No. Name(s) Location Category  $^1$  Resource(s) $^2$  Form  $^3$  Type $^4$  Brief description

References 5

Brief description

BASE BY U. S. GEOLOGICAL SURVEY, 1963

Table 1.--Mineral deposits and occurrences in the Talkeetna quadrangle

No. Name(s) Location Category Resource(s) Form Type 4

EXPLANATION FOR GENERALIZED GEOLOGIC MAP [Geology generalized from Reed and Nelson (1977)] CORRELATION OF MAP UNITS SURFICIAL DEPOSITS Qs } QUATERNARY SEDIMENTARY AND VOLCANIC ROCKS INTRUSIVE AND ULTRAMAFIC ROCKS (OR) JURASSIC MESOZOIC AND (OR) UPPER PALEOZOIC - PENNSYLVANIAN - UPPER PALEOZOIC PALEOZOIC SILURIAN AND ORDOVICIAN LOWER PALEOZOIC DESCRIPTION OF MAP UNITS SURFICIAL DEPOSITS Qs UNCONSOLIDATED SEDIMENTARY DEPOSITS SEDIMENTARY ROCKS, UNDIVIDED--Chiefly limestone SEDIMENTARY AND VOLCANIC ROCKS MARBLEIZED LIMESTONE, CHERT, AND SHALE CONTINENTAL SEDIMENTARY ROCKS -- Includes Kenai Group SEDIMENTARY AND VOLCANIC ROCKS, UNDIVIDED METAMORPHOSED SEDIMENTARY AND VOLCANIC ROCKS, UNDIVIDED MARINE SEDIMENTARY ROCKS, UNDIVIDED INTRUSIVE AND ULTRAMAFIC ROCKS PILLOW BASALT Tf GRANODIORITE OF FORAKER PLUTON MAFIC VOLCANIC ROCKS, UNDIVIDED McKINLEY SEQUENCE Chiefly quartz monzonite and granite INTRUSIVE ROCKS, UNDIVIDED--Chiefly granodiorite and quartz diorite SEDIMENTARY AND VOLCANIC ROCKS, UNDIVIDED LIMESTONE-CHERT CONGLOMERATE INTRUSIVE ROCKS, UNDIVIDED

> Contact, dashed where approximately located, dotted where concealed Fault, dashed where approximately located, dotted where concealed Thrust or high-angle reverse fault; sawteeth on upper plate

GEOLOGIC SYMBOLS

SEDIMENTARY ROCKS (FLYSCH), UNDIVIDED

Ni, 115; Pb, 29; eU, 29; V, 344; Zn, 688.

No. Name(s) Location Category<sup>1</sup> Resource(s)<sup>2</sup> Form<sup>3</sup> Type<sup>4</sup>

Nine samples of pillow basalt range between 200 and 500 ppm Cu.

		, ,		Criteria 1/											
And a	Regards	Second State of the state of th	the state of the s		15 15 16 16 16 16 16 16 16 16 16 16 16 16 16	3) 15 15 15 15 15 15 15 15 15 15 15 15 15	datue de la constitución de la c	to took suite	COLUMN ALEGER AND ALEG	St. S.	Scottered Signature	S P. S.			\$
			A	В	C	D	E	F	G	Н	1	J	K	L	M
	Ag, Sn (Pb,W, U)	Stockworks, greisen, vein, disseminated	Х	X	X	Х	X	X	Х	X	X			×	
2	Be (Sn)	Greisen, pegmatite(?)	X	Х	X		χ.		×	X					
3	Sn (Be, W)	Disseminated greisen	X	Х			Х		X	Х	×				
4	Sn (Be, ₩)	Disseminated greisen(?)	X	Х			X				×			X	X
5	Cu (Pb, Cr, Ni, Ag, W)	Vein, disseminated	Х	X			×		Х	X	×	X	X	X	
6	(Pb,Zn,Ag,Sn, Sb,Mo,Cu)		Х	X			×		X	×	×		X		
7	Cu (Zn, Pb, Ag, Au)	Volcanogenic massive sulfides, disseminated	Х	X	Х		X	×	×	×	×		X		
8	Cr (Ni,Pt)	Magmatic segregation	Χ	X	×	X	×		×	×	×	×			×
9	Mo, Cu	Porphyry, stockwork	X	X		Х	Х		×	X	X			X	×
0	W (Sn)	Vein, contact metamorphic disseminated greisen(?)	X	X		X			X		×		×		
11	Cu (W, Ag, Ni, Sn, Au, Cr)	Disseminated, vein	X	·X			×		×.	×	×		×		
12	Cu, Au, Ag,	Contact metamorphic, vein disseminated, placer	, Х	X		X	×		×	х	×		×		X
ЗА	Au (Ag, Pt, W, Cu)	Placer, vein	X	×	44		Х	×	×	X	×		×	×	
3B	Au (Ag, W)	Placer, vein	Χ	×							×		X		
3C	Au (Ag, Pt, Sn, Cu, U, W)	Placer, vein	Х	×			X	×	X	Х	X		×	X	
14	,	<u>6</u> /	Х	×	×	×									
15		7/	X	X	X						X		X		

