MAP, TABLES, AND SUMMARY OF FOSSIL AND ISOTOPIC AGE DATA, MOUNT HAYES QUADRANGLE, EASTERN ALASKA RANGE, ALASKA

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INTRODUCTION

This report describes, summarizes, and interprets all known bedrock fossil and isotopic age studies for the Mount Hayes quadrangle, eastern Alaska Range, Alaska. The accompanying map shows the location of all known bedrock fossil and isotopic sample localities in the quadrangle on a generalized geologic base map. These fossil and isotopic age data are obtained from new studies, unpublished data of the U.S. Geological Survey, contributed unpublished data, and published data. This report is one result of a five-year mineral-resource assessment of the quadrangle that was done during the summers of 1978 through 1982, with additional topical studies in 1985 and 1986. This report is one part of a folio on the geological, geochemical, geophysical, and mineral-resource assessment studies of the quadrangle prepared as part of the Alaskan Mineral Resource Assessment Program (AMRAP) of the U.S. Geological Survey.

The fossil studies determine the ages of stratified units in the quadrangle. The isotopic age studies determine either the ages of intrusion of plutonic rocks or the age of metamorphism(s) for metamorphosed sedimentary, volcanic, and plutonic rocks. These geochronologic data are important for (1) determining the stratigraphy and geologic history of bedrock units, (2) interpreting the age of formation of lode mineral deposits, and (3) interpreting the tectonic history of the quadrangle and adjacent region.

The Mount Hayes quadrangle is in the eastern Alaska Range that forms a great glacially sculptured arcuate mountain wall extending approximately 1,000 km from the Canadian border on the east to the Aleutian Range on the west and southwest. The eastern Alaska Range is characterized by high peaks ranging to over 4,180 m in elevation and spectacular valley glaciers as long as 65 km. The range is bisected by the Denali fault that is a major geologic and geographic boundary between the Yukon River basin in interior Alaska to the north and the Copper River basin of southern Alaska to the south. To the north, the bedrock geology is dominated by the Devonian and older Yukon-Tanana terrane, a complex of multiply deformed and metamorphosed sedimentary, volcanic, and plutonic rocks (Jones and others, 1987; Aleinikoff and Nokleberg, 1985a, b; Nokleberg and Aleinikoff, 1985). To the south, the bedrock geology is dominated by the Mesozoic Maclaren and Paleozoic and Mesozoic Wrangellia terranes (Jones and others, 1987; Nokleberg and others, 1982, 1985, 1989). A moderate number of mainly granitic and lesser gabbroic plutons, chiefly of Mesozoic age, are found both north and south of the Denali fault, as well as major faults or sutures separating terranes, and younger Cenozoic faults that are present chiefly within terranes.

In the last three decades, the Mount Hayes quadrangle has been the focus of many bedrock geologic studies. Bedrock geologic maps were published by Holmes (1965), Pewe and Holmes (1964), Rose (1965; 1966a, b; 1967), Rose and Saunders (1965), Matteson (1973), Bond (1976), Stout (1976), Richter and others (1977), and Nokleberg and others (1982). The geologic base for this study is based partly on that geology and to a greater degree on 1:63,360-scale geologic mapping of the entire quadrangle that was done for the mineral resource assessment study of the area (Nokleberg and others, 1990).

Isotopic studies were published for parts of the quadrangle by Holmes and Foster (1968), Kleist (1971), Matteson (1973), Smith and Turner (1973), Turner and Smith (1974), Bond (1976), Turner and others (1980), Foley (1982, 1984), Aleinikoff (1984), Aleinikoff and Nokleberg (1983, 1984, 1985a, b), LeHuray and others (1985), Aleinikoff and others (1981, 1984, 1986, 1987), Nokleberg and others (1985, 1986a, 1989), and Wilson and others (1985).

Stratigraphic and structural studies were published by Bond (1973, 1976), Richter and Dutro (1975), Stout (1976), Nokleberg and others (1981a, b, c; 1983, 1985, 1986a, 1989), and Nokleberg and Aleinikoff (1985).

Fossil studies were published for parts of the quadrangle by Mendenhall (1905), Moffit (1912, 1942, 1954), Benninghoff and Holmes (1961), Rose (1965, 1966a, b, 1967), Rose and Saunders (1965), Richter (1966), Wolfe (1966, 1972), Rowett (1969a, b; 1975), Rowett and Timmer (1973), Petocz (1970), Richter and Dutro (1975), Bond (1976), Matteson, (1973), Stout (1976), Richter and others (1977), Turner and others (1980), Nokleberg and others (1982, 1985), and Busch (1983).

An exploration geochemistry survey of the area was published by Curtin and others (1989). A study of the mineral-resource potential of the area has been published by Nokleberg and others (1990). A study of the mines, mineral deposits, and occurrences has been completed by Nokleberg and others (1991). Summary studies of mineral deposits in and metallogenesis of the Mount Hayes quadrangle were published by Nokleberg and others (1984) and Nokleberg and Lange (1985). A geologic bibliography of the Mount Hayes quadrangle was published by Zehner and others (1980).

SUMMARY AND INTERPRETATION OF AGE DATA NORTH OF DENALI FAULT

YUKON-TANANA TERRANE

The southern Yukon-Tanana terrane is a major block of crystalline rocks that is present north of the Denali fault. In the eastern Alaska Range, the upper structural and stratigraphic slices of the southern Yukon-Tanana terrane are the Hayes Glacier and Jarvis Creek Glacier subterranes (Nokleberg and Aleinikoff, 1985; Nokleberg and others, 1989). These slices are interpreted as the upper levels of a Devonian and Mississippian igneous arc, the lower levels of which are found in the Macomb subterrane along the north flank of the Alaska Range, and in the Lake George subterrane north of the Tanana River (map). The metasedimentary, metavolcanic, and metaigneous rocks of the southern Yukon-Tanana terrane are multiply metamorphosed and deformed.

Lake George subterrane

The Lake George subterrane (Aleinikoff and Nokleberg, 1985a, b; Nokleberg and Aleinikoff, 1985) is present in the northeastern part of the quadrangle, and is composed of (1) polydeformed, medium to coarse-grained, metasedimentary rocks consisting of muscovite-quartz-biotite-garnet schist and metaquartzite derived from quartz-rich to clay-rich shale and quartzite (lgs); (2) relatively younger, medium-grained, gneissose granodiorite and granite (lgr); and (3) still younger, coarse-grained augen gneiss derived from granite and granodiorite (lga). The metasedimentary rocks and metamorphosed plutonic rocks are ductilely deformed and regionally metamorphosed under conditions of the middle or upper amphibolite facies into mylonitic schist and mylonitic gneiss, and exhibit local retrogression to the lower greenschist facies (Nokleberg and others, 1986a, 1989).

One U-Pb zircon isotopic analysis of metagranodiorite (lgr) yields an isotopic age of about 360 Ma (table 2, locality 4) indicating intrusion in the Late Devonian or Early Mississippian. U-Pb zircon isotopic analysis of orthoaugen gneiss (lga) in the Big Delta quadrangle about 50 km to the north yields an isotopic age of 333 to 345 Ma (mid-Mississippian) (Aleinikoff and others, 1986). A Rb-Sr mineral isochron analysis of the metagranodiorite indicates regional metamorphism and penetrative deformation of the schistose minerals in this lithic unit at 110 Ma (table 2, locality 4) in the mid-Cretaceous.

The protolith for the metasedimentary rocks of the Lake George subterrane is relatively older than the Late Devonian metagranodiorite, that is, Devonian or older. To the north in the Big Delta quadrangle, U-Pb zircon analysis of a quartz-feldspar-biotite schist, interpreted as a metatuff layer in metasedimentary rocks of the Lake George subterrane, yields an isotopic age of 362 Ma or Late Devonian (Aleinikoff and others, 1986).

Macomb subterrane

The Macomb subterrane (Aleinikoff and Nokleberg, 1985a; Nokleberg and Aleinikoff, 1985) is found south of the Lake George subterrane in the eastern part of the quadrangle. The Macomb subterrane is composed of (1) older, polydeformed, medium-grained pelitic schist, calc-schist, and quartz-feldspar-biotite schist derived from shale, marl, and sandstone (ms) of Devonian or older age; and (2) a suite of relatively younger, shallow-level, fine- to medium-grained gneissose granite, granodiorite, quartz diorite, and diorite (mg) of Devonian age. The metasedimentary rocks and the metamorphosed plutonic rocks are ductilely deformed and regionally metamorphosed under conditions of the epidote-amphibolite facies to upper greenschist facies into mylonitic schist (Nokleberg and others, 1986a).

U-Pb zircon isotopic analyses of samples of metagranodiorite and metagranite are complicated by inheritance of Proterozoic(?) cores and by post-emplacement episodes of Pb-loss. Fine-grained fractions from 6 samples of metaplutonic and metavolcanic rocks form a composite chord with an upper intercept of 372 Ma (table 2, localities 7, 10) and indicate intrusion in the Devonian. A Rb-Sr internal isochron for the Devonian metagranodiorite indicates a regional metamorphic event and penetrative deformation of the schistose minerals in this lithic unit at 102 Ma (table 2, locality 10) (recalculated from Nokleberg and others, 1986a). The protolith for the metasedimentary rocks of the Macomb subterrane is relatively older than the Devonian metagranitic rocks, that is, Middle Devonian or older.

Jarvis Creek Glacier subterrane

The Jarvis Creek Glacier subterrane (Aleinikoff and Nokleberg, 1985a, Nokleberg and Aleinikoff, 1985) is found across the northern part of the quadrangle, south of the Macomb subterrane. The Jarvis Creek Glacier subterrane consists of fine-grained, polydeformed schist derived from Devonian or older sedimentary and volcanic rocks. This subterrane is subdivided into three lithic units: (1) a metasedimentary rocks unit (jcs) rich in fine-grained metasedimentary rocks with very minor metavolcanic rocks; (2) a metavolcanic rocks unit (jcv) rich in fine-grained metavolcanic rocks with moderate amounts of fine-grained metasedimentary rocks; and (3) an areally restricted unit of gneissic granodiorite, diorite, and augen gneiss (jcg) in the north-central part of the quadrangle.

The metasedimentary rocks are almost totally recrystallized and consist of varying proportions of pelitic schist, quartzite, calc-schist, quartz-feldspar schist, and marble. Protoliths for these rocks consist of shale, quartz sandstone, marl, sandstone, volcanic graywacke, and limestone. The metavolcanic rocks consist of various proportions of abundant metaandesite and metamorphosed quartz keratophyre, less abundant metadacite and metabasalt, and very sparse metarhyodacite.

The metasedimentary rocks and metavolcanic rocks units are ductilely deformed and regionally metamorphosed under conditions of the greenschist facies into mylonitic schist or local phyllonite (Nokleberg and others, 1986a). Locally, large areas of upper greenschist-facies and lower amphibolite-facies metamorphism are found in the northern part of the Jarvis Creek Glacier subterrane in the area south of Granite Mountain and southeast of Donnelly Dome. The higher grade metamorphic minerals to the north are progressively replaced by lower grade metamorphic minerals to the south.

U-Pb zircon isotopic analysis of samples of metavolcanic rocks (jcv), locally interlayered with metasedimentary rocks, plot on the composite chord that suggests an age of 372 Ma (table 2, localities 12, 15, 28), and are interpreted to indicate submarine extrusion in the Devonian. On strike to the west in the eastern Healy quadrangle, metasedimentary rocks correlated with the metasedimentary rocks unit of the Jarvis Creek Glacier subterrane contain Devonian to Mississippian conodonts (Sherwood and Craddock, 1979; Csejtey and others, 1986). U-Pb isotopic analysis of detrital zircons in quartzites in the metasedimentary rocks unit (jcs) indicates the protolith was derived in part from an Early Proterozoic source rock with ages of 2.0 and 2.3 Ga (table 2, localities 22, 23) (Aleinikoff and Nokleberg, 1985a; Aleinikoff and others, 1987).

U-Pb zircon isotopic analysis of a sample of a small body of augen gneiss intruding the Jarvis Creek Glacier subterrane, in the area southeast of Donnelly Dome, plots on the 372 Ma composite chord (Table 2, locality 17) and indicates intrusion in the Devonian, contemporaneously with extrusion of the metavolcanic rocks.

Isotopic analyses of the schistose minerals in the metasedimentary and metavolcanic rocks units indicate that regional metamorphism and associated penetrative deformation occurred in the Early to mid-Cretaceous. K-Ar isotopic analysis of white mica yields isotopic ages of 106, 107, 118, and 115 Ma (table 2, localities 14, 16, 18, 20). These isotopic ages are interpreted as the age of metamorphism, rather than as the age of later cooling, because higher temperature isotopic systems for higher grade rocks, in the deepest structural levels of the Yukon-Tanana terrane to the north, yield the same Early to mid-Cretaceous ages (Nokleberg and others, 1989).

Hayes Glacier subterrane

The Hayes Glacier subterrane (Aleinikoff and Nokleberg, 1985a; Nokleberg and Aleinikoff, 1985) is present across the central part of the quadrangle, south of the Jarvis Creek Glacier subterrane. The Hayes Glacier subterrane consists of fine-grained, polydeformed phyllite, derived from Devonian or older sedimentary and volcanic rocks, that can be subdivided into two major lithic units: (1) a metasedimentary rocks unit (hgs) with sparse metavolcanic rocks; and (2) a metavolcanic rocks unit (hgv) with moderate to substantial amounts of metasedimentary rocks. Rocks in both units are almost totally recrystallized with few to no relict minerals.

In the eastern part of the quadrangle, the metasedimentary rocks unit consists of various proportions of pelitic phyllite, quartz-rich phyllite, quartz-feldspar phyllite, and minor calc-phyllite and marble derived from shale, chert or less likely quartz siltstone, volcanic graywacke, marl, and limestone. In the western part of the quadrangle, the metasedimentary rocks unit consists predominantly of polydeformed black to dark-gray pelitic schist, quartz-mica schist and lesser quartzite, and calc-schist derived from shale, quartz siltstone and sandstone, and marble. The metavolcanic rocks consist of various proportions of abundant meta-andesite and metamorphosed quartz keratophyre, and sparse metadacite and metabasalt. The metasedimentary rocks and metavolcanic rocks units are ductilely deformed and regionally metamorphosed under conditions of the lower and middle greenschist facies into phyllonite and blastomylonite (Nokleberg and others, 1986a).

U-Pb zircon isotopic analysis of a sample of metarhyolite (hgv), interlayered with metasedimentary rocks, plots on the 372-Ma composite chord (table 2, locality 32). Two other samples of metavolcanic rocks (table 2, localities 34 and 36) have complex isotopic systematics but are probably the same age as the metarhyolite. These data are interpreted to indicate submarine extrusion in the Middle Devonian. The age of the interlayered metasedimentary rocks is interpreted to be Middle Devonian or older.

No isotopic data are available on the age of metamorphism of the metasedimentary and metavolcanic rocks of the Hayes Glacier subterrane. A penetrative fabric similar to that found in the Jarvis Creek Glacier subterrane, suggests an equivalent Early to mid-Cretaceous age of metamorphism.

AURORA PEAK TERRANE

The Aurora Peak terrane (Nokleberg and others, 1985) is found north of the Denali fault in the western part of the quadrangle. This terrane consists of (1) metasedimentary rocks, chiefly fine- to medium-grained and polydeformed calc-schist, marble, quartzite, pelitic schist (as); and (2) lesser amounts of relatively younger, regionally metamorphosed and penetratively deformed granitic rocks (ag) consisting of gneissose quartz diorite, granodiorite, granite, and sparse amphibolite derived from gabbro and diorite. Protoliths for the metasedimentary rocks include marl, quartzite, and shale.

