U.S. DEPARTMENT OF THE INTERIOR
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MINERAL RESOURCE POTENTIAL MAPS OF THE ANCHORAGE 1° × 3° QUADRANGLE, SOUTHERN ALASKA

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INTRODUCTION

The area of the Anchorage 1:250,000-scale quadrangle straddles the bend in the Pacific Border Ranges of southern Alaska. The quadrangle contains the city of Anchorage and numerous smaller towns, including Eagle River, Palmer, and Wasilla. Tidewater extends into the quadrangle from the head of Cook Inlet into Knik and Turnagain Arms, and from Prince William Sound as northward-projecting glacial fiords and inlets. The rugged and scenic Talkeetna Mountains to the north and the Chugach Mountains to the south are separated by the Matanuska Valley, an eastward extension of the broad lowlands at the head of Cook Inlet (fig. 1).

The mineral resource potential maps show areas that contain known and potential resources and that are favorable for occurrences of metals, uranium, coal, and oil and gas in the quadrangle. The U.S. Geological Survey (USGS), Alaska Division of Geological and Geophysical Surveys (DGGS), and students and faculty from the University of Alaska have cooperated informally in geologic, geochemical, and geophysical investigations to determine areas of mineral-resource favorability in the Anchorage quadrangle (Burns and others, 1991; Burns, 1982, 1985; Conwell and others, 1982; Csejtey and others, 1978; McMillin, 1984; Newberry, 1986; Richter, 1967; and Rose, 1966). The most recent geologic map was compiled by Winkler (1990, 1992), and it was simplified for this report. During various regional geochemical reconnaissance programs, personnel of the USGS collected stream sediment, glacial-moraine sediment, heavy-mineral concentrate from stream sediment, and rocks from accessible areas in the quadrangle. Geochemical sample localities, sampling methods, analytical data, and interpretations are provided in the following reports: Goldfarb and others (1984); Arbogast and others (1987); Madden and Tripp (1987a,b); Madden and others (1988); Madden (1991a,b); Tripp and Madden (1991); and Madden-McGuire and Tripp (1993). Data from these studies supplemented earlier, more detailed, higher density USGS stream-sediment and rock geochemical sampling (Clark and Bartsch, 1971a,b; Clark and Yount, 1972; Clark and others, 1976), as well as the less dense quadrangle-wide stream-sediment sampling done by the Los Alamos National Laboratory for the NURE (National Uranium Resource Evaluation) program (Zinkl and others, 1981). Aeromagnetic surveys and land measurements for gravity were made for the Anchorage quadrangle. The geophysical data were compiled and intepreted by L.E. Burns (Alaskan DGGS, written commun., 1991, aeromagnetic data), Burns and others (in press), and by D.F. Barnes (USGS, written commun., 1991, gravity data).

Mines, prospects, and occurrences for metal commodities in the Anchorage quadrangle are listed in table 1 and shown on figure 1. Gold, chromite, and coal are the commodities of greatest interest in this quadrangle (Madden-McGuire and Winkler, 1993). The quadrangle contains two historic lode-gold mining districts: Willow Creek and Girdwood. These gold-mining areas have the highest potential for additional resources of gold in quartz veins and in placers. Based on our geologic mapping, geochemical sampling, and geophysical studies, we extended areas of high potential for gold in quartz veins outward from the clusters of historic gold mines, and we identified additional areas of moderate and low potential elsewhere in the quadrangle. Similarly, we have compiled occurrences of metals such as chromium, and we have delineated areas having various levels of resource potential on the basis of (1) known mineral deposits or occurrences, (2) locations of geologic contacts and fault boundaries surrounding favorable geologic units, (3) mineralogy of heavy-mineral concentrate from stream sediment, (4) geochemical anomalies in stream sediment, glacial-moraine sediment, and heavy-mineral concentrate, and (5) geophysical anomalies. The mineral-resource evaluation was loosely based on the criteria explained by Goudarzi (1984) (summarized in table 2). These criteria were adapted for this report so as to determine relative levels of resource potential and relative levels of certainty of assessment within the Anchorage quadrangle. In general, areas with previous significant mining activity have been assigned a high potential; areas with known resources, but no previous mining activity have been assigned a moderate or low potential. We assigned a low potential to areas with a favorable or permissive geologic setting and (or) geophysical anomalies and (or) insignificantly mineralized rock. The low-potential areas generally lack locatable mines, but some contain prospects and (or) stream-sediment geochemical anomalies. Use of these criteria allowed us to show relative levels of potential and certainty within the Anchorage quadrangle. In general, areas with previous mining activity and with rock geochemical evidence for mineral deposits are assigned a D level of certainty, and areas lacking mines but containing geologic and (or) geochemical evidence for mineralization are assigned either a C or B level of certainty.

GEOLOGIC SETTING

The Anchorage 1°×3° quadrangle is underlain by three lithotectonic terranes (Silberling and Jones, 1984), which are distinctive fault-bounded assemblages of rock that differ from each other in stratigraphy, age, structural style, and types of mineral and energy resources. The Peninsular terrane underlies the Talkeetna Mountains, Matanuska Valley, and northern Chugach Mountains; the Chugach terrane underlies the rugged crest of the Chugach Mountains; and the Prince William terrane underlies the extreme southeastern part of the quadrangle in Prince William Sound (Winkler, 1990, 1992; Burns and others, 1991). The terranes were accreted successively to southern Alaska from Middle Jurassic to middle Eocene time (Plafker and others, 1977,

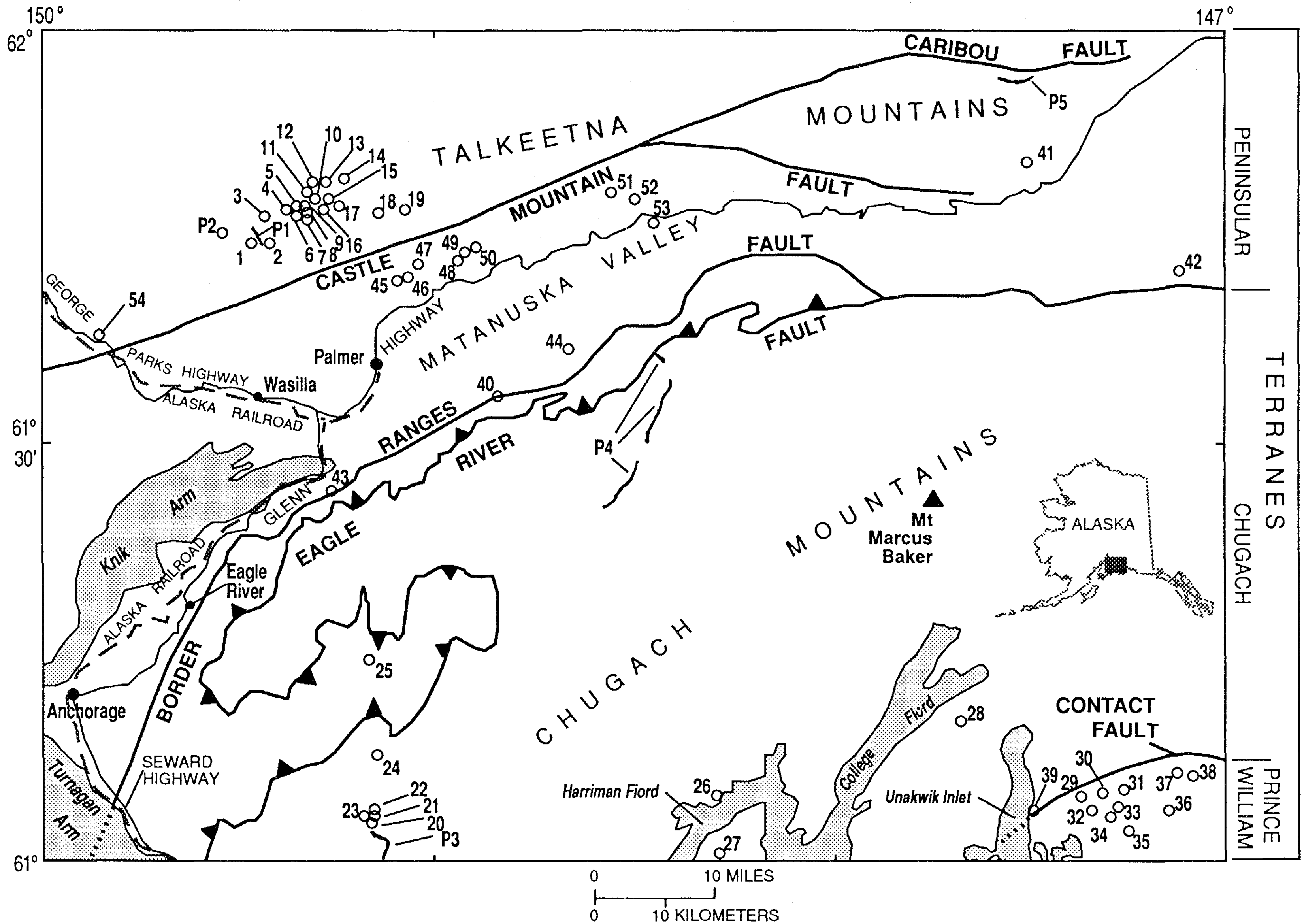

Figure 1. Index map of the Anchorage 1°×3° quadrangle, southern Alaska, showing known mines, prospects, and mineral occurrences. Locality numbers 1–54 and P1–P5 are referred to in table 1.

1989; Csejtey and others, 1978; Tysdal and Case, 1979; Burns and others, 1991).

The Peninsular terrane is bounded on its south side by the Border Ranges fault system (Winkler, 1990). In adjacent quadrangles, it is bounded on its north side by the Taral–West Fork fault system (Winkler and others, 1981; Plafker and others, 1989). In the Anchorage quadrangle, the terrane consists of Triassic(?) to Tertiary bedded volcanic and sedimentary rocks, Early Jurassic to Tertiary intrusive rocks, and Paleozoic(?) to Jurassic metamorphic rocks (Csejtey and others, 1978; Pavlis, 1983; Winkler, 1990). Rocks older than mid-Cretaceous are allochthonous; rocks younger than mid-Cretaceous overlap the accretionary assemblages and cover much of the eastern part of the quadrangle.

South of the Peninsular terrane is the Chugach terrane, which is bounded by the Border Ranges fault system on the north and by the Contact fault system on the south. In the Anchorage quadrangle, the Chugach terrane consists of a landward subduction assemblage of melange and broken formation of the McHugh Complex and seaward trench-fill and trench-slope deposits of the Valdez Group (Plafker and others, 1977; Burns and others, 1991).

Exposures of the Mesozoic McHugh Complex form a discontinuous band along the south side of the Border Ranges fault system, within the upper plate of the Eagle River thrust fault. The McHugh Complex contains Carboniferous to mid-Cretaceous blocks of mafic metavolcanic and metaclastic rocks, bedded chert, and minor lenses of limestone and ultramafic rocks in an argillaceous matrix. These blocks were chaotically faulted together, metamorphosed to prehnite-pumpellyite facies, and accreted between Middle Jurassic and mid-Cretaceous time (Clark, 1973; Winkler and others, 1981; Plafker and others, 1989; Burns and others, 1991). The McHugh Complex overlies the Valdez Group along the Eagle River thrust fault.

The Upper Cretaceous Valdez Group consists of metamorphosed, rhythmically interbedded graywacke, siltstone, and argillite, some pebble conglomerate, and some mafic tuff. The sedimentary rocks are interpreted as trench-fill and trench-slope deposits (Burns and others, 1991). The thickness of the metamorphosed and deformed Valdez Group is unknown in the Chugach Mountains. To the southeast, on Sanak, Shumagin, Afognak, and Kodiak Islands, correlative strata have been estimated to be 3–5 km thick (Moore, 1973; Nilsen and Moore, 1979). The age of the Valdez Group is Campanian(?) and Maestrichtian (Jones and Clark, 1973). The Valdez Group was accreted between latest Cretaceous and early Paleocene time, prior to deposition of the Orca Group, and it was intruded by widespread felsic plutons and regionally metamorphosed during a thermal event that culminated in early middle Eocene time (48–52 Ma; Hudson and Plafker, 1982; Sisson and Hollister, 1988; Plafker and others, 1989; Burns and others, 1991).