Table 2. -- Favorable mineral resource areas

ULTRAMAFIC ROCKS, UNDIVIDED

the various criteria are: Reed and Nelson (1977), geology; Curtin and others (1978a-d), Tripp and others (1978), geochemistry; Griscom (1978), aeromagnetics; Steele and Albert (1978), Landsat imagery. <sup>2</sup> Known metallic resources indicated by chemical symbol; possible metallic resources suggested by geochemical anomalies and/or geologic association, and potential byproducts in parentheses. High geochemical stream-sediment values used in this report are equal to or greater than the following (in ppm): Ag, 1; As, 500; Au, 1; B, 500, Be, 7; Co, 100; Cr, 500; Cu, 200; Mo, 15; Ni, 500; Pb, 50; Sn, 15; W, 100; Zn, 700. These values are equal to or greater than the 94 percentile. High pan concentrate values are from the fraction that has a specific gravity greater than 2.87 and are nonmagnetic at 0.6 amps. In this report these values are equal to or greater than the following (in ppm): Ag, 5; As, 7000; Au, 30; B, 2000; Co, 300; Cr, 5000; Cu, 2000; Mo, 20; Ni, 1000; Pb, 1000; Sn, 700; W, 300; Zn, 2000. With the exception of Ag and W, 88 and 91 percentile respectively, these values are equal to or greater than the 94 percentile. Many prospects listed for area 13C are active placer gold mines (see table 1). Eight samples of black carbonaceous shales have the following average metal values (in ppm): Ag, 10; Cr, 194; Cu, 111; Mo, 24;

More specific information about the criteria within each area is given in the summary of selected criteria below. Sources of

EXPLANATION FOR MINERAL RESOURCES MAP Lode mineral deposit. Includes prospects and mineral occurrences; number corresponds to number in table 1 that

> along streams indicate areas of major production: number corresponds to number in table 1 that describes the mineral deposits of the Talkeetna quadrangle. Coal occurrence. Number corresponds to number in table 1 that describes the mineral deposits of the Talkeetna quadrangle. Favorable mineral resource area. Mineral commodities, deposit types, and criteria used to define these areas

Areas that have average high metal contents in bedrock;

describes the mineral deposits of the Talkeetna quadrangle.

Placer mines, prospects, and occurrences. Heavy lines

SUMMARY OF SELECTED CRITERIA USED TO DEFINE

resource significance unknown.

A. As, B, Be, Sn, W B. Ag, B, Cr, Mo, Sn, W, Zn Biotite granite; Sn, 7-30 ppm Coincidence of mineral occurrences with major lineament A. B, Be, Sn B. Ag, As, B, Co, Cu, Mo, Ni, Sn, W Arsenopyrite, cassiterite, scheelite

A. Ag, Be, Sn B. Ag, As, B, Co, Cu, Mo, Sn, W . Arsenopyrite, cassiterite, chalcopyrite, fluorite, L. Area occurs in center of large circular feature K. Magnetic low (T. 33 N., R. 15 W.) suggests concealed L. Curvalineaments correspond to mapped faults A. Ag, B, Co, Cu, Mo, Ni, Pb, Sn, Zn Ag, Co, Cu, Pb, Zn . Magnetic low (T. 31 N., R. 17 W.) suggests concealed

B. Ag, Co, Cu, Mo, Ni, Pb, W, Zn Copper content of pillow basalt ranges between 200 and I. Chalcopyrite, galena K. Magnetic high (T. 29 N., R. 19 W.) suggests concealed Ag, Cr, Ni 23, 25, 26, 27, 30, 31, 32

of ultramafic rocks A. Cu, Sn, W B. Ag, Cu, Mo, Sn, W . Gold, scheelite

B. Ag, As, Au, B, Cr, Co, Cu, Mo, Ni, Pb, Sn, W G. 17, 18, 19, 20, 21, 22 Arsenopyrite, chalcopyrite, fluorite, gold, galena Aeromagnetic anomalies suggest additional concealed Ag, As, Au, Co, Cr, Cu, Pb, Sn, W K. Patterns of aeromagnetic anomalies suggest extensive oncealed plutons at relatively shallow depth

