

DESCRIPTION OF MAP UNITS STRINE AND DELTAIC DEPOSITS (HOLOCENE ID PLEISTOCENE) If and lake sediments—Deposits bordering Tanada ke probably associated with a higher lake level during askan Glaciation (Holocene) time. Others from small ands and commonly covered with peat. Chiefly clay and the deposits—Shown only where of significant size, ong Tanada Creek; presumably associated with a their level of Tanada Lake, during Alaskan Glaciation	-QTdb	A sample of a flow from high in the section at the extreme northern extent of unit (sec. 17, T. 8 N., R. 13 E.) yielded a K-Ar (whole rock) age of 2.77±0.10 m.y. (M. Lanphere, written commun., 1977). Similar rocks from the adjacent Nabesna C-5 quadrangle yielded an age of 1.97±0.15 m.y. (Richter and Schmoll, 1973). Basalt and andesite dikes—Small, usually less than 2 m thick, nearly vertical dikes, often occurring in closely spaced subparallel sets. Chiefly fine-grained, nonporphyritic olivine basalt and hypersthene andesite. Locally glassy, particularly at selvage. Locally pronounced col-
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time. Sand and gravel ALLUVIAL DEPOSITS (HOLOCENE) perhaps widely separate in time Modern coarse-grained stream alluvium—Restricted to active flood plains and lower terraces of larger streams. Chiefly gravel and sand, some boulders; generally

Modern fine-grained stream alluvium—Restricted to active or recently active flood plains. Chiefly sand and silt, some gravel; generally stratified Coarse-grained alluvial fans and cones—Chiefly gravel and poor; thickness unknown sand that have been actively water transported. Smaller Rhyolite breccia and flows, undifferentiated—Presumably and more poorly defined fans and cones included with Fine-grained alluvial fans and cones—Usually margins of

larger fans; chiefly sand and silt that have been actively water transported. Smaller and more poorly defined fans and cones included with unit Qcu Old alluvial deposits-Mapped on some higher terraces along larger streams; probably related to the older phase of the Alaskan Glaciation, Chiefly gravel and sand COLLUVIAL DEPOSITS (HOLOCENE AND PLEIS-Jack Creek, approximately 7 m of tillite exposed at base of Landslide deposits-Mostly young debris avalanches, dif-

ferentiated from unit Qcu by freshness of appearance. Chiefly coarse rubbly diamicton Undifferentiated colluvial deposits—Chiefly talus and slope debris that has not been actively water transported. Developed on both bedrock and old unconsolidated material. Also includes alluvium from smaller streams, poorly defined landslide and rock glacier deposits, and scattered drift from Wisconsin and older glaciations. Silt to boul-

Org ROCK GLACIER DEPOSITS (HOLOCENE)—Diamicton of presently or recently active rock glaciers. Differentiated from Qcu by presence of obvious lobate flow fronts SOLIFLUCTION AND OLDER GLACIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)—Deposits on lowangle, low-relief slopes, at high elevation. Mostly bedrock rubble, but includes some glacial drift. All covered by glaciers during pre-Wisconsin time; some areas, particularly in south part of map area, probably also covered by ice of Wisconsin age
GLACIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)

Deposits of the Alaskan Glaciation—Chiefly ablation and terminal moraines of Holocene age directly related to existing glaciers; may include some older deposits. Mostly Deposits of the late Wisconsin Glaciation—Ground moraine of Pleistocene age in lower Jacksina Creek valley; old lateral and terminal moraines elsewhere. Chiefly till Deposits of the main Wisconsin Glaciation—Chiefly ground moraines of Pleistocene age, with drumlinoid features outlined by dashed lines, north and west of Tanada Lake. Elsewhere predominantly lateral moraines. Chiefly till

Andesite and basalt scoria—Red to black cinder cones, less than 500 m in diameter. Usually identifiable from air Andesite flows-A variety of medium to thick, augitehypersthene-olivine-bearing andesite flows. Apparently from local but mostly unknown sources, which are probably to the south in the Nabesna A-5 quadrangle. Ranges from light- to dark-gray rock; not conspicuously porphyritic. K-Ar date of similar rocks in the Nabesna A-5 quadrangle indicates age of 1.46±0.03 m.y. (Richter and