Southeast of the Valdez Group is the Paleocene and Eocene Orca Group of the Prince William terrane, which consists of 6–10 km of interbedded graywacke, siltstone, shale, conglomerate, and minor greenstone that resemble rocks of the Valdez Group (Nelson and others, 1984). The Chugach and Prince William terranes are separated by the Contact fault, a northward-dipping thrust. Between Columbia Glacier and Unakwik Inlet, the Valdez and Orca Groups are intruded by mafic to felsic plutons of Oligocene age (Nelson and others, 1985). The plutons are significant in terms of mineral resources. The mafic rocks (such as the Miners Bay pluton, host for base and strategic metal concentrations) contain disseminated pyrrhotite, pentlandite, and chalcopyrite, and the more felsic plutons contain fluorite, sphalerite, galena, and chalcopyrite (Nelson and others, 1984).

In the western part of the Anchorage quadrangle is the Cook Inlet region. Kirschner and Lyon (1973) discussed the stratigraphy and tectonics of the region. The inlet is underlain by more than 40,000 ft of Mesozoic marine rocks and as much as 30,000 ft of Tertiary estuarine and nonmarine rocks that record three Mesozoic cycles of marine sedimentation and two Tertiary cycles of estuarine and nonmarine sedimentation. Cycles of deposition were interrupted by times of orogeny and corresponding (related) shifts in the depositional center of the proto-Cook Inlet basin. The Tertiary strata contain most of the coal deposits in the Anchorage quadrangle and account for most of the oil and gas production in southern Alaska.

SUMMARY OF GEOPHYSICAL DATA

Three aeromagnetic surveys were made for the Anchorage quadrangle during the 1970's and 1980's, at a barometric elevation of about 300 m above ground level (L.E. Burns, written commun., 1991; Burns and others, in press). The data were corrected for the regional field before being contoured. Burns (written commun., 1991; Burns and others, in press) interpreted the aeromagnetic data, relating the geophysical anomalies to the main rock units causing the anomalies. The magnetic susceptibilities of various units in the adjacent Valdez quadrangle, to the east, were previously determined and reported in Burns (1982) and Case and others (1985). Since these rock units are continuous into the Anchorage quadrangle, their magnetic susceptibilities were not remeasured. Interpretations of aeromagnetic data in the western part of the Anchorage quadrangle were based in part on Grantz and others (1963), Csejtey and Griscom (1978), and Case and others (1979, 1985).

Positive aeromagnetic anomalies probably are related to the discontinuous belt of ultramafic and mafic plutonic rocks of Jurassic age in the northern Chugach Mountains (Burns, 1985). The belt includes the informally named Eklutna (ultramafic) complex of Clark and Greenwood

(1972), the Wolverine Complex of Carden and Decker (1977) and Clark (1972), and the Nelchina River Gabbronorite (Burns, 1985; Burns, written commun., 1988; Burns and others, in press; and Burns and others, 1991). The positive aeromagnetic anomalies suggest that there are large bodies of gabbroic and ultramafic rocks underlying the northern Chugach Mountains and Cook Inlet in the area between the Border Ranges and Castle Mountain–Caribou faults (Burns, written commun., 1991; Burns and others, in press). The positive anomalies, which follow the oroclinal bend of the northern Chugach Mountains, are about 1,000 gammas near the Border Ranges fault, due to the presence of ultramafic rocks or sheared gabbro along the fault, and about 1,500 gammas to the north and northwest of the fault, possibly due to subsurface gabbro. An anomalous area at the head of Knik Arm beneath Duck Flats, called the Knik Arm anomaly by Grantz and others (1963), measures 1,348 gammas. This area is probably underlain by gabbroic rocks. Aeromagnetic and gravity modeling by Burns and others (in press) suggests that the upper surface of the gabbroic rocks dips to the north and northwest at a shallow angle.

Mafic rocks of the Nelchina River Gabbronorite create the greatest magnetic and gravity anomalies (L.E. Burns, written commun., 1991, and D.F. Barnes, written commun., 1991) in the quadrangle; their magnetic susceptibilities are as much as an order of magnitude higher than those of the ultramafic rocks (Case and others, 1985), with some overlap between various rock types. Some of the gabbroic rocks, particularly in the eastern part of the Anchorage quadrangle, contain 5–15 percent modal magnetite (Burns, written commun., 1988).

A magnetic anomaly near the Eklutna (ultramafic) Complex extends along strike beneath the Knik River, for a distance of 7 km northeast of the exposed body. The source rocks for this anomaly probably are ultramafic rocks at shallow depth, concealed by a thin cover of gravel of the Knik River. This anomaly suggests that there are additional areas of low potential for subsurface chromite beneath the surficial deposits.

SUMMARY OF GEOCHEMICAL DATA

The geochemical data served as the basis for outlining many of the areas in this report and for assigning them a mineral resource potential. In 1982–85, the USGS collected samples of stream sediment and panned heavy-mineral concentrate to supplement existing data for a regional geochemical and mineralogical study of the Anchorage quadrangle. U.S. Geological Survey personnel primarily sampled first-order (unbranched) and second-order (below the junction of two first-order streams) streams as shown on USGS 1:63,360-scale topographic maps. At each site, we collected both a stream-sediment sample and a concentrate sample. In addition to sampling sediment from streams, we also sampled sediment from medial and lateral moraines in areas of extensive glacial cover and treated them the same as the samples collected from streams. In the Peninsular terrane, we collected samples of minus-80-mesh stream- and glacial-moraine sediment at 562 sites and the heavy-mineral fraction of the sediment at 524 of these sites. In the Chugach and Prince William terranes, we collected samples of stream and glacial-moraine sediment at 735 sites and the heavy-mineral fraction of these sediment samples at 644 of these sites. Sixteen Chugach terrane samples were composite rock samples collected from nunataks for the purpose of concentrating the heavy minerals. Collection from the nunataks expanded the area sampled for heavy-mineral concentrate into the previously unsampled snowfields of the Chugach Mountains. The nunatak rocks were coarsely pulverized in the laboratory with ceramic plates, panned, and then treated the same way as the other heavy-mineral concentrate.

The multi-element geochemical maps and mineralogical map of the Anchorage quadrangle show sample localities enriched in selected elements (Au, Ag, As, Zn, Cu, Pb, Bi, Sb, Ni, Cr, Cd, Mo, W, and Sn) and ore-related heavy minerals (gold, arsenopyrite, sphalerite, chalcopyrite, galena, cinnabar, cassiterite, and scheelite) (Madden, 1991a,b; Tripp and Madden, 1991). Areas outlined on the geochemical maps generally encompass all potential source areas for the metal-enriched samples. The area boundaries generally correspond to ridge tops separating drainage basins, as do most of the boundaries of the resource-potential areas outlined on these maps. Heavy-mineral concentrate collected in the two gold-mining districts (Willow Creek and Girdwood) is enriched in Au, Ag, As, W, and Pb, and stream sediment is enriched in As, Ag, and Pb. Heavy-mineral concentrate from placer-gold-bearing streams (Boulder Creek, Chickaloon River, Alfred Creek, Metal Creek, Grasshopper Valley), is enriched in Au and Ag, and stream sediment commonly is enriched in As. Sediment draining the Wolverine Complex and Eklutna complex is enriched in Cr, Ni, Cu, and other metals. Additional areas enriched in Au and (or) base metals in concentrate and stream sediment are outlined on geochemical maps (Madden, 1991a,b).

MINERAL RESOURCE POTENTIAL

KNOWN MINERAL OCCURRENCES

Compilations of all known mineral occurrences in the Anchorage quadrangle are available in Cobb (1979) and Bottge and Northam (1986). These compilations can be used with figure 1 and the accompanying resource-potential maps. Gold has been produced from gold-quartz veins and related placer deposits, primarily in the Willow Creek and Girdwood mining districts (Cobb, 1979, and table 1; Madden-McGuire and Tripp, 1993). In the Willow Creek district (northwest part of the quadrangle, in the Peninsular terrane), high-sulfide gold-quartz-carbonate veins cut a 79 to 72 Ma pluton (recording multiple stages of alteration) and adjacent pelitic schist. In the Girdwood district (southwest part of the quadrangle, in the Chugach terrane), Au and Ag are concentrated in quartz-carbonate veins in joints and shears within greenschist-facies metasedimentary rocks of Cretaceous age and quartz diorite (53 Ma) of Tertiary age. On the west side of Nelchina Glacier (far eastern margin of quadrangle), sulfide-rich, gold-bearing veins are exposed and have been prospected. Several gold mines and prospects are in the area of Prince William Sound (southwest part of quadrangle) near Harriman Fiord and the Coghill River. Additional placer gold (and platinum) is in Metal Creek (center of quadrangle) and Alfred Creek (northeast part of quadrangle).

Podiform chromite is in presently subeconomic concentrations within two fault-bounded ultramafic complexes near Eklutna (central western part of quadrangle) and in the upper part of Wolverine Creek (center of quadrangle), on the north side of the Border Ranges fault system (Cobb, 1979; Newberry, 1986; and table 1). Cumulate chromitite is within deformed cumulate dunite and wehrlite.

The quadrangle contains areas with known base-metal veins and massive-sulfide deposits (Cobb, 1979; Jansons and others, 1984; and table 1). Numerous base-metal prospects are in the southeastern corner of the quadrangle, in the Prince William terrane, between Unakwik Inlet and Columbia Glacier. The prospected veins and massive-sulfide occurrences are locally highly enriched in Zn, Cu, Pb, and Ag. Other known occurrences of base-metal concentrations are in the Sheep Mountain (Cobb, 1979; Newberry, 1986) and Jim Creek areas (Cobb, 1979).

The Wishbone Hill coal-mining district, once called the "only producing bituminous coal district in Alaska" (Barnes and Payne, 1956), produced high-volatile B bituminous coal, some with fair to poor coking properties. Coal production was 3,284,723 million short tons between 1916 and 1952, with almost one-third of that total produced between 1916 and 1934 (Barnes and Payne, 1956). The Chickaloon district (Castle Mountain, Chickaloon, and Coal Creek mines) produced considerably less coal (bituminous, high-volatile A with strong coking properties), due to complex structure and lateral discontinuity of coal beds (Warfield, 1967; Warfield and Landers, 1966). Subbituminous and bituminous coal was mined near Houston, where about 10,000 tons were produced between 1917 and 1920 (Barnes and Sokol, 1959) and 65,000 tons between 1948 and 1952 (Conwell and others, 1982).

Gold-bearing Quartz-carbonate Veins (Au ±Ag) in the Peninsular Terrane (Map A, Table 3)

The area that includes the Willow Creek gold-mining district, area G1a in the northwestern part of the quadrangle, is assigned a high potential (certainty level D) for gold-quartz veins (map A). In the Willow Creek mining district, gold-enriched veins are in a 79–72 Ma, propylitically altered pluton and in an adjacent pelitic schist. The pluton is zoned with an outer margin of hornblende-quartz diorite and hornblende tonalite and a core of hornblende-biotite granodiorite and biotite-quartz monzonite (Winkler, 1990). Mineralized veins are near the contact between the zoned pluton and the pelitic schist; the contact is interpreted to be a fault that may have served as a conduit for ore-forming fluids at 66 Ma and 57–55 Ma (Madden-McGuire and others, 1989). Adjacent granite (67 and 65 Ma) to the northwest is barren of gold-bearing quartz veins and might have formed after the main period of mineralization. Gold-quartz veins in the zoned pluton are in shear zones, where they formed by cavity filling during shearing. The gold is concentrated in fractures within the quartz. Samples containing hundreds of parts per million (ppm) Au are immediately adjacent to barren outcrops along strike and up- or down-dip within the gold zone (Dorff, 1984). The ore is free-milling gold, meaning that it can be mechanically separated from the rock. The ore is in quartz, with minor pyrite, arsenopyrite, sphalerite, chalcopyrite, tetrahedrite, galena, scheelite, stibnite(?), and telluride minerals including nagyagite (Ray, 1954). In the pelitic schist, gold is in shear zones of comminuted schist with calcite, quartz, albite, chlorite, muscovite, pyrite, marcasite, arsenopyrite, chalcopyrite, sphalerite, and very fine-grained cerrusite or anglesite (Madden-McGuire and others, 1989).

