuff of map unit Tvf and yields a ^{40}Ar-^{39}Ar age of 44.47 ± 0.41 Ma (sample 01AWs 67, Table 1). The older olivine basalt may, in part, be a sill as locally it is overlain by contact-metamorphosed rocks of unit KJvs. It yields a ^{40}Ar-^{39}Ar isochron age of 53.71 ± 0.61 Ma (sample 01AWs 55, table 1). Many of the rocks of this map unit are associated with eruptive centers. An isolated andesitic plug in northeast Dillingham quadrangle yielded a ^{40}Ar-^{39}Ar isochron age of 47.95 ± 1.39 Ma (sample 01AWs 49, Table 1). Overall, dates on rocks of this map unit range from 29.5 ± 1.4 to the 53.71 ± 0.61 Ma age mentioned above

Tertiary and (or) Cretaceous

TKv Volcanic rocks (Tertiary and [or] Cretaceous)—Volcanic rocks including tuff, tuff breccia, and breccia. Compositional as well as age data is not available for these rocks (Eakins and others, 1978, W.K. Wallace, written commun., 2002). Subdivided into:

TKr Rhyolite and dacite flows, tuff, dikes, and sills—Rhyolite and dacite flows and tuff cut by dikes or sills which locally contain phenocrysts of sanidine and high temperature quartz. These rocks primarily occur in the valley of the Mulchatna River in the Lake Clark quadrangle spatially associated with rocks of the Koksetna River sequence of Wallace and others (1989). An additional area of exposure is in the northeast Dillingham quadrangle where the unit consists of porphyritic, quartz-eye and feldspar phenocrystic felsic rocks that are variably hydrothermally altered (Wilson and others, 2003). In general, unit appears to represent the roof area of plutons of the immediate area. Only the larger of scattered occurrences of felsic hypabyssal rocks are shown. Eakins and others (1978) reported two K-Ar dates for rocks from this map unit, 59.5 ± 1.8 Ma on biotite from dacite and 62.7 ± 1.9 Ma on biotite from andesite included within a dacite map unit (TKd) by Eakins and others (1978)

TKb Basalt flows—Scattered occurrences west of Lark Clark. No further lithologic description available (Eakins and others, 1978). Thrupp (1987) reported 2 K-Ar dates from this map unit, both whole-rock K-Ar determinations. One was 44.4 ± 1.7 and the other 65.8 ± 13.2 Ma (Table 1, herein). Eakins and others (1978) shows a date of 56.2 ± 1.7 Ma on rocks mapped within this unit, but described the rock as “hornblende-biotite granodiorite”, which suggests either a map or sample location error

TKg Granitic rocks, undivided (Tertiary and [or] Cretaceous)—Fine-, medium-, and coarse-grained, light- to dark-gray, rarely pink granitic rocks widely present west of the Alaska-Aleutian Range crest. Chiefly granite, quartz monzonite, and quartz monzodiorite; however, many of the individual plutons include a range of lithologies. Biotite and hornblende are locally common; muscovite is uncommon. These plutons are common in the western Dillingham quadrangle (Wilson, 1977). Many of the plutons in the western Dillingham quadrangle are unusual in that they tend to have biotite and pyroxene, often orthopyroxene, as their mafic minerals, regardless of the overall pluton composition (see Wilson, 1977). In the northeastern Dillingham quadrangle, alkali content (F.H. Wilson, unpub. data, 2003) of these rocks is high relative to normal for their SiO_2 content (LeMaitre, 1976). Map unit also includes fine-, medium-, and coarse-grained, light- to dark-gray, plutonic granitic rocks mixed with felsic dikes and contact metamorphosed volcanic or sedimentary rocks in the northeastern Dillingham quadrangle. K-Ar and ^{40}Ar-^{39}Ar ages range from 54 to 72.5 Ma throughout the map area (Table 1). Subdivided into:

TKgr Granite and alaskite—Ranging from very leucocratic alaskite to highly potassic, peralkaline monzogranite, the rocks of this unit are widely distributed in the map area. In the Dillingham quadrangle (Wilson and others, 2003), a large (7 km in diameter) coarse- to fine-grained white to off-white alaskite (alkali-feldspar granite) consisting of white feldspar and smoky quartz is present. Mafic minerals and mica exceedingly sparse in this alaskite body; where present, biotite appears late or secondary, rare amphibole is sodic, locally cyan-blue pleochroic. Smoky quartz and pegmatitic zones are common throughout unit. SiO2 content is high, ranging from 74.8 to 75.4 percent. Also in the Dillingham quadrangle, a large medium- to coarse-grained, light-gray to pinkish biotite monzogranite is exposed in the eastern part of the quadrangle. It contains large (2cm) phenocrysts of potassium feldspar (orthoclase), has biotite as the dominant mafic mineral; the biotite to hornblende ratio is approximately 3:1. Based on multiple chemical analyses (F.H. Wilson, 2006, unpub. data), rocks of this pluton cluster about the intersection of the quartz monzonite, monzogranite, granodiorite, and quartz monzodiorite fields of Streckeisen (1975); however, visually estimated modes place the rock unit primarily in the monzogranite field. The Tikchik Lake and Akuluktuk plutons of Wilson (1977) are also assigned to this map unit. Another relatively large granite pluton is exposed in the central Lake Clark quadrangle; in this body biotite and hornblende are in sub-equal proportions (Nelson and others, 1983). Other granite bodies are widely scattered in the Dillingham and Taylor Mountains quadrangle. Available K-Ar and ^{40}Ar-^{39}Ar ages for this unit range from a minimum age on hornblende of 54.5 ± 1.6 Ma (Wallace and others, 1989; Table 1 herein) to 69.6 ± 2.1 on a discordant biotite (74 B 57, Hoare and Coonrad, 1978; Table 1 herein)