L. Curvalinear features probably reflect plutons A. Ag, As, Au, Co, Cu, Sn B. Ag, As, Au, Co, Cu, Pb, Sn, W F. 45, 49-51, 68-89 I. Arsenopyrite, cassiterite, chalcopyrite, platinum, scheelite, radioactive minerals, gold K. Numerous magnetic lows suggest concealed intrusive L. Structurally significant lineaments coincide with mineral occurrences

A. Ag, Co, Cu, Mo, Ni, Pb, Zn See table 2. footnote 6 H. Trace amounts of pyrite and pyrrhotite near intrusive L. Bounded by significant northeast-trending lineaments

OIL AND GAS The Tyonek Formation, of late Oligocene through middle Miocene age, produces oil in the Cook Inlet basin. This formation is in the Kenai Group and crops out locally along the foothills that flank the northern part of this basin in the Talkeetna quadrangle. Although oil production is currently restricted to areas south of the Castle Mountain fault, other Tertiary sedimentary rocks within the quadrangle are considered to contain favorable reservoirs fo hydrocarbon accumulation. Two gravity lows within the quadrangle probably represent thick sequences of Tertiary estuarine and nonmarine sedimentary rocks. The larger of these lows called the Susitna basin, is a northeast-trending, 120-mgal minimum that is centered 20 km south of T. 22 N., R. 9 W. (Hackett, 1977). A well (SW%, T. 23 N., R. 8 W.) drilled in the northern part of that basin to a depth of 2,214 m bottomed in an interbedded sequence of volcanic flows, claystone, conglomerate, and coal. The section penetrated, however, contains adequate reservoir-quality rocks and is believed to be favorable for petroleum accumulation k. 1971). It is not known whether adequate petroleum source rocks or traps are present, and there are no petroleum seepages along the margins of the basin. The Yentna basin, a 110-mgal gravity minimum centered 5 km south of Youngstown Bend in

MINERAL RESOURCE POTENTIAL

T. 24 N., R. 13 W., probably contains another thick sequence of Tertiary sedimentary rocks (Hackett, 1977). Although no wells have been drilled in this basin, sandstone beds in nearby outcrops of the Tertiary Kenai Group are locally as much as 30 m thick, poorly indurated, and moderately well sorted and appear to have good porosity-permeability characteristics. Mesozoic sedimentary rocks that are highly folded and metamorphosed to low grades crop out along the flanks of the mountains and presumably form much of the depositional surface for the Kenai Group in this area. They show little promise as either hydrocarbon reservoirs or sources Aeromagnetic data suggest the presence of either a hypabyssal plug or volcanic rocks (T. 25 N., R. 14 W.) at less than 300 m below the surface (A. Griscom, oral commun., 1977). The potential for oil accumulation in this basin is considered minimal, although accumulations of dry

Combined geologic and geophysical data suggest that the Tertiary sedimentary rocks northeast of these gravity lows have a general thickness of probably less than 1,200 m, although somewhat greater thicknesses may locally be present in small graben basins. In these areas the sequence is probably too thin to have permitted sufficient maturation of organic materials to

Subbituminous coal deposits in the Talkeetna quadrangle are present in middle and upper Tertiary continental sedimentary rocks. South of the Denali fault the coal occurs in the Kenai Group, and north of the Denali fault the coal-bearing rocks on the Little Tonzona River are tentatively correlated with rocks of the Nenana coal field. Coal occurs in an undetermined but large number of beds that range in thickness from 0.1 m to more than 15 m and that are interbedded with shale, siltstone, sandstone, and conglomerate. Estimated resources of known coal occurrences in the Talkeetna quadrangle are given in the following table: Metric tons (x10°) References Locality (map number) Little Tonzona River (1) -----23.0 Johnson Creek (52)-------10.3-----Barnes (1966) Nakochna River (53)-------7.7-----I. Ellersieck (written commun., 1977) Cottonwood Creek (55) ------Barnes (1966) ----6.5-----I. Ellersieck (written Lower Cache Creek (58)-------Barnes (1966) Hansen Bar (59)----------Barnes (1966)

The tonnage figures are low because exposures are isolated and of undetermined extent, and little is known about the continuity and uniformity of individual beds. Owing to lack of road transportation, use of coal has been restricted to a local source of power for dredges and heating for placer miners. The economic potential of coal within the quadrangle depends on its proximity to urban population centers; it is currently low. Future use of coal in this quadrangle as an energy source must, however, be considered economically

GEOTHERMAL ENERGY Because igneous rocks in the Talkeetna quadrangle are older than 1.0 m.y., they are not considered favorable geothermal energy sources.