Silberman and others (1978a, 1978b, and 1979) published the first isotopic ages in the Willow Creek district, in conjunction with reconnaissance geochemical data and interpretations from the district. Burleigh (1987 and 1988) discussed mineralization in the Willow Creek district. Madden and others (1987) and Madden and others (1989) discussed mineralization, plutonism, and faulting in the Willow Creek district. They presented several alternative hypotheses regarding how mineralization fits into the geologic history of the area.

Lode gold production from the Willow Creek district has been most significant from veins cutting the zoned pluton. The first lode claims were staked in 1906 at the site of the Martin mine; the first production came from the Independence mine, which operated continuously until 1951 (Dorff, 1984). Total production (1909 to 1950) from the Willow Creek district was 623,874 ounces (oz) (Dorff, 1984), mostly from lode deposits. The district was the second largest gold producer in Alaska between 1931 and 1942. The Independence mine was allowed to operate during World War II (until the fall of 1943), despite Presidential Order L–208 closing all gold mines in the country, because the Independence mine produced minor amounts of scheelite (Cohen, 1982; Dorff, 1984). After the wartime ban was lifted in late 1945, the mine never was so productive again due to lawsuits, labor problems, and the increased expenses of mining (Cohen, 1982). The Independence mine (and Gold Bullion, Martin, Mabel, War Baby, and Lucky Shot mines) reopened in the early 1980's for several years of development work, closed in the mid 1980's without significant production, then reopened in 1987. In 1987, the Independence mine produced 1,050 tons of ore (Schneider, 1989). Quartz veins in the district are locally enriched in gold: as much as 440 ppm in the Gold Bullion mine (based on analyses of 10 grab samples), 180 ppm and 160 ppm in the Independence mine (based on 22 grab samples), 180 ppm in the Mabel mine (3 samples), and 130 ppm in the Eldorado mine (2 samples) (Madden and others, 1988; M.L. Silberman, USGS, unpub. data, 1991).

Geochemical and mineralogical study of heavy-mineral concentrate samples collected from the Willow Creek area (G1a) contained visible gold in ten samples and enrichment of Ag, As, Sb, and Pb in some of the ten samples. USGS stream-sediment samples in area G1a showed As enrichment in 15 samples, including one sample that contained 600 ppm As and several other samples that contained 200, 160, and 150 ppm As (Arbogast and others, 1987). Stream sediment, which was sampled and analyzed during the NURE program (Zinkl and others, 1981), is locally enriched in As (as much as 184 ppm) within the outlined area.

The Willow Creek gold district, and the host rocks that are favorable for gold-quartz veins, are exposed north of the Castle Mountain fault. Boundaries for the high-potential gold area, G1a, including Willow Creek, are drawn north of the Castle Mountain fault, so as to enclose (1) abandoned gold mines in the Willow Creek mining district, (2) drainages where gold was found in heavy-mineral concentrate, (3) adjacent drainages where As was enriched in NURE stream-sediment samples, and (4) geologically favorable host rocks, such as the zoned pluton, the pelitic schist, and the unnamed fault along the contact between them. The southern boundary coincides with the surface expression of the Castle Mountain fault. The boundary is this far south, because arsenic is enriched in stream sediment collected from drainages on the north side of the fault. The northern boundary coincides with the contact between gold-bearing granodiorite and barren granite. The northeastern boundary corresponds to drainage divides and encloses abandoned gold mines and nearby drainages containing gold in heavy-mineral concentrate. The western boundary encloses gold-bearing drainages and separate, but adjacent, As-enriched drainages identified by NURE stream-sediment analyses.

Area G1b is defined on the basis of aeromagnetic data. The aeromagnetic pattern over the Willow Creek gold-mining district suggests that the gold-bearing plutonic host rock is more magnetic than surrounding rocks (Burns, written commun., 1991; Burns and others, in press). The pattern of slightly anomalous signatures extending west-southwest from the mining district might reflect subsurface igneous rocks that could be related either to Tertiary intrusions (Burns and others, in press), the serpentinite exposed in the Willow Creek area, a subsurface extension of the anomalous gold-bearing pluton exposed in Willow Creek, or an extension of the barren plutonic unit exposed in Willow Creek (area G1b). Because of the possibility that the aeromagnetic pattern might indicate a subsurface extension of the gold-bearing pluton, area G1b is assigned a low potential (certainty level B) for gold-quartz veins. Granitic rocks, white to light gray, with abundant mica, quartz, and feldspar, are in the subsurface at depths of 1,700–1,800 ft along the trend of the aeromagnetic pattern in sec. 13, T. 17 N., R. 6 W., and sec. 24, T. 18 N., R. 5 W. (Conwell and others, 1982).

On the west side of the Nelchina Glacier, area G2 exposes sulfide-rich, gold-bearing veins (Henning and Pessel, 1980; Newberry, 1986) and is therefore assigned a moderate potential for lode gold (certainty level D). An irregular northeast-trending felsic aphanite-matrix breccia, within a major dike system, is cut by northwest-trending calcite-siderite-sulfide veins containing as much as 35.9 ppm Au, 150 ppm Ag, 1,279 ppm As, 9.3 percent Pb, 2.7 percent Zn, and 5,900 ppm Cu (Henning and Pessel, 1980; Newberry, 1986). The mineralogic source of the Au and Ag was not determined (Henning and Pessel, 1980). Newberry (1986) estimated about 500 tons of rock containing 0.5 oz per ton Ag and several percent Zn and Pb. In spite of the local, Au-enriched bedrock, gold was not found in nearby USGS samples of heavy-mineral concentrate, nor were USGS samples of stream-sediment enriched in Au (Arbogast and others, 1987). One slight anomaly of 200 ppm Cu from a concentrate sample is nearby (Arbogast and others, 1987), but no chalcopyrite, galena, or sphalerite were found in nearby samples of heavy-mineral concentrate.

A low potential (certainty level B) is assigned to several areas that contain gold in heavy-mineral concentrate (and local, sparse Au enrichment in stream-sediment samples). These areas are underlain partly by Jurassic plutonic rocks, but they contain little or no Au-enriched outcrops. The areas (G3a, G3b, G3c, and G3d) include four drainages within the Chickaloon River basin with anomalous amounts of Ag and As in some heavy-mineral concentrate samples and some metal-enriched rocks. For example, metal-enriched plutonic rocks exposed on a ridgetop in area G3A contain 1–5 ppm Ag, 1,500–20,000 ppm Cu, 320 ppm As in one sample, and as much as 0.01 ppm Au (Madden and others, 1988). Area G4 is a small drainage on the east side of the South Fork river with anomalous amounts of As in heavy-mineral concentrate. The Jurassic plutonic units underlying these areas may contain gold-quartz veins, but they are assigned a low potential because they do not host significant concentrations of Au in other areas.

Gold is enriched in stream sediment, but not in heavy-mineral concentrate, in area G5 on the south side of

Matanuska Peak and in area G6 north of Wolverine Creek. Area G5, on the south side of Matanuska Peak, yielded a stream-sediment sample containing 0.03 ppm Au (S.H.B. Clark, unpub. data, 1990). The adjacent ridgetop on the southeast side of this drainage exposes a very fine grained, altered diorite containing 1,000 ppm Zn and lacking detectable Au, Ag, or As (Madden and others, 1988). North of Wolverine Creek, in area G6, a stream-sediment sample derived from Jurassic plutonic rocks contained 0.8 ppm Au (S.H.B. Clark, unpub. data, 1990); an adjacent drainage to the east yielded a heavy-mineral concentrate sample enriched in Ag (Arbogast and others, 1987). The ridge separating the two drainages exposes an iron-stained tonalite that contains 7 ppm Ag and no detectable Au (at a detection level of 0.002 ppm) or As (Madden and others, 1988). Areas G5 and G6 are assigned a low potential (certainty level B).

Gold-bearing Quartz-Carbonate Veins (Au±Ag) In the Chugach and Prince William Terranes (Map A)

In the Chugach terrane, gold-enriched quartz veins are concentrated in areas underlain by metasedimentary rocks of the Valdez Group that have been regionally metamorphosed to medium greenschist facies (characterized by incipient growth of biotite in graywacke) and, locally, in thermally metamorphosed rocks adjacent to plutons where the pressure and temperature (P–T) conditions were similar to those of medium-grade greenschist-facies metamorphism (Goldfarb and others, 1986). Rocks of the Orca Group generally have been metamorphosed under lesser P–T conditions and do not contain significant gold occurrences, except locally near plutons where adjacent country rocks were sufficiently heated. The vein-forming fluids were produced from metamorphic devolatilization during Tertiary regional metamorphism. Mineralization is younger than 53 Ma in the Girdwood district (veins cut hornfels adjacent to a 53 Ma stock, Goldfarb and others, 1986) and younger than 34 Ma in the Port Wells district, where veins cut a 34 Ma stock (Lanphere, 1966). Vein emplacement followed hydraulic fracturing during uplift of the region (Goldfarb and others, 1986). Veins consist mostly of quartz, injected in multiple stages, and later calcite and ankerite with traces of gold and sulfide minerals. Arsenopyrite is the most abundant and earliest sulfide mineral to form, and is followed by pyrite, pyrrhotite, sphalerite, galena, chalcopyrite, and sparse stibnite (Goldfarb and others, 1986).

The entire Valdez Group within the Anchorage quadrangle is considered permissive for gold- and silver-bearing quartz veins, but areas where gold is in heavy-mineral concentrate are more likely to contain gold-quartz veins and are assigned a higher potential. The Valdez Group is bounded by the Border Ranges and Eagle River faults to the north and it extends to the quadrangle boundaries to the south and east. Much of the area underlain by the Valdez Group is assigned a low potential (certainty level C), because gold was not detected in heavy-mineral-concentrate samples from the area (these areas are labeled LC and are not numbered on map A). However, large parts of this low-potential area were not sampled thoroughly because these areas were nearly inaccessible. The relatively low sampling density might explain the lack of gold in concentrate samples.

Area G7, including the Girdwood gold-mining district, is assigned a high potential (certainty level D) for Au and Ag concentrated in quartz-carbonate veins in shear zones and joints within metasedimentary rocks of the Valdez Group. Within the district, abandoned lode gold mines in upper Crow Creek produced 4,932 oz Au from veins in the Monarch and Jewel mines, mostly between 1937 and 1942 (Cobb, 1979; Jansons and others, 1984). A lesser known, Ag-rich prospect in upper Eagle River contains 1.5 ppm Au and 855 ppm Ag (Cobb, 1979). Heavy-mineral concentrate samples from Crow Creek and from surrounding drainages contain gold (and in some places also are enriched in Ag, As, and Sb). Boundaries of the Girdwood area (G7) were drawn so as to enclose the abandoned gold mines and the drainages where gold was found in heavy-mineral concentrate. The boundaries are drawn to the south of the Eagle River fault; the area is underlain by metasedimentary rocks of the Valdez Group, which are cut by intrusions of quartz diorite (Park, 1933) that are generally too small to show at the scale of the geologic map.

Two areas in the southeastern part of the quadrangle are assigned a moderate potential (certainty level D) for gold-quartz veins: the areas around Harriman Fiord (G8) and the Coghill River (G9). The Harriman Fiord area (G8) includes gold-quartz veins at a mine and two prospects, gold in heavy-mineral concentrate, Ag and As enrichment in heavy-mineral concentrate, and Au enrichment in stream sediment (0.31 ppm in one sample and 0.13 ppm in two other samples; S.H.B. Clark, unpub. data, 1990). The "Alaska Homestake" gold mine produced 83 oz. of gold and 33 oz. of Ag (Jansons and others, 1984). Rock samples from the Olson and Viette prospect and an unnamed prospect near Lagoon Creek contained 2.4 ppm and 0.15 ppm Au and were assigned low mineral development potential by Jansons and others (1984). In the Coghill River area (G9), outcrops of gold-quartz veins on the margin of a small granitic stock contain 16 ppm Au and 38 ppm Ag (Jansons and others, 1984). Heavy-mineral concentrate contains gold and anomalous amounts of Ag.