TKgs Syenitic rocks—Medium-grained biotite monzogranite to syenogranite found in the mountains immediately south of the Koktuli River (Wilson and others, 2003). Biotite is the only mafic mineral and orthoclase has moderate development of string perthite. SiO_2 of analyzed samples has a narrow range of 65.5 to 65.7 percent and K_2O is relatively high (>4.80 percent; F.H. Wilson, unpub. data, 2003). ^{40}Ar-^{39}Ar ages range between 65.50 ± 0.05 and 66.24 ± 0.08 Ma on biotite (Iriondo and others, 2003; Table 1 herein. Rocks of syenitic affinity are restricted largely to the northern Dillingham and southern Taylor Mountains quadrangle. The largest representative of this map unit is the so-called “northern pluton” of Wilson and others (2003)

TKqm Quartz monzonite and quartz monzodiorite—Medium- to coarse-grained, light-gray monzogranite or quartz monzodiorite, may contain biotite, hornblende, sodic amphibole, and (or) clino- and orthopyroxene. Locally contain large phenocrysts of orthoclase; biotite to hornblende ratio is variable but generally sub-equal although a few plutons do not contain biotite. Locally there is minor development of string perthite texture in orthoclase. These plutons are the most common of the Tertiary and (or) Cretaceous plutons of the map area, occurring in the Lake Clark, Taylor mountains and Dillingham quadrangles. K-Ar and ^{40}Ar-^{39}Ar ages range from 60.5 ± 1.8 to 71.3 ± 2.1 Ma (Table 1)

TKgd Granodiorite—Medium-grained, hypidiomorphic granular, seriate granodiorite. Biotite tends to more abundant than hornblende. Common in the Lake Clark and Kenai quadrangles (Reed and Lanphere (1972, 1973, Magoon and others, 1976, Detterman and others, 1976). K-Ar ages of range between 65.1 ± 1.9 and 70.5 ± 2.0 Ma (Table 1)

TKqd Monzodiorite and quartz diorite—Generally located in the central Lake Clark quadrangle and northeast Dillingham quadrangle, these plutons are largely fine- to medium-grained monzodioritic and dioritic rocks, but locally include diorite and gabbro. Rocks typically have sparse biotite and abundant amphibole and clinopyroxene, and locally show evidence of contact metamorphism. A ^{40}Ar-^{39}Ar age on biotite of 64.42 ± 0.04 Ma was determined on a sample (Iriondo and others, 2003; Table 1 herein) in the Dillingham quadrangle, whereas a K-Ar age of 69.4 ± 2.1 Ma was reported in the Lake Clark quadrangle on one pluton (Eakins and others, 1978; Table 1 herein). One of plutons, map unit TKi1 of Nelson and others (1983), which outcrops near Upper Tazimina Lake in the Lake Clark quadrangle, may be as old as Jurassic

Mesozoic

Mzmi Mafic igneous rocks (Mesozoic?)—Predominantly diabase, probably intrusive. Isolated outcrops in the north-central Dillingham quadrangle. Intrudes rocks provisionally assigned to map unit KTrag, suggesting age may be Triassic or younger. Volcanic rock outcrops to the northeast within the quadrangle were inferred to be Triassic by Wallace and others (1989); in neither case does true age control exist. To the west, the buried mafic and ultramafic rocks of the Kemuk prospect (Hudson, 2001; ARDF record DI003) have been dated by ^{40}Ar-^{39}Ar at 86.05 ± 0.08 Ma on biotite (Iriondo and others, 2003; Table 1 herein)

Cretaceous

Kg Plutonic rocks, undivided (Cretaceous)—No description available beyond granodiorite, quartz diorite, and diorite (Magoon and others, 1976; Reed and others, 1992), but assumed to include representatives of the Cretaceous granitic rocks described below. Primarily located in the northeast part of the map area, east of the Lake Clark fault, these rocks were mapped as Tertiary or Cretaceous by Magoon and others (1976). On the basis of K-Ar dates between 67.2 ± 1.9 and 74.4 ± 2.2 Ma (Reed and Lanphere, 1972; Table 1 herein), they are shown as Cretaceous here:

Kqms Quartz monzonite and syenite (Late Cretaceous)—Massive, coarse-grained light-gray porphyritic quartz monzonite (Detterman and Reed, 1980, Nelson and others, 1993). Includes plutons in the Iliamna and Lake Clark quadrangles and the pluton of the Okstukuk Hills in the Dillingham quadrangle (Wilson, 1977), which consists of biotite granite or syenite having very coarse feldspar laths, medium-grained very fresh biotite and fine-grained clinopyroxene. K-Ar ages range from 75.6 to 85.5 Ma (Reed and Lanphere, 1972, Table 1 herein) and a ^{40}Ar/^{39}Ar age on biotite yielded 84.49 ± 0.05 Ma in the Okstukuk Hills (Iriondo and others, 2003; Table 1 herein)

Klgd Granodiorite (Late Cretaceous)—Isolated porphyritic granodiorite body having phenocrysts of quartz, plagioclase, biotite, and glomeroporphyritic clusters of pale-green amphibole in a groundmass of quartz and mostly potassic feldspar in the southcentral Lake Clark quadrangle (Nelson and others, 1983) and a small granodiorite pluton in the eastern Taylor Mountains quadrangle (F.H. Wilson, unpub. data, 2001). Reported K-Ar age for the Lake Clark pluton on biotite is “Late Cretaceous” (Nelson and others, 1983); a ^{40}Ar-^{39}Ar age on hornblende from the Taylor Mountains pluton is 75.22 ± 0.32 Ma (Iriondo and others, 2003; Table 1 herein)

Kgr Granite—Coarse-grained, light-pink, biotite granite (Detterman and Reed, 1980, Nelson and others, 1993). Exposed on the southern margin of the Lake Clark quadrangle and northern Iliamna quadrangle. No age control available