RADIOACTIVE MINERALS

The most extensive investigation for radioactive minerals in the quadrangle was made in the Cache Creek and upper Peters Creek area (map numbers 78, 82) in 1945 (Robinson and others, 5), during which the radioactivity of placer concentrates was examined. The maximum eU livalent uranium) value obtained from sluice boy concentrates i uranium and thorium in zircon, monazite, and uranothorianite. The radioactive minerals may, in part, be derived from continental sedimentary rocks of the Kenai Group. The placer deposits examined in the Cache Creek and upper Peters Creek area do not appear to contain sufficient amounts of radioactive minerals to be considered as important resources. However, other placer deposits that are known to contain radioactive minerals (Robinson and others, 1955) but that have not been investigated occur on Canyon and Poorman Creeks (85, 86) and on the Kahiltna River (66). The possibility of radioactive minerals in placer deposits in the Fairview Mountain area (68-70) should also be considered. While it is doubtful that any of these areas could be mined solely for radioactive minerals, it is conceivable that some radioactive minerals could be recovered as a byproduct of gold placer operations. During 1954, a radioactive anomaly was discovered along the Happy River (37) in unmetamorphosed, fractured units of tuff, tuff-breccia, and sedimentary rocks. Areas with high radioactivity are small, at the most a few feet long, and occur in and adjacent to joint surfaces. joint-controlled occurrences of the anomalous radioactivity and its low grade are unfavorable indicators for the presence of ore-grade material at Shirley Lake (Freeman, 1963). Similar rocks crop out northwest of Shirley Lake, but their uranium content is unknown. Other areas considered favorable for secondary uranium enrichment are the interbedded coal and tuff beds of the Kenai Group that underlie the upper Cook Inlet basin. The most favorable part of the basin is considered to lie immediately south of the Talkeetna quadrangle where middle Tertiary plutonism and volcanism in the Alaska Range (Reed and Lanphere, 1973) may have provided sufficient source materials for secondary uranium enrichment. Recently, industry has conducted aerial radiometric surveys and water and rock sampling in the Susitna Lowland and hills along the south flank of the Alaska Range. The results of these investigations are not icly available. The U.S. Geological Survey conducted radiometric analyses on water samples from Peters Creek in 1975 and 1976, but significant anomalies were not detected (R. Snyder,

Metazeunerite and zeunerite (copper-uranium-arsenate) have been identified in rock samples of altered siderite from the Mespelt prospect (5) which locally contains up to 0.14 percent eU (Maloney and Thomas, 1966). The host rock is biotite granite. Additional investigation of this occurrence appears justified. The Minchumina basin, which contains middle Tertiary coal-bearing rocks along the north flank of the Alaska Range, could provide a suitable environment for the deposition of uranium minerals. On the basis of field checks with a scintillometer, however, the coal beds on the Little Tonzona River (1) are not considered to be anomalously radioactive.

METALS

Gold is the principal metallic mineral commodity currently mined in the Talkeetna quadrangle. Major placer deposits were discovered and first worked in 1905. Production for the period 1905-1960 from the Yentna district (which includes the Cache Creek basin and Fairview Mountain areas) totaled slightly over 204,000 ounces, with a maximum production in 1922 of 10,788 ounces (Clark and Hawley, 1968). The recent rise in the price of gold has brought many mines back into operation, but production figures have not been reported. This trend of activity will likely continue if environmental restrictions can be met economically. The placers are found in stream and bench deposits of the present streams, glaciofluvial

deposits of Pleistocene age, and reworked Tertiary sedimentary rocks. These placers also include auriferous quartz conglomerate and breccia that is probably locally derived and related to hydrothermal activity along faults. Although the highly productive Cache Creek basin of the Yentna district has been mined extensively, there are unmined bench and buried-channel deposits near Cache Creek and in lower Cache Creek. One deposit near Bird Creek has drilled reserves of about \$1 million at \$35 per ounce (Hawley and Clark, 1973); very likely there are other deposits whose approximate resources are known by owners, but this information is not available. Because the placer deposits are of many types and ages, the possibility of finding additional placers appears good. It is not unreasonable to assume that as much, and quite likely more, placer gold remains in the Yentna district and Fairview Mountains areas as has been produced. Although Dutch and Bear Creeks (87-89) have recorded only minor production, their geologic setting is similar to the Cache Creek district. Geologic mapping and geophysical data indicate that the Mesozoic sedimentary rocks there are locally underlain by granitic rocks at relarively shallow depths. Gold is probably a significant resource in both of these creeks; a limiting factor to production, however, is the amount of overburden that must be removed before gold-bearing gravels can be mined. Production in 1974 on Dutch Creek justified an industry exploration drilling program that is currently underway (F. Charlton, oral commun.