Smith, 1976)

Basalt and basaltic andesite flows—Dense thin to thick flows, locally exhibiting pronounced columnar jointing Chiefly gray to dark-gray olivine basalt, with abundant olivine and minor hypersthene phenocrysts in a felty to intergranular matrix of augite and plagioclase. Apparently originated from vents in southeast corner of map area and to the south in the Nabesna A-5 quadrangle. K-Ar date of equivalent rocks in A-5 quadrangle is 0.89±0.21 m.y. (Richter and Smith, 1976) Basalt tuff—Chiefly palagonitized air-fall lapilli tuff and ash, nd accretionary lapilli, in beds from 1 cm to 1 m thick. Rocks are semi-indurated and characteristically buff to yellow orange. Block, lapilli, and ash fragments consist wholly of glassy scoria containing abundant olivine and

minor plagioclase phenocrysts. Deposits probably result in large part from sub-ice eruptive activity from sources to the south in the Nabesna A-5 quadrangle Andesite and basaltic andesite flows—Thin to medium flows with oxidized dark-red scoriaceous tops and bottoms Gray to dark gray in color, with sparse olivine, hypersthene, and plagioclase phenocrysts. Apparently related to an extensive sequence of flows in Nabesna A-5 quadrangle, where presumed local sources are presently

Qadf Andesite and dacite(?) flows—Thick, often glassy porphyritic flows, with plagioclase the most common phenocryst. lows exhibit small-scale but pronounced columnar jointing. Sources unknown, probably local Massive andesite and dacitic andesite flows and

agglutinates-Flows as much as 100 m thick that exhibit pronounced columnar jointing. Exposed only in southwest corner of quadrangle. In adjacent Nabesna B-6 quadrangle, unit is very extensive and makes up all of the high Tanada peaks. Flow rocks are gray to dark gray, the agglutinates green to grayish green with clasts chiefly of dark-gray, glassy, dacitic andesite. Rocks locally altered to chlorite and clay minerals. Source(s) unknown Rhyodacite breccia—Strongly brecciated zones, probably epresenting vent areas, less than 100 m in diameter. Consists of rocks very similar to lighter-colored phases of unit QTr and presumably related to them. Unit contains minor dacitic to rhyolitic rocks. Locally, breccias contain small glassy plugs and scoria. No topographic expression

Rhyodacite domes and associated flows-Massive, usually gray rocks that weather pinkish gray to tan. Commonly porphyritic, with abundant phenocrysts of plagioclase (as much as 60 percent of rock), hypersthene, and minor oxuhornblende and altered biotite. Locally devitrified and altered to chlorite and clay minerals. K-Ar date on rangle (sec. 7, T. 7 N., R. 13 E.) is 3.74 m.y. (M. Lanphere, written commun., 1977)

PQTdr Rhyodacite dikes—Medium-grained, locally porphyritic rocks with phenocrysts of hornblende, hypersthene, and plagioclase. Dikes range from 1 to 20 min width and often occur in subparallel sets. Apparently associated with rhy odacite domes (unit QTr). Locally fissile, parallel to dip; or, show columnar jointing, perpendicular to dip. Host andesites (QTau) locally contain sulfide minerals, chiefly pyrite, near contact Andesite and basaltic andesite flows—Extensive sequence

of thin to medium flows with oxidized dark-red scoriace-

ous tops and bottoms. May include younger thin basalt

flows from local eruptive centers. Rocks are gray to dark

gray with small (<1 mm) phenocrysts of olivine and minor

hypersthene in a fine-grained intergranular to interserta

matrix of plagioclase and augite. Locally, rocks are altered to chlorite and clay minerals. Sources probably to the west in the Nabesna B-6 quadrangle. Rocks distinguished from similar unit QTau by predominance of olivine over hypersthene and by absence of pyroclastic QTad Andesite and dacitic andesite dome—Light- to dark-gray rocks with plagioclase phenocrysts in a glassy to finegrained groundmass. Locally extremely fissile. Unit includes minor flows where protrusions breached the surface. May be associated with younger rocks of unit QTau