Kgd Granodiorite—Granodiorite and quartz monzodiorite bodies mapped by Nelson and others (1983) in the eastern Lake Clark quadrangle, as well as plutons surrounding the Pebble Copper deposit (Bouley and others, 1995) in the Iliamna quadrangle. The rocks are medium- to coarse-grained, light-to medium-gray in color, contain hornblende and biotite and rarely muscovite and locally have cataclastic textures. Although mapped as separate plutons by Nelson and others (1983), a number of these are thought to be fault offset extensions of each other. Age control shows a wide range of K-Ar ages, between 63.1 ± 1.8 and 69.0 ± 2.0 discordant biotite and hornblende on one sample (Reed and Lanphere, 1972; Table 1 herein) to 99.8 ± 5.0 on potassium feldspar (Bouley and others, 1995; Table 1 herein). Bouley and others also report 89.2 0.2 Ma on zircon from a tonalite. One of the plutons (Ki13 of Nelson and others, 1983) intrudes rocks of apparent Late Cretaceous age

Kqd Quartz diorite—Locally foliated, largely medium-grained hornblende-biotite quartz diorite, but includes hornblende-pyroxene gabbro and diorite, quartz diorite, tonalite, and minor granodiorite (Nelson and others, 1983). Occurs only in the Lake Clark quadrangle. Reed and Lanphere (1972) reported a K-Ar age on one pluton as 65.6 ± 1.8 on biotite and 68.7 ± 2.0 on hornblende (Table 1)

Table 1. Radiometric ages from the Northern Alaska Peninsula map area.

[Samples listed by map unit, in the order of the list in the Description of Map Units and from north to south within a map unit. Sample collectors: ADt, R.L. Detterman; AH, T.L. Hudson; ALe, M.A. Lanphere; AM, M.L. Miller; APc, C.C. Preller-Schlenker; AR, B.L. Reed; AWs, F.H. Wilson; BT, T.K. Bundtzen; MR, M.S. Robinson. Methods used: K-Ar, conventional Potassium-Argon; 40/39, ^{40}Argon-^{39}Argon; U-Pb, Uranium-Lead. Minerals dated: AM, amphibole; BI, biotite; FD, feldspar; HO, hornblende; KF, potassium feldspar; MI, mica; MU, muscovite; PL, plagioclase; WR, whole-rock; WR*, whole rock, matrix only; ZI, zircon]. Where appropriate (shown by RECAL), originally reported ages have been recalculated using the constants of Steiger and Jager (1977)

Quadrangle	Map unit	Sample number	Latitude N.	Longitude W.	Rock type, map unit	Method	Mineral	Age (MA)	Error (m.y.)	Comment	References
Taylor Mountains	Kkv?	94ADw 59b	60.972	158.4528	Basalt	40/39?	?	70.0	0.4	Basalt flow	Riehle and others in prep.
Kenai	Jnc	62ALe 6e	60.1133	152.5850	Quartz diorite	K-Ar	BI	156.6	n.a.	Rounded granitic boulders within the Chisik Conglomerate member of the Naknek Formation, RECAL	Detterman and others, 1965, Magoon and others, 1976
Kenai	Qamp	78AR 290LT	60.717	152.667	Andesite	K-Ar	WR	0.627	0.024	Light band in banded andesite, approximate location	Reed and others, 1992
Kenai	Qamp	78AR 290DK	60.717	152.667	Andesite	K-Ar	WR	0.763	0.017	Dark band in banded andesite, approximate location	Reed and others, 1992
Kenai	Qamp	90AR 99	60.77	152.7	Andesite	K-Ar	WR	0.887	0.015	Approximate location	Reed and others, 1992
Taylor Mountains	Tb	82MR 322	60.8833	158.8583	Basalt	K-Ar	WR	4.72	0.10		Reifenstuhl and others, 1985b
Taylor Mountains	Tb	82MR 322	60.8833	158.8583	Basalt	K-Ar	PL	4.62	0.14		Reifenstuhl and others, 1985b
Iliamna	Tb	6-27-1	59.0733	154.0417	Basalt	K-Ar	WR	4.4	0.5	Olivine basalt dike	Magoon and others, 1976, Detterman and Reed, 1980

Iliamna	Tb	6-27-1	59.0733	154.0417	Basalt	K-Ar	WR	5.1	1.0	Olivine basalt dike	Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Tmv	82-107J (GT4)	59.6400	154.4500	Andesite	K-Ar	PL	33.8	6.8	Southeast of Lake Iliamna	Thrupp, 1987
Iliamna	Tmv	83-108A (GT8)	59.11	154.94	Andesite	K-Ar	WR	31.3	0.9	North of Battle Lake	Thrupp, 1987
Dillingham	Tmf	01AWs 67B	59.6140	156.3110	Rhyolite	40/39 plateau age	PL	45.10	0.19	Dacite tuff	Iriondo and others, 2003
Dillingham	Tmf	AL00	59.0050	156.0440	Rhyolite	40/39 average age	PL	41.62	0.18	Maroon and white banded rhyodacite porphyry, fine-grained wholly crystalline. Phenocrysts plucked in thin-section, remnants appear fresh plagioclase.	Iriondo and others, 2003
Iliamna	Tmba	82-76 (GT3)	59.95	155.16	Andesite	K-Ar	WR	38.5	1.2	Top of Groundhog mountain	Thrupp, 1987
Iliamna	Tmba	82-82 (GT1)	59.95	155.18	Andesite	K-Ar	WR	39.7	2.4	Base of Groundhog mountain	Thrupp, 1987
Dillingham	Tmba	01AWs 55	59.7910	156.2980	Basalt	40/39 isochron	WR*	53.71	0.61	Columnar jointed basalt.	Iriondo and others, 2003
Dillingham	Tmba	01AWs 49	59.7620	156.0110	Andesite	40/39 isochron	WR*	47.95	1.39	Basalt plug.	Iriondo and others, 2003
Iliamna	Tmba	-- (GT13)	59.73	154.72	Andesite	K-Ar	WR	36.4	n.a.	Rabbit Island, Lake Iliamna	Thrupp, 1987
Dillingham	Tmba	01AWs 67	59.6140	156.3110	Basalt	40/39 isochron	WR*	44.47	0.41	Basalt flow - fresh, sparse olivine phenocrysts.	Iriondo and others, 2003