Area G10, between the Marcus Baker Glacier and the Matanuska River, on the south side of the Border Ranges fault system, is assigned a moderate potential (certainty level C) for gold-bearing quartz-carbonate veins. The area exposes mineralized base-metal-enriched and gold-enriched quartz veins in altered, iron-stained metasedimentary and plutonic (quartz diorite) intrusions (Richter, 1967; Cobb, 1979; Madden and others, 1988). The veins contain as much as 0.25 ppm Au, 5 ppm Ag, 2,000 ppm As, 2,000 ppm Cu, and >2,000 ppm Zn (Madden and others, 1988). The local Zn enrichment in rocks has not produced a corresponding Zn enrichment in stream sediment in this area. Only one stream-sediment sample, in Grasshopper Valley, contains 200 ppm Zn. This one sample is unrelated to the known mineralized areas. Heavy-mineral concentrate in the lower half of the Grasshopper Valley drainage contains chalcopyrite (eight samples), sphalerite (three samples), galena (seven samples), and arsenopyrite (13 samples), as well as gold. Many heavy-mineral concentrate samples collected throughout area G10 are enriched in Ag, As, and Sb.

Drainages within the Valdez Group that contain gold in heavy-mineral concentrate but lack any known gold prospects or occurrences of mineralized rocks are assigned a moderate potential (certainty level B), and they are described in the following list. (G11)—Gold was found in a heavy-mineral-concentrate sample collected in a tributary north of Friday Creek. The stream drains exposures of the Valdez Group immediately south of the Border Ranges fault; (G12)—Indian Creek, southeast of Anchorage, on the southeast side of the Eagle River fault; (G13)—An area southeast of Mount Gordon Lyon (near the military ski slope), on the south side of the Eagle River fault; (G14)—The northeast side of Harp Mountain, north of the Eagle River fault; (G15)—The middle part of Peters Creek drainage basin; (G16)—Southeast side of Pioneer Peak, south of Border Ranges Fault; (G17 and G18)—Two areas west of Hunter Creek; (G19)—East side of Mt. Palmer; (G20)—The area between Hunter Glacier and Troublesome Creek; (G21)—East side of Lake George; (G22)—Metal Creek, south of the Eagle River and Border Ranges faults; (G23)—The area north of Glacier Fork; (G24)—The area below Gannett Glacier, on the south side of the Knik Glacier; (G25 and G26)—Two areas between the Knik and Marcus Baker Glaciers; (G27)—Two unnamed glaciers north of Marcus Baker Glacier; (G28 to G30)—Three areas in the upper part of the Knik Glacier; (G31)—South side of Mt. Wickersham, south of the Border Ranges fault; (G32)—Area on the east side of the Matanuska Glacier; (G33)—The area in the upper part of the Matanuska Glacier; (G34)—The area of Finland, Sweden, Norway, and Denmark Peaks, which extends northward to the Border Ranges fault; (G35)—The area on the east side of South Fork, just below an unnamed glacier; (G36 and G37)—Two areas on the west side of Powell Glacier; (G38 and G39)—Two areas east of Powell Glacier (between Powell and Sylvester Glaciers); (G40)—The area between Sylvester and Tarr Glaciers; (G41)—East side of lower Sylvester Glacier; (G42 and G43)—Three areas on the south side of the Border Ranges fault, one east of South Fork and two next to the Nelchina Glacier; (G44)—The area between Mt. Marcus Baker and Harvard Glacier; (G45)—Upper Harvard Glacier; (G46)—Upper Yale Glacier; (G47)—Area on south side of lower part of Harvard Glacier; (G48)—The area between Yale and Meares Glaciers; (G49)—The area southwest of Meares Glacier; (G50)—An area on the southeast side of College Fiord; (G51)—Muth Glacier; (G52)—The area northwest of Jonah Bay; (G53)—Amherst and Lafayette Glaciers (bounded to the south by quadrangle border); (G54)—Mount Emerson; (G55)—The area east of Unakwik Inlet and northwest of the Contact fault; (G56)—The area south of Pedro Glacier, on the north side of the Contact fault; and (G57 and G58)—Two areas next to the Columbia Glacier, near its First Branch. Area G50, on the southeast side of College Fiord, reportedly contains one gold-quartz vein occurrence, which Jansons and others (1984) were unable to locate. USGS heavy-mineral-concentrate samples in this area were enriched in Au and Ag.

Area G59, southwest of Mt. Curtis, is assigned a low potential (certainty level D). The Mt. Curtis area was reported to contain eight occurrences of gold-quartz veins (Cobb, 1979; Jansons and others, 1984), but only two prospects were located and these contained only a trace of gold and 9 ppm Ag (Jansons and others, 1984). Heavy-mineral-concentrate samples near Mt. Curtis lacked gold, although Ag was enriched in one sample. Despite all the prospecting, no significant gold-quartz veins have yet been found.

Sedimentary rocks of the Orca Group generally lack gold-bearing quartz veins, but one exposure of the Orca Group near the Columbia Glacier contributed gold to the heavy-mineral fraction of a glacial-moraine sediment sample. Area G60, which contains this exposure, is assigned a low potential (certainty level B).

The McHugh Complex consists of metaclastic and metavolcanic rocks that are only weakly metamorphosed regionally to prehnite-pumpellyite facies (Clark, 1973). Although the McHugh has not proved to be a favorable host-rock unit for veins that are significantly enriched in gold (except locally in Peters Creek, as reported by Cobb, 1979), gold does occur in heavy-mineral concentrate (and Au is enriched in some stream-sediment samples) in areas draining the McHugh Complex. These drainages are assigned a low potential (certainty levels B and C) for gold-enriched quartz veins, and the drainages are described in the following list. (G61)—Several drainages southeast of Anchorage, between Avalanche Mountain and McHugh Peak on the northeast side of the Eagle River fault, contain gold in heavy-mineral concentrate and detectable Au in a few stream-sediment samples (0.03 ppm Au in one sample and 0.07 ppm Au in two samples, S.H.B. Clark, unpub. data, 1990). (G62)—East of Anchorage in the Chugach State Park, an area that includes Flute Glacier (between Ship Creek and the Eagle River) on the southeast side of the Eagle River fault, contains a Au-enriched stream sediment sample (0.2 ppm Au, S.H.B. Clark, unpub. data, 1990); and local As enrichments in heavy-mineral concentrate; (G63)—The northeast side of Pioneer Peak, north of the Eagle River fault, contains Au-enriched stream sediment (0.1 ppm Au in two samples, S.H.B. Clark, unpub.data, 1990) derived from the McHugh Complex; (G64)—The upper part of Peters Creek, near Mt. Yukla, Bellicose Peak, and Peeking Mountain, south of the Eagle River fault, contains gold and local enrichments of Ag and As in heavy-mineral concentrate derived from the allochthon (upper plate) of the Eagle River fault. Cobb (1979) described a gold-enriched quartz vein (with pyrite, galena, chalcopyrite, and 53 ppm Au) in greenstone of the McHugh Complex in the upper part of Peters Creek, which raises the level of certainty to C for this area.

Volcanic, Hypabyssal Intrusive, and Tertiary Paleoplacer Gold In the Peninsular Terrane (Map A)

Gold was found in heavy-mineral concentrate from areas that are underlain by (1) volcanic and sedimentary rocks of the Upper Triassic(?) and Lower Jurassic Talkeetna Formation, which has geologic potential for stratiform and strata-bound sulfide deposits with slight gold enrichments; (2) Tertiary (Paleocene to Miocene?) volcanic and hypabyssal intrusive rocks with siliceous rhyolitic domes in the basal part, which contain local base-metal anomalies (Madden and others, 1988) and may contain associated epithermal gold deposits, and (3) Tertiary sedimentary rocks that have potential for paleoplacer deposits (map A).

Area MG1, which is the middle part of the Boulder Creek drainage (north of Anthracite Ridge and east of Puddingstone Hill), is assigned a low potential for gold concentration (certainty level C). Geologic and geochemical characteristics described below suggest that the area is favorable for relatively low levels of gold concentration associated with possibly syngenetic base-metal enrichments in Lower Jurassic and Upper Triassic(?) volcanic rocks of the Talkeetna Formation and with base-metal enrichments in Tertiary hypabyssal intrusions; the few available analyses for Au from volcanic bedrock show relatively low amounts (0.1 ppm Au and 10 ppm Ag) as described below. Heavy-mineral concentrate from Boulder Creek contains gold, but not chalcopyrite, so Boulder Creek (MG1) is not assigned any copper resource potential. Because of the gold in heavy-mineral concentrate, middle Boulder Creek is assigned a low potential for gold (in addition to base-metals—see below).

Mineralized rocks in area MG1 are exposed in two small side drainages on the north side of Boulder Creek, where the Talkeetna Formation (and possibly adjacent units) is altered along fractures trending about N. 55° W. Rocks are locally silicified, brecciated, intruded by dikes, and contain visible pyrite. Altered rocks contain 0.1 ppm Au, 10 ppm Ag, and enrichments in base metals (as much as 2 percent Cu, 5,000 ppm Pb, >2,000 ppm Zn, and 3,000 ppm Ba; Madden and others, 1988), based on analyses of nine grab samples. Newberry (1986) interpreted similar mineral occurrences in the Talkeetna Formation as being originally syngenetic and localized by structures. Although the volcanic and sedimentary rocks of the Talkeetna Formation are locally mildly Au-enriched in the Anchorage and Valdez quadrangles, as described by Newberry (1986), they are not known to host any significant gold deposits. The northeastern part of area MG1 exposes a felsic border phase of an Eocene hypabyssal intrusion along a fault on the east side of Boulder Creek. The margin of the intrusion contains disseminated sulfide minerals and 0.052 ppm Au, 500 ppm Ag, 500 ppm Cu, 2,000 ppm Pb, and 1,500 ppm Zn (Madden and others, 1988). Tertiary felsic volcanic rocks to the north in the Talkeetna Mountains quadrangle contain gold and copper occurrences (Singer and others, 1978).

The boundaries of the middle Boulder Creek area are defined by the altered and metal-enriched outcrops described above, as well as the adjacent drainages where gold was found in heavy-mineral concentrate. Areas of less certain potential, lacking known mineralized outcrops, are to the east and west.

Areas that contain gold in heavy-mineral concentrate (and local sparse Au enrichment in stream-sediment samples), but have no known Au-enriched bedrock, are assigned a low potential (certainty level B). These areas are underlain by volcanic rocks of the Talkeetna Formation, Tertiary volcanic and hypabyssal intrusive rocks, and (or) Paleocene and Eocene siliciclastic sedimentary units that are permissive for paleoplacer gold deposits (though none have been reported). The areas are MG2, the south side of Eska Mountain; MG3, a small drainage on the south side of Castle Mountain; MG4, MG5, MG6, and MG7, parts of five drainages in the Chickaloon River basin (with Ag and As in some heavy-mineral concentrate); MG8 and MG9, upper and lower parts of Boulder Creek (with Ag and As enrichments in heavy-mineral-concentrate samples); MG10, Strelshla Mountain (with Ag enrichment in heavy-mineral concentrate); MG11, lower part of Fortress Creek (with Ag enrichment in heavy-mineral concentrate, but no Ag or As enrichments in rock samples collected in the area); MG12, East Fork Creek (Ag and As also enriched in heavy-mineral concentrate); and MG13, the drainages of Caribou and Alfred Creeks.