The Aurora Peak terrane was twice ductilely metamorphosed and deformed, once during an earlier period of upper amphibolite-facies metamorphism into mylonitic schist, and later during a period of middle greenschist-facies metamorphism into blastomylonite (Nokleberg and others, 1985). The general parallelism of the schistosity in the batholith with the Denali fault may suggest that metamorphism and deformation of the batholith occurred during faulting.

The age range of the protoliths of the metasedimentary rocks is Silurian to Triassic as indicated from conodont fragments of post-Ordovician morphotype from one marble body (table 1, locality 7). The metasedimentary rocks may correlate with a unit of weakly metamorphosed, calcareous sedimentary rocks to the west in the Healy quadrangle that contains Triassic conodonts (Brewer, 1982; Csejtey and others, 1986).

U-Pb zircon isotopic analysis of a metaquartz diorite yields an age of about 71 Ma (table 2, locality 38), interpreted as indicating a Late Cretaceous age of intrusion in the Aurora Peak terrane. To the west in the east-central Healy quadrangle, ^{40}Ar-^{39}Ar isotopic analysis of hornblende in correlative (meta)granitic rocks yields an age of 106 Ma (locality 33 in Csejtey and others, 1986).

K-Ar isotopic analyses of schistose biotite and hornblende in metagranitic rocks indicate either very young metamorphism and associated penetrative deformation, and (or) uplift and cooling of the Aurora Peak terrane in the middle Tertiary. K-Ar isotopic analysis of biotite yields isotopic ages of 18.2, 24.0, and 27.0 Ma (table 2, localities 37, 38). K-Ar isotopic analysis of hornblende yields an isotopic age of 36.8 Ma (table 2, locality 37). Because of the presence of the Aurora Peak terrane adjacent to the Denali fault, these K-Ar isotopic ages are interpreted as the age of uplift and cooling of the Aurora Peak terrane during its Cenozoic migration along the Denali fault (Nokleberg and others, 1985, 1989).

WINDY TERRANE

The Windy terrane (Jones and others, 1987; Nokleberg and others, 1985) is found within branches of the Denali fault, north of the Maclaren terrane, and south of the Aurora Peak and Yukon-Tanana terranes. Unlike the adjacent terranes to the north and the south, the Windy terrane exhibits mainly sedimentary or volcanic rather than metamorphic textures and structures in appropriate units. Relict sedimentary structures include bedding, graded bedding, and crossbedding.

The Windy terrane is a structural composite of two assemblages. One assemblage consists fault-bounded lenses of Cretaceous flysch and volcanic rocks consisting mainly of argillite, and weakly metamorphosed quartz-pebble siltstone, quartz sandstone, graywacke, conglomerate, and lesser andesite and dacite. This assemblage contains one known fragment of a Cretaceous ammonite (table 1, locality 8). The ammonite fragment was found in float, but is derived from the clastic sedimentary rocks (J.H. Stout, written commun., 1976). The other assemblage in the melange of the Windy terrane consists of small to large, fault-bounded lenses of limestone and marl that contain Silurian(?) and Devonian megafossils and microfossils (table 1, localities 8, 9, 10, 11). Marble on strike to the southeast in the Nabesna quadrangle contains Middle Devonian rugose corals (Richter, 1976). A correlative unit of melange is found on strike to the west in the Healy quadrangle and is considered to be the Windy terrane by Jones and others (1982, 1987; Csejtey and others, 1986). Csejtey and others (1986) divided this melange into three sheared and intermixed units designated m_2 (sandstone, argillite, and subordinate conglomerate), l_2 (limestone), and um (serpentinized ultramafic rocks). Unit l_2 yields Ordovician or Devonian mollusks, brachiopods and conodonts, Devonian crinoids and corals, Middle Devonian corals and stromatoporoids, late Middle Devonian conodonts, and Late Triassic pelecypods and an ammonite(?). Unit m_2 yields Mississippian and Jurassic radiolarians and Late Jurassic to Late Cretaceous pelecypods.

The Windy terrane is singly deformed with a weak schistosity that, along with parallel bedding, generally dips steeply and parallels the west-northwest-trending Denali fault. Locally, however, the terrane is intensely deformed, with development of phyllonite and protomylonite in narrow shear zones. The Windy terrane locally exhibits sparse incipient greenschist-facies metamorphism.

CRETACEOUS AND CENOZOIC PLUTONIC ROCKS NORTH OF DENALI FAULT

Several suites of Cretaceous and early Cenozoic plutonic rocks are found north of the Denali fault. From oldest to youngest, the suites consist of (1) sparse to locally abundant sills and dikes, and one large pluton of hornblende metagabbro and hornblende metadiorite; (2) small dikes, stocks, and a few large plutons of granite, granodiorite, and diorite; and (3) widely scattered, local dikes and small plutons of lamprophyre and alkalic gabbro and diorite that in the Mount Hajdukovich area form an intrusive complex of small plutons and dikes partly surrounded by a ring dike of granite.

Sparse to locally abundant sills, dikes, and plutons of hornblende metagabbro and hornblende metadiorite

Small to large sills, dikes, and plutons of hornblende metagabbro and hornblende metadiorite (gb) intrude the Jarvis Creek Glacier and Hayes Glacier subterranes (of the Yukon-Tanana terrane) and the Windy terrane. The dikes and sills are generally as wide as few meters and several hundred meters long. Most of the sills and dikes are too narrow to depict on the geologic map. The dikes and sills are fine- to medium-grained, and are generally sub-concordant to acutely crossing the intense younger schistosity and parallel compositional layering. The common igneous minerals in the metamorphosed mafic dikes, sills, and plutons are hornblende, plagioclase, minor clinopyroxene and biotite, and sparse quartz.

The mafic dikes and sills are strongly deformed along the younger schistosity, and are partly metamorphosed to lower greenschist-facies minerals, mainly chlorite, actinolite, epidote, albite, and sericite. Field relations indicate that the mafic dikes and sills are relatively older than Cretaceous granitic rocks, which locally crosscut and intrude the mafic dikes and sills and are relatively younger than the Early to mid-Cretaceous regional metamorphism of the host rocks, discussed above. Because of generally intense, low-grade metamorphism, argon-based isotopic analyses are unsuitable for isotopic age determinations of these mafic plutonic rocks. An attempt at separating zircons from a sample of metagabbro intruding the Windy terrane to the southeast in the northwest part of the Nabesna quadrangle yielded too few zircons for U-Pb isotopic analysis.

Small dikes, stocks, and plutons of granite, granodiorite, and quartz diorite

The Yukon-Tanana and Windy terranes are intruded by small dikes, stocks and, locally, large plutons of granite, granodiorite, and quartz diorite (grn). The larger plutons are at Buchanan Creek and Molybdenum Ridge, west of the Richardson Highway, Granite Mountain, east of the Richardson Highway, and Macomb Plateau in the east-central part of the quadrangle. The granitic rocks are generally equigranular to porphyritic and are generally medium grained. The mafic minerals are usually both hornblende and biotite. Alteration of feldspars to sericite is slight and biotite is locally altered to chlorite.

Locally in the Macomb Plateau area and in the northeastern part of the quadrangle, many of the Cretaceous granitic plutons exhibit a weak to moderate schistosity with formation of lower greenschist-facies actinolite, chlorite, and white mica along the schistosity. Generally, a very narrow contact-metamorphic aureole or none at all, found around the granitic rocks; this suggests intrusion during the waning stages of regional metamorphism and penetrative deformation while the wall rocks were still warm (Nokleberg and others, 1989).

In the southern Yukon-Tanana terrane, the isotopic ages for granitic plutons are (1) U-Pb zircon isotopic ages of about 90 Ma (three determinations), (table 2, localities 3, 13, 19); (2) K-Ar hornblende age of 92.9, 84.0, 88.7, 100.3, 103.6 Ma and biotite ages of 88.8, 93.3, (table 2, localities 2, 13, 27, 33, 35); and (3) Pb-alpha ages of 90, 105, and 110 Ma (two determinations), and 115 Ma (table 2, localities 1, 5, 6, 8, 11). Excluding the older and relatively less reliable Pb-alpha ages, these ages range from 84 to 104 Ma and suggest intrusion of the older granitic plutons in the mid-Cretaceous to Late Cretaceous. Ages of the granitic plutons in the Macomb Plateau region in the east-central part of the quadrangle were determined only by isotopic methods on Pb-alpha and need additional study.

In the eastern part of the quadrangle, southeast of the Robertson River, the Jarvis Creek Glacier and Hayes Glacier subterranes are stitched together by a massive granite pluton that intruded along the Mount Gakona fault. K-Ar isotopic analysis of hornblende from this pluton yields an age of 88.7 Ma (table 2, locality 27). If the K-Ar age represents the age of granitic intrusion, movement on the Mount Gakona fault ceased by the Late Cretaceous.

In the Windy terrane, a narrow, vertical granitic pluton exhibits K-Ar biotite and hornblende ages of 85.2, 85.9, 89.6, and 94.7 Ma (table 2, localities 39, 40, and 41). These K-Ar values may be minimum ages for the pluton because of low-grade hydrothermal alteration and (or) low-grade granoblastic metamorphism. The pluton may be Late Cretaceous in age, but could be older. A nearby granodiorite pluton to the northwest in the Aurora Peak terrane may be of similar age.

Lamprophyre, alkalic gabbro, and alkalic diorite dikes, sills, and plutons

Scattered dikes, sills, and a few small plutons of lamprophyre, alkalic gabbro, and alkalic diorite (la) intrude the Jarvis Creek Glacier and Hayes Glacier subterranes of the southern Yukon-Tanana terrane, mainly in the eastern part of the quadrangle. Most of the dikes and sills are too small to depict on the geologic map. The related igneous complex of Mount Hajdukovich is found in the Jarvis Creek Glacier subterrane east of the Richardson Highway. This complex consists of an intricate variety of small plutons and dikes of lamprophyre, alkali gabbro and diorite, and monzonite, partly surrounded by a ring dike of granite. On the accompanying map, these rocks are grouped together into lamprophyre and alkalic gabbro (la) and monzonite (m) units. The alkalic rocks generally contain a wide variety of minerals. In a single thin section, olivine, orthopyroxene, clinopyroxene, hornblende, biotite, plagioclase, and K-feldspar may be present. Interstitial carbonate alteration is common, and some dikes are almost completely replaced locally by carbonate. The predominant textures in relatively unaltered rocks are idiomorphic granular to porphyritic.

Two important field relations bear on the age of the alkalic and related rocks. The lamprophyres and alkalic gabbros and related rocks crosscut all penetrative structures and are younger than the intense Early to mid-Cretaceous penetrative deformation and regional metamorphism of the Yukon-Tanana terrane, discussed below. In addition, these alkalic and related rocks are found only in the southern Yukon-Tanana terrane, in the Jarvis Creek Glacier and Hayes Glacier subterranes relatively near the Denali fault, and not in the deeper level Macomb and Lake George subterranes to the north.

The lamprophyres, alkalic gabbros, and alkalic diorites exhibit two clusters of K-Ar ages: (1) in the Robertson River area in the southeastern part of the quadrangle, a suite of Late Cretaceous to early Tertiary biotite ages of 62.9, 67.6, and 69.2 Ma (table 2, localities 9, 25, 26,; Foley, 1982, 1984); and (2) in the Tok River area, also in the southeastern part of the quadrangle, a suite of mid-Cretaceous to Late Cretaceous K-Ar ages of 75.6 Ma for amphibole, 69.3 Ma for biotite, and 107.6 Ma for amphibole (table 2, localities 29, 30, 31; Foley, 1984). One additional K-Ar age to the east in the southwestern Tanacross quadrangle is 91.6 Ma for hornblende (Foley, 1984). These data indicate probable intrusion of the alkalic mafic rocks mainly during Late Cretaceous and early Tertiary, with one sample apparently intruded in the mid-Cretaceous. No data are yet available for these lithologies in the Mount Hajdukovich area. The granites that constitute a partial ring dike around and form a small pluton within the igneous complex of Mount Hajdukovich exhibit K-Ar isotopic ages on biotite of 53.4 and 54.3 Ma (table 2, localities 21, 24).

TERTIARY SEDIMENTARY ROCKS

North of the Denali fault, scattered outcrops of continental Tertiary sedimentary rocks consist of, from oldest to youngest, sedimentary rocks and coal of the Jarvis Creek coal field (Wahrhaftig and Hickox, 1955), a sandstone unit, and the Nenana Gravel. Many of the larger outcrops of Tertiary sedimentary rocks are in the Jarvis Creek coal field east of the Richardson Highway. The sandstone unit is present in fault-bounded slivers in several areas.

Sedimentary rocks of the Jarvis Creek coal field

The Jarvis Creek coal field is located between the Delta River and Jarvis Creek, east of the Richardson Highway. The sedimentary rocks and coal-bearing rocks that comprise the Jarvis Creek coal field consist mainly of conglomerate, sandstone, and coal beds (Wahrhaftig and Hickox, 1955). Sparse plant fossils are indicative of a Tertiary age (table 1, locality 5). To the west in the Healy quadrangle, similar, correlative units in the Nenana coal field are Eocene to late Miocene in age (Wahrhaftig and others, 1969; Csejtey and others, 1986).

Sandstone

This unit (Ts) consists mainly of sandstone, graywacke, and argillite and found mainly in fault-bounded prisms along the north edge of the Alaska Range. Sparse plant fossils are indicative of Oligocene, Miocene, and Pliocene ages (Table 1, localities 1, 2, 3, 4, 6).

Nenana Gravel

The Nenana Gravel (Tn) is found mainly in the northwest corner of the quadrangle and in the central part of the quadrangle, north of the Jarvis Creek coal field. The Nenana Gravel consists of thick-bedded to massive, poorly sorted conglomerate with lesser sandstone and siltstone. The Nenana Gravel is unconformably overlain by Pleistocene glacial deposits, and locally unconformably overlie the Oligocene to Pliocene sandstone unit. Locally the Nenana Gravel also overlies the coal-bearing sedimentary rocks of the Jarvis Creek coal field that are inferred to be of early Tertiary age (Moffit, 1942; Wahrhaftig and Hickox, 1955). Because of these relations, the Nenana Gravel is inferred to be of late Tertiary (Pliocene) age in this area. The Nenana Gravel also is present to the west in the Healy quadrangle, and on the basis of similar relations, is considered there to be Miocene(?) and Pliocene in age by Csejtey and others (1986).

SUMMARY AND INTERPRETATION OF AGE DATA SOUTH OF DENALI FAULT

TERRANE OF ULTRAMAFIC AND ASSOCIATED ROCKS

The terrane of ultramafic and associated rocks are found in the southeastern part of quadrangle either as a fault-bounded sliver along the Denali fault, or as klippen south of the Denali fault. This terrane (um) consists of ultramafic rocks, sparse associated mafic rocks, sparse metasedimentary rocks, and granitic rocks that represent part of a string of alpine peridotite bodies that are found along or near the Denali fault for several hundred kilometers in east-central Alaska (Richter and others, 1977; Nokleberg and others, 1982, 1985). The ultramafic rocks are chiefly dark-green serpentinized pyroxenite and peridotite, light-gray to green dunite, and dark-green, schistose amphibolite and lighter hornblende-plagioclase gneiss derived from gabbro. Interlayered with the gneiss are sparse, thin lenses of light-green and gray marble and zones of dark-gray graphitic schist. The ultramafic and mafic rocks are intruded by light-gray tonalite and granite. The ultramafic and mafic rocks are ductilely deformed, regionally metamorphosed, and exhibit a locally well-defined, medium- to coarse-grained schistosity. The tonalite and granite locally exhibit a weak schistosity that parallels schistosity in the ultramafic and mafic rocks.