Dillingham	Tmba	01AWs 60	59.6010	156.3230	Basalt	40/39 isochron	WR*	44.38	0.38	Incredibly fresh columnar jointed basalt flow.	Iriondo and others, 2003
Iliamna	Tmba	GT14	59.393	155.11	Andesite	K-Ar	WR	35.0	n.a.	Peter's Plug	Thrupp, 1987
Iliamna	Tmba	83-118 (GT9)	59.31	154.62	Andesite	K-Ar	WR	29.5	1.4	Southwest Gibraltar, south of Lake Iliamna	Thrupp, 1987
Lake Clark	Togd	68AR 244	60.9467	153.5450	Granodiorite	K-Ar	BI	31.9	0.9	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976, Nelson and others, 1983
Lake Clark	Togd	68AR 244	60.9467	153.5450	Granodiorite	K-Ar	HO	36.3	1.8	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Nelson and others, 1983
Lake Clark	Togd?	66ALe 25	60.4150	153.6100	Quartz monzonite	K-Ar	BI	39.6	n.a.	Not mapped, unit assignment provisional, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976
Iliamna	Togd	66AR 1289	59.0533	154.6517	Quartz diorite	K-Ar	HO	37.0	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Togd	66AR 1289	59.0533	154.6583	Quartz diorite	K-Ar	BI	35.6	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon, and others, 1976, Detterman and Reed, 1980

Lake Clark	Teg	68AR 245	60.9300	153.3450	Quartz monzonite	K-Ar	BI	34.6	1.3	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	70AR 165	60.8683	153.4150	Granodiorite	K-Ar	BI	37.5	1.0	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	68AR 248	60.8383	153.5817	Quartz monzonite	K-Ar	BI	38.6	1.1	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	70AR 181	60.7683	153.3367	Granodiorite	K-Ar	BI	34.8	1.0	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	68AR 251	60.7233	153.5383	Granodiorite	K-Ar	BI	39.4	1.1	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	68AR 251	60.7233	153.5383	Granodiorite	K-Ar	HO	41.90	1.3	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	70AR 159	60.7050	153.2800	Granodiorite	K-Ar	BI	38.6	1.1	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Teg	70AR 159	60.7050	153.2800	Granodiorite	K-Ar	HO	39.3	1.9	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976

Lake Clark	Tipg	66ALe 23	60.0400	154.1700	Quartz monzonite	K-Ar	BI	43.9	n.a.	RECAL	Reed and Lanphere, 1969, 1972
Lake Clark	Tigd	66AR 1393	60.1383	154.0700	Granodiorite	K-Ar	BI	62.8	n.a.	RECAL	Reed and Lanphere, 1969, 1972, Nelson and others, 1983
Lake Clark	Tigd	66AR 1393	60.1383	154.0700	Granodiorite	K-Ar	HO	61.0	n.a.	RECAL	Reed and Lanphere, 1969, 1972, Nelson and others, 1983
Dillingham	Tvig	01AM 109A	59.6910	156.5310	Dacite tuff	40/39 total fusion age	BI	59.25	0.05	Rubble crop of fine- to medium-grained, biotite granodiorite. Biotite looks great, grain size about 1-3 mm.	Iriondo and others, 2003
Dillingham	Tvig	00AWs 16	59.6750	156.6050	Dacite tuff	40/39 total fusion age	BI	59.69	0.05	Stuyahok Hills. Hornblende-biotite dacite porphyry. Contains excellent fresh biotite, hornblende fresh but loaded with biotite inclusions.	Iriondo and others, 2003
Dillingham	Tvig	82BB422	59.642	156.45	Dacite	K-Ar	HO	57.9	1.7	Hornblende-biotite dacite, approximate location	Wallace and others, 1989
Dillingham	Tvig	82BB422	59.642	154.45	Dacite	K-Ar	BI	58.6	1.8	Hornblende-biotite dacite, approximate location	Wallace and others, 1989

Dillingham	Tvig	01AWs 61	59.6080	156.3950	Dacite tuff	40/39 total fusion age	BI	59.34	0.03	Fine-grained porphyritic intrusive rock. Contains phenocrysts of very fresh biotite and feldspar in an aphanitic tuffaceous(?) matrix. Hypabyssal?	Iriondo and others, 2003
Lake Clark	TKv in JPk	82BB289	60.3833	153.88	Mafic dike	K-Ar	HO	79.6	2.4	Mafic dike cutting Tlikakila Complex, approximate location	Wallace and others, 1989
Lake Clark	TKr	77E 216	60.3700	155.2033	Dacite	K-Ar	BI	59.5	1.8	Biotite dacite	Eakins and others, 1978
Lake Clark	TKr	K-Ar5	60.2772	154.8378	Andesite	K-Ar	BI	62.7	1.9	Augite andesite porphyry	Eakins and others, 1978
Lake Clark	TKb	83-133 (GT10)	60.57	154.34	Basalt	K-Ar	WR	44.4	1.7	South of Snipe Lake, north of Lake Clark	Thrupp, 1987
Lake Clark	TKb	K-Ar2	60.3075	154.6433	Granodiorite	K-Ar	BI	56.2	1.7	Hornblende biotite granodiorite	Eakins and others, 1978
Lake Clark	TKb	82-95 (GT2)	60.2655	154.635	Basalt	K-Ar	WR	65.8	13.2	Top of “eastern mesa,” north of Lake Clark	Thrupp, 1987