Gold placers may also be present in streams that drain hydrothermally altered zones in the Mesozoic rocks such as those described along Dollar and Thunder Creeks (Clark and Hawley 1968). Similar altered zones were observed east of McDoel Peak (38), on the ridge north of Johnson Creek, in the hills west of Youngstown Bend (near 40), at the headwaters of Treasure Creek (71), and at the headwaters of Dutch and Bear Creeks (88, 89). Occurrence 38 is of particular interest because it lies within a hydrothermally altered area of graywacke and argillite, adjacent to a granodiorite stock. The creek contains abundant float of vein quartz and, although analyses of several quartz cobbles showed no gold, a pan concentrate sample of gravels yielded more than 30 colors of fine gold. High gold values in analyses of both stream sediment and pan concentrate samples in areas 12, 13A, and 13B suggest that placer deposits also may be present in these areas.

Known lode deposits in the region consist mainly of low-grade vein deposits associated with felsic dikes and/or quartz veins. Examples are Mount Goldie (45, 46) and the south side of the Dutch Hills (49, 50, 51). Quartz veins in the Mount Estelle pluton contain anomalous amounts of gold associated with chalcopyrite and arsenopyrite (Reed and Elliott, 1970). Free gold is present in thin calcite-diopside seams in tactite in area 12 (19) (C. C. Hawley, written

Numerous occurrences of copper suggest that it may be a significant resource in the Talkeetna quadrangle. It occurs in a variety of deposit types--volcanogenic, contact metamorphic, and possibly as stockwork and porphyry deposits. The volcanogenic and contact metamorphic deposits appear to be the most promising. In area 7 (14) marine volcanogenic massive sulfide deposits occur within eugeosynclinal sedimentary rocks that are overlain by submarine basaltic pillow flows. The copper content of the basalt ranges between 200 and 300 ppm. Mineralogically, the deposits consist, in order of decreasing abundance, of pyrite, marcasite, sphalerite, chalcopyrite, galena, and pyrrhotite. copper, 0.8 and 1.7 percent zinc, 0.9 and 2.4 ounces per ton silver, and less than 0.5 percent lead (Reed and Eberlein, 1972). Indicated tonnage of the known sulfide bodies is on the order of 50,000 tonnes, but the possibility of finding additional massive sulfide bodies in area 7 is considered very high to excellent. Although not defined as a potentially favorable area for

mineral resources on the accompanying map, the belt of undivided Paleozoic marine sedimentary rocks, which continues northeast of area 7, is considered to be a favorable environment for copper-bearing massive sulfide deposits, particularly wherever volcanic rocks are present. A lenslike body of massive bornite and chalcopyrite (19) occurs within tactite (C. C. Hawley, tite to granodiorite. The massive sulfides contain in excess of 40 percent copper, and a sample of bornite and chalcopyrite also contains about 32 ounces per ton silver. Free gold is also present in calcite-diopside seams in the tactite (C. C. Hawley, written commun., 1977 There examined by Hawley, the massive sulfides range in width from 0.1 to 0.8 m. The lateral extent of the occurrence is unknown, but additional deposits are probably present because similar rock types occur north of the fault between the West Fork of the Yentna River and the Dall Glacier--a distance of about 20 km. High values of copper, gold, silver, and other metals in pan concentrate samples indicate that the area has a very high potential for several metals, Numerous other copper occurrences (34, 17, 22, and 33) are in the quadrangle, but data are not available to assess their potentials. Porphyry copper deposits may also be associated with the Foraker pluton (area 9), discussed under the section on molybdenum.