> old andesite and basaltic(?) scoria—Identified by zones of oright-red breccia and bomb fragments cutting older diameter less than 100 m) Andesite flows, flow breccias, and volcaniclastic rocks, undifferentiated—Light- to dark-gray hypersthene andesite flows, commonly showing red scoriaceous tops and bottoms. The rocks are holocrystalline, often with labradorite phenocrusts in a trachutic groundmass of plagio lase, minor clinopyroxene, and traces of olivine. Flows are often highly vesicular and locally amygdaloidal, with chalcedony the most common vesicle filling. Although individual flows are rarely over 5 m in thickness, the entir unit may exceed 1,000 m in places. Massive lenses of andesite breccia, up to several hundred meters thick ncluding some vent debris and thinner lenses of volcanic lastic sand, gravel, and boulder deposits, as much as

several meters thick, occur scattered through the unit.

rocks from ed an age of g in closely site. Locally ounced columnar jointing, perpendicular to dip. Dikes almost cer-

tainly represent more than one episode of intrusion, Volcanic gravel—Unconsolidated to poorly consolidated deposits, ranging from totally unsorted diamicton, with boulders of lava and basement rocks as much as 1 m in diameter, to well-bedded, locally sorted volcaniclastic debris that may have been fluvially reworked. Matrix often white to buff ash. Where semiconsolidated, locally eroded to form distinct pillars. Exposures usually very

formed from debris shed from domes (unit QTrd). Deposits generally occur at the margins of domes, usually in areas of poor exposure Rhyolite and rhyodacite pyroclastic deposits-Buff to light-gray air-fall and nuee ardente deposits, locally reworked by water. Stratification ranges from absent, in ballistic-fall debris, to good, in fluvially reworked deposits and air-fall ash. Thickness variable, may locally exceed 100 m; unit is generally poorly exposed. Presumably associated with rhyolite domes (unit QTrd). Northeast of

Rhyolite flow-Light-gray, devitrified, microcrystalline rocks with red and black vitrophyre phases exhibiting pronounced flow banding. Usually very massive. Viscous extrusives of local origin, presumably from rhyolite domes (unit QTrd) Rhyolite domes-Light-gray to buff, massive rocks with

small (<1 mm) phenocrysts of potassium feldspar, oxyhornblende, and altered biotite in a cryptocrystalline groundmass. Minor tridymite and (or) cristobalite line avities in groundmass Basalt flows-Dark-gray to greenish-black, vesicular, fineto medium-grained flows; locally porphyritic. Olivine, pigeonite, and abundant plagioclase (labradorite) occur as phenocrysts and in the groundmass. Locally, vesicles filled with chalcedony and minor calcite and chlorite. Rocks locally chloritized and altered to clay minerals.

Individual flows generally thin (<5 m), although entire unit may exceed 100 m in thickness locally. K-Ar date on sample from Wait Creek (sec. 12, T. 6 N., R. 12 E.) yielded age of 13.9+0.8 m.y. (Deininger, 1972) Hornblende porphyry-Small, complex, intrusive masses consisting chiefly of a variety of porphyries, ranging in composition from dacite to andesite. Phenocrysts of hornblende, augite, biotite, and sparse feldspar occur in a fine- to medium-grained, subhedral, granular to pilotaxitic groundmass. Unit occurs only in southeast corner of the quadrangle and is much more extensive to the east in the Nabesna B-4 quadrangle, where K-Ar date gives age of 18.4 m.y. (Richter, 1971; Richter and Lanphere, un-

publ. data)