Dillingham	TKg	01AH 63	59.8680	156.1650	Hypabyssal dacite	40/39 total fusion age	BI	65.26	0.06	Biotite granodiorite, screens of metamorphic rocks locally, scattered xenoliths, and some fine-grained segregation within the granodiorite.	Iriondo and others, 2003
Dillingham	TKg	00AWs 39	59.3860	156.5350	Granodiorite	40/39 isochron	BI	61.86	0.44	Isolated pluton containing excellent biotite and good hornblende, fair amount of K-feldspar.	Iriondo and others, 2003
Taylor Mountains	TKgr	82MR 309	60.9383	157.3717	Granite	K-Ar	BI	65.3	2.0		Reifenstuhl and others, 1985a,b
Taylor Mountains	TKgr	83MR 234C	60.9333	157.3683	Granite	K-Ar	BI	67.6	2.0		Reifenstuhl and others, 1985a,b
Taylor Mountains	TKgr	83MR 235C	60.9333	157.3683	Granite	K-Ar	BI	65.0	2.0		Reifenstuhl and others, 1985a,b
Taylor Mountains	TKgr	83MR 235C	60.9333	157.3683	Granite	K-Ar	MI	64.5	1.9	White mica	Reifenstuhl and others, 1985a,b
Taylor Mountains	TKgr	83MR 234C	60.9333	157.3683	Granite	K-Ar	MI	65.5	2.0	White mica	Moll, written commun., 1986
Taylor Mountains	TKgr	99AWs 17	60.9260	156.7320	Monzodiorite	40/39 total fusion age	BI	67.69	0.04	Hoholitna pluton. Biotite granite or quartz monzonite intruding Kuskokwim Group. Fair biotite, hornblende secondary after clinopyroxene.	Iriondo and others, 2003

Taylor Mountains	TKgr	83MR 233C	60.9200	156.7217	Quartz monzonite	K-Ar	BI	67.0	2.0		Reifenstuhl, oral commun., 1984, Moll, written commun., 1986
Taylor Mountains	TKgr	83MR 233C	60.9200	156.7217	Quartz monzonite	K-Ar	AM	67.1	2.0		Reifenstuhl, oral commun., 1984, Moll, written commun., 1986
Taylor Mountains	TKgr	01AH 83	60.4100	156.0690	Muscovite granite	40/39 plateau age	MU	67.18	0.28	Probably 10+ foot wide medium-grained equigranular muscovite granite dike - euhedral muscovite.	Iriondo and others, 2003
Taylor Mountains	TKgr	98-07, 98-10	60.41	158.12	Granite porphyry	40/39 plateau	BI	69.7	0.3	Shotgun deposit, mean plateau age of 4 samples	Rombach, 2000
Taylor Mountains	TKgr	01AWs 41	60.0450	157.0850	Granite	40/39 total fusion age	BI	60.41	0.06	Sleitat pluton, tin-bearing biotite granite.	Iriondo and others, 2003
Taylor Mountains	TKgr	--	60.044	157.083	Muscovite veinlet in granite	K-Ar	MU	56.8	2.8	Dates late stage hydrothermal event, approximate location	Burleigh, R.E., 1991
Dillingham	TKgr	01AH 70	59.8370	156.3510	Alaskite	40/39 average age	KF	58.40	0.20	Rubble crop of orange weathering granite - interstitial graphic textures vuggy over most of area. Probably dueterically altered.	Iriondo and others, 2003

Dillingham	TKgr	01AH 80	59.8050	156.3770	Alaskite	40/39 average age	KF	58.30	0.20	Aplitic granite with greenish tourmaline clots and vug fillings. Locally, vugs also have euhedral quartz and K-spar.	Iriondo and others, 2003
Dillingham	TKgr	01AWs 39	59.7260	156.2040	Granodiorite	40/39 isochron	BI	60.93	0.65	Isolated knoll in Stuyahok River valley. Medium- to coarse-grained hornblende granodiorite.	Iriondo and others, 2003
Dillingham	TKgr	01AWs 39	59.7260	156.2040	Granodiorite	40/39 plateau age	HO	60.07	0.25	Isolated knoll in Stuyahok River valley. Medium- to coarse-grained hornblende granodiorite.	Iriondo and others, 2003
Dillingham	TKgr	00AWs 31A	59.7030	157.9870	Biotite granite	40/39 total fusion age	BI	64.45	0.11	Small cirque of northeast side of Kemuk Mountain. Medium-grained biotite granite, deep weathering rinds, slightly vuggy. Good biotite.	Iriondo and others, 2003

Dillingham	TKgr	01AWs 80	59.6330	156.1930	Granite	40/39 total fusion age	BI	61.63	0.05	Stuyahok Hills pluton. Hornblende-biotite granodiorite with large 2-3 cm feldspar phenocrysts and common mafic xenoliths.	Iriondo and others, 2003
Dillingham	TKgr	01AWs 64	59.6290	156.1960	Granite	40/39 plateau age	HO	64.20	0.27	Coarse- to medium-grained porphyry granite. Large K-spar phenocrysts to 2 cm.	Iriondo and others, 2003
Dillingham Goodnews Bay	TKgr	74 B 57	59.6267	159.00	Granite	K-Ar	BI	69.6	2.1	Akuluktok Mountain pluton	Hoare and Coonrad, 1978
Dillingham Goodnews Bay	TKgr	74 B 57	59.6267	159.00	Granite	K-Ar	HO	63.4	1.9	Aluluktok Mountain pluton	Hoare and Coonrad, 1978
Dillingham	TKgr	01AWs 57	59.6180	156.1220	Granite	40/39 total fusion age	BI	61.57	0.06	Dark colored, medium to coarse-grained hornblende-biotite quartz monzonite or granodiorite, with large 2 cm K-spar phenocrysts.	Iriondo and others, 2003

Dillingham	TKgr	01AWs 24	59.6070	156.3210	Granite	40/39 total fusion age	BI	61.70	0.06	Biotite-hornblende granodiorite with 2 cm K-spar phenocrysts. Good fresh mafic minerals. Local xenoliths.	Iriondo and others, 2003
Dillingham	TKgr	00AWs 38	59.6060	156.1590	Granite	40/39 total fusion age	BI	61.15	0.04	Granite, biotite is fine-grained and in good shape, also contains clinopyroxene and common K-feldspar. No hornblende.	Iriondo and others, 2003
Dillingham	TKgr	01APc 18	59.6060	156.2230	Granite	40/39 total fusion age	BI	61.28	0.05	Pegmatitic biotite granite.	Iriondo and others, 2003
Dillingham	TKgr	01APc 20	59.6040	156.2540	Granite	40/39 total fusion age	BI	61.30	0.05	Biotite granite.	Iriondo and others, 2003
Dillingham	TKgr	82BB421	59.6	156.23	Granite	K-Ar	HB	54.50	1.6	Hornblende-biotite granite, approximate location.	Wallace and others, 1989
Dillingham	TKgr	82BB421	59.6	156.23	Granite		Bi	61.15	1.8	Hornblende-biotite granite, approximate location.	Wallace and others, 1989
Dillingham	TKgr	01APc 23	59.5890	156.2400	Granite	40/39 total fusion age	BI	61.64	0.05	Granite	Iriondo and others, 2003