Although there are no known copper deposits north of the Denali fault, analyses of sediment and pan concentrate samples from streams that drain the belt of Mesozoic slate, graywacke, phyllite, and pillow basalt (KJs, KJb) show high values for copper. Sedimentary rocks adjacent to this belt locally contain small secondary lenses of copper minerals, and trace amounts of malachite were found in some pan concentrate samples. The cluster of copper anomalies in sediment and pan concentrate samples in area 6 may be related to the small granitic body in this area. opper anomalies in pan concentrate samples in area 5 apparently are related to a small body f serpentinite (MzPzu). The pillow basalt in area 15 may constitute a future copper resource. Nine samples of the basalt, which locally has a thickness of at least 1,300 m, contain between 200 and 500 ppm (0.02-0.05 percent) copper. Although the copper in the basalt is not currently minable, future technological advances in the recovery of copper from low-grade deposits may increase the significance of this resource

Molybdenum, along with copper, occurs as porphyry, vein, or stockwork deposits adjacent to or within the 38-m.y.-old granodiorite of Mount Foraker (area 9). It may be economically significant, but virtually no data are available to assess its potential. Evidence that suggests molybdenum deposits exist is limited but includes: (1) altered cobbles of granodiorite that have fractures healed with molybdenite, pyrite, and chalcopyrite (28, 29); (2) reddish-orange alteration zones, 2-5 km2 in size, within and along the borders of the pluton; (3) analysis of a sediment sample in glacial moraine derived from one of the alteration zones (T. 31 N., R. 13 W.) that shows high values of molybdenum and copper; and (4) occurrence of a molybdenite-bearing quartz vein (24) believed to be genetically associated with the pluton. Although molybdenite in the last occurrence occurs as foliated tabular crystals as much as 5 cm in diameter, the vein is considered more as a mineralogical anomaly than as a potential resource. Owing to their inaccessibility, the alteration zones, as well as numerous quartz veins adjacent to the pluton, were not examined on the ground. Taken collectively, however, this evidence suggests that the granodiorite of Mount Foraker is potentially favorable for molybdenum and copper deposits of the porphyry or stockwork type. Because none of the areas favorable for porphyry molybdenum/copper deposits has been examined on the surface or drilled, it is not possible to be certain that there are any such deposits in the quadrangle. The evidence presented above, however, suggests that at least one deposit exists in area 9. On the basis of this evidence and particularly the number of untested alteration zones within the pluton, the number of porphry or stockwork molybdenum/copper de-

a 50 percent chance that there are 2 or more deposits; (3) a 10 percent chance that there are 4 or more deposits Some ideas about grades and tonnages of this type of deposit can be obtained from porphyry molybdenum deposits in Canada. Average grades of MoS<sub>2</sub> in six deposits range from 0.11 to 0.43 percent, and ore tonnages range from 1.4 to 194 million metric tons (Drummond and Godwin, 1976). Contained MoS $_2$  in these deposits ranges from 5 to 270 thousand metric tons. The molybedenite occurrence near the Alaska Railroad (48) apparently is minor, and there is no evidence that it has been explored recently. The high molybdenum values from streams the high background values of molybdenum (24 ppm) in these rocks. The molybdenum values in stream-sediment samples in area 6 are of interest because they are associated with what appears to be a cupola of granite related to the Tonzona pluton, and small amounts of other base metal sulfides are locally abundant in this area.

The average fineness of gold from the Cache Creek area is 865 (Smith, 1941). The recent increase in placer gold mining activity indicates that moderate production of silver from placer Silver may be a significant resource in other deposits within the quadrangle. The massive bornite-chalcopyrite occurrence (19) in tactite contains about 32 ounces per ton silver. The size of this contact metamorphic deposit is unknown, but the potential for additional deposits in this area is very high. The Hogback (4) and Mespelt (5) prospects contain amounts of silver that may be economically significant. The Hogback is considered the more promising and consists of a 3- to 10-m-wide sequence of parallel fissure veins that contain argentiferous galena. One vein ranges in width from 0.3 to 0.6 m and contains 5 to 48 percent lead and 32 to 70 ounces per ton silver (Conwell, 1973). The extent of the veins is unknown, but their Creek tin prospect (8) intersected 16.5 m of "green breccia" (as reported in drill logs), vein quartz, and metasedimentary rocks with an average grade of 10 ounces per ton silver. Minor amounts of copper, lead, and zinc are associated with the silver mineralization. Two other drill holes also penetrated relatively thick sections of high-grade silver. Silver Shellabarger Pass (14) contain between 0.9 and 2.4 ounces per ton silver, which could be recovered as a byproduct. Silver may be a potential resource in any molybdenum-copper deposits that are associated with the granodiorite of Mount Foraker (area 9).