K-Ar isotopic analyses of biotite and hornblende from pyroxenite yield nearly concordant ages of 123.1 and 125.9 Ma (table 2, localities 80, 81). These Early Cretaceous ages are interpreted as the apparent age of regional metamorphism and penetrative deformation of the terrane. The age of the protoliths of the ultramafic and mafic rocks is older, perhaps early Mesozoic. The relatively younger granitic bodies form elongate plutons and possess a weaker fabric compared to the ultramafic and mafic rocks. These relations suggest that the granitic rocks possibly intruded during regional metamorphism and penetrative deformation in the Early Cretaceous. The Early Cretaceous ages of metamorphism and deformation for the terrane of ultramafic and associated rocks are similar to the interpreted age of regional metamorphism and penetrative deformation of the Yukon-Tanana terrane to the north. Both may have been metamorphosed and deformed during the same event.

MACLAREN TERRANE

The Maclaren terrane is present south of the Denali fault in the central and western parts of the quadrangle. The Maclaren terrane consists of two major lithic units: (1) the penetratively deformed and regionally metamorphosed granitic plutonic rocks of the East Susitna batholith to the north; and (2) the schist and amphibolite, phyllite, and argillite and metagraywacke of the Maclaren Glacier metamorphic belt to the south (Nokleberg and others, 1982, 1985, 1989). The contact between the East Susitna batholith and the Maclaren

Glacier metamorphic belt is a faulted intrusive contact named the Meteor Peak fault (Nokleberg and others, 1982, 1985).

Maclaren Glacier metamorphic belt

The Maclaren Glacier metamorphic belt is found to the south of the East Susitna batholith and is a prograde, Barrovian-type metamorphic belt. From south to north, its principal lithic components are (1) argillite and metagraywacke, (2) phyllite, and (3) schist and amphibolite (see Nokleberg and others, 1982, 1985). The contacts between these three lithic parts of the terrane are generally faults with intense shearing and abrupt changes of metamorphic facies at each contact. The argillite and metagraywacke lithology, the lowest-grade rocks in the metamorphic belt, is composed predominantly of volcanic graywacke and siltstone, and sparse andesite and basalt, with lesser calcareous and quartz siltstone.

The protolith for the sedimentary and volcanic rocks of the metamorphic belt is Late Jurassic or older in age. To the west in the southeastern Healy quadrangle, an alkali gabbro pluton intrudes the southern part of the metamorphic belt and yields discordant K-Ar isotopic ages of 146 Ma for hornblende and 133 Ma for biotite (Smith and Lanphere, 1971; Turner and Smith, 1974; Smith, 1981; Csejtey and others, 1986). These relations suggest that at least part of the protolith is Late Jurassic or older. A minimum age for the protolith is indicated by intrusion of dikes of the Late Cretaceous and early Tertiary East Susitna batholith into the schist and amphibolite lithology of the metamorphic belt.

The Maclaren Glacier metamorphic belt is ductilely deformed into protomylonite and phyllonite in the argillite and metagraywacke lithology, phyllonite in the phyllite lithology, and mylonitic schist in the schist and amphibolite lithology. A general increase in metamorphic grade is found from the argillite and metagraywacke lithology in the south to the schist and amphibolite lithology in the north, grading from lower greenschist facies in the argillite and metagraywacke lithology to lower or middle amphibolite-facies metamorphism in the schist and amphibolite lithology (Nokleberg and others, 1985). These relations are interpreted to be the result of regional metamorphism and penetrative deformation during syntectonic intrusion of the East Susitna batholith to the north (Nokleberg and others, 1985, 1989).

K-Ar isotopic analyses of biotite and muscovite from the *schist and amphibolite lithology (mmb, part)* in the metamorphic belt range from 48.0 to 30.6 Ma (table 2, localities 70-72). One K-Ar hornblende isotopic analysis yields an age of 69.6 Ma (table 2, locality 70). The oldest isotopic age of 69.6 Ma may represent prograde regional metamorphism and penetrative deformation during syntectonic intrusion of portions of the East Susitna batholith. The younger K-Ar mica ages may represent either retrograde metamorphism and (or) unroofing and cooling of the Maclaren terrane during lateral migration along the Cenozoic Denali fault.

East Susitna batholith

The East Susitna batholith consists of five major units: (1) gneissic granitic rocks (gg)—gneissose granodiorite and granite; (2) migmatite (mig); (3) migmatitic schist (mgsh); (4) schist and amphibolite (sa); and, (5) schist, quartzite, and amphibolite (sq)—roof pendants of metasedimentary rocks, mainly calc-schist, quartzite, and para-amphibolite. The gneissic granitic plutonic rocks of the East Susitna batholith are derived mainly from diorite and granodiorite, with lesser granite. The gneissose granitic rocks locally grade into migmatite, migmatitic schist, and schist and amphibolite. The latter unit (sa) consists mainly of older, more intensely regionally metamorphosed and penetratively deformed gabbro and diorite and lesser high-grade, pelitic sedimentary rocks.

The East Susitna batholith is ductilely deformed and metamorphosed into mylonitic gneiss and schist under conditions of the upper amphibolite facies, with local retrograde metamorphism at conditions of the lower greenschist facies (Nokleberg and others, 1985). Small roof pendants of calc-schist, quartzite, and amphibolite are found in the batholith near the west edge of the quadrangle. The East Susitna batholith is a part of the Kluane arc of Plafker and others (1989).

Schist, quartzite, and amphibolite

Small roof pendants (sq) in the batholith in the west-central part of the quadrangle are composed of relatively older metasedimentary rocks, mainly calc-schist, quartzite, and para-amphibolite. Similar rocks on strike to the west in the Healy quadrangle contain Triassic conodonts (Sherwood and Craddock, 1979; Csejtey and others, 1986).

Gneissose granitic rocks

Isotopic analyses from gneissose granitic rocks (gg) on U-Pb zircon, U-Pb sphene, and K-Ar mica and hornblende yielded a wide range of ages—from 70 to 29.2 Ma (table 2, localities 42, 44, 45, 49, 53, 56-69). The oldest isotopic age is 70 Ma from a U-Pb zircon analysis of a gneissic granodiorite (table 2, locality 45). The oldest, nearly concordant K-Ar hornblende and biotite isotopic ages from a single sample are 65.9 and 56.9 Ma (table 2, locality 50). To the west in the Healy quadrangle, the oldest K-Ar hornblende isotopic age is 87.4 Ma (Turner and Smith, 1974; Csejtey and others, 1986). These ages are interpreted as representing intrusion of this part of the East Susitna batholith in the Late Cretaceous, and continued syntectonic intrusion, regional metamorphism, and penetrative deformation in the early Tertiary (Nokleberg and others, 1985, 1989).

Other, younger isotopic ages range from about 56 Ma to 30 Ma. A U-Pb isotopic analysis of metamorphic sphene yields a concordant age of about 56 Ma from the sample of 70-Ma gneissic granodiorite (table 2, locality 45; Nokleberg and others, 1985). Metamorphic biotite from this sample yields a

K-Ar age of 56.9 Ma (table 2, locality 45). These and similar ages are also interpreted as regional metamorphism and penetrative deformation of this granodiorite that occurred after intrusion (Nokleberg and others, 1985).

The youngest K-Ar isotopic ages range from 29.2 to 36.6 Ma for muscovite, biotite, and hornblende (table 2, localities 56-65, 67-69). These youngest isotopic ages are from outcrops close to the Denali fault and are interpreted as representing either continued, syntectonic intrusion of parts of the East Susitna batholith or unroofing and cooling of the East Susitna batholith during lateral migration along the Cenozoic Denali fault. Argon loss due to faulting may also contribute to these younger ages. The general parallelism of the schistosity in the batholith with the Denali fault suggests that some metamorphism and deformation of the batholith occurred during faulting (Nokleberg and others, 1985).

Schist and amphibolite, migmatite, and migmatitic schist

The migmatite (mig) unit is transitional between the migmatitic schist (mgsh) and gneissose granitic rocks (gg) units. The migmatitic schist (mgsh) unit is transitional between the migmatite (mig) and schist and amphibolite (sa) units. Both units mig and mgsh are interpreted as possible partial melting products of the schist and amphibolite (sa) unit. K-Ar ages on hornblende and biotite from the migmatitic schist unit (mgsh) range from 33.7 to 65.9 Ma, suggesting that migmatization was possibly related to the Late Cretaceous and early Tertiary intrusion of the East Susitna batholith (table 2, localities 43, 47, 50-52, 55). K-Ar ages from similar rocks on strike to the west in the Healy quadrangle range from 48.4 to 77.3 Ma (Turner and Smith, 1974).

Younger granitic plutons and alkalic gabbro dikes in the Maclaren terrane

The Maclaren terrane is intruded by two relatively young plutons of nongneissose granitic rocks. One of the plutons consists of granodiorite that intrudes the northwest part of the East Susitna batholith and is truncated by the Denali fault in the west-central part of the quadrangle. K-Ar hornblende and biotite isotopic analyses yield nearly concordant ages of 35.5, 35.6, and 36.1 Ma (table 2, localities 48, 54). These early Tertiary ages are similar to the youngest ages for gneissose granitic rocks in the East Susitna batholith and may represent intrusion of the granodiorite pluton in a small area that was tectonically quiet.

In the western part of the quadrangle, a very small pluton of nongneissose, hydrothermally altered biotite granite of early(?) Tertiary age intrudes the argillite and metagraywacke lithology of the Maclaren Glacier metamorphic belt.

Local sparse alkalic gabbro dikes intrude the southwestern part of the East Susitna batholith. A K-Ar biotite isotopic analysis yields an age of 52.8 Ma (early Tertiary) (table 2, locality 46). These dikes are similar in petrology and age to the locally abundant alkalic dikes that occur across the Denali fault in the southern Yukon-Tanana quadrangle in the east-central part of the quadrangle.

CLEARWATER TERRANE

The Clearwater terrane (csv) (Jones and others, 1987; Nokleberg and others, 1982, 1985) is found in the western part of the quadrangle as a narrow, fault-bounded lens along the Broxson Gulch thrust between the Maclaren terrane to the north and the Wrangellia terrane to the south. The Clearwater terrane consists of weakly deformed chlorite schist, muscovite schist, schistose rhyodacite, Upper Triassic marble, and greenstone derived from pillow basalt (csv). The Clearwater terrane is weakly deformed and metamorphosed at conditions of the lower greenschist facies. To the west in the southeastern Healy quadrangle, marble layers in sedimentary rocks correlative with the Clearwater terrane contain *Heterastridium* sp. of Late Triassic age (Jones and others, 1987; Csejtey and others, 1986). The Clearwater terrane is locally intruded by a fault-bounded and weakly gneissose pluton of diorite and quartz diorite. The age of pluton is assumed to be Jurassic and (or) Cretaceous.

WRANGELLIA TERRANE

The Wrangellia terrane (Jones and others, 1987; Nokleberg and others, 1982, 1985, 1989) is found across the southern part of the quadrangle. The Wrangellia terrane is subdivided into the Slana River subterrane to the northeast, and the Tangle subterrane to the southwest (Nokleberg and others, 1982, 1985). The Slana River subterrane is bounded to the north by the Broxson Gulch thrust and to the south by the Eureka Creek fault. The Tangle subterrane is present south of the Eureka Creek fault. The Wrangellia terrane is weakly regionally metamorphosed under conditions of the lower greenschist facies (Nokleberg and others, 1985). Metamorphic minerals are generally fine-grained and disseminated, and abundant relict minerals are present in most rocks.

Slana River subterrane

The Slana River subterrane consists mainly of upper Paleozoic marine volcanic and sedimentary rocks, associated late Paleozoic hypabyssal and plutonic rocks, the disconformably overlying massive basalt flows of the Triassic Nikolai Greenstone, coeval gabbro and cumulate mafic and ultramafic rocks, Triassic limestone, and younger Mesozoic flysch.

Tetelna Volcanics

The Tetelna Volcanics(IPt) (Mendenhall, 1905) forms the lowest stratigraphic part of the Slana River subterrane and is found mainly in the southeast corner of the quadrangle. The Tetelna Volcanics consists mainly of andesite flows, mud and debris avalanches, and tuff interbedded with fine- to coarse-grained volcaniclastic rocks. The Tetelna Volcanics is unfossiliferous and is interpreted to be of Pennsylvanian age because it is located stratigraphically beneath and consists of volcanic rocks similar to those in the Slana Spur Formation (Richter, 1976; Richter and others, 1977).

Slana Spur Formation

The Slana Spur Formation (PIPs) (Richter and Dutro, 1975) is found in the southeastern and south-central parts of the quadrangle and disconformably overlies the Tetelna Volcanics. The Slana Spur Formation consists mainly of a thick sequence of marine calcareous and noncalcareous volcaniclastic rocks with lesser limestone, tuff, and volcanic breccia. The Slana Spur Formation, second most fossiliferous unit in the quadrangle, has previously been subdivided locally into a lower volcaniclastic member (PIPsl), not depicted separately on the geologic map) and an upper calcareous volcaniclastic member (PIPsu), not depicted separately on the geologic map) (see Richter and others, 1977). Ages of abundant megafossils and microfossils, mainly brachiopods, corals, and foraminifers, range from Middle Pennsylvanian through Early Permian (table 1, localities 13-16, 52-57, 59-63, 65-69, 71-72, 76, 86, 107-108). The lower member contains the only definitive Middle Pennsylvanian fusulinids (table 1, localities 108, 56, 54).

Granitic plutons south of Denali fault and shallow-level intrusive stocks, dikes, sills, and small plutons

Sparse Pennsylvanian granitic plutons and shallow intrusive andesite and lesser dacite stocks, sills, and dikes of Permian(?) age intrude the Slana Spur Formation. These units are interpreted as the plutonic and hypabyssal parts of a late Paleozoic arc. The submarine volcanic rocks of the Tetelna Volcanics and Slana Spur Formation form the extrusive parts of the arc.

The Slana River subterrane is also intruded by a granite pluton (IPg) in the southeastern part of the quadrangle. U-Pb zircon isotopic analysis of this pluton yields an age of 309 Ma (table 2, locality 79), which is interpreted as the age of intrusion. This granite is probably the northwest extension of the Pennsylvanian Ahtell pluton in the northwestern Gulkana quadrangle (Richter, 1966; Beard and Barker, 1989). In the south-central part of the Mount Hayes quadrangle, K-Ar hornblende isotopic analysis of the southern part of the informally named granodiorite of Rainbow Mountain yields a value of 326 Ma (table 2, locality 76). This value, if correct, would be a Late Mississippian age (according to the time scale of Palmer, 1983) and would be older than the surrounding wallrocks of the Slana Spur Formation. This value is tentatively interpreted as a Pennsylvanian age; however, the isotopic analysis might have measured minor or major amounts of excess argon. The granitic pluton may be slightly to greatly younger. A K-Ar hornblende analysis from the northern part of the Rainbow Mountain pluton yields a value of about 110 Ma (Early Cretaceous) (table 2, locality 75).