Placer Gold and Platinum (Au, Pt) (Map B, Table 4)

Area PG1, which includes the Willow Creek mining district, is assigned a high potential (certainty level D) for gold-bearing placers (map B), particularly Willow Creek, Grubstake Gulch, and Wet Gulch. Placer gold has been mined since 1897 from Willow Creek and Grubstake Gulch, and briefly in 1906 from the lower part of Fishhook Creek, which proved to be uneconomical because of large boulders (Cobb, 1979). In 1990, the district supported several small placer operations, two on Willow Creek and one on the Little Susitna River (Swainbank and others, 1991). USGS heavy-mineral-concentrate samples contained gold from all the above-mentioned streams, plus from Craigie Creek. During the early 1990's, placer gold was still being mined from Willow Creek, just below the mouth of Grubstake Gulch.

The Alfred Creek drainage, area PG2, is assigned a moderate potential (certainty level D) for placer gold and a low potential (certainty level B) for placer deposits of platinum. Placer gold was discovered there in 1911 and it was mined for decades; small-scale mining was continuing there at the time of these investigations (early 1980's). However, only a few USGS heavy-mineral concentrate samples from Alfred Creek contain gold (five samples from Alfred Creek and two tributaries out of a total of 28 samples in the whole drainage). Therefore, we believe that the area has only a moderate potential for additional discoveries. At the northeast end of the Alfred Creek drainage near Table Mountain, placer gold was found in South Creek in 1913 and in Poorman Creek in 1914 (Cobb, 1979). However, our heavy-mineral-concentrate samples from near Table Mountain lacked gold. Brooks (1925) and Cobb (1979) reported small quantities of platinum in the placers. The source of the platinum is uncertain. Perhaps it came from paleoplacer deposits in Jurassic sedimentary rocks in the Alfred Creek drainage.

Caribou Creek, area PG3, is assigned a low potential (certainty level C). Mining was reported in 1912 (Cobb, 1979), but there was no sign of operations during the early 1990's. Many USGS heavy-mineral-concentrate samples were enriched in Au in Caribou Creek.

Boulder Creek, area PG4, is assigned a moderate potential (level of certainty C) for additional occurrences of placer gold in small quantities. Mendenhall (1900) described small placer-gold prospects in the lower part of Boulder Creek as the best ones in the area (Cobb, 1979, localities 86 and 87). Gold prospects were reported in and below the canyon, but there are no records of commercial production (Cobb, 1979) and there was no sign of operations during the early 1990's. Four out of sixteen USGS heavy-mineral concentrate samples contained gold in the drainage, and some of these gold-bearing samples were enriched in As and Ag. Platinum is included as a commodity for Boulder Creek placers according to J.Y. Foley of the USBM (written commun., 1991).

The Chickaloon River, area PG5, is assigned a low potential (certainty level C). Placer-mining was reported in the early 1900's, but the mine locations were thought to be in the upper part of the river, perhaps north of the Anchorage quadrangle (Cobb, 1979). Gold also was reported from the lower part of the river, near the mouth of Boulder Creek. Only three out of twenty USGS heavy-mineral-concentrate samples were enriched in Au (and Ag). Felsic volcanic rocks north of the Anchorage quadrangle host copper and gold occurrences (Singer and others, 1978).

The area that includes the Girdwood mining district, area PG6, particularly Crow Creek, is assigned a high potential (certainty level D) for placer gold. Placer-gold deposits on Crow Creek were first claimed in 1896 or 1897, were mined continuously until World War II (Cobb, 1979), and were mined sporadically since then. Most mining was done near the southern boundary of the Anchorage quadrangle. Crow Creek has been the largest producing placer-gold stream in the Chugach National Forest, producing about 42,500 oz. between 1898 and 1982 (Jansons and others, 1984). Production between 1979 and 1983 was 400 oz; recreational mining was popular in 1981–82. The inferred placer gold reserve in Crow Creek, within and south of the Anchorage quadrangle, is estimated at >1,000,000 cubic yards of gold-bearing gravel (Jansons and others, 1984). USGS heavy-mineral-concentrate samples from the Girdwood area contain gold in the upper parts of Crow Creek, Raven Creek, Bird Creek, North Fork of Ship Creek, and Glacier Creek, but creeks other than Crow Creek may contain placer deposits with only subeconomic quantities of gold (Jansons and others, 1984).

Area PG7, the Metal Creek drainage basin, is assigned a moderate potential (certainty level C) for placer gold and a low potential (certainty level B) for placer platinum; the basin was mined early in the 1900's, and some USGS heavy-mineral-concentrate samples contain gold. Placer gold was discovered in Metal Creek in about 1906 and mined sporadically for about 20 years in the early 1900's (Richter, 1967; Cobb, 1979). Three grains of native silver were found in one sample of placer-gold concentrate (Richter, 1967; Cobb, 1979). USGS heavy-mineral-concentrate samples from Metal Creek and four tributaries were enriched in Au; upper Cottonwood Canyon, the canyon north of Paradise Creek, and the first and third canyons south of Metal Creek Glacier contained gold in heavy-mineral concentrate. No sign of placer-mining operations was seen in the early 1980's. The occurrence of platinum is disputable. Placer platinum was reported by Smith (1926), but not by Richter (1967).

Area PG8, between Marcus Baker Glacier and the Matanuska River (including the upper parts of Gravel Creek and Grasshopper Valley), is assigned a low potential (certainty level B) for placer gold deposits. Many heavy-mineral-concentrate samples throughout the area contained gold, but the fluvioglacial setting might be less favorable for the development of placer deposits than the more fluviatile settings of Metal Creek and Crow Creek.

Podiform Chromite (Cr) and Platinum-group Elements (PGE's) (Map B, Table 5)

Podiform chromite is within two fault-bounded ultramafic complexes on the north side of the Border Ranges fault system (map B): the informally named Eklutna (ultra-mafic) complex of Clark and Greenwood (1972; described by Rose, 1966) and the Wolverine Complex of Carden and Decker (1977; first studied and described by Clark, 1972) in areas C2 and C4. The chromitite generally is within dunite cumulates, and less commonly within harzburgite and wehrlite. USGS and NURE stream-sediment samples from basins draining the exposed ultramafic complexes are enriched in Cr and Ni (Arbogast and others, 1987). According to Newberry (1986), the north-central Chugach Mountains have chromite resource potential; however, the lateral continuity of individual chromite-bearing horizons is poorly known, so tonnages can only be estimated. The chromite-rich "Twin Peaks ridge" prospect (area C1) within the Eklutna (ultramafic) complex and Newberry's (1986) chromite-rich prospects in area C3 (two outcrops that are only 500 ft apart, within the Wolverine Complex) are assigned a moderate potential for chromite (certainty level D). Adjacent outcrop areas of ultramafic and gabbroic rocks of the Eklutna complex (area C2) and the Wolverine Complex (area C4) are assigned a moderate potential for chromite (certainty level C), because no significant concentrations of chromite have been reported (map B).

Within the Eklutna complex (area C2), Cobb (1979) listed five, separate, subeconomic exposures of chromitite. Newberry (1986) described an igneous stratigraphy of cumulate dunite and chromitite grading up into wehrlite, clinopyroxenite, and gabbronorite. Layers of chromitite (deformed by magmatic or early postmagmatic processes) are restricted to olivine cumulates, and the area of abundant high chromitite apparently is quite limited; chromitite bands and layers cannot be extrapolated more than 100 ft along strike or down dip (Newberry, 1986). At "Twin Peaks ridge" (area C1), which exposes the richest chromite concentrations found in the Eklutna complex, Newberry estimated 50,000–100,000 tons of 8 percent Cr_2O_3.

The Wolverine Complex (area C4), 25 mi to the east-northeast, consists of fault-bounded blocks of dunite-wehrlite-harzburgite, gabbro-clinopyroxenite, and amphibolite-metachert; chromitite is in layers separated by dunite and minor wehrlite (in fault contact with gabbronorite) and in lenses and deformed nodules interlayered within harzburgite and dunite (Newberry, 1986). Chromitite layers are sheared into elongate bodies along faults; structural complexity suggests that effective exploration for chromite would be difficult here, but more mapping is needed (Newberry, 1986). Newberry (1986) estimated 100,000–300,000 tons of 8 percent Cr_2O_3 and 20,000–40,000 tons of 10 percent Cr_2O_3 in the richest parts of the Wolverine Complex (area C3). Worldwide, cumulate ultramafic rocks comparable to the Eklutna complex and Wolverine Complex rarely contain significant chromite (Newberry, 1986).

A magnetic anomaly between the Eklutna complex and Wolverine Complex suggests that ultramafic rocks are beneath gravel of the Knik River. This area (C15) is assigned a low potential for chromite (certainty level B), based on the magnetic data.

Outcrop areas C1, C2, C3, and C4 of the Eklutna complex and Wolverine complex are assigned a low potential (certainty level D) for platinum-group elements (PGE's). Rocks sampled from the Eklutna complex contain a maximum of 0.1 ppm Pt (mean of 0.042 ppm Pt) and a maximum of 0.14 ppm Pd (mean of 0.04 ppm), based on analyses of an unstated number of samples (Clark and Greenwood, 1972); rocks sampled from the Wolverine complex contain 0.007–0.05 ppm Pt, and 0.002–0.04 ppm Pd, based on analyses of 16 samples (Clark, 1972). Later analyses of 10 samples from the Eklutna (ultramafic) complex showed similar results: the ten samples contained an average of 46 ppb Pt, 40 ppb Pd, and maximums of 100 ppb Pt and Pd (J.Y. Foley, USBM, written commun., 1991). One sample of coarse-grained clinopyroxenite contained 94 ppb Pt and 91 ppb Pd (J.Y. Foley, USBM, written commun., 1991).

Along the strike of the Border Ranges fault system, in drainages where no ultramafic rocks are mapped, USGS and NURE stream-sediment samples were enriched in Cr (and Ni). These drainage areas C5, C6, C7, C8, C9, C10, and C11, which are underlain by faulted metamorphic basement rocks and by plutonic rocks of a Jurassic island-arc sequence (Burns, 1985), are assigned a low potential for chromite (certainty level B). The areas are assigned a potential based on the stream-sediment anomalies and the possibility that small, unmapped chromite-bearing outcrops of ultramafic rock might be discovered along faults. An Early and Middle Jurassic gabbronorite (unit Jg, Winkler, 1990), which contains local outcrops of totally to partly serpentinized ultramafic rocks, is mapped in some of these drainages. Some of these areas of low potential are adjacent to drainages that enclose ultramafic rocks and form one continuous, elongate area (area C6), whereas others are separate areas (one area near Pinnacle Mountain, C7; three areas between Coal Creek and the Matanuska Glacier, C8, C9, and C10; and an area on the west side of the Nelchina Glacier, C11).

Southeast of Anchorage, in the upper part of the Ship Creek drainage, Cr and Ni are enriched in stream sediment derived from the McHugh Complex in areas C12 and C13. (Similar stream-sediment enrichments are in area C5.) Though no chromitite concentrations have been reported from these areas exposing the McHugh Complex, they are assigned a low potential for chromite (certainty level B) because of the Cr-enrichments in stream sediment and the fact that the McHugh locally contains ultramafic rocks as small, isolated, discontinuous outcrops or lenticular masses (Clark, 1973).

The areas labeled C14a are in the Willow Creek mining district. Most of the small areas that make up area C14a are labeled LD on the map, because they expose ultramafic rocks. The rest of the C14a areas are labeled LC on the map, because they expose pelitic schist (Jps; LC). The pelitic schist (LC) contains serpentinized dunite and wehrlite-lherzolite (LD) enriched in Cr and Ni (as much as 5,000 ppm Cr and >5,000 ppm Ni; Madden and others, 1988, 1989; Csejtey and Evarts, 1979). Concentrations of Ni are higher than those for Cr in the northwesternmost exposure of serpentinite and concentrations of Cr are higher than those for Ni in other exposures. The foliation in serpentinite is parallel to that in the schist; some exposures suggest that the serpentinite underlies the schist (Madden and others, 1987, 1989). We did not observe chromitite in these rocks, or Cr or Ni enrichments in stream sediment. The areas actually exposing ultramafic outcrops (LD) are assigned a low potential (certainty level D) for chromite; the rest of the pelitic schist (LC) is assigned a low potential (certainty level C), because more, unmapped serpentinite bodies might occur (C14a includes the small outlying areas exposing schist to the east and west of the larger body of schist).