GRANODIORITE AND QUARTZ DIORITE (CRETA-CEOUS)—Fine- to medium-grained, subhedral, granular rocks containing hornblende, plagioclase, and quartz, with minor biotite, augite, and potassium feldspar. Chloritization and saussuritization common. Host marine sedimentary rocks (KJs), limestone (Rtl, Rml), and Nikolai Greenstone (Rn) have been extensively thermally metamorphosed, and locally contain masses, veins, and segregations of sulfide minerals
CHISANA FORMATION (LOWER CRETACEOUS)—Dark-

gray-green volcanic flows, massive volcanic breccias, and minor interbedded volcaniclastic rocks. Dominantly andesites and basaltic andesites, generally containing conspicuous augite phenocrysts KJs NUTZOTIN MOUNTAIN SEQUENCE (LOWER CRETA-CEOUS AND UPPER JURASSIC)—Unit consists chiefly of a marine assemblage of dark-gray argillite, gray siltstone, and graded beds of argillite-siltstonegraywacke. Sparse Buchia indicate a late Mesozoic age. In the vicinity of White Mountain, rocks at or near the contact with quartz diorite (unit Kg) have been thermall

metamorphosed to light-gray, buff, and light-green banded calc-silicate hornfels RtI THIN-BEDDED LIMESTONE (UPPER TRIASSIC)—Darkgray, fine-grained limestone in beds ranging from a few ntimeters to as much as 2 m thick, with thin interbeds of dark carbonaceous shale and gray argillite. Chiefly micrite and biomicrite, locally recrystallized and dolomitized; weathers light gray. Near quartz diorite on White Mountain, rocks have been thermally metamorph osed, chiefly along bedding planes, to a garnet-rich calc silicate skarn locally containing disseminated sulfide minerals. Age designation based largely on fossil evidence in Nabesna C-5 quadrangle (Richter and Schmoll,

RMI MASSIVE LIMESTONE (UPPER TRIASSIC)—Gray to darkgray, fine-grained limestone, massive, in poorly distinuishable beds generally greater than 2 m thick. Contains locally abundant lenses and nodules of gray to dark-gray chert and irregular patchworks of siliceous material. dolomitized; weathers light gray. Near quartz diorite on White Mountain, limestone has been thermally metamorphosed to massive, garnet-rich calc-silicate skarn, locally containing disseminated and massive sulfide minerals. Age designation based largely on fossil evidence in Nabesna C-5 quadrangle (Richter and

Rn NIKOLAI GREENSTONE (UPPER AND/OR MIDDLE TRIASSIC)—Dark-green, dark- greenish-brown, and greenish-gray amygdaloidal basalt flows, separated locally by thin, greenish-gray volcaniclastic beds. Intermixed aa and pahoehoe flows ranging from a few centimeters to more than 15 m thick. Rocks largely thermally netamorphosed to fine-grained assemblages of actinoe, epidote, and chlorite. Unit includes a number of riassic gabbro sills and dikes that are not separated on

TC CONGLOMERATE AND SHALE (MIDDLE TRIASSIC)— Intermixed conglomerate and dark-gray carbonaceous shale and argillite. Conglomerate contains subangular to rounded clasts of Mankomen Group (Pm) and Tetelna Volcanics (PPt) in a dark-brownish-gray silty matrix. Shale beds contain abundant Daonella of Middle Triassic Pm MANKOMEN GROUP (LOWER PERMIAN)—Dark-gray to gray-green argillite, with subordinate interbedded light

gray to brown calcareous siltstone and grit. Upper 150 m argillite and siltstone, grading to silty limestone, in beds 10 cm to 1 m thick, showing a ribbon-like appearance. Cephalopods, brachiopods, and corals indicate an Earl Permian age. Unit is locally intruded by gabbro dikes and sills of Triassic age, not separated on map TETELNA VOLCANICS (PERMIAN AND PENNSYL VANIAN)-Interbedded dark-gray-green flows, chiefly andesite, massive lahars, lapilli-pumice tuffs, and vol caniclastic rocks ranging from mudstone to conglomerate, which are thin bedded and locally graded. No fossil

 CONTACT—Known, approximately located, or inferred FAULT—Dotted where concealed; ball denotes downthrown

found; age designation based on stratigraphic evidence

from elsewhere in the Nabesna quadrangle (Richter,

1976) and in the adjacent Mt. Hayes quadrangle (Richter

STRIKE AND DIP OF PLANAR ROCK UNITS

and Dutro, 1975)