The shallow intrusive rocks, mainly stocks, dikes, and sills of andesite with lesser dacite to rhyolite and diabase (Pi), intrude the Slana Spur Formation in the south-central and southeastern parts of the quadrangle. These shallow intrusive rocks do not intrude the younger, Lower Permian Eagle Creek Formation and therefore are interpreted to be of Early Permian age and to be comagmatic with the submarine volcanic rocks of the Slana Spur Formation.

Eagle Creek Formation

The Eagle Creek Formation (Pe) (Richter and Dutro, 1975) is found in the southeastern and south-central parts of the quadrangle and disconformably overlies the Slana Spur Formation. The Eagle Creek Formation is the most fossiliferous unit in the quadrangle. Abundant megafossils and microfossils, mainly brachiopods, corals, and foraminifers, indicative of an Early Permian age (table 1, localities 17-51, 73-74, 80-84, 87-94, 96-106, 109-110). Ages range from earliest Permian (Asselian or early Wolfcampian) through latest Early Permian (Artinskian or late Leonardian); two collections contain cephalopods that may be early Late Permian (table 1, localities 100 and 101 in the upper part of the Eagle Creek Formation).

Shale, limestone, and chert

An unnamed unit of interbedded, black, carbonaceous shale, gray, thin-bedded argillite, light-colored chert, and light-gray limestone is found in the southeastern part of the quadrangle (Richter and others, 1977). This unit is too thin to depict separately on the geologic map; it is mapped in this report as part of the Eagle Creek Formation. The unit also contains minor amounts of gray siltstone and conglomerate. Sparse limestones contain scant crinoid fragments, shale locally contains abundant *Daonella* of Middle Triassic age (table 1, locality 95). The unit is structurally conformable with the underlying upper part (argillite) of the Eagle Creek Formation, but the unit is extremely discontinuous and thickness ranges from 0 to 40 m. An erosion interval of long duration is represented at this contact.

Nikolai Greenstone

The Upper Triassic Nikolai Greenstone (Trn) (Rohn, 1900) disconformably overlies the Eagle Creek Formation (and its included, unnamed unit of shale, limestone, and chert). The Nikolai Greenstone consists of massive, subaerial, amydgaloidal basalt flows about 1,500 m thick, and is present across central and eastern parts of the Slana River subterrane. The Nikolai Greenstone is unfossiliferous in the Slana River subterrane, but is overlain by Upper Triassic limestone, described below, and contains Middle or Late Triassic fossils in the Tangle subterrane, described below.

Limestone

Conformably overlying the Nikolai Greenstone are thin to thick beds of limestone (Ŧl), which locally contain moderately abundant Late Triassic megafossils and microfossils (table 1, localities 78-79, 111-119). Some outcrops of this limestone are too small to depict on the geologic map.

Marine sedimentary rocks

Unconformably overlying the Upper Triassic limestone and Nikolai Greenstone in the eastern part of the quadrangle is a thick flysch sequence composed of marine graywacke, argillite, conglomerate, and lesser andesite flows of Late Jurassic and Early Cretaceous age (KJs). The flysch sequence comprises the extreme northwestern part of the Gravina-Nutzotin belt, which extends several thousand kilometers to the southeast (Berg and Richter, 1972). One locality in the southeastern part of the quadrangle yields Late Jurassic megafossils (table 1, locality 77). In the Nabesna quadrangle to the southeast, the unit contains locally abundant Buchia assemblages ranging in age from Late Jurassic to Early Cretaceous (Richter, 1976).

Tangle subterrane

Relative to the Slana River subterrane, the Tangle subterrane consists of a thinner sequence of upper Paleozoic and Lower Triassic sedimentary and tuffaceous rocks, and a thicker sequence of unconformably overlying pillow basalt and subaerial basalt flows of the Triassic Nikolai Greenstone, and locally overlying limestone.

Aquagene tuff, argillite, limestone, chert, andesite tuff, and greenstone

The basal unit of the Tangle subterrane consists of aquagene tuff, dark-gray argillite, minor andesite tuff and flows, and very sparse light-gray limestone (Pzt). Sparse megafossils are suggestive of a late Paleozoic age for the unit (table 1, locality 125).

Nikolai Greenstone

Unconformably overlying the upper Paleozoic unit (Pzt) is a thick sequence of the Nikolai Greenstone that is subdivided into a lower pillow basalt flow (Ŧnp) unit and an upper unit of subaerial basalt flows and minor associated sedimentary rocks (Ŧnf). Sparse layers and lenses of argillite in the basal unit yield very sparse Middle or Late Triassic megafossils (table 1, locality 124). Late Triassic fossils are found in the same unit to west in southeastern Healy quadrangle (Csejtey and others, 1986). Diagnostic fossils in the southern Wrangell Mountains are indicative of a Late Triassic age (MacKevett, 1978).

Limestone

Limestone layers (Ŧl) that are faulted against the Nikolai Greenstone in the southwestern part of the quadrangle yield Late Triassic fossils (table 1, localities 120, 123). Nearby in the southeastern part of the Healy quadrangle, similar limestone layers within the basal member of the Nikolai Greenstone contain megafossils and microfossils also of Late Triassic age (Csejtey and others, 1986).

Units found throughout the Wrangellia terrane

Gabbro diabase, and metagabbro and cumulate mafic and ultramafic rocks

Locally extensive gabbro dikes (ga) and cumulate mafic and ultramafic sills intrude the Nikolai Greenstone and older rocks in the Wrangellia terrane. These dikes and sills (cu) are interpreted as comagmatic with the basalts that formed the Nikolai Greenstone. K-Ar hornblende isotopic analyses yield ages of ages of 91.9 and 97.7 Ma (table 2, localities 73, 74). Because the cumulate mafic and ultramafic rocks exhibit local, low-grade metamorphism, these Late Cretaceous ages could represent the age of the low-grade regional metamorphism of the Wrangellia terrane. Alternatively, the ultramafic rocks at localities 73 and 74 are present in narrow, fault-bounded lenses near the Denali and Broxson Gulch faults, and could represent younger, Late Cretaceous intrusions. A K-Ar hornblende isotopic analysis of a weakly metamorphosed mafic nodule in the Slana Spur Formation yields an age of 94.4 Ma (table 2, locality 82). This age may also represent the age of the low-grade regional metamorphism of the Wrangellia terrane.

McCarthy Formation

The Upper Triassic and Lower Jurassic McCarthy Formation (JŦcm) (Mackevett, 1978) is found in a narrow, fault-bounded lens along branches of the Broxson Gulch thrust in the western part of the quadrangle. This lens is present between the Clearwater terrane to the north and the Wrangellia terrane to the south. A distinctive occurrence of *Monotis subcircularis(?)* in the calcareous shales of the McCarthy Formation is indicative of a Late Triassic age for part of these rocks in this area (table 1, localities 121, 122). The nearest other occurrence of the McCarthy Formation is about 220 km to the southeast in the type area in the McCarthy quadrangle, where the unit's age ranges from the Late Triassic to the Early Jurassic (MacKevett, 1978). This age range is adopted for this unit in the Mount Hayes quadrangle.

Mesozoic granitic plutons in the Wrangellia terrane

The Wrangellia subterrane is intruded by small- to moderate-size, igneous-textured Mesozoic granitic plutons (grs) that are locally, weakly to extensively, hydrothermally altered. These granitic plutons are interpreted as being coeval and comagmatic with the Upper Jurassic and Lower Cretaceous flysch and volcanic rocks of the Gravina-Nutzotin belt, and the marine and subaerial andesite volcanic flows and volcaniclastic rocks of the Lower Cretaceous Chisana Formation, part of the Gravina-Nutzotin belt to the southeast in the Nabesna quadrangle (Richter, 1976). This suite of granitic plutons and coeval volcanic rocks is named the Gravina arc by Stanley and others (1990). Sparse K-Ar hornblende isotopic analyses yield ages of about 110, 129, and 146 Ma (Late Jurassic and Early Cretaceous) (table 2, localities 75, 83, 85). However, because some of the undated Mesozoic(?) granitic plutons in the Wrangellia terrane are petrographically identical to the Pennsylvanian granitic plutons, they could possibly be of late Paleozoic age.

GULKANA RIVER TERRANE

A small part of the Gulkana River terrane—mapped previously in the Gulkana quadrangle (Nokleberg and others, 1986b)—is found in the south-central part of the quadrangle, south of the Wrangellia terrane. The two terranes are separated by the Paxson Lake fault. In the map area, the Gulkana River terrane consists of unfossiliferous, massive to weakly schistose, weakly metamorphosed hornblende andesite (mha). Samples of meta-andesite were too poor in zirconium to warrant U-Pb zircon isotopic analysis. The Gulkana River terrane is correlative with the Haley Creek metamorphic assemblage of Plafker and others (1989) in the northern Valdez quadrangle to the southeast, which contains similar late Paleozoic metamorphosed andesite and basalt flows.

TERTIARY SEDIMENTARY AND VOLCANIC ROCKS

South of the Denali fault scattered outcrops are found of continental Tertiary sedimentary and volcanic rocks that are herein mapped as, from oldest to youngest, volcanic rocks (Tv), conglomerate (Tc), and sandstone and conglomerate (Tsc). Similar sedimentary and volcanic rock types are found in all three units. The sandstone and conglomerate unit contains sparse volcanic ash and argillite, and the conglomerate unit contains sparse sandstone and argillite. The stratigraphic succession of these units is best established along the southern flanks and to the southeast of Rainbow Mountain in the south-central part of the quadrangle. Elsewhere, these three sedimentary and volcanic rock units may laterally grade into one another.

Volcanic rocks

The volcanic rocks (Tv) unit consists chiefly of vitric-lithic-crystal ash-flow tuff, breccia, agglomerate, flows, dikes, and sills with lesser volcanic sandstone, conglomerate, and limestone. The igneous rocks are chiefly rhyodacite, dacite, and andesite. The volcanic rocks unit outcrops in scattered localities as wide as 3.5 km, mainly north of the McCallum Creek-Slate Creek fault in the south-central part of the quadrangle. The volcanic rocks unit also is found in fault-bounded lenses within splays of the Broxson Gulch thrust in the southwestern part of the quadrangle. The volcanic rocks unit is overlain by, and locally is in fault contact with the units of conglomerate (Tc) and sandstone and conglomerate (Tsc), and is locally faulted against older bedrock of the Slana River subterrane (of Wrangellia terrane).

The age of the volcanic rocks unit is Eocene. It is relatively older than the overlying sandstone and conglomerate unit of Eocene to Miocene age. A K-Ar isotopic whole-rock analysis of a rhyodacite tuff from about 1.6 km southeast of The Hoodoos yields an age of 49 Ma (Eocene) (table 2, locality 77).

Conglomerate

The conglomerate unit (Tc) is exposed in several outcrops as wide as 2 km north of the McCallum Creek-Slate Creek fault in the south-central part of the quadrangle; it also is present in several smaller exposures, too thin to be depicted on the geologic map, west of the Delta River. Locally, the conglomerate unit is faulted against older bedrock. The conglomerate unit consists of continental clastic deposits of mainly poorly sorted, crudely bedded to massive, polymictic conglomerate and lesser sandstone with abundant clasts of rhyodacite to dacite tuff and flows, the Nikolai Greenstone, argillite, volcanic sandstone, and andesite to dacite flows from the Eagle Creek and Slana Spur Formations, quartz diorite, greenschist, gabbro, and ultramafic rocks. Thin beds of coal are found locally in the sandstone layers. The conglomerate unit overlies the Tertiary volcanic rocks (Tv) unit and older bedrock of the Slana River subterrane (of Wrangellia terrane). Although unfossiliferous the conglomerate unit is presumably Eocene in age. It is relatively younger than the underlying, volcanic rocks unit of Eocene age, and is relatively older than the overlying sandstone and conglomerate unit of Eocene to Miocene age.

Sandstone and conglomerate

The sandstone and conglomerate (Tsc) unit is found in scattered exposures as wide as 4 km, and overlies the conglomerate (Tc) unit. The sandstone and conglomerate unit is generally faulted against older bedrock. The unit consists mainly of continental clastic deposits of light-brown, fine-grained, poorly sorted, sandstone with locally interbedded siltstone, pebbly sandstone, pebble to cobble conglomerate, and sparse thin coal layers, and sparse white rhyodacite ash layers south of The Hoodoos.

The age of the sandstone and conglomerate unit ranges from Eocene to Pliocene. K-Ar isotopic analysis of hornblende from a white rhyodacite ash layer about 0.8 km south of The Hoodoos has yielded an age of 5.5 Ma (late Miocene) (table 2, locality 78). K-Ar isotopic analyses of hornblende from a rhyodacite tuff from a fault-bounded wedge of sandstone in the southwestern part of the quadrangle has yielded an age of 31.1 Ma (Oligocene) (table 2, locality 84). Several localities, mainly in the south-central and southeastern parts of the quadrangle have yielded plant and pollen fossils that range in age from late Eocene to Pliocene (table 1, localities 12, 58, 64, 70, 75, 85).

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Table 1. *Fossils, locations, host rocks, and ages; Mount Hayes quadrangle, eastern Alaska Range, Alaska*
[The various North American and European age terms appearing in table 2 are those used by the identifying paleontologists]

Map No.	Field No.	Location (lat. and long.)	Fossil group(s) or fossil(s)	Fossil age	Map unit symbol; map unit name or host rock if known	Identifer	Reference; remarks
Cenozoic Sedimentary Rocks in the Yukon-Tanana terrane							
1	81ANK056A	63° 39'49" N. 146° 13'52" W.	Fossil leaves, not yet identified	Tertiary(?)	Ts; mudstone in unnamed Tertiary sandstone unit		USGS report pending Collected by I.M. Lange, 1981
2	76AH74	63° 34'00" N. 146° 04'00" W.	Leaves, *Alnus cappsi* or *A. corylina*	Middle to late Miocene	Ts; shale in unnamed Tertiary sandstone unit	J.A. Wolfe	USGS Report A-77-1M Collected by George Plafker, 1976
3	AEK75129	63° 34'00" N. 146° 04'00" W.	Leaves, *Metasequoia* cf. *M. glyprostrobo* *Alnus evidens*	Oligocene	Ts; mudstone in unnamed Tertiary sandstone unit	J.A. Wolfe	USGS Report A-76-23M collected by Inyo Elleresieck, 1975
4	80AAF060A	63° 34'18" N. 146° 03'51" W.	Leaves, *Metasequoia* sp. *Alnus* sp.	Oligocene to Miocene	Ts; mudstone in unnamed Tertiary sandstone unit	J.A. Wolfe	USGS Report A-81-5M Collected by J.N. Aleinikoff, 1980
5	36 AM-F1	63° 38' N. 145° 44' W.	*Glyptostrobus europaeus* (Brongniert) Heer *Alnus* Sp *Fagus antipofi* Abich	Tertiary	Tsj; shale and sandstone in coal-bearing sedimentary rocks of Jarvis Creek coal field	R.W. Brown	F.H. Moffit, 1942 Collected by F.H. Moffit
6	Not available	63° 26'38" N. 144° 45'50" W.	Conifers, *Picea* *Pinus* *Tsuga* Broadleaf *Betula* *Alnus* *Carya* *Juglans(?)* *Quercus(?)* *Tilia* *Ilex* Ferns *Dryopteris* *Osmunda* *Cinnamomea* *Adiantum* Club moss *Lycopodium*	Pliocene Miocene(?)	Ts; mudstone in unnamed Tertiary sandstone unit	W.S. Benninghoff J.A. Wolfe	W.S. Benninghoff and G.W. Holmes, 1961; G.W. Holmes and H.L.Foster, 1968, p. 25