SCALE 1:250 000 CONTOUR INTERVAL 200 FEET DATUM IS MEAN SEA LEVEL

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FOLIO OF THE TALKEETNA QUADRANGLE MISCELLANEOUS FIELD STUDIES MAP MF - 870-D

REED AND OTHERS - MINERAL RESOURCES The Talkeetna quadrangle has several large bodies of biotite and/or muscovite granite (McKinley sequence) that are locally fluoritized or tourmalinized. This mineralization, in itself, suggests a terrane favorable for tin metallization. Furthermore, cassiterite is a common heavy mineral in pan concentrates from many areas within or adjacent to these granitic bodies, and the nonmagnetic fractions of these concentrates commonly contain in excess of 1,000 ppm tin. Although the presence of favorable rock types is no guarantee that workable tin lodes will be found in or near a particular granite, the possibility exists that tin is a significant resource A recently discovered deposit at Boulder Creek (8) occurs in thermally metamorphosed metasedi-

deposit lies about 100 m north of a granite contact of the McKinley sequence, and drill hole data suggest that it overlies a marginal cusp. In surface exposures cassiterite-sulfide-siderite mineralization is controlled by clusters of narrow, open-space fracture fillings that suggest a stockwork type of deposit in which mineralization is localized along small pipelike fracture zones. It is exceedingly difficult to prove tonnages in this type of deposit by means of a diamond drill. Drill hole data (David Purkey, written commun., 1977) suggest that one zone of cassiterite mineralization is irregularly distributed over a width of 1 to 6 m along a steeply dipping fracture(?) zone to a depth of about 60 m. Other tin-rich drill intersections, however, show no apparent geometric connection to this zone. Tin in excess of 0.5 percent was found in l2 of 15 drill holes. Mineralized intervals generally range between 0.6 and 2.4 m in width and roughly average 2 percent tin although some intersections contain as much as 5 percent tin over a 3.6 m length. A 3 m channel sample taken across one of the fracture clusters contains 1.57 percent tin and 10.8 ounces per ton silver, and selected samples from adjacent clusters contain up to 18 percent tin and 230 ounces per ton silver. Late-stage hydrothermal sulfide mineralization has produced these anomalous concentrations of silver. Tin and silver mineralization may occur at the same interval, but the largest concentrations of sulfide minerals are not necessarily associated with cassiterite. Exploration to date indicates that tin of minable grade occurs in minable widths, but indicated tonnages are small. High tin values in pan concentrate samples collected along the northern granite-sedimentary rock contact suggest that tin mineralization occurs for at least 5 km west of the Boulder Creek prospect, and the possibility that additional tin-silver deposits occur along this northern contact zone is considered excellent. The deposits most likely will occur as veins and disseminations in greisen or as cassiteriterich pipes or veins developed along the borders of the granite or in the seidmentary rocks.

Several high tin concentrations (>1,000 ppm) are present in pan concentrate samples from a deeply weathered and locally altered biotite granite in area 4. The source of the cassiterite is not currently known, but it most likely is associated with late-stage greisen zones similar to occurrence 42. Disseminated deposits of this type are, at present, rarely worked commercially unless erosion of such lodes has resulted in placer deposits (as in southeast Asia and else-

Podiform chromite is present in alpine-type ultramafic rocks exposed along the Yentna and Lacuna Glaciers. Chromite-bearing dunite occurs as sills as much as 90 m thick and 7 km long , 31, 32) and as a larger irregular body of dunite and serpentinite (25, 26). The magmatic high in T. 30 N., R. 14 W. near occurrence 27 suggests that similar ultramafic rocks may intrude the upper Paleozoic flysch (Pzus) at depth. The presence of ultramafic rocks is also suggested by the weakly magnetic high along the upper reaches of the Dall Glacier where sheared ultramafic rocks and chromite are locally present (23). Chromite occurs chiefly in the dunite sills as (1) disseminated rounded grains 1-3 mm in diameter, (2) streaks and lenses, (3) disrupted and irregular pods of various shapes as much as 2 m in maximum dimension, and (4)lenslike bodies as much as 2 m thick and 20 m long. The chromite content of typical dunite ranges between 0.5 and 1 percent. The average of three microprobe analyses from one sample of chromite is 58.4 percent Cr<sub>2</sub>O<sub>3</sub>, 21.1 percent FeO, 8.9 percent MgO, and 9.7 percent Al<sub>2</sub>O<sub>3</sub> (T. Thayer, written commun., 1976). None of these dunite bodies was investigated in detail, and although the observed chromite occurrences are small, additional exploration for minable deposits is

High chromium values in stream-sediment and pan concentrate samples in area 5 suggest that mag matic segregation-type deposits of chromite are associated with the small body of serpentine in T. 32 N., R. 15 W. High chromium values in stream-sediment and pan concentrate samples are also associated with the composite plutons (Reed and Nelson, 1977) in the western part of the quadrangle. Peridotite locally is an early intrusive phase of these plutons and is probably the source of the chromium.