The small areas of C14a that are labeled LD delineate the outcrops of serpentinite and are assigned a low potential (certainty level D) for platinum-group metals. Serpentinite contains a maximum of 0.03 ppm for both Pt and Pd, based on analyses of 10 samples from six different bodies; serpentinite was not analyzed for other PG's (Csejtey and Evarts, 1979). Two samples of talc schist from a soapstone occurrence within the pelitic schist (Jps) contained 0.001–0.003 ppm Pd and no detectable Pt, Rh, Ru, or Ir (Madden and others, 1988).

Porphyry Deposits (Cu) (Map C, Table 6)

Plutons of intermediate composition (diorite, quartz diorite, tonalite, and granodiorite) in the northern Chugach Mountains may have potential for porphyry-copper-gold deposits, based on comparison of these rocks with host rocks for the deposits described by Hollister (1978). Newberry (1986) observed minor malachite staining and pyritic zones, but no sulfide-bearing quartz veins or copper sulfides. In addition, no significant Au enrichment has been found (Newberry, 1986; Madden and others, 1988). Jurassic intermediate plutonic rocks are widespread along an east-west-trending belt on the north side of the Chugach Mountains and also within the southern Talkeetna Mountains. These units are as follows: Late Jurassic trondhjemite (Jtr), Middle Jurassic granodiorite (Jgd), Middle Jurassic quartz diorite (Jqd), Middle Jurassic quartz diorite and tonalite (Jqt), and Early and Middle Jurassic mafic and intermediate plutonic rocks (Jgq) (Winkler, 1990).

Newberry's (1986) prospects are assigned a low potential (certainty level D) and are shown on map C as areas PO1, PO2, PO3, PO4, and PO5. The prospects lack evidence for major hydrothermal systems (for example, sulfide-bearing quartz veins, secondary biotite, potassium feldspar or muscovite, and copper sulfides), contain low copper values (generally less than 100 ppm Cu, but one sample contained 142 ppm Cu), and lack detectable Au in rock samples, suggesting a lack of significant metal deposition (Newberry, 1986). The areas of low potential (certainty level D) are drawn so as to include prospects noted by Cobb (1979) and Newberry (1986) and some adjacent areas underlain by Jurassic plutonic rocks, as follows: areas PO1 and PO2 on either side of Coal Creek (including Newberry's (1986) prospects 25–27), area PO3 between Gravel and Glacier Creeks (including Newberry's (1986) prospects 23 and 24), and areas PO4 and PO5 on either side of South Fork (including Newberry's (1986) prospects 21 and 22, and Cobb's (1979) prospect 49).

Intermediate plutonic units sampled in other areas locally contain as much as 2 percent Cu, but the extent of mineralized rock needs further study. These outcrops and immediately adjacent areas underlain by similar plutonic rocks are enclosed here within areas of moderate potential (certainty level C), which are described in the following list. (PO6)—An area in the southern Talkeetna Mountains, west of the Chickaloon River, where samples of malachite-stained quartz diorite from unit Jgd (Winkler, 1990) contain 1,500–20,000 ppm Cu and 20–50 ppm Mo (Madden and others, 1988). (PO7 and PO8)—Two areas west-southwest and south of Pinnacle Mountain, where tonalite and gabbro contain 500 ppm and 700 ppm Cu, respectively (Madden and others, 1988). (PO9)—The area north of uppermost Wolverine Creek, where tonalite contains 3,000 ppm Cu, 1,500 ppm V, and less than 5 ppm Mo (barely detectable; Madden and others, 1988). (PO10)—The area east of Ninemile Creek, where intermediate plutonic rocks contain as much as 2,000 ppm Cu, 1,500 ppm V, 0.5 ppm Ag, and 0.008 ppm Au. Heavy-mineral concentrate samples lack chalcopyrite in these areas. (PO11)—An area enclosing the Willow Creek mining district, where rock samples contain as much as 8,000 ppm Cu (and >2,000 ppm Mo in one sample of quartz vein from a mine; Silberman and others, 1978b; Madden and others, 1988). Copper-enrichment was first noted by Capps and Tuck (1935), who observed numerous small veins of glassy quartz, containing chalcopyrite and bornite, grading into the plutonic host rock in the Willow Creek district. Ray (1954) noted that the most abundant veins in the Willow Creek district are vuggy, glassy quartz veins characterized by chalcopyrite, molybdenite, and minor pyrite and arsenopyrite. The chalcopyrite is altered to azurite and malachite at the surface. Silberman and others (1978a, 1978b) sought evidence in the Willow Creek district for hypothesized porphyry-type disseminated copper deposits, which are in similar granitic rocks in the eastern Alaska Range. Burleigh (1987, 1988), while carrying out geochemical, stable-isotope, and fluid-inclusion studies of mineralization, noted widespread Cu-Mo quartz veins in the plutonic host rocks of the Willow Creek district.

The remaining areas underlain by favorable geologic units (plutonic rocks of intermediate composition), where Cu is enriched in heavy-mineral concentrate (and stream sediment), are assigned a low potential (certainty level C) for porphyry-copper deposits. Two of these areas (PO12 and PO13) are in the southern Talkeetna Mountains. In area PO12, chalcopyrite was found in one heavy-mineral-concentrate sample just west of and downstream from this area. In area PO13, which is north of the Willow Creek district, three out of about 20 heavy-mineral concentrate samples are enriched in Cu. Two other areas (PO14 and PO15) are in the northern Chugach Mountains on either side of the Matanuska Glacier.

Skarns (Cu±Ag) (Map D, Table 7)

Calc-silicate rocks (skarns) are in (1) marble in amphibolite schist (Newberry, 1986) in unit JPu (Winkler, 1990) in the northern Chugach Mountains and in (2) roof pendants of Upper Triassic(?) marble in the east fork of the Kings River in the southern Talkeetna Mountains. USGS heavy-mineral-concentrate samples in these areas are enriched in Cu (plus or minus Ag and Co), and many stream-sediment samples are enriched in Cu below the skarn exposures. Heavy-mineral-concentrate samples lack chalcopyrite in these areas. All of the sampled outcrops of skarn described below are assigned a low potential (certainty level D) because of low metal grades (map D).

Newberry (1986) recognized sulfide-bearing skarns enriched in Cu and associated metals; for example, Ag and (or) Co, with no significant enrichments in W, in the following areas in the northern Chugach Mountains. (SK1)—In upper Wolverine Creek, where garnet-pyroxene skarn contains 156 ppm Cu, 0.3 ppm Ag, and 2 ppm W along a contact between marble and schist; (SK2)—In upper Carbon Creek, where garnet-epidote skarn adjacent to diorite contains 1 ppm Cu, 0.2 ppm Ag, and 2 ppm W, and garnet-pyroxene-wollastonite skarn adjacent to quartz diorite and diabase dikes contains 429 ppm Cu, 0.2 ppm Ag, and 10 ppm Co; (SK3)—West of the Nelchina Glacier, where garnet-epidote skarn contains 39 ppm Cu, 204 ppm Zn, and 5–8 percent pyrite. Scheelite was found in two heavy-mineral-concentrate samples near the Nelchina Glacier skarn.

In area SK4, in the upper part of the Kings River drainage (eastern fork), exposures of the Upper Triassic(?) marble in contact with diorite contain skarn zones of very fine grained epidote, garnet, and diopside. Skarn rocks contain as much as 700 ppm Cu, 0.5 ppm Ag, and 0.01 ppm Au (Madden and others, 1988). (Scheelite was found in one heavy-mineral concentrate sample below the Kings River skarn, but it may be unrelated to the skarn.) No chalcopyrite was found downstream from any of the skarns in the northern Chugach Mountains or in the Talkeetna Mountains.

Additional, unsampled outcrops of Upper Triassic(?) limestone and marble in the southern Talkeetna Mountains and limestone and marble in unit JPu in the northern Chugach Mountains in areas SK5, SK6, SK7, SK8, and SK9 (where heavy-mineral concentrate is enriched in Cu with and without enrichment in Ag) are assigned a low potential (level of certainty C). No chalcopyrite was found downstream from these outcrops. Scheelite was found in four heavy-mineral-concentrate samples west of the outcrops of unit JPu, in area SK5 near Jim's Lake, and in seven heavy-mineral-concentrate samples along outcrops of unit JPu west of the Nelchina Glacier, but it may be unrelated to skarn mineralization. The outcrops of unit JPu southeast of the Knik Arm, between Elmendorf Air Force Base and Twin Peaks, lack Cu or Ag enrichments in heavy-mineral concentrate and were not assigned a potential for skarn mineralization because they may not expose any limestone or marble in proximity to younger intrusive rocks.

Base-Metal Deposits—Stratiform and Strata-bound and Related Syngenetic Mineralization (Cu, Pb, Zn, Ag, and Au) In the Peninsular Terrane (Map E, Table 8)

Amphibolite schist of unit JPu in the northern Chugach Mountains hosts foliated, stratiform disseminated sulfide minerals and strata-bound veinlets containing sulfide minerals (Newberry, 1986). The protoliths for the amphibolite are interpreted as sulfide-bearing mafic sills or flows in a sedimentary-volcanic sequence (Newberry, 1986). The amphibolite and enclosed sulfide bodies have been altered to varying degrees by retrograde metamorphism. Amphibole, biotite, and plagioclase are locally altered to chlorite and muscovite; in the sulfide zones, pyrrhotite is altered to pyrite. During retrograde alteration, fluids moved along structural conduits causing the crosscutting relationships of the strata-bound veinlets and the abundance of retrograde pyrite (Newberry, 1986). Based on 13 samples from five localities, the sulfide zones are enriched slightly in Cu (65–194 ppm), Ag (as much as 0.2 ppm), and Co (13–40 ppm), and contain pyrrhotite, pyrite, lesser chalcopyrite, and minor chalcocite. USGS heavy-mineral-concentrate samples lacked chalcopyrite below these exposures. Their low metal grades and complex deformation indicate that these sulfide bodies probably have low economic potential in the northern Chugach Mountains (Newberry, 1986).

Two amphibolite-hosted sulfide occurrences are assigned a low potential (certainty level D) for metamorphosed syngenetic base- and precious-metal deposits, because of their low metal values and lateral discontinuity (map E). Area ST1 is between Carpenter and Caribou Creeks ("Amphibolite Ridge" and "Red Reef" of Newberry, 1986); area ST2 is on a ridge west of Monument Creek (Newberry's prospect 4).

A third amphibolite-hosted sulfide occurrence, area ST3, which includes the Jim Creek prospect of Cobb (1979), is assigned a moderate potential (certainty level C). The prospect exposes a sulfide-rich calcite vein with chalcopyrite, sphalerite, and pyrrhotite, cutting silicified greenstone. The vein contains 15 percent Cu, 3 percent Zn, and 60 ppm Ag; accessibility was very poor and there was not much development (Cobb, 1979). One USGS stream-sediment sample from Jim Creek, below this prospect, contained 150 ppm Ag. The rest of unit JPu was not assigned a potential for this type of mineralization, because of lack of geochemical data indicating metal concentration and the low metal values found elsewhere.

Volcanic rocks of the Talkeetna Formation host mineral occurrences in which metals probably were formed by syngenetic processes and concentrated by later deformation (Newberry, 1986). Numerous stratiform and strata-bound zones of pyrite, slightly enriched in Ag, are restricted to intermediate to silicic volcanic rocks. Sparse quartz veinlets are enriched in other metals and contain visible Cu-sulfide minerals. The veinlets are restricted to the volcanic rocks and do not cut overlying sedimentary rocks, suggesting a volcanic (pre-sedimentation) origin. Newberry (1986) studied a number of prospects in the northern Chugach Mountains (brief descriptions are given below); their economic potential is poor because of the low metal abundances in the stratiform and strata-bound occurrences and the small size and extent of the metal-rich quartz veinlets. No chalcopyrite was found in USGS heavy-mineral-concentrate samples below these prospects.