			Aurora Peak terrane				
7	80AAF045C	63° 30'50" N. 146° 01'25" W.	Conodonts; Bar and blade fragments of post-Ordovician morphotype	Silurian to Triassic	as; marble	A.G. Harris	USGS Report A-82-2 Collected by J.N.Aleinikoff, 1980
			Windy terrane				
8	JS101B71	63° 26'36" N. 145° 57'36" W.	Corals, *Heliolites* *Syringopora* *digitate favositids* Crinoidal debris	Silurian or Devonian	wm; limestone and calcareous sandstone	C.W. Merriam	USGS Report A-71-16M and A-72-23 Collected by J.H. Stout, 1971
			Ammonite fragment (*Eupachydiscus*(?)	Late Cretaceous(?)	wm; Float of ferruginous sand-stone, possibly a faulted lens, adjacent to lime-stone and cal-careous sandstone	R.W. Imlay	USGS Report A-71-16M collected by J.H.Stout, 1971
9	72AWR158	63° 26'36" N. 145° 57'36" W.	Stromatoporoids, *Amphipora sp.* Tabulate corals, *Thamnopora sp.* Conodonts, *Hindeodella sp.* Ostracods, *Gravia* sp. *Selebratina* sp. cf. *s. pustulodentata* Mc Gill *Hypotetragona* sp. *Bekena* sp. cf. *B. homolibera* Mc Gill *Tricornina(?)* sp. *Acanthoscapha*(?) sp. *Bairdia sp.* *Libumella sp.* *Bairdiocypris sp.*	Late Middle Devonian	wm; limestone and calcareous sandstone	A. Oliver J.M. Berdan J.W. Huddle	USGS Report A-72-13 Collected by F.R. Weber, 1972
10	79ANK228C	63° 26'36" N. 145° 57'54" W.	Coelentrates, *Amphipora* sp. *Thamnopora* sp. *Temnophyllum(?)* sp.	Devonian	wm; calcareous sandstone	W.A. Oliver	USGS Report A-79-44 Collected by W.J. Nokleberg, 1979

11	79ANK165B	63° 03'38" N. 144° 09'38" W	Conodonts, *Palmatolepis* sp. of the *P. glabra* group *Polygnathus* sp.	Late Devonian	wm; limestone	A.G. Harris	USGS Report A-82-2 Collected by W.J. Nokleberg, 1979
			Slana River subterrane (of Wrangellia)				
12	Not available	63° 17'30" N. 146° 06'25" W.	*Alnus evidens* *Metasequoia*(?) sp.	Oligocene	Tsc; sandstone and conglomerate	J.A. Wolfe	J.A. Wolfe, 1966, 1972; J.H. Stout, 1976
13	79AZN015A	63° 19'34" N. 146° 01'58" W.	Echinoderm debris, indeterminate Bryozoans, ramose, indeterminate Brachiopods, *Waagenoconcha* sp. *Neospirifer* sp.	Early Permian	PPs; Slana Spur Formation (lower part)	J.T. Dutro, Jr.	USGS Report A-79-44 Collected by R.E. Zehner, 1979
14	85AIL023A,B	63° 20'00" N. 146° 00'03" W	Rugose corals Phaceloid, indeterminate *Pseudotaphrentoides*? sp. Fusulinids, *Pseudofusulinella* sp.	Pennsylvanian to Permian	PPs; Slana Spur Formation	W. Sando R.C. Douglass	This report
15	79ANK018A	63° 19'24" N. 145° 59'30" W.	Echinoderm debris and columnals, indeterminate Bryozoans, *Polypora* sp. Brachiopods, *Arctitreta* sp. *Terrakea*(?) sp. productoid fragments, indeterminate *Spiriferella* sp. *Neospirifer*(?) sp	Permian	PPs; Slana Spur Formation (upper part)	J. T. Dutro, Jr.	USGS Report A-79-44 Collected by W.J. Nokleberg, 1979
16	52APW52	63° 21'00"N. 145° 57'30"W. (approximate)	Bryozoans, *Fenestella* sp. *Polypora* sp.. stenoporoids indeterminate Brachiopods, *Dictyoclostus* sp. *Linoproductus*(?) sp. *Orthotichia*(?) sp.	Permian	PPs; fault-bounded slice of Slana Spur Foundation (lower part)	H. Duncan J.T. Dutro Jr.	USGS Report MG-53-7 collected by W. McConn, 1952
17	WRM 9	63° 16'33" N. 145° 52'01" W.	Fusulinids, *Schwagerina rainyensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 9-13
18	WRM 10	63° 16'33" N. 145° 52'01" W.	Fusulinids, *Schwagerina mankomenensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 9-13

19	WRM 6, 7	63° 16'34" N. 145° 52'00" W.	Fusulinids, *Schwagerina rainyensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 9-1
20	WRM 8	63° 16'34" N. 145° 52'00" W.	Fusulinids, *Schwagerina hyperborea* *Schwagerina mankomen-ensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R. G. Petocz	Petocz, 1970, p. 9-13
21	WRM 4.5	63° 16'35" N. 145° 51'59" W.	Fusulinids, *Schwagerina hyperborea* *Schwagerina mankomen-ensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 9-13
22	WRM 3, 3.5	63° 16'37" N. 145° 51'54" W.	Fusulinids, *Schwagerina hyperborea* *Schwagerina mankomen-ensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 9-13
23	WRM 2	63° 16'37" N. 145° 51'44" W.	Fusulinids, *Schwagerina rainyensis*	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 9-13
24	RC 25	63° 16'31" N. 145° 50'25" W.	Fusulinids, *Schwagerina* sp. C	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
25	RC 21	63° 16'31" N. 145° 50'20" W.	Tabulate corals, *Sinopora* sp.	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
26	RC 24	63° 16'31" N. 145° 50'20" W.	Rugose corals, *Hapsiphyllid*, indeterminate	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
27	RC 20	63° 16'33" N. 145° 50'18" W.	Rugose corals, *Clisiophyllum* sp. Fusulinids, *Schwagerina moffiti* *Schubertella* sp.	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
28	RC 22	63° 16'29" N. 145° 50'18" W.	Fusulinids, *Schwagerina heineri* Rugose corals, *Auloclisia deltense* *Clisiophyllum*(?) spp. Brachiopods, *Antiquatonia* sp. *Camerisma* sp. *Neospirifer* sp.	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
29	RC 23	63° 16'29" N. 145° 50'18" W.	Fusulinids, *Schwagerina heineri* *Schwagerina* sp. B	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
30	RC 26, 27	63° 16'26" N. 145° 50'18" W.	Fusulinids, *Schwagerina* sp. C	Early Permian (Artinskian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20

31	RC 18	63° 16'27" N. 145° 50'12" W.	Rugose corals, *Clisiophyllum* sp. B Brachiopods, *Neospirifer* sp. *Spiriferellina*(?) *Spirifella* sp. *Camerisma*(?) sp. *Antiquatonia* sp.	Early Permian	Pe; Eagle Creek Formation	C.L. Rowett	Rowett, 1969b, p. 120; Rowett, 1975, p. 68
32	RC 18, 19	63° 16'34" N. 145° 50'08" W.	Fusulinids, *Eoparafusulina waddelli* *Schwagerina callosa*	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
33	78NK201A	63° 15'42" N. 145° 50'02" W.	Brachiopods, orthotetacean, indeterminate *Anemonaria* sp. linoproductid, indeterminate spiriferoid, indeterminate Pelecypods, pectenoid, indeterminate Fusulinids, *Schwagerina mankomenesis* Bryozoans, Acanthocladid(?), indeterminate *Dyscritella*(?) sp. *Fenestella* spp. Fenestelloid, indeterminate Fistuliporid(?) *Polypora*(?) spp. *Rhabdomesids*(?), indeterminate *Rhombotrypella* sp. *Streblotrypa* sp. fenestrate and ramose forms, indeterminate	Early Permian (Leonardian)	Pe; Eagle Creek Formation	J.T. Dutro, Jr. R.C. Douglass O.L. Karklins	USGS Report A-78-35 Collected by W.J. Nokleberg, 1978
34	RC 1, 2	63°16'30" N. 145° 50'00" W.	Fusulinids, *Pseudofusulinella* sp.	Early Permian (Asselian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
35	RC 17	63°16'27" N. 145°49'47" W.	Fusulinids, *Eoparafusulina mendenhalli* *Schwagerina rowetti* *Schwagerina callosa* Rugose corals, *Caninia* sp.	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
36	RC 15	63°16'26" N. 145°49'42" W.	Fusulinids, *Eoparafusulina mendenhalli* *Schwagerina rowetti* *Schwagerina whartoni* Rugose corals, *Caninia petoczi* Brachiopods, *Stenoscisma* sp. *Linoproductus* sp.	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20

37	RC 16	63°16'26" N. 145°49'42" W.	Fusulinids, *Eoparafusulina mendenhalli* *Schwagerina rowetti* *Schwagerina callosa*	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
38	RC 8, 9	63°16'29" N. 145°49'39" W.	Fusulinids, *Pseudofusulinella* sp. A(?) *Schwagerina pseudokaragasensis* *Schwagerina* sp. A	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
39	RC 10	63°16'29" N. 145°49'39" W.	Fusulinids, *Pseudofusulinella* sp. A(?) *Schwagerina* sp. cf. *S. emaciata* Rugose corals, *Caninia* sp.	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
40	RC 11, 12	63°16'29" N. 145°49'39" W.	Fusulinids, *Pseudofusulinella valkenburghae* *Schwagerina* sp. cf. *S. emaciata* *Schwagerina whartoni*	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
41	RC 13	63°16'28" N. 145°49'39" W.	Fusulinids, *Pseudofuslinella* sp. cf. *P. parvula* *Schwagerina* sp. A *Schwagerina callosa*	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
42	RC 14	63°16'28" N. 145°49'39" W.	Fusulinids, *Eoparafusulina mendenhalli*	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
43	RC 7	63°16'30" N. 145°49'36" W.	Fusulinids, *Pseudofusulinella sp. A*	Early Permian (Asselian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
44	RC 17	63°16'28" N. 145°49'36' W.	Rugose corals, *Caninia petoczi* Brachiopods, *Linoproductus* sp. *Stenoscisma* sp. Fusulinids, *Eoparafusulina* sp. *Schwagerina* sp. *Pseudofusulinella* sp. *Schubertella* sp.	Early Permian	Pe; Eagle Creek Formation	C.L. Rowett	Rowett, 1969b, p. 119; Rowett, 1975, p. 68
45	RC 3, 4	63°16'29" N. 145°49'29" W.	Fusulinids, *Pseudofusulinella* sp. A	Early Permian (Asselian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20
46	RC 5	63°16'26" N. 145°49'27" W.	Fusulinids, *Pseudofusulinella*	Early Permian (Asselian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 17-20

47	18115-PC	63°15'30" N. 145°48'48" W.	Sponges, *Scheiia* cf. *S. tuberosa* *Tschernyschew and Stepanow* Rugose corals, *Caninophylum* sp. *Heritschioides* sp. Brachiopods, *Muirwoodia* sp. aff. *M. transversa* Cooper *Spiriferella* sp. aff. *S. saranae* Verneuil *Neospirifer*(?) sp. *Antiquatonia*(?) sp. Linoproductid, indeterminate Crinoid columnals, indeterminate Bryozoans fragments, indeterminate	Permian	Pe; Eagle Creek Formation	J.T. Dutro, Jr. H.M. Duncan	USGS Report A-59-1 Collector unknown, transmitted by Clyde Wahrhaftig, 1958
48	DR 16	63°15'58" N. 145°48'44" W.	Rugose corals, *Auloclisia deltense* Sponges, *Hindia*(?) sp. Brachiopods, poorly preserved, indeterminate Fusulinids, schwagerinid, indeterminate	Early Permian	Pe; Eagle Creek Formation	C.L. Rowett	Rowett, 1969b, p. 120; Rowett, 1975, p. 69
49	DR 15	6315'52" N. 145°48'44" W.	Rugose corals, *Timania* sp. A. Tabulate corals, *Sinopora*(?) sp.	Early Permian	Pe; Eagle Creek Formation	C.L. Rowett	Rowett, 1969b, p. 120; Rowett, 1975, p. 69
50	DR 14	63°16'08" N. 145°48'10" W.	Rugose corals, *Caninia peroczi* Fusulinidae, *Eoparafusulina* sp. *Schubertella*(?) sp. *Schwagerina* sp. Brachiopods, poorly preserved	Early Permian	Pe; Eagle Creek Formation	C.L. Rowett	Rowett, 1969b, p. 119; Rowett, 1975, p. 68, 69
51	DR 14	63°16'08" N. 145°48'10" W.	Fusulinids, *Eoparafusulina mendenhalli* *Schwagerina whartoni* *Schwagerina* sp. Brachiopods, poorly preserved, indeterminate	Early Permian (Sakmarian)	Pe; Eagle Creek Formation	R.G. Petocz	Petocz, 1970, p. 18, 19

52	52APW39	63°17'25" N. 145°47'35" W.	Brachiopods, *Dictyoclostus sp.* Bryozoans, *Fenestella sp.* *Polypora* stenoporoids rhomboporoids fistuliporoids	Late Paleozoic	PPs; Slana Spur Formation (upper part)	H.M Duncan	USGS Report MG-53-7 Collected by T.L. Pewe, 1952
53	78AAL003B	63°19'48" N. 145°43'32" W.	Echinoderm columnals, indeterminate Brachiopods *Dyoros*(?) sp. chonetid, indeterminate *Cancrinella* sp. linoproductid, indeterminate *Terrakea*(?) sp. *Pseudomartinia* sp. *Reticulatia*(?) sp. *Neospirifer* sp. Pelecypods, pectenoid, indeterminate	Early Permian (Wolfcampian)	PPs; Slana Spur Formation (lower part)	J.T. Dutro, Jr.	USGS Report A-78-35 Collected by N.R.D. Albert, 1978
54	RM 8	63°19'48" N. 145°43'32" W.	Rugose corals, *Cryptophyllum striatum* Tabulate corals, *Cladochonus* sp. *Michelinia* sp. Brachiopods, *Linoproductus* sp. *Juresania* sp. *Stenocisma* sp. *Institina*(?) sp. *Chaoiella*(?) sp. Cephalopods, *Pseudoparalegoceras hansoni*	Early to Middle Pennsylvanian	PPs; Slana Spur Formation (lower part)	C.L. Rowett	Rowett, 1969b, p. 118; Rowett and R. Timmer, 1973, p. 1-16
55	52APW64	63°18'42" N. 145°41'12" W.	Crinoidal material Horn coral fragment, aberrant clisiophyllid Rugose corals, *Bothrophyllum* sp. cf. *B. pseudoconicum* Dobrolyubova	Permian	PPs; Slana Spur Formation (lower part)	H.M. Duncan C.L. Rowett	USGS Report MG-53-7; Rowett, 1975, p. 67 Collected by T.L. Pewe, 1952
56	Not available	63°17'15" N. 145°37'55" W.	Fusulinids, *Fusulinella* sp.	Middle Pennsylvanian	PPs; Slana Spur Formation	J.W. Skinner	G.C. Bond, 1976, p. 5
57	MC 0	63°15'47" N. 145°37'04" W.	Rugose corals, *Timania* sp. A. Tabulate corals, *Sinopora*(?) sp.	Early Permian (Wolfcampian)	PPs; Slana Spur Formation	C.L. Rowett	Rowett, 1969b, p. 119; Rowett, 1975, p. 67