Dillingham	TKgr	01AWs 59	59.5810	156.3320	Granite	40/39 total fusion age	BI	61.65	0.05	Yellowish biotite granite or quartz monzonite. Another mafic could be orthopyroxene.	Iriondo and others, 2003
Dillingham	TKgr	01APc 25	59.5790	156.2400	Granite	40/39 total fusion age	BI	61.26	0.05	Hornblende biotite granite.	Iriondo and others, 2003
Dillingham	TKgr	01AWs 78	59.5660	156.2630	Granite	40/39 total fusion age	BI	60.90	0.04	Stuyahok Hills pluton. Hornblende-biotite granodiorite with large 2-3 cm feldspar phenocrysts and common mafic xenoliths.	Iriondo and others, 2003
Dillingham	TKgr	00AWs 15A	59.3290	158.3010	Biotite granite	40/39 total fusion age	BI	67.94	0.04	Main part, Muklung Hills. Nearly hypabyssal appearing biotite granite having very fresh biotite and abundant K-feldspar. Fair to poor hornblende	Iriondo and others, 2003

Dillingham	TKgs	01AH 59	59.9140	156.1820	Quartz monzonite	40/39 total fusion age	BI	65.50	0.05	Outcrops of medium-grained, medium light gray equigranular biotite granodiorite. Small disseminated euhedral biotite books.	Iriondo and others, 2003
Dillingham	TKgs	01AH 62	59.9000	156.1980	Quartz monzonite	40/39 total fusion age	BI	65.75	0.03	Medium-grained, medium light gray seriate biotite granodiorite - small clean biotite crystals. Oxidized sulfides present?	Iriondo and others, 2003
Dillingham	TKgs	01AWs 46	59.8980	156.1930	Quartz monzonite	40/39 total fusion age	BI	66.24	0.08	Granodiorite having quite a bit of chlorite and some epidote, little biotite.	Iriondo and others, 2003
Lake Clark	TKqm	77BT 217	60.8300	153.5233	Quartz monzonite	K-Ar	BI	64.0	1.9		Eakins and others, 1978, Nelson and others, 1983
Taylor Mountains	TKqm	69ACk 1008	60.4917	158.0667	Granite	K-Ar	BI	67.3		RECAL	Berry and others, 1976
Lake Clark	TKqm	77E 217	60.4833	155.2183	Granodiorite	K-Ar	BI	71.3	2.1	Biotite pyroxene granodiorite	Eakins and others, 1978, Nelson and others, 1983
Lake Clark	TKqm	77E 211	60.3967	154.9033	Granodiorite	K-Ar	BI	61.6	1.8	Biotite granodiorite	Eakins and others, 1978

Lake Clark	TKqm	K-Ar6	60.405	154.5533	Granodiorite	K-Ar	BI	60.5	1.8	Hornblende biotite granodiorite	Eakins and others, 1978
Dillingham	TKqm	01AWs 2	59.8910	156.2510	Quartz diorite	40/39 plateau age	HO	63.77	0.27	Pike Creek. Massive, dark-gray, medium-coarse-grained hornblende-bearing intermediate intrusive rock.	Iriondo and others, 2003
Dillingham	TKqm	01AWs 48	59.8420	156.1710	Quartz monzonite	40/39 total fusion age	BI	65.72	0.04	Coarse-grained biotite-hornblende granodiorite.	Iriondo and others, 2003
Dillingham	TKqm	01AH 64	59.8220	156.2010	Quartz monzonite	40/39 total fusion age	BI	66.49	0.07	Medium-grained, equigranular to seriate biotite granodiorite. Euhedral small biotite books.	Iriondo and others, 2003
Dillingham	TKqm	01AH 69	59.8040	156.1550	Quartz diorite	40/39 total fusion age	BI	64.42	0.04	Fine- to medium-grained, equigranular hornblende-biotite granodiorite.	Iriondo and others, 2003
Dillingham	TKqm	01AH 67	59.8020	156.0280	Quartz monzodiorite	40/39 plateau age	HO	61.30	0.20	Medium dark greenish gray, fine-medium grained, seriate to porphyritic quartz diorite(?) or granodiorite. Few K-spar crystals to 2cm long.	Iriondo and others, 2003

Dillingham	TKqm	00AWs 37	59.7890	156.0880	Quartz monzonite	40/39 total fusion age	BI	63.09	0.05	Similar sample 00AWs 35a, however biotite not as fresh and secondary hornblende more common. Plagioclase is sericitized.	Iriondo and others, 2003
Dillingham	TKqm	00AWs 35a	59.7780	156.1340	Quartz monzodiorite	40/39 total fusion age	BI	61.67	0.05	Large tor of biotite granite. Coarse, almost pegmatitic phase containing excellent biotite. Clinopyroxene is common and hornblende after clinopyroxene.	Iriondo and others, 2003
Dillingham	TKqm	01AWs 50	59.7690	156.1330	Quartz diorite?	40/39 total fusion age	BI	61.11	0.07	Biotite granite, south edge (?) of pluton.	Iriondo and others, 2003
Dillingham	TKqm	00AWs 13A	59.3040	158.1210	Granodiorite	40/39 total fusion age	BI	65.81	0.06	East side Muklung Hills. Biotite-hornblende granodiorite containing abundant hornblende and biotite. Biotite slightly chloritized, hornblende in fair shape.	Iriondo and others, 2003