The areas of Talkeetna Formation surrounding these prospects are assigned a low potential (certainty level D) for syngenetic mineral deposits. These areas (and brief descriptions from Newberry, 1986) are: (ST4)—Carbon Creek-Coal Creek (andesite tuff and dacite with 2–5 percent pyrite, both without metal enrichment); (ST5)—Ninemile Creek (silicified dacite and andesite with 2–5 percent pyrite, rhyodacite tuff with 0.5-2 percent pyrite, dacite with 10 percent disseminated pyrite, and andesite tuff with 1–2 percent pyrite, as much as 61 ppm Cu, 136 ppm Zn, and 0.1 ppm Ag and Au); (ST6)—Mount Wickersham to Glacier Creek (silicified andesite tuff with secondary quartz containing 168 ppm Zn and 73 ppm Cu, and dacitic lithic tuff with 56 ppm Cu and 0.1 ppm Ag); (ST7)—Rock Glacier Creek (silicified andesite tuff; one sample with 1.1 ppm Ag and 268 ppm As, and another sample with 168 ppm Zn); (ST8)—An area on the east side of South Fork (pyrite-veined andesite with 31 ppm Cu and 10 ppm Co); and (ST9)—Sheep Mountain, where McMillin (1984) and Newberry (1986) reported erratic and low values for precious metals and low values for base metals, but Jasper (1965) reported 3 percent Cu in a gabbroic rock grab sample.

Two small tributaries north of Boulder Creek (east of Puddingstone Hill) expose altered, metal-enriched, volcanic rocks of the Talkeetna Formation in areas ST10 and ST11. These outcrops contain as much as 2 percent Cu, 5,000 ppm Pb, >2,000 ppm Zn, 3,000 ppm Ba, 0.1 ppm Au, and 10 ppm Ag (Madden and others, 1988). One stream-sediment sample, immediately downstream from a mineralized outcrop, contains 160 ppm Zn, but Zn anomalies in stream sediment (if originating in these mineralized outcrops) are not displaced far. USGS heavy-mineral-concentrate samples below these outcrops lack chalcopyrite. These areas, and immediately surrounding areas, are assigned a moderate potential (certainty level C) for syngenetic base-metal deposits, because of the relatively high metal values and concurrent lack of knowledge regarding the extent of the metal enriched rocks. These rocks are cut by numerous Tertiary porphyritic intrusions and are strongly deformed; they may have been subjected to more enrichment and localization of metals than other outcrops of the Talkeetna Formation.

Newberry (1986) estimated the Ag, Pb, and Zn resources of the prospects west of the Nelchina Glacier (his Nelchina 1 and 2 lodes; area BM8). Area BM8 is shown as area G2 on our gold-vein map. Because the carbonate veins in these prospects are so enriched in Au, they are discussed under the section about vein gold, rather than in this section. However, the veins have anomalous concentrations of Ag, Pb, Zn, and possibly Cu.

Area ST13, in the west part of the quadrangle, contains greenstone and silicified rhyolite (Cobb, 1979). These volcanic rocks contain small amounts of sulfides as scattered crystals and in veins (arsenopyrite, pyrite, sphalerite, and galena). The sulfide minerals were too sparse for mining development, as described by Cobb (1979) and MacKevett and Holloway (1977). USGS stream-sediment samples were not anomalous in any metals in this area. Area ST13 is therefore assigned a low potential (certainty level D) for syngenetic base-metal deposits.

Base-Metal Deposits—Massive Sulfides and Veins (Zn, Cu, Ag, Pb) and Strategic Metals (Ni, Co) In the Chugach and Prince William Terranes (Map E, Table 8)

Volcanic- and sediment-hosted iron-, copper-, and zinc-enriched, massive-sulfide deposits have been reported in the Orca and Valdez Groups (Winkler and others, 1977;

Nelson and others, 1984). Base metals from these types of deposits may have been remobilized and concentrated in base-metal veins during metamorphism (R.J. Goldfarb, oral commun., 1990).

Base-metal concentrations are in the southeast part of the Anchorage quadrangle, in an area between Columbia Bay and Unakwik Inlet (Orca Group) and in the area of Grasshopper Valley (Valdez Group). In the first area (between Columbia Glacier and Unakwik Inlet), shear zones cutting slate, sandstone, conglomerate, and greenstone of the Orca Group and felsic dikes that intrude the Orca Group, contain veinlets of chalcopyrite, pyrite, galena, and sphalerite (Jansons and others, 1984). One of these occurrences, the "Columbia Claim," contains stratiform pods of massive sulfides (R.J. Goldfarb, oral commun., 1990). Jansons and others (1984) assigned a low mineral-development potential to all of the prospects except for one. They assigned a moderate development potential to Long Bay No. 1, in which mineralized shear zones cutting the Orca Group were found to contain as much as 3.2 percent Zn, 2.6 percent Pb, and 8 oz per ton Ag. USGS rock samples from another prospect in this area, called the "Four-in-One," contain as much as 150 ppm Ag, >20,000 ppm Cu, 650 ppm Zn, 270 ppm As, and 0.15 ppm Au, but contain no enrichment in Pb (Madden and others, 1988).

A moderate potential (certainty level D) for base-metal vein and massive-sulfide deposits is assigned to area BM1, which contains numerous prospects. This area is south of the Contact fault, between Miners Lake and Kadin Lake, and extends southward to the quadrangle boundary (map E). Area BM1 includes prospects described by Jansons and others (1984). Many (15–20) USGS heavy-mineral concentrate samples collected in area BM1 contain chalcopyrite and sphalerite. A low potential (certainty level C) is assigned to area BM2, which encloses Terentiev Lake and extends southward to the quadrangle boundary. Area BM2 contains metal anomalies (Ag, As) in heavy-mineral concentrate, and it is reported to contain a copper prospect called "Globe" (Jansons and others, 1984). Neither we nor Jansons and others (1984) located the Globe prospect in the 1980's.

Area BM3 is north of the Contact fault, within the Valdez Group, on the north side of the First Branch Columbia Glacier. BM3 yielded both sphalerite and chalcopyrite in heavy-mineral concentrate, but contained no reported prospects; this area is assigned a low potential (certainty level B) for base metal mineralization.

East of Unakwik Inlet, adjacent to the Contact fault, area SM1 contains the "Miners River Nickel Prospect" (hosted in the Miners Bay pluton). This area is assigned a moderate potential (certainty level D) for concentrations of the strategic metals Ni and Co and for Cu in the mafic plutonic rocks and in "fissures" (mineralized fractures, cracks, or joints) cutting the pluton. The Oligocene pluton is medium-grained clinopyroxene (plus or minus orthopyroxene) gabbro with lesser amounts of clinopyroxene-bearing quartz diorite (Nelson and others, 1985). The more mafic rocks host disseminated pyrrhotite, pentlandite, and chalcopyrite. Jansons and others (1984) reported chip samples containing 400–2,000 ppm Ni, 93–2,000 ppm Co, and 100–2,000 ppm Cu. Mineral development potential was considered to be low; inferred reserves were estimated as 11,000 tons at 0.2 percent Ni, 0.2 percent Cu, and no estimate for Co (Jansons and others, 1984).

In the upper part of the Grasshopper Valley drainage (area BM4), mineralized metasedimentary rocks of the Valdez Group contain as much as 5 ppm Ag, 10,000 ppm Cu, >2,000 ppm Zn, >2,000 ppm As, only 0.25 ppm Au, and no enrichment in Pb (Madden and others, 1988). Chalcopyrite, sphalerite, and galena (and gold) were found in heavy-mineral concentrate in the lower part of the outlined area, presumably derived from the known mineralized outcrops. Area BM4, containing the mineralized outcrops and adjacent areas south of the Border Ranges fault system, is assigned a moderate potential (certainty level C) for base-metal vein deposits. Area BM5, encompassing the drainages to the south where chalcopyrite and anomalous amounts of Ag and As might have originated so as to contribute to heavy-mineral concentrate in Grasshopper Valley, is assigned a low potential (certainty level C).

Nelson and others (1984) found evidence for base-metal vein deposits in the Crow Pass area of the Girdwood mining district (area BM6) and in the area of Harvard and Yale Glaciers (area BM7). These areas yielded sphalerite and chalcopyrite in heavy-mineral concentrate and are assigned a low potential (certainty level B) for base-metal vein deposits.

URANIUM POTENTIAL (U)
(MAP F, TABLE 9)

Some areas in the Anchorage quadrangle contain geochemical evidence for uranium mineralization associated with granitic rocks (map F). Areas U1 and U2, in the southeastern part of the Anchorage quadrangle (west of Columbia Bay), yielded NURE stream sediment enriched in U (2–22 ppm). Heavy-mineral-concentrate samples in these areas are enriched in Sn, La, Y, and Th, a suite of elements that frequently accompanies uranium mineral deposits associated with granitic intrusions. Drainages expose intrusions of biotite ± hornblende granite with a granodiorite border phase (Nelson and others, 1985). These granitic intrusions are tentatively correlated with Oligocene dikes and leucocratic plutons in western Prince William Sound (Winkler, 1990); the intrusions might be the sources for U enrichment in stream sediment. Areas U1 and U2 are assigned a low potential (certainty level B) for granite-associated uranium mineral deposits, because uranium values are only weakly anomalous in five stream-sediment samples (2–5 ppm U), and outcrops of plutons are small.

Area U3, immediately to the northeast of the two areas described above, includes the largest outcrop area of granite. Two stream-sediment samples contain 21.6 ppm U (U:Th=1.1) and 19.1 ppm U (U:Th=2.5). Area U3 is assigned a low potential (certainty level C) for uranium deposits (map F). The average crustal Th:U ratio is 3.2 and the average Th:U ratio in granite is 4 (Krauskopf, 1979). Thus, the U:Th ratios that we consider to be anomalous in these stream-sediment samples are high, suggesting that the exposed source rock has high concentrations of uranium and that there is potential for a uranium deposit, perhaps U-enriched veins in granite (D.L. Leach, USGS, oral commun., 1991). In the stream environment, a high U:Th ratio suggests derivation from a uranium-rich mineral, rather than from minerals that are simply enriched in rare-earth elements or thorium (thorite). The common uranium minerals, such as uraninite and pitchblende, are extremely soluble under oxidizing conditions (Wenrich-Verbeek, 1980), and they should not travel far in the stream. Where U in the stream sediment is derived from a soluble uranium-rich mineral, the source of uranium should be close to the sediment sample locality.

Area U4, the upper part of Bird Creek near Camp Robber Peak and Raggedtop Mountain, contains stream sediment that is enriched in U (9–22.8 ppm; area U4). Ratios of U:Th are greater than 1 in four stream-sediment samples; ratios range from 1.2 to 5.2. Heavy-mineral-concentrate samples contain only modest amounts of La (100 ppm), Y (500 ppm), W (500 ppm), and Nb (50 ppm). The basin in area U4 might expose small, unmapped felsic intrusions that could be contributing U to stream sediment. The area is assigned a low potential (certainty level B) for U deposits related to granitic intrusions. Area U5 is assigned the same potential because of a U-enriched stream-sediment sample.

Northwest of the Willow Creek mining district, in area U6, 10 samples of U-enriched stream sediment (5–44 ppm U) were collected from an area exposing a large epizonal biotite and muscovite-bearing granitic pluton of Late Cretaceous and Paleocene age (Csejtey and others, 1978). One ratio of U:Th is as high as 10, and most ratios are greater than 2. Heavy-mineral-concentrate samples from drainages in this pluton are enriched in Mo (as much as 700 ppm), Sn (100 ppm), W (200 ppm), La (>2,000 ppm), Y (1,500 ppm), and Th (500 ppm). Area U6, exposing the pluton, is assigned a low potential (certainty level C) for uranium deposits related to granitic intrusions.

Areas U7 and U8, west of the Kings River drainage, are assigned a low potential (certainty level B) for uranium deposits, because two stream-sediment samples contain 46 ppm U (U:Th=25.6) and 26 ppm U (U:Th=7.9). The sediment was eroded, in part, from unit Jtr (Late Jurassic trondhjemite), which consists of epizonal muscovite-biotite leucocratic plutons, including some quartz diorite near the northern boundary of the quadrangle (Csejtey and others, 1978). The leucocratic plutonic rocks might be the source for the uranium enrichment in the stream sediment. Area U7, which is along the northern boundary of the quadrangle, is mostly covered by glacial ice.