58	72AWR183	63°13'30" N. 145°37'00" W.	Pollen sample (most abundant species), *Alnus* 30.8% *Picea* 16.0% *Pinaceae* 12.5% *Betula* 9.1% monocots, indeterminate 6.3% dicots, indeterminate 4.6%	Miocene and Pliocene(?) (Homerian)	Tsc; Tertiary sandstone	E.B. Leopold	USGS Report A-72-10D Collected by F.R. Weber, 1972
59	MC 7	63°16'31" N. 145°36'26" W.	Rugose corals, *Bothrophyllum* sp. cf. *B. pseudoconicum dobrolyubova* *Carninia*(?) sp. Tabulate corals, *Michelinia* sp. Brachiopods, poorly preserved, indeterminate	Early Permian (Wolfcampian)	PPs; Slana Spur Formation	C.L. Rowett	Rowett, 1969b, p. 118; Rowett, 1975, p. 68
60	MC 6	63°16'23" N. 145°36'23" W.	Rugose corals, *Heritschiodes summitensis* Brachiopods, poorly preserved Fusulinids, schwagerinid	Early Permian (Wolfcampian)	PPs; Slana Spur Formation (upper part)	C.L. Rowett	Rowett, 1969b, p. 118; Rowett, 1975, p. 68
61	78ANK185A	63°16'22" N. 145°36'20" W.	Rugose corals, *Heritschioides*(?) sp. *Autoclisia*(?) sp. horn corals, indeterminate Brachiopods, chonetid, indeterminate Pelecypod fragments, indeterminate	Early Permian (Wolfcampian)	PPs; Slana Spur Formation (upper part)	J.T. Dutro, Jr.	USGS Report A-78-35 Collected by W.J. Nokleberg, 1978
62	MC 1	63°15'56" N. 145°36'20" W.	Rugose corals, *Pseudobradyphyllum*(?) sp. A. *Bradyphyllum*(?) sp. A. *Bothrophyllum* sp. A. Brachiopods, *Spiriferella* sp. *Choristites* sp. *Reticulatia* sp. *Linoproductus* sp. *Yakovlevia* sp. *Kochiproductus*(?) sp. Fusilinidae, *Pseudofusulinella*(?) sp.	Early Permian (Wolfcampian)	PPs; Slana Spur Formation (upper part)	C.L. Rowett	Rowett, 1969b, p. 119; Rowett, 1975, p. 67

63	MC 13	63°16'12" N. 145°36'12" W.	Rugose corals, *Timania rainbowensis* Gastropods, *Omphalotrochus*(?) Fusulinids, *Pseudofusulinella* sp. Brachiopods, poorly reserved productid and spirifered, indeterminate	Early Permian (Wolfcampian)	P₽s; Slana Spur Formation (upper part)	C. L. Rowett	Rowett, 1969b, p. 118; Rowett, 1975, p. 68
64	EL-63-45B	63°13'54" N. 145°36'06" W. (approximately)	Pollen sample (most abundant species), *Pinus* 22.6% *Betula* 15.6% Monocots 9.8% Nap, indeterminate 9.2% Sphagnum 8.6% *Picea* 7.9% *Taxodiaceae*, TCT types 6.7% *Ericales* 4.9% *Pseudotsuga*. 3%	Pliocene	Tsc; Tertiary lignitic and wood-bearing clays	E.B. Leopold	USGS Report A-74-4D Collected by F.R. Weber and E.B. Leopold
65	MC 5	63°16'07" N. 145°36'04" W.	Tabulate corals, *Syringopora katoi* Brachiopods, *Plicatifera* sp. *Derbyia* sp. Bryozoans, well-preserved fenestrate fronds, indeterminate	Early Permian (Wolfcampian)	P₽s; Slana Spur Formation (upper part)	C. L. Rowett	Rowett, 1969b, p. 119; Rowett, 1975, p. 68
66	MC 3	63°16'04" N. 145°35'43" W.	Rugose corals, *Bothrophyllum pseudoconicum* Dobrolyubova Brachiopods, *Neospirifer* sp. *Choristites* sp. *Unispirifer*(?) sp. *Yakovlevia* sp. *Linoproductus* sp. *Calliprotonia*(?) sp. *Rugosochonetes* sp. *Denticulophora*(?) sp. Fusilinidae, *Pseudofusulinella* sp. *Eoparafusulina*(?) sp.	Early Permian (Wolfcampian)	P₽s; Slana Spur Formation (upper part)	C.L. Rowett	Rowett, 1969b, p. 119; Rowett, 1975, p. 68
67	VV21A	63°14'14" N. 145°33'47" W.	Corals, *Timania* sp. cf. *T. schmidti* Stuckenberg	Early Permian	P₽s; Slana Spur Formation	C.L. Rowett	Rowett, 1969b, p. 120; Rowett, 1975, p. 69

68	VV21B	63°14'14" N. 145°33'47" W.	Rugose corals, *Durhamina alaskaensis* n. sp. Tabulate corals, *Sinopora ninatoi* Fusulinids, *Pseudofusulinella* sp., *Schwagerina* sp.	Early Permian	PPs; Slana Spur Formation	C.L. Rowett	Rowett, 1969b, p. 120; Rowett, 1975, p. 69
69	78ANK179B	63°15'16" N. 145°30'40" W.	Echinoderm debris, indeterminate Corals, silicified horn, indeterminate Brachiopods, *Spiriferella* sp. brachiopod fragments indeterminate	Early Permian (Wolfcampian)	PPs; Slana Spur Formation (upper part)	J.T. Dutro, Jr.	USGS Report A-78-35 Collected by W.J. Nokleberg, 1978
70	73AWR226	63°11'09" N. 145°29'36" W.	Pollen sample (most abundant species), *Picea* 35.8% *Alnus* 9.1% Nap indeterminate 6.8% *Pinus* 6.1% *Pinus or Picea* 6.1%	Pliocene	Tsc; pod of Tertiary mudstone in Quaternary alluvium	E.B. Leopold	USGS Report A-74-3D Collected by Weber 1973
71	10AM1	63°15'00" N. 145°28'00" W. (approximate)	Brachiopods, *Derbyia*(?) sp. *Productus aagardi* *Productus gruenewaldti* *Dielasma* sp. *R.* *Rhynchopora* sp. aff. *R. nikitini* *Spirifer arcticus* *Athyris* sp. aff. *A. geraldi*(?) Pelecypods, *Edmondia*(?) sp.	Late Carboniferous	PPs; Slana Spur Formation—Small pod in Quaternary sediments	G.H. Girty	F.H. Moffit, 1912; in 1912, Late Carboniferous included, for G.H. Girty, what is now the Permian.
72	10AM2	63°15'00" N. 145°28'00" W. (approximate)	Brachiopods, *Productus aagardi* *Productus cora* Pelecypods, *Aviculipecten*(?) sp. *Aviculipecten* Crinoid stem, indeterminate	Late Carboniferous	PPs; Slana Spur Formation—Small pod in Quaternary sediments	G.H. Girty	F.H. Moffit, 1912; see note above

73	52APW020	63°14'00" N. 145°27'00" W.	Crinoidal debris, indeterminate Bryozoans, *Rhombotrypella* sp. *Polypora* sp., indeterminate *Fenestella*(?) sp. (mold) Brachiopods, *Dictyoclostus*(?) sp. *Marginifera*(?) Pelecypod, indeterminate	Permian(?)	Pe; Eagle Creek Formation	J.T. Dutro, Jr.	USGS Report MG-53-7 Collected by T.L. Pewe, 1952
74	Not available	63°13'30" N. 145°26'45" W. (approximate)	Conodonts, *Lonchodina* sp. aff. *L. festiva*	Mid-Permian to Late Permian	Pe; Eagle Creek Formation	Unknown	G.C. Bond, 1976, p. 5
75	Not available	63°09'N. 145°08'W. (approximate)	*Sequoia* sp. *Taxodium tinajorum* Heer *Taxodium distichum* *miocenum* (Brgt.) Heer *Carylus macQuarrii* (Forbes) Heer *Juglans nigella* Heer *Tilia alaskana?* Heer	Late Eocene	Tsc; calcareous sediment	F.H. Knowlton	Mendenhall, 1905
76	83AIL077A	63°06'02" N. 144°51'14" W.	Echinoderm debris, indeterminate Bryozoans fenestrate and ramose, indeterminate Brachiopods *Anidanthus* sp. productoid fragments, indeterminate *Neospirifer*? sp. *Spiriferella*? sp.	Early Permian	PIPs; Slana Spur Formation	J.T. Dutro, Jr.	This report Collected by P. Burrell, 1983
77	AK-27344	63°10'18" N. 144°49'30" W.	Pelecypod *Buchia concentrica* Ammonite *Phylloceras*?	Late Jurassic (Oxfordian)	KJs; Argillite	D.L. Jones	This report Collected by A. Bakke and J. Foley, 1989
78	A-206	63°09'17" N. 144°44'26" W.	Gastropods, *Zygopleura* sp. *Strobeus* sp. Corals, *Procyathopora* sp.	Triassic	TRl; Limestone	R. Allison E. Yochelson	Matteson, 1973, p. 23, 24
79	79ANK199	63°09'17" N. 144°44'26" W.	Coelentrates- *Spongiamorpha*	Late Triassic	TRl; Limestone	N.J. Silberling	USGS Report A-79-44 Collected by W.J. Nokleberg, 1979

80	lot 2	63°09'N. 144°44'W.	Crinoid stems Bryozoans, *Batostomella* sp. Brachiopods, *Chonetes* sp. aff. *C. granulifer* *Productus* sp. *Marginifera* sp. aff. *M. involuta* *Rhynchopora nikitini* *Spirifer cameratus* Tsch. (non Morton)	Permian	Pe; Eagle Creek Formation	G.H. Girty	This report collected by J. W. Young, 1917
81	A-204	63°09'00" N. 44°43'30" W.	Brachiopods, *Anemonaria*(?) *Horridonia*(?) *Kochiproductus*(?) *Neospirifer* sp. *Orthotichia* sp. *Thamnosia* sp. *Yakovlevia*(?) sp	Early Permian(?) (Artinskian?)	Pe; fault bounded slice of Eagle Creek Formation	R.E. Grant	Charles Matteson, 1973, p. 11
82	lot 1	63°08'50" N. 144°43'30" W.	Bryozoans, *Batostomella* sp. *Polypora* sp. Braciopoda, *Chonetes* sp. aff. *C. granulifer* *Productus* 2 sp. *Marginifera* sp. aff. *M. involuta* *Spirifer* sp. aff. *S. cameratus* Tsch. non Morton *Spiriferina* sp. Pelecypods, *Nucula?* sp. Gastropod, *Bellerophon* sp. aff. *B. crassus* Cephalopods, *Orthoceras* sp.	Permian	Pe; Eagle Creek Formation	G.H. Girty	This report, collected by J.W. Young, 1917
83	79ANK093A	63°08'36" N. 144°42'41" W.	Echinoderm debris, indeterminate Bryozoansns, indeterminate Brachiopods, *Anidanthus* sp. *Anemonaria* sp. *Neospirifer* sp. *Septospirifer*(?) sp. *Spiriferella* sp. punctuate spiriferid, indeterminate *Rhynchopora* sp. Pelecypods, pectenoid, indeterminate	Early(?) Permian	Pe; Fault bounded slice of Eagle Creek Formation	J.T. Dutro, Jr.	USGS Report A-79-44 Collected by W.J. Nokleberg, 1979

84	A-205	63°08'36" N. 144°42'41" W.	Brachiopods, *Chonetina*? sp. *Rhynchopora* sp. *Thamnosia* sp.	Early Permian(?) (Artinskian?)	Pe; fault bounded slice of Eagle Creek Formation	R.E. Grant	Charles Matteson, 1973, p. 11
85	A-238	63°08'50" N. 144°42'36" W.	*Metasequoia* sp.	Early Tertiary	Tsc; Tertiary sedimentary rocks	C. Matteson	C. Matteson, 1973, p. 36
86	79ARM027A	63°07'18" N. 144°42'36" W.	Brachiopods, *Neospirifer* sp. Echinoderm debris, indeterminate	Early Permian	PPs; Slana Spur Formation	J.T. Dutro, Jr.	USGS Report A-79-44 Collected by R.T. Miyaoka, 1979
87	74ARH114	63°04'50" N. 144°34'32" W.	Cephalopods, *Daubichites* sp., indeterminate *Peritrochia* sp. aff. *P. typica*	Early Permian	Pe; Eagle Creek Formation	M. Gordon, Jr.	Richter and others, 1977
88	73ARH011	63°04'12" N. 144°33'59" W.	Brachiopods, *Derbyia*(?) sp. *Reticulatia* sp. *Neospirifer* sp. Pelecypods, *Aviculopecten*(?) Bryozoans, fenestrate and ramose, indeterminate	Early Permian	Pe; Eagle Creek Formation	J.T. Dutro, Jr.	Richter and others, 1977
89	73ARH010	63°04'04" N. 144°33'46" W.	Brachiopods, *Reticulatia*(?) sp. *Bathymyonia*(?) sp. *Neospirifer* sp. *Spiriferellina* sp. Pelecypods, *Acanthopecten* sp. *Aviculopecten* sp. Bryozoans, fenestrate and ramose, indeterminate	Early Permian	Pe; Eagle Creek Formation	J.T. Dutro, Jr.	Richter and others, 1977
90	Not available	63°07' N. 144°33' W.	Bryozoans, *Fistulipora* sp. *Batostomella* sp. *Fenestella* sp. *Polypora* sp. Brachiopods, *Productus* sp. aff. *P. humboldti* *Productus* sp. *Marginifera* sp. aff. *M. involuta* *Rhynchopora* sp. aff. *R. nikitini*	Permian	Pe; Eagle Creek Formation	G. H. Girty	This report,collected by J.W.Young, 1917

			Camarophoria sp. aff. *C. mutabilis* *Spirifer cameratus* Tsch. non Morton *Spirifer* sp. *Squamularia*? sp. *Ambocoelia* sp. *Spiriferina* sp. aff. *S. spinosa* Pelecypods, *Aviculipecten* sp. Trilobite, *Griffithides* sp.				
91	73ARH009	63°03'38" N. 144°32'57" W.	Fusulinids, *Schwagerina* sp., possibly related to *S. jenkinsi* Thorsteinsson	Early Permian (late Wolfcampian)	Pe; Eagle Creek Formation	R.C. Douglass	Richter and others, 1977
92	74ARH123	63°07'00" N. 144°31'24" W.	Cephalopods, *Paragastrioceras* sp. cf. *P. kirgizhorum* *Uraloceras* sp. cf. *U.* *federowi*	Early Permian	Pe; Eagle Creek Formation	M. Gordon, Jr.	DRichter and others, 1977
93	73ARH001	63°05'10" N. 144°30'24" W.	Brachiopods, *Chonetina*(?) sp. cf. *C.* *superba* Gobbett *Chonetinella* sp. *Anemonaria*(?) sp. *Horridonia* sp. *Calliprotonia*(?) sp *Punctospirifer*(?) sp Echinoderm debris, indeterminate Bryozoans, fenestrate and ramose indeterminate	Early Permian (late Leonardian)	Pe; Eagle Creek Formation	J.T. Dutro, Jr.	Richter and others, 1977
94	73ARH007	63°04'02" N. 144°29'36" W.	Fusulinids, *Eoparafusulina* *mendenhalli* Petocz	Early Permian	Pe; Eagle Creek Formation	R.C. Douglass	Richter and others, 1977
95	73ARH013	63°05'30" N. 144°29'30" W.	Pelecypods, *Daonella* sp. cf. *D. frami* *Kittl*	Middle Triassic	Pe; Shale, in unit of shale, limestone, and chert herein included within uppermost part of Eagle Creek Formation	N.J. Silberling K.M. Nichols	Richter and others, 1977