16 • PETROGRAPHIC SAMPLE LOCALITY—Number refers to those in accompanying table of chemical analyses ORE MINERAL LOCALITY—Number refers to occurrences described in accompanying table F6 • FOSSIL LOCALITY—Number refers to collections described

ERUPTIVE CENTERS Strato volcano Andsite dome

Rhyolite, rhyodacite dome Younger andesite or basalt cinder cone CHEMICAL ANALYSES OF THE WRANGELL LAVA FROM THE NABESNA B-5 QUADRANGLE, ALASKA [Analyses by U.S. Geological Survey rapid rock method (Shapiro and Brannock, 1962). Analysts G. Chloe, P. J. D. Elmore, John Glenn, James Kelsey, and Hezekiah Smith]

Sample No. ...72-PCL-68 72-PCL-83 72-PCL-9 72-PCL-30 72-PCL-85 72-PCL-41 71-PCL-238 71-PCL-195 71-PCL-231 71-PCL-242 71-PCL-268

99.7 99.1 99.8 74.0 67.2 66.2 65.7 65.8 ... 57.8 57.1 54.7 (Water free normalized to 100)

Sample No. ...71-PCL-275 72-PCL-16 72-PCL-62 72-PCL-71 72-PCL-72 72-PCL-74 72-PCL-75 71-PCL-209 71-PCL-235 69-TAK-5 100.0 100.0 99.9 SiO₂ 69.8 69.8 69.0 68.8 68.9 (Water free normalized to 100)

Sample No. ... 71-PCL-35 71-PCL-41 71-PCL-198 71-PCL-243 69-TAK-11 71-PCL-157A 69-TAK-25 71-PCL-239 71-PCL-84 71-PCL-39 QTru QTrf 99.9 100.7 99.0 99.0 ... 100.0 100.1 100.0 100.0 99.6 SiO₂ 57.8 57.9 57.8 58.2 76.1 74.3 75.2

ORE MINERAL OCCURRENCES

(Water free normalized to 100)

M1 Unnamed Sec. 7, T. 8 N., Quartz vein with pyrite and chalcopyrite in shear zone in M2 Rambler Mine Sec. 16, T. 7 N., Contact metasomatic deposit of massive gold-bearing pyrrhotite and pyrite in recrys-

tallized limestone. Active M3 Nabesna Mine Sec. 21, T. 7 N., Contact metasomatic deposit of massive magnetite with pyrite, veins and masses of pyrrhotite, and veins of gold-bearing pyrite and chalcopyrite, at contact of quartz diorite and limestone. Inactive mine. Total production when mine closed in

1940 was \$1,870,000 in gold (Moffitt, 1954). M4 Royal Develop- Sec. 21, T. 7 N., Disseminated pyrite in quartz diorite, and small quartzpyrite veins. Minor gold production in 1907 (Moffitt,

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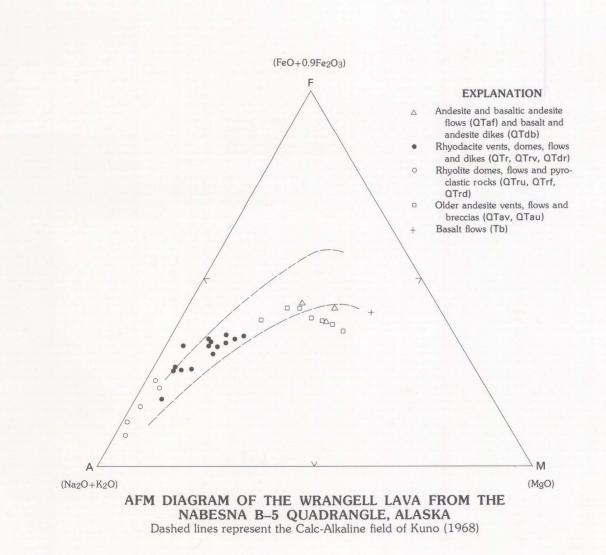
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GEOLOGIC MAP OF THE NABESNA B-5 QUADRANGLE, ALASKA