Kenai	TKgd	70AR 140	60.9433	152.8617	Granodiorite	K-Ar	BI	65.1	1.9	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	TKgd	70AR 140	60.9433	152.8617	Granodiorite	K-Ar	HO	70.5	2.0	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Kenai	TKgd	70AR 147	60.8650	152.6800	Granodiorite	K-Ar	BI	65.4	1.8	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Kenai	TKgd	70AR 147	60.8650	152.6800	Granodiorite	K-Ar	HO	67.6	2.0	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Kenai	TKgd	70AR 146	60.7433	152.9583	Granodiorite	K-Ar	BI	68.2	1.0	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Taylor Mountains	TKgd	00AWs 22	60.0410	156.8200	Granodiorite	40/39 total fusion age	BI	66.55	0.07	Northeast end of Sleitat Mountain ridge. Biotite-hornblende granodiorite(?) intruding Kuskokwim Fm. Excellent biotite, poor hornblende.	Iriondo and others, 2003
Lake Clark	TKqd	77BT 224	60.6317	154.5783	Diorite	K-Ar	HO	69.4	2.1	Hornblende diorite	Eakins and others, 1978, Nelson and others, 1983

Dillingham	TKqd	01AH 65	59.7930	156.1430	Diorite	40/39 isochron	HO	60.60	0.30	Diorite complex. Fine- to medium-grained greenish-gray diorite with some amphibole crystals to 1 cm long.	Iriondo and others, 2003
Dillingham	Mzmi?	KEMUK	59.7200	157.7000	Pegmatitic ultramafic	40/39 total fusion age	BI	86.05	0.08	Kemuk iron-PGE prospect. Biotite book from core sample, drillhole number 6, depth 621'. Approx. location Sec. 24(?) T. 5 S., R. 50 W.	Iriondo and others, 2003
Kenai	Kg	70AR 179	60.9850	152.2800	Quartz diorite	K-Ar	BI	71.3	2.0	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	Kg	70AR 179	60.9850	152.2800	Quartz diorite	K-Ar	HO	70.6	2.1	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	Kg	70AR 158	60.8317	152.5817	Quartz diorite	K-Ar	BI	70.0	2.0	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976

Kenai	Kg	70AR 158	60.8317	152.5817	Quartz diorite	K-Ar	HO	74.4	2.2	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	Kg	70AR 173	60.7483	152.8117	Diorite	K-Ar	BI	67.2	1.9	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Kenai	Kg	70AR 173	60.7483	152.8117	Diorite	K-Ar	HO	71.5	2.1	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Lake Clark	Kgd	70AR 169	60.5983	153.4050	Granodiorite	K-Ar	BI	63.1	1.8	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Kgd	70AR 169	60.5983	153.4050	Granodiorite	K-Ar	HO	69.0	2.0	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Iliamna	Kgd	--	59.898	155.296	Granodiorite	K-Ar	KF	99.8	5	Coarse fresh K-feldspar from drillhole at NW edge of Pebble Copper deposit; approximate location	Bouley and others, 1995
Iliamna	Kgd	--	59.898	155.296	Biotite pyroxenite	K-Ar	BI	96.1	4.8	Coarse fresh biotite; approximate location	Bouley and others, 1995

Iliamna	Kgd	--	59.898	155.296	Granodiorite	K-Ar	KF	90.5	4.5	Secondary K-feldspar from hydrothermal alteration associated with Pebble Copper deposit; approximate location	Bouley and others, 1995
Iliamna	Kgd	--	59.8536	155.323	Tonalite	U-Pb	ZI	89.7	0.2	Tonalite from batholith associated with Sill (or 25 Gold) prospect; approximate location	Bouley and others, 1995
Lake Clark	Kqd	70AR 168	60.6417	153.1583	Quartz diorite	K-Ar	BI	65.6	1.8	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	Kqd	70AR 168	60.6417	153.1583	Quartz diorite	K-Ar	HO	68.7	2.0	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Iliamna	Kqms	65AR 818	59.8467	153.8583	Quartz diorite	K-Ar	BI	79.8	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Kqms	65AR 910	59.8267	154.2067	Quartz diorite	K-Ar	BI	82.7	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980

Iliamna	Kqms	65AR 910	59.8267	154.2067	Quartz diorite	K-Ar	HO	85.5	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Kqms	65AR 1034	59.8050	154.2467	Quartz monzonite	K-Ar	HO	75.6	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Dillingham	Kqms	00AWs 12	59.4610	158.1990	Syenite	40/39 total fusion age	BI	84.49	0.05	Okstukuk Hills at VABM Kokwok. Biotite granite or syenite having very coarse feldspar laths, medium-grained very fresh biotite and fine-grained clinopyroxene.	Iriondo and others, 2003
Taylor Mountains	Klgd	01AH 85A	60.2790	156.0800	Granodiorite	40/39 average age	HO	75.22	0.32	Rubble crop of medium-grained, equigranular, medium-light gray biotite hornblende granodiorite. Both biotite and hornblende are euhedral.	Iriondo and others, 2003

Lake Clark	KJg	68AR 261	60.8867	153.0317	Granodiorite	K-Ar	BI	58.8	1.7	RECAL	Reed and Lanphere, 1969, 1973, Magoon and others, 1976, Nelson and others, 1983
Lake Clark	KJg	68AR 261	60.8867	153.0317	Granodiorite	K-Ar	HO	97.5	3.8	RECAL	Reed and Lanphere, 1969, 1973, Magoon and others, 1976, Nelson and others, 1983
Lake Clark	KJg	70AR 184	60.7367	153.1033	Quartz diorite	K-Ar	BI	72.4	2.0	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Lake Clark	KJg	70AR 184	60.7367	153.1033	Quartz diorite	K-Ar	HO	95.8	2.8	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Iliamna	Jtr	65AR 905	59.9200	153.6083	Trondhjemite	K-Ar	MU	148	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980, Nelson and others, 1983
Iliamna	Jqm	6-14-6	59.9217	153.285	Quartz monzonite	K-Ar	WR	170.0	4.0		Detterman and Reed, 1980
Iliamna	Jqm	6-14-6	59.9217	153.285	Quartz monzonite	K-Ar	WR	174.0	4.0		Detterman and Reed, 1980
Kenai	Jqd	70AR 156	60.8050	152.4917	Diorite	K-Ar	HO	146.0	4.3	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976