COAL POTENTIAL (MAP F, TABLE 10)

In the Anchorage quadrangle, coal has been mined from the Matanuska coalfield (recorded mining in the Wishbone Hill and Chickaloon districts, no recorded mining in Anthracite Ridge district) and from the area of Houston (sometimes referred to as the Little Susitna district).

During the late 1980's and early 1990's, open-pit mining was being planned in the Wishbone Hill district, Matanuska Valley, where high-quality, bituminous coal with low moisture and sulfur contents is exposed in the Chickaloon Formation (Schneider, 1989). Underground mining was recently planned for the old Jonesville mine, but earthquake-induced landslide damage to the mine portal ended preparations. Open-pit mining was recently planned for the Wishbone Hill mine (Wishbone Hill district) and for the Castle Mountain mine (Chickaloon district), but mining had not yet begun in either district as of early 1992. Mapping, trenching, and sampling were done at the Evan Jones mine (Wishbone Hill district) and at the Castle Mountain mine (Chickaloon district) during 1990, in preparation for development (Swainbank and others, 1991). During 1990, no coal was produced from the Anchorage quadrangle (Swainbank and others, 1991).

Areas CO1 and CO2 include abandoned coal mines of the Wishbone Hill coal-mining district and are assigned a high potential (certainty level D); coal was mined from the Paleocene and Eocene Chickaloon Formation (map F). Barnes and Payne (1956) called this the "only producing bituminous coal district in Alaska." Ranges for proximate values of raw coal are as follows: heating value, 10,400 to 12,500 Btu; ash, 5–24 percent; fixed carbon, 37–47 percent; volatile matter, 33–41 percent; and moisture, 3–7 percent (Conwell and others, 1982). Coal production was 3,284,723 million short tons between 1916 and 1952, with almost one-third of that total produced early, between 1916 and 1934 (Barnes and Payne, 1956). Total coal reserves are 112.5 million tons (6.6 million tons measured, 48.6 million tons probable, and 57.3 million tons inferred; Barnes and Payne, 1956; Conwell and others, 1982). Though coal zones in the Chickaloon Formation are extensive, the individual coal beds thin out abruptly into clastic rocks. The rocks in the mining district are folded into a syncline, which is cut into segments by major faults (Barnes and Payne, 1956). Tonstein partings (altered volcanic ash) are in the formation. Several radiometric ages from a coal-bearing interval are an average of 55 Ma (Conwell and others, 1982; Triplehorn and others, 1984).

The area of the Chickaloon Formation exposed to the northwest of Moose Creek (area CO3) is assigned a low potential for coal (certainty level B), because, according to Barnes and Payne (1956), the coal-bearing part of the Chickaloon Formation has been eroded from this area, leaving only the non-coal-bearing, lower part of the Chickaloon Formation exposed.

Areas CO4 and CO5 include abandoned coal mines of the Chickaloon district and are assigned a high potential (certainty level D). Records show only limited commercial production of coal in mines such as the Coal Creek and Chickaloon of the Chickaloon district, due to the structural complexity of the coal-bearing strata (Warfield, 1967). At present, there is interest in redeveloping the Castle Mountain mine, northwest of Chickaloon (Swainbank and others, 1991). The Castle Mountain mine produced about 6 million tons of coal between 1920 and 1968; current reserves are estimated at about 22.4 million tons (Swainbank and others, 1991) in small, broken-up beds, which are intruded by igneous sills that follow coal and carbonaceous shale.

The area of Anthracite Ridge, in the north-central part of the map, and adjacent areas where coal is exposed in the Chickaloon Formation (and locally in the Arkose Ridge and Matanuska Formations) on both sides of the Matanuska Valley, are assigned a moderate potential for coal (certainty level D). There is no record of commercial coal production from the Anthracite Ridge area, where coal beds of the Chickaloon Formation have been locally heated by igneous intrusions to produce anthracite, exposed over a local (half-mile-square) area on the south side of the ridge (Waring, 1936). Proximate analyses of raw coal are as follows: heating values, 11,510–14,210 Btu; ash, 4–22 percent; fixed carbon, 46–81 percent; volatile matter, 8-32 percent; and moisture, 2–7 percent (Conwell and others, 1982).

Area CO6 in the Little Susitna coal district, including the coal mine near Houston, is assigned a high potential (certainty level D) for coal; subbituminous and bituminous coal are in the Tyonek Formation. Ranges for proximate analyses of raw coal are as follows: 8,460–9,210 Btu's; ash, 9.2–20.5 percent; fixed carbon, 34.1–38.9 percent; volatile matter, 31.3–32.5 percent; and moisture, 14.1–20.3 percent (Conwell and others, 1982). Mining produced about 10,000 tons of coal from a 3.5-ft-thick bed between 1917 and 1920 (Barnes and Sokol, 1959), and 65,000 tons of coal between 1948 and 1952 (Conwell and others, 1982). Other outlined areas are briefly discussed below and are unnumbered on the overlay.

Four small areas in the Little Susitna coal district that expose the Tyonek Formation east of Houston (areas labeled CO7) are assigned a moderate potential (certainty level D), because coal has been found in these areas (Barnes and Sokol, 1959). The areas include a small abandoned coal mine along Coal Creek in the Little Susitna district, where coal was mined for local use in the gold mines (Barnes and Sokol, 1959).

Unlabeled areas permissive for surface coal in the Chickaloon and Tyonek Formations are assigned a moderate potential (certainty level C). In the Matanuska Valley, the coal-bearing Chickaloon Formation is projected into the subsurface between outcrops. To the west, subsurface drill data show that coal in the Tyonek Formation and lignite in the Sterling Formation are within 3,000 ft of the surface (Conwell and others, 1982). Therefore, unlabeled areas permissive for subsurface coal are assigned a low potential (certainty level C).

OIL AND GAS (TABLE 11)

The Cook Inlet petroleum province contains oil and gas fields producing mostly from upper Tertiary sedimentary rock units in the subsurface west and southwest of the Anchorage quadrangle. The petroleum province is Alaska's main gas-producing area (Schneider, 1989). The closest gas fields to the Anchorage quadrangle are Beluga River and North Cook Inlet (about 30 mi west of Anchorage); the closest oil field is Swanson River (about 35 mi southwest of Anchorage). Most of the oil is produced from the Hemlock Conglomerate (Oligocene) and Tyonek Formation (Miocene), and much of the dry gas is produced from sandstone within the upper part of the Beluga Formation and the lower Miocene part of the Sterling Formation of the Kenai Group (Kirschner and Lyon, 1973; Wolfe and Tanai, 1980). Within the Anchorage quadrangle, wells were drilled through the Mesozoic and Cenozoic clastic units north of the Border Ranges fault system and both north and south of the Susitna segment of the Castle Mountain fault. Although several anticlines and potential fault traps were tested, no oil or gas fields were discovered. Magoon and others (1976) showed numerous dry holes, but no producing wells in the area of the quadrangle. Apparently, well locations in the Anchorage quadrangle are situated near the margins of the Tertiary depositional basin of upper Cook Inlet, where unconformities, rapid facies changes, and structural complications have prevented successful exploration for horizons that produce hydrocarbons to the southwest. The uppermost Cook Inlet area within the Anchorage quadrangle (the lowlands of the Knik and Turnagain Arms) is assigned a low potential (certainty level B) for oil and gas (no overlay).

MISCELLANEOUS

The Anchorage quadrangle contains abundant resources of peat, sand and gravel, limestone, clay in low-lying areas, and glacial ice in the higher areas. During 1990, the Alaska Railroad reported an increase in the amount of sand and gravel shipped from the Palmer-Wasilla area to Anchorage, due to mild growth in construction and to road improvements along the Seward Highway, south of the Anchorage quadrangle (Swainbank and others, 1991). Gravel is supplied from pits along the Glenn Highway and near Wasilla. Limestone has been supplied from near Wasilla and from a locality in the upper part of the Kings River drainage; clay has been produced from near Houston and Eagle River (Bottge and Northam, 1986). Although peat has potential uses as an energy fuel, its only use to date in the area is in local greenhouses. Local market conditions for glacial ice are untested. However, in the 1980's, glacial ice from southeastern Alaska was shipped to Japan. Mordenite and other zeolites are in the lower part of the Talkeetna Formation in the Horn Mountain and Albert Creek area, and similar deposits might be found elsewhere in the formation (Singer and others, 1978).

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Table 1. ***Selected mines, prospects and occurrences in the Anchorage 1° by 3° quadrangle, southern Alaska. Locality numbers refer to figure 1***

Locality Number	Name
	WILLOW CREEK MINING DISTRICT (Au)
1	Thorpe mine
2	Wheeler prospect
3	Lucky Shot mine and War Baby mine
4	Gold Bullion mine
5	Kelly-Willow prospect
6	Penthouse prospect
7	Martin mine
8	Independence mine
10	High Grade mine and Gold Cord mine
11	Marion Twin mine
12	Holland prospect
13	Fern mine
14	Snowbird prospect
15	Arch prospect
16	Rae-Wallace mine
17	Mabel mine
18	Lonesome mine
19	Moose Creek prospect
	GIRDWOOD MINING DISTRICT AND SURROUNDING AREA (Au)
20	Jewel mine
21	Monarch mine
22	Bahrenberg mine
23	Brenner mine
24	Eagle River prospect
25	Peters Creek prospect
	PRINCE WILLIAM SOUND AREA
26	Alaska Homestake mine (Au, Ag)
27	Olson and Viette prospect (Au, Ag)
28	Dartmouth Glacier occurrence (Au, Ag, As)
29	Brown Bear prospect (Pb, Zn, Ag, Au)

Table 1. Continued

Locality Number	Name
30	Miners River No. 1 prospect (Zn, Pb, Cu, Ag, Au, As)
31	Four-in-One prospect (Cu, Ag, Ni)
32	Miners River No. 2 prospect (Zn, Pb, Ag, Au, As)
33	Wells Bay No. 3 prospect (Zn, Pb, Ag)
34	Wells Bay No. 2 prospect (Pb, Cu, Au, Ag)
35	Long Bay No. 1 prospect (Zn, Pb, Ag)
36	Terentiev Lake occurrence (Pb, Ag, As)
37	Idle Claim prospect (Zn, Cu, Ag, Pb)
38	Columbia Claim prospect (Cu, Ag, Zn, Pb)
39	Miners River Nickel prospect (Ni, Co, Cu)
	OTHER AREAS IN QUADRANGLE
40	Jim Creek prospect (Cu, Zn, Ag, Au)
41	Sheep Mountain prospect (Cu, Au)
42	Nelchina Glacier prospects (Au, Ag, As, Pb, Zn, Cu)
43	Twin Peaks ridge prospect (Cr_2O_3)
44	Wolverine complex prospect (Cr_2O_3)
	COAL MINES (Barnes and Payne, 1956; Barnes and Sokol, 1959)
45	Premier mine
46	Baxter mine
47	Buffalo mine
48	Evan Jones mine
49	Eska mine
50	Knob Creek mine
51	Castle Mountain mine
52	Chickaloon mine
53	Coal Creek mine
54	Houston mine
	PLACER GOLD, SILVER, AND PLATINUM (Cobb, 1979)
P1	Grubstake Gulch, Willow Creek district (Au)
P2	Wet Gulch, Willow Creek district (Au)

Table 1. Continued

Locality Number	Name
P3	Crow Creek, Girdwood district (Au)
P4	Metal Creek (Au, Pt)
P5	Alfred Creek (Au, Ag, Pt)

Table 2. *Definition of levels of mineral resource potential and certainty of assessment*

Definitions of Mineral Resource Potential

LOW mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics define a geologic environment in which the existence of resources is unlikely. This broad category embraces areas with dispersed but insignificantly mineralized rock as well as areas with few or no indications of having been mineralized.