Chromite occurs in the placers of the Yentna district (Mertie, 1919) and is probably locally derived from altered mafic or ultramafic dikes cutting the Mesozoic sedimentary rocks (Clark and Hawley, 1968).

Platinum-group minerals The occurrence of platinum-group metals was first reported by Mertie (1919) from gold placers in the Yentna district. Analysis of a hand-picked sample of a concentrate from Poorman Creek (85) showed the following platinum-group metals: iridosmium, 32 percent; iridium, 11 percent; rhodium, 1.4 percent; platinum, 47.3 percent; palladium, trace; and other elements 8.3 percent (Mertie, 1919). The platinum-group minerals may have been derived from altered mafic or ultramafic dikes that cut the Mesozoic sedimentary rocks in this area (Clark and Hawley, 1968) Platinum is also present in concentrate samples from the Fairview Mountain area (A. L. Clark, oral commun., 1977). Fine platinum along with fine gold has also been recovered from the Kahiltna River (66), the mouth of the Nakochma River (39), and the Kichatna River (Cobb, 1973) The source of platinum in the latter two occurrences is probably related to the ultramafic phases of the composite plutons (Reed and Nelson, 1977). Although the known occurrences of platinum do not currently constitute a minable resource, platinum could be a valuable byproduct of large-scale placer gold operations.

The content of platinum-group elements in a grab sample of chromite (30) is 0.020 ppm each ruthenium and iridium. Although these values are not considered anomalously high and none of these elements were detected in four grab samples of dunite, the possibility that this group of ultramafic rocks may contain local concentrations of platinum-group elements that are limited th stratigraphically and areally can not be discounted.

Galena and sphalerite, common ore minerals of lead and zinc, occur in varying amounts in many of the known mineral occurrences, but none of these occurrences approaches exploitable quality solely for lead and zinc. Lead could be produced as a byproduct of the argentiferous galena in veins at the Hogback prospect (4), and byproduct lead and zinc could be recovered from the Boulder Creek (8), Mespelt (5), and Shellabarger Pass massive sulfide deposits (14). High zinc values in analyses of stream-sediment and pan concentrate samples are virtually limited to the terrane north of the Denali fault. Some of these anomalies no doubt reflect the high background values for this metal in the Paleozoic black carbonaceous shales (Pzsl). values for lead and zinc in samples from area 6 are appparently related to the small intrusive body in this area. The source for the large amounts of zinc in pan concentrate samples north of area 7 and the lead in area 5 is not known but should be investigated. Two occurrences of beryl-rich greisen (9, 10) and high values of beryllium in pan concentrate

and stream-sediment analyses indicate that the composite biotite granite pluton (area 2) is a favorable area for beryllium deposits. Other biotite granite plutons of the McKinley sequence (area 3, 4) have a potential for beryllium as well as tin deposits. Tungsten anomalies in analyses of pan concentrates are associated with granites of the McKinley sequence and the composite plutons in area 12. The only tungsten occurrence presently known is a quartz-tourmaline-wolframite vein in lime silicates north of Cathedral Spires pluton (16) Stream-sediment and pan concentrate samples from streams adjacent to the pluton suggest that additional tungsten occurrences may be present. The high tungsten values in analyses from area 12 may indicate contact metamorphic tungsten deposits. Scheelite has been found in most pan concentrates from areas draining granitic rocks south of the Denali fault.

NONMETALS

Sand, gravel, rock, and limestone The Talkeetna quadrangle contains large quantities of sand and gravel, rock suitable for crushed stone, and limestone for lime and possibly cement. Limestone deposits are currently far from urban centers, and their economic potential is low for this reason. Sand and gravel are of value for local road construction, and deposits along the Chulitna and Susitna Rivers were utilized for the construction of the George Parks Highway. A granite quarry (T. 30 N., R. 5 W.) on this highway provided material for bridge construction and erosion control. Future value and use of these materials will depend on their proximity to population centers or high-

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153 150 TALKEETNA ALASKA MEDFRA MT MC KINLEY HEALY QUADRANGLE LIME HILLS TYONEK ANCHORAGE QUADRANGLE

LOCATION

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Reprinted 1979 Interior--Geological Survey, Reston, Va.--1978 For sale by Branch of Distribution, U.S. Geological Survey Box 25286, Federal Center, Denver, CO 80225