96	73ARH014	63°05'56" N. 144°29'24" W.	Brachiopods, *Anemonaria* *Waagenoconcha* sp. *Septospirifer*(?) sp. *Spiriferellina*(?) sp. *Rhynchopora*(?) sp. productoid, indeterminate Pelecypods, *Wilkingia* sp. Echinoderm debris, indeterminate	Early Permian	Pe; Eagle Creek Formation	J.T. Dutro, Jr.	Richter and others, 1977
97	73ARH015	63°05'59" N. 144°28'08" W.	Brachiopods, *Anemonaria*(?) sp. *Megousia*(?) sp.	Early Permian (late Leonardian)	Pe; Eagle Creek Formation	J.T. Dutro, Jr.	Richter and others, 1977
98	72ARH030	63°02'24" N. 144°26'12" W.	Fusulinids, *Eoparafusulina mendenhalli* Petocz *Schwagerina rowetti* Petocz *E. alaskensis* (Dunbar)	Early Permian	Pe; Eagle Creek Formation	R.C. Douglass	DRichter and others, 1977
99	72ARH028	63°02'24" N. 144°26'06" W.	Crinoid columnals, indeterminate Brachiopods, indeterminate Bryozoans, indedterminate Fusulinids, *Schwagerina* sp.	Early Permian (Wolfcampian)	Pe; Eagle Creek Formation	J.T. Dutro, Jr., R.C. Douglass	Richter and others, 1977
100	72ARH039	63°02'49" N. 144°26'05" W.	Cephalopods, *Artinskia*(?) sp.	Late Permian	Pe; Eagle Creek Formation	M. Gordon, Jr.	Richter and others, 1977
101	72ARH040	63°02'56" N. 144°26'00" W.	Cephalopods, *Artinskia*(?) sp. Brachiopods, *Neochonetes* sp.	Late Permian	Pe; Eagle Creek Formation	M. Gordon, Jr.,	Richter and others, 1977
102	72ARH025	63°02'28" N. 144°25'50" W.	Fusulinids, *Eoparafusulina wadelli* Petocz	Early Permian (Wolfcampian)	Pe; Eagle Creek Formation	R.C. Douglass	Richter and others, 1977
103	Not available	63°04'06" N. 144°25'48" W.	Cephalopods, *Uraloceras* sp. aff. *U. involutum* *Almites* sp. aff. *A invariabilis* *Paraceltites* sp. *Paragastrioceras* sp. aff. *P. ellipsoidale* *Uraloceras* sp.	Early Permian (late Leonardian)	Pe; Eagle Creek Formation	M. Gordon, Jr.	USGS Report A-78-4 Collected by R.E. Busch, Jr. 1974, 1975

104	1894	63°04' N. 144°29' W. (approximate)	Brachiopods, *Productus* *semiretinculatus* var. *Productus* cf. *P. undatus* *Productus* sp. *Camarophoria* sp. *Rhynchopora* cf. *R. nikitini* Tsch. *Reticularia* cf. *R. lineata* (Martin) *Spirifer* cf. *S. striatus* *Spirifer* cf. *S. supramosquensis* *Spirifer* cf. *S. alatus*	Permian	Pe; Eagle Creek Formation	C. Schuchert, G.H. Girty	F.H. Moffit, 1954 Collected by W.C. Mendenhall, 1902
105	72ARH064	63°03'56" N. 144°24'18" W.	Brachiopods, *Megousia* sp. *Cancrinella* sp. *Waagenoconcha* sp. *Neospirifer* sp. Pelecypods, *Wilkingia*(?) sp. Cephalopods, *Daubichites*(?) sp.	Early Permian	Pe; Eagle Creek Formation	J.T. Dutro, Jr. M. Gordon, Jr.	Richter and others, 1977
106	72ARH059	63°03'42" N. 144°24'18" W.	Fusulinids, *Pseudofusulinella* sp. *Schwagerina* sp. aff. *S. hyperborea* Salter *Schwagerina* sp. Brachiopods, *Anemonaria* sp. *Bathymyonia* sp. *Horridonia* sp. *Kochiproductus*(?) sp. *Spiriferella* sp. *Cleiothyridina* sp. *Spiriferellina* sp. Bryozoans, indeterminate ramose	Early Permian (Wolfcampian)	Pe; Eagle Creek Formation	J.T. Dutro, Jr. R.C. Douglass	Richter and others, 1977
107	79AHZ066A	63°02'15" N. 144°21'57" W.	Brachiopods, *Reticulatia*	Early Permian	PIPs; Slana Spur Formation (upper part)	J.T. Dutro, Jr.	USGS Report A-79-44 Collected by P.L.Herzon, 1979
108	72ARH076	63°00'56" N. 144°21'48" W.	Fusulinids, *Fusulinella* sp. *Bradyina* sp. *Climacammina* sp.	Middle Pennsylvanian (Atokan?)	PIPs; Slana Spur Formation (lower part)	R.C. Douglass	Richter and others, 1977
109	1890	63°03' N. 144°21' W.	Brachiopods, Productus semireticulatus var. *Spirifer* cf. *S. striatus* *Spiriferina* sp.	Permian	Pe; Eagle Creek Formation	C. Schuchert G.H. Girty	F.H. Moffit, 1954 collected by W.C. Mendenhall, 1902

110	1891	63°03' N. 144°21' W.	Bryozoan, *Goniocladia* sp. Brachiopods, *Productus* cf. *P. multistriatus*(?) *Productus* cf. *P. semireticulatus* *Productus* cf. *P. humboldti* *Camarophoria* cf. *C. pinguis* Waagen *Rhynchopora* cf. *R. nikitini* Tsch.	Permian	Pe; Eagle Creek Formation	C. Schuchert G.H. Girty	F.H. Moffit, 1954 collected by W.C. Mendenhall, 1902
111	78ANK204A	63°04'46" N. 144°19'31" W	Conodonts, *Epigondolella*, possibly *E. abneptis* (Huckriede)	Late Triassic	TR; Limestone	A.G. Harris	USGS Report A-82 Collected by W.J. Nokleberg, 1978
112	S6622	63°04'45" N. 144°19'30" W.	Possible silicified sponges indeterminate	Indeterminate	TR; Limestone	R.E. Grant	USGS Report A-67-2 Collected by D.H. Richter, 1966
113	S6624	63°04'00" N. 144°18'00" W.	Neritacean gastropod, indeterminate Brachiopods, *Composita*	Post-Mississippian	TR; limestone	R.E. Grant	USGS Report A-67-2 Collected by Richter, 1966
114	72ARH428	63°03'10" N. 144°16'32" W.	Hexacorals, *Thamnastraea* sp. *Isastraea* sp. Pelecypods Brachiopods	Late Triassic	TR; Limestone	J.T. Dutro, Jr.	Richter and others, 1977
115	72ARH431	63°03'38" N. 144°16'30" W.	Hexacoral(?), indetermimant bivalve fragments, indeterminate	Late Triassic	TR; Limestone	J.T. Dutro, Jr.	Richter and others, 1977
116	S6625	63°03'00" N. 144°16'00" W.	Silicified sponges, indeterminate	Indeterminate	TR; Limestone	R.E. Grant	USGS Report A-67-2 Collected by D.H. Richter, 1966
117	72ARH427	63°02'58" N. 144°15'48" W.	Hexacoral, indeterminate	Late Triassic	TR; Limestone	J.T. Dutro, Jr.	Richter and others, 1977
118	72ARH401	63°02'56" N. 144°14'24" W.	Chaetetiform corals, indeterminate Hexacoral, indeterminate	Late Triassic	TR; Limestone	J.T. Dutro, Jr.	Richter and others, 1977
119	72ARH400	63°02'24" N. 144°12'24" W.	Brachiopods, *Rhaetina*(?) sp.	Triassic	TR; Limestone	J.T. Dutro, Jr.	Richter and others, 1977

Tangle Subterrane and Fault-bounded Block of McCarthy Formation within Broxson Gulch Thrust							
120	USGS6570	63°09'01" N. 146°59'56" W.	Cephalopods, *Tropites* sp. Pelecypods, *Halobia* sp. cf. *H. superba*	Late Triassic (late Karnian)	Ŧr; limestone	N.J. Silberling	USGS Report A-69-4M Collected by F.H. Moffit, 1910; recollected by T.E. Smith, 1968
121	USGS6571	63°10'43" N. 146°56'12" W.	Pelecypods, *Monotis subcircu-laris* or *M. salinaria*	Late Triassic (late Norian)	JŦrm; McCarthy Formation	N.J. Silberling	USGS Report A-69-4M Collected by F.H. Moffit, 1910; Ross, 1931
122	82ACB002A	63°10'44" N. 146°55'48" W.	Pelecypods, *Monotis subcircu-laris (?)*	Late Triassic (late Norian)	JŦrm; McCarthy Formation	N.J. Silberling	USGS Report A-82-4D Collected by C.H. Buhrmaster, 1982
123	A-1801	63°12'56" N. 146°41'32" W.	Pelecypods, *Halobia* sp. cf. *H. superba*	Late Triassic (late Karnian)	Ŧr; limestone	N.J. Silberling	USGS Report 0-83-2D Collected by C.W. Allison
124	Not available	63°07'45" N. 145°51'05" W.	Pelecypods, *Daonella* or *Halobia*	Middle or Late Triassic	Ŧrn; argillite in Nikolai Greenstone	N.J. Silberling	J.H. Stout, 1976; W.J. Nokleberg and others, 1982
125	78ANK161A	63°07'04" N. 145°48'50" W.	Bryozoans, indeterminate	Late Paleozoic	Pzl; limestone	N.J. Silberling	W.J. Nokleberg and others, 1982

Table 2. *Isotopic sample localities, analyzed minerals, host rocks, and ages, Mount Hayes quadrangle, eastern Alaska Range, Alaska*[1]

Map No.	Field No.	Location (lat. and long)	Method	Mineral	Age (Ma)	Map unit symbol; rock type	Source; remarks
				Lake George subterrane of Yukon-Tanana terrane			
1	AA78	63° 49'12" N. 144° 53'12" W.	Pb-Alpha	Zircon	105±10	grn; granodiorite	Holmes, 1965; Holmes and Foster, 1968
2	75AFR2172	63° 49'12" N. 144° 53'12" W.	K-Ar	Biotite	88.8±2.7	grn; granite	Wilson and others, 1985
	75AFR2172	63° 49'12" N. 144° 53'12" W.	K-Ar	Hornblende	92.9±2.8	grn; granite	Wilson and others, 1985
3	79AFR2002	63° 49'12" N. 144° 12" W.	U-Pb	Zircon	~90?	grn; granite	This report
4	81ANK105A	63° 51'29" N. 144° 09'33" W.	U-Pb	Zircon	367±34 (~360)	lgr; granodiorite	This report
	81ANK105A	63° 51'29" N. 144° 09'33" W.	Rb-Sr	Biotite, K-feldspar, wholerock, plagioclase	110±8	lgr; granodiorite	This report
5	BB21	63° 43'00" N. 144° 07'06" W.	Pb-Alpha	Zircon	110±10	grn; quartz diorite	Holmes and Foster, 1968
6	G115	63° 43'18" N. 144° 03'48" W.	Pb-Alpha	Zircon	115±15	grn; quartz diorite	Marvin and Dobson, 1979
				Macomb subterrane of Yukon-Tanana terrane			
7	81ANK234A	63° 38'53" N. 44° 48'50" W.	U-Pb	Zircon	[2]372±8	mg; metagranodiorite	Aleinikoff and Nokleberg, 1985b
8	BB20	63° 38'15" N. 144° 43'40" W.	Pb-Alpha	Zircon	90.0±10	grn; granodiorite of Macomb Plateau	Holmes, 1965; Holmes and Foster, 1968
9	190	63° 31'30"N. 144° 43'00"W.	K-Ar	Biotite	62.9±1.9	la; alkali clinopyroxenite dike	Foley, 1984

10	81ANK136B	63° 25'11" N. 144° 21'28" W.	U-Pb	Zircon	[2]372±8	mg; granite	Aleinikoff and Nokleberg, 1985b
	81ANK136B	63° 25'11" N. 144° 21'28" W.	Rb-Sr	Biotite, plagioclase, wholerock, apatite	102±3	mg; granite	This report
11	BB22	63° 39'58" N. 144° 05'12" W.	Pb-Alpha	Zircon	110±10	grn; granodiorite of Macomb Plateau	Holmes, 1965; Holmes and Foster, 1968
				Jarvis Creek Glacier subterrane of Yukon-Tanana terrane			
12	81ANK233A	63° 42'51" N. 146° 45'22" W.	U-Pb	Zircon	364±9	jcv; metarhyodacite	Aleinikoff and Nokleberg, 1985a
13	80AAF001A	63° 49'59" N. 146° 41'24" W.	K-Ar	Biotite	93.3±2.8	grn; granodiorite of Molybdenum Ridge	This report
	80AAF001A	63° 49'59" N. 146° 41'24" W.	K-Ar	Hornblende	84.0±2.5	grn; granodiorite of Molybdenum Ridge	This report
	80AAF001B	63° 49'59" N. 146° 41'24" W.	U-Pb	Zircon	~90	grn; granodiorite of Molybdenum Ridge	This report
14	85ANK134A	63° 41 40 N. 145° 53 20 W.	K-Ar	Muscovite	106.5±3.2	jcv; metarhyolite	This report
15	80AAF040A	63° 34'49" N. 145° 51'50" W.	U-Pb	Zircon	~375?	jcs; metavolcanic schist	Aleinikoff and Nokleberg, 1985b
16	85ANK131A	63° 30'58" N. 145° 51'17" W.	K-Ar	Muscovite	107±3.2	jcs; metasedimentary schist	This report
17	80AAF030B	63° 44'57" N. 145° 41'06" W.	U-Pb	Zircon	[2]372±8	jcg; augen gneiss	Aleinikoff and Nokleberg, 1985b
18	71AWR482	63° 20'54" N. 145° 34'42" W.	K-Ar	Muscovite	117.7±3.5	jcs; Metasedimentary schist	Turner and Smith, 1974
19	80AAF047A	63° 45'59" N. 145° 25'22" W.	U-Pb	Zircon	~90?	grn; granite of Granite Mountain	This report
20	71AWR483	63° 19'12" N. 145° 24'54" W.	K-Ar	Muscovite	115.2±3.6	jcs; metasedimentary schist	Turner and Smith, 1974