Kenai	Jqd	66AR 1464	60.8033	152.3550	Quartz monzonite	K-Ar	BI	159.0	n.a.	RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	Jqd	70AR 178	60.6767	152.4517	Granodiorite	K-Ar	BI	165.0	4.8	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	Jqd	70AR 178	60.6767	152.4517	Granodiorite	K-Ar	HO	162.0	4.8	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Kenai	Jqd	70AR 177	60.6150	152.6283	Quartz diorite	K-Ar	BI	163.0	4.7	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976
Kenai	Jqd	70AR 177	60.6150	152.6283	Quartz diorite	K-Ar	HO	161.0	4.7	RECAL	Reed and Lanphere, 1972, 1973, Detterman and others, 1976, Magoon and others, 1976
Kenai	Jqd	70AR 175	60.5900	152.7800	Granodiorite	K-Ar	BI	97.8	2.8	RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976, Detterman and others, 1976

Kenai	Jqd	62ALe 5	60.2533	152.8860	Granodiorite	K-Ar	BI	174	n.a.	Alaska-Aleutian Range batholith, RECAL	Detterman and others, 1965, Reed and Lanphere, 1969, 1972, Magoon and others, 1976
Kenai	Jqd	62ALe 5	60.2533	152.8860	Granodiorite	K-Ar	HO	171.9	n.a.	Alaska-Aleutian Range batholith, RECAL	Detterman and others, 1965, 1976, Magoon and others, 1976, Reed and Lanphere, 1969, 1972
Iliamna	Jqd	65AR 906	59.8833	153.7450	Quartz diorite	K-Ar	BI	78.0	n.a.	Alaska-Aleutian Range batholith, RECAL, reset age?	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	65AR 906	59.8833	153.7450	Quartz diorite	K-Ar	HO	90.1	n.a.	Alaska-Aleutian Range batholith, RECAL, reset age?	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	65AR 827	59.7717	153.6450	Diorite	K-Ar	BI	161	n.a.	Alaska-Aleutian Range batholith, **not** RECAL	Detterman and others, 1965, Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	65AR 827	59.7717	153.6450	Diorite	K-Ar	HO	160	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980

Iliamna	Jqd	62ALe 2	59.7683	153.9150	Granodiorite	K-Ar	BI	87.1	n.a.	Alaska-Aleutian Range batholith, RECAL, too young?	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	62ALe 2	59.7683	153.9150	Granodiorite	K-Ar	HO	92.3	n.a.	Alaska-Aleutian Range batholith, RECAL, too young?	Reed and Lanphere, 1969, 1972, Detterman and Reed, 1980
Iliamna	Jqd	62ALe 1	59.7017	153.7000	Quartz diorite	K-Ar	BI	163	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Detterman and Reed, 1980
Iliamna	Jqd	62ALe 1	59.7017	153.7000	Quartz diorite	K-Ar	HO	172	n.a.	Alaska-Aleutian Range batholith, RECAL	Detterman and others, 1965, Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	6-26-1	59.6083	153.5617	Quartz diorite	K-Ar	FD	155.0	3.0		Detterman and Reed, 1980
Iliamna	Jqd	66ALe 13	59.4217	154.4483	Quartz diorite	K-Ar	BI	156.0	4.6	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, 1973, Magoon and others, 1976
Iliamna	Jqd	66ALe 13	59.4217	154.4483	Quartz diorite	K-Ar	HO	157.0	4.6	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Iliamna	Jqd	66ALe 22	59.4017	154.6333	Quartz diorite	K-Ar	BI	135.0	5.0	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1972, Magoon and others, 1976

Iliamna	Jqd	66ALe 22	59.4017	154.6333	Quartz diorite	K-Ar	HO	151.0	4.5	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Iliamna	Jqd	64ADt 715	59.3967	154.3083	Quartz diorite	K-Ar	BI	156	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	64ADt 715	59.3967	154.3083	Quartz diorite	K-Ar	MU	164	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	66ALe 45	59.3767	154.3217	Quartz diorite	K-Ar	BI	158.0	4.6	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Iliamna	Jqd	66ALe 45	59.3767	154.3217	Quartz diorite	K-Ar	MU	160.0	4.7	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1972, 1973, Magoon and others, 1976
Iliamna	Jqd	64ADt 420A	59.3750	154.4667	Quartz diorite	K-Ar	BI	158	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	64ADt 863	59.3417	154.4500	Quartz diorite	K-Ar	BI	161	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980

Iliamna	Jqd	64ADt 863	59.3417	154.4500	Quartz diorite	K-Ar	HO	159	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	64AR 612	59.3000	154.3050	Quartz diorite	K-Ar	BI	167	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jqd	64AR 612	59.3000	154.3050	Quartz diorite	K-Ar	HO	158	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jmu	65ADt 1084	59.7300	153.8483	Hornblendite	K-Ar	HO	160	n.a.	Alaska-Aleutian Range batholith, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Iliamna	Jmu	64AE 98	59.2683	154.4900	Gabbro	K-Ar	HO	183	n.a.	Alaska-Aleutian Range batholith, hornblende gabbro, RECAL	Reed and Lanphere, 1969, 1972, Magoon and others, 1976, Detterman and Reed, 1980
Lake Clark	MzPzb	82BB404A	60.3	154.58	Schist	K-Ar	BI	63.2	1.9	Biotite schist, thought to be metamorphosed Koksetna River sequence of Wallace and others (1989). Approximate location.	Wallace and others, 1989

Iliamna	?	--	59.8536	155.323	Latite	U-Pb	ZI	46.2	0.2	Latite near Sill (or 25 Gold) prospect; approximate location	Bouley and others, 1995