21	A78853	63° 32'03" N. 145° 20'50" W.	K-Ar	Biotite	53.4±2.0	grn; granite	This report; J.T.Galey, written commun., 1987
22	80AAF021B	63° 43'36" N. 145° 17'06" W.	U-Pb	Detrital zircon	[3]~2.0 Ga	jcs; metapelite	This report
23	80AAF057A	63° 42'27" N. 145° 10'38" W.	U-Pb	Detrital zircon	[3]~2.3 Ga	jcs; quartzite	Aleinikoff and others, 1984
24	A82400	63° 33'59" N. 145° 07'46" W.	K-Ar	Biotite	54.3±3.6	grn; granite of intrusive complex of Mount Hajdukovich	This report; J.T. Galey, Jr., written commun., 1987
25	BT48	63° 23"08" N. 144° 35'36" W.	K-Ar	Biotite	69.2±1.9	la; alkali diorite dike	Foley, 1982, 1984
26	8A	63° 24'13" N. 144° 34'30" W	K-Ar	Biotite	67.6±2.0	la; alkali monzodiorite dike	Foley, 1984
27	87ANK065A	63° 13 00 N. 144° 16 05 W.	K-Ar	Hornblende	88.7±2.7	grn; granodiorite	This report
28	81ANK235A	63° 15'56" N. 144° 13'38" W.	U-Pb	Zircon	[2]372±8	jcv; metarhyolite to metadacite	Aleinikoff and Nokleberg, 1985b
29	78	63° 14'32" N. 144° 06'37" W.	K-Ar	Amphibole	107.6±3.2	la; alkali diorite dike	Foley, 1984
30	88A	63° 10'14" N. 144° 06'37" W	K-Ar	Amphibole	75.6±2.3	la; lamprophyre dike	Foley, 1984
31	67	63° 15'45" N. 144° 01'12" W	K-Ar	Biotite	69.3±2.9	la; alkali clinopyroxenite dike	Foley, 1984
				Hayes Glacier subterrane of Yukon-Tanana terrane			
32	80AAF039A (80ANK023D)	63° 41'00" N. 146° 40'41" W.	U-Pb	Zircon	[2]375±8	hgv; metarhyolite	Aleinikoff and Nokleberg, 1983; Aleinikoff and Nokleberg, 1985a
33	87ANK025R	63° 34 08 N. 146° 12 40 W.	K-Ar	Hornblende	100.3±3.0	grn; schistose granodiorite	This report
34	81ANK237A,B	63° 15'32" N. 144° 47'00" W.	U-Pb	Zircon	~375?	hgv; metaandesite to rhyodacite	Aleinikoff and Nokleberg, 1985b
35	72067	63° 10'30" N. 144° 36'55" W.	K-Ar	Hornblende	103.6±3.1	grn; granodiorite	Matteson, 1973

36	82ANK046A	63° 10'13" N. 144° 18'04" W.	U-Pb	Zircon	~375?	hgv; metarhyodacite	This report
				Aurora Peak terrane			
37	82ANK028A	63° 32'30" N. 146° 58'30" W.,	K-Ar	Biotite	18.2±0.6	ag; metagranite	This report
	82ANK028B	63° 32'30" N. 146° 58'30" W.	K-Ar	Hornblende	36.8±1.1	ag; metagranite	This report
	82ANK028B	63° 32'30" N. 146° 58'30" W	K-Ar	Biotite	24.0±0.7	ag; metagranite	This report
38	80ANK075A	63° 31'14" N. 146° 44'55" W.	U-Pb	Zircon	71.0±5.0	ag; metaquartz diorite	This report
	80ANK075A	63° 31'14" N. 146° 44'55" W.	K-Ar	Biotite	27.0±0.8	ag; metaquartz diorite	This report
				Granodiorite Pluton in Windy terrane			
39	71AWR479	63° 25'30" N. 145° 50'30" W.	K-Ar	Biotite	94.7±2.9	grn; granodiorite	Turner and Smith, 1974
	71AWR479	63° 25'30" N. 145° 50'30" W.	K-Ar	Hornblende	89.6±2.7	grn; granodiorite	Turner and Smith, 1974
40		63° 23'35" N. 145° 44'30" W.	K-Ar	Biotite	85.2±2.7	grn; granodiorite	Kleist, 1971
41	DT72-42A	63° 23'35" N. 145° 44'30" W.	K-Ar	Biotite	85.9±2.6	grn; granodiorite	Turner and Smith, 1974
				East Susitna Batholith of Maclaren terrane			
42	DT73-207	63° 29'30" N. 147° 00'00" W.	K-Ar	Biotite	51.4±1.5	gg; migmatite	Turner and Smith, 1974
	DT73-207	63° 29'30" N. 147° 00'00" W.	K-Ar	Hornblende	49.6±1.4	gg; migmatite	Turner and Smith, 1974

43	DT73-205	63° 28'48" N. 146° 57'00" W.	K-Ar	Hornblende	59.1±1.7	mgsh; amphibolite	Turner and Smith, 1974
44	79ANK248A	63° 26'12" N. 146° 55'45" W.	K-Ar	Biotite	54.7±0.3	gg; schistose granodiorite	This report
45	79ANK249A	63° 20'43" N. 146° 55'26" W.	K-Ar	Biotite	56.9±3.9	gg; schistose granodiorite	Aleinikoff and others, 1981
	79ANK249A	63° 20'43" N. 146° 55'26" W.	U-Pb	Sphene	~56	gg; schistose granodiorite	Aleinikoff and others, 1981
	79ANK249A	63° 20'43" N. 146° 55'26" W.	U-Pb	Zircon	70±7	gg; schistose granodiorite	Aleinikoff and others, 1981
46	79ANK089E	63° 18'22"N 146° 51'10" W.	K-Ar	Biotite	52.84±1.59	Alkalic gabbro dike in gg	This report
47	72AST214	63° 21'54" N. 146° 50'36" W.	K-Ar	Hornblende	59.8±1.7	mgsh; amphibole gneiss	Turner and Smith, 1974
48	72AST311	63° 29'48" N. 146° 49'30" W.	K-Ar	Biotite	36.1±1.1	grs; granodiorite	Turner and Smith, 1974
	72AST311	63° 29'48" N. 146° 49'30" W.	K-Ar	Hornblende	35.6±1.0	grs; granodiorite	Turner and Smith, 1974
49	DT73-204	63° 24'42" N. 146° 49'30" W.	K-Ar	Biotite	53.3±1.5	gg; gneiss	Turner and Smith, 1974
	DT73-204	63° 24'42" N. 146° 49'30" W.	K-Ar	Hornblende	59.8±1.7	gg; granodiorite gneiss	Turner and Smith, 1974
50	DT73-201	63° 22'36" N. 146° 48'48" W.	K-Ar	Biotite	56.9±1.7	mgsh; pelitic gneiss	Turner and Smith, 1974
	DT73-201	63° 22'36" N. 146° 48'48" W.	K-Ar	Hornblende	65.9±1.7	mgsh; pelitic gneiss	Turner and Smith, 1974
51	DT73-202	63° 22'36" N. 146° 48'48" W.	K-Ar	Hornblende	61.7±1.8	mgsh; pelitic gneiss	Turner and Smith, 1974
52	DT73-203	63° 22'36" N. 146° 48'48" W.	K-Ar	Biotite	55.9±1.6	mgsh; pegmatite	Turner and Smith, 1974
	DT73-203	63° 22'36" N. 146° 48'48" W.	K-Ar	Hornblende	58.5±1.7	mgsh; pematite	Turner and Smith, 1974
53	82ANK019A	63° 23'22" N. 146° 48'05" W.	K-Ar	Hornblende	55.06±1.65	gg; metadiorite	This report

54	71AWR472	63° 30'12" N. 146° 45'48" W.	K-Ar	Biotite	35.5±1.0	grs; granodiorite	Turner and Smith, 1974
55	DT72-39A	63° 29'00" N. 146° 34'00" W.	K-Ar	Biotite	33.7±1.0	mgsh; gneiss	Smith and Turner, 1973 Turner and Smith, 1974
56	DT72-38A	63° 28'15" N. 146° 23'00" W.	K-Ar	Biotite	31.4±0.9	gg; quartz diorite	Turner and Smith, 1974
57	DT72-38B	63° 28'15" N. 146° 23'00" W.	K-Ar	Biotite	31.2±0.9	gg; quartz diorite	Turner and Smith, 1974
	DT72-38B	63° 28'15" N. 146° 23'00" W.	K-Ar	Hornblende	36.6±1.1	gg; quartz diorite	Turner and Smith, 1974
58	DT72-40A	63° 24'18" N. 146° 19'30" W.	K-Ar	Biotite	31.9±0.9	gg; granodiorite	Turner and Smith, 1974
	DT72-40A	63° 24'18" N. 146° 19'30" W.	K-Ar	Muscovite	32.1±0.9	gg; granodiorite	Turner and Smith, 1974
	DT72-40B	63° 24'18" N. 146° 19'30" W.	K-Ar	Biotite	30.8±0.9	gg; granodiorite	Turner and Smith, 1974
	DT72-40B	63° 24'18" N. 146° 19'30" W.	K-Ar	Muscovite	31.6±0.9	gg; granodiorite	Turner and Smith, 1974
59	DT72-37A	63° 27'06" N. 146° 14'18" W.	K-Ar	Muscovite	32.1±1.0	gg; granodiorite	Turner and Smith, 1974
	DT72-37B	63° 27'06" N. 146° 14'18" W.	K-Ar	Biotite	30.3±0.8	gg; granodiorite	Turner and Smith, 1974
	DT72-37B	63° 27'06" N. 146° 14'18" W.	K-Ar	Muscovite	31.3±0.9	gg; granodiorite	Turner and Smith, 1974
60	79ANK099I	63° 26'06" N. 146° 14'12" W.	K-Ar	Biotite	30.1±0.4	gg; schistose granodiorite	This report
61	71AWR480	63° 26'24" N. 146° 03'00" W.	K-Ar	Biotite	30.3±0.9	gg; granodiorite	Turner and Smith, 1974
	71AWR480	63° 26'24" N. 146° 03'00" W.	K-Ar	Muscovite	30.0±0.9	gg; granodiorite	Turner and Smith, 1974
62	A59B-71	63° 25'38" N. 146° 00'40" W.	K-Ar	Biotite	31.3±0.9	gg; gneiss	Turner and Smith, 1974
63	71AWR452	63° 24'56" N. 145° 52'30" W.	K-Ar	Muscovite	33.5±1.0	gg; mylonitic gneiss	Turner and Smith, 1974

64	DT72-31B	63° 24'56" N. 145° 52'30" W.	K-Ar	Biotite	29.2±0.8	gg; granitic gneiss	Turner and Smith, 1974
65	DT72-36A	63° 23'18" N. 145° 49'06" W.	K-Ar	Biotite	32.4±0.9	gg; gneiss	Turner and Smith, 1974
	DT72-36B	63° 23'18" N. 145° 49'06" W.	K-Ar	Biotite	31.6±0.9	gg; gneiss	Turner and Smith, 1974
	DT72-36B	63° 23'18" N. 145° 49'06" W.	K-Ar	Hornblende	48.8±1.4	gg; gneiss	Turner and Smith, 1974
66	71AWR474B	63° 23'18" N. 145° 49'06" W.	K-Ar	Hornblende	47.1±1.4	gg; diorite	Turner and Smith, 1974
	71AWR474C	63° 23'18" N. 45° 49'06" W.	K-Ar	Hornblende	44.9±1.3	gg; diorite	Turner and Smith, 1974
67	71AWR476	63° 22'12" N. 145° 49'06" W.	K-Ar	Biotite	31.9±0.9	gg; granite	Turner and Smith, 1974
	71AWR476	63° 22'30" N. 145° 48'55" W.	K-Ar	Muscovite	36.4±1.1	gg; granite	Turner and Smith, 1974
68	85BT232	63° 22'05" N. 145° 47'41" W.	K-Ar	Biotite	32.03±0.96	gg; granite	This report; T.K. Bundtzen, written commun., 1986
	85BT232	63° 22'05" N. 145° 47'41" W.	K-Ar	Muscovite	42.20±1.27	gg; granite	This report; T.K. Bundtzen, written commun., 1986
69	A146	63° 23'00" N. 145° 47'30" W.	K-Ar	Biotite	34.5±1.0	gg; gneiss	Turner and Smith, 1974
	A146	63° 23'00" N. 145° 47'30" W.	K-Ar	Hornblende	50.0±1.5	gg; gneiss	Turner and Smith, 1974
				Maclaren Glacier metamorphic belt of Maclaren terrane			
70	72AST228	63° 20'12" N. 146° 46'30" W.	K-Ar	Biotite	48.0±1.4	mmb; metasedimentary schist	Turner and Smith, 1974
	72AST228	63° 20'12" N. 146° 46'30" W.	K-Ar	Hornblende	69.6±2.1	mmb; metasedimentary schist	Turner and Smith, 1974
71	553B-71	63° 23'20" N. 145° 54'20" W.	K-Ar	Biotite	31.4±0.9	mmb; paragneiss	Turner and Smith, 1974

72	A34-71	63° 23'20" N. 145° 54'20" W.	K-Ar	Biotite	30.6±0.9	mmb; paragneiss	Turner and Smith, 1974
				Slana River subterrane of Wrangellia terrane			
73	85BT234	63° 21'01" N. 145° 49'09" W.	K-Ar	Hornblende	91.89±2.76	cu; hornblende diorite at top of picrite diorite sill	This report; T.K. Bundtzen, written commun., 1986
74	85BT235	63° 21'31" N. 145° 47'30" W.	K-Ar	Hornblende	97.67±2.93	cu; hornblende diorite at top of picrite diorite sill	This report; T.K. Bundtzen, written commun., 1986
75	85AKRM-1	63° 20'15" N. 145° 38'25" W.	K-Ar	Hornblende	~110	grs; granodiorite	This report
76	85AKRM-2	63° 17'32" N. 145° 35'22" W.	K-Ar	Hornblende	325.94±9.78	IPg(?); granodiorite	This report
77	Not available	63° 13'10" 145° 25'15"	K-Ar	Whole rock(?)	49	Tsc; rhyodacite tuff	D.L. Turner, oral commun., cited in Bond, 1976
78	GT-2	63° 13'00" N. 145° 25'00" W. (approximate location)	K-Ar	Hornblende	5.5±03	Tsc; unnamed sandstone and conglomerate	Turner and others, 1980; Bond, 1976
79	78ANK211A	63° 01'22" N. 144° 56'28" W.	U-Pb	Zircon	309±2	IPg; granite	This report
80	72068	63° 09'58" N. 144° 43'02" W.	K-Ar	Biotite	123.1±3.7	um; pyroxenite	Matteson, 1973,
81	72069	63° 09'58" N. 144° 43'02" W.	K-Ar	Hornblende	125.9±3.8	um; pyroxenite	Matteson, 1973,
82	79AHZ067F	63° 01'54" N. 144° 21'26" W.	K-Ar	Hornblende	94.4±8.9	Mafic nodule in IPPs	This report
				Tangle subterrane of Wrangellia terrane			
83	71H224	63° 14'30" N. 146° 44'00" W.	K-Ar	Hornblende	128.9±3.9	grs; quartz diorite	Smith and Turner, 1973 Turner and Smith, 1974

84	82ANK010A	63° 13'12" N. 146° 41'54" W.	K-Ar	Hornblende	31.14±0.93	Tsc; rhyodacite tuff in small unnamed unit of sandstone and conglomerate	This report
85	71AST42	63° 07'54" N. 146° 38'30" W.	K-Ar	Amphibole	146.2±4.4	grs; granodiorite	Turner and Smith, 1974

[1]K-Ar ages that were calculated with older "western" decay constants have been recalculated with updated decay constants from Dalrymple (1979). Ages in Ma unless otherwise noted.

[2]Composite age calculated for 10 fine-grained fractions from 6 samples.

[3]Multigrain fractions; probably contains zircons of many ages, thus upper intercept age is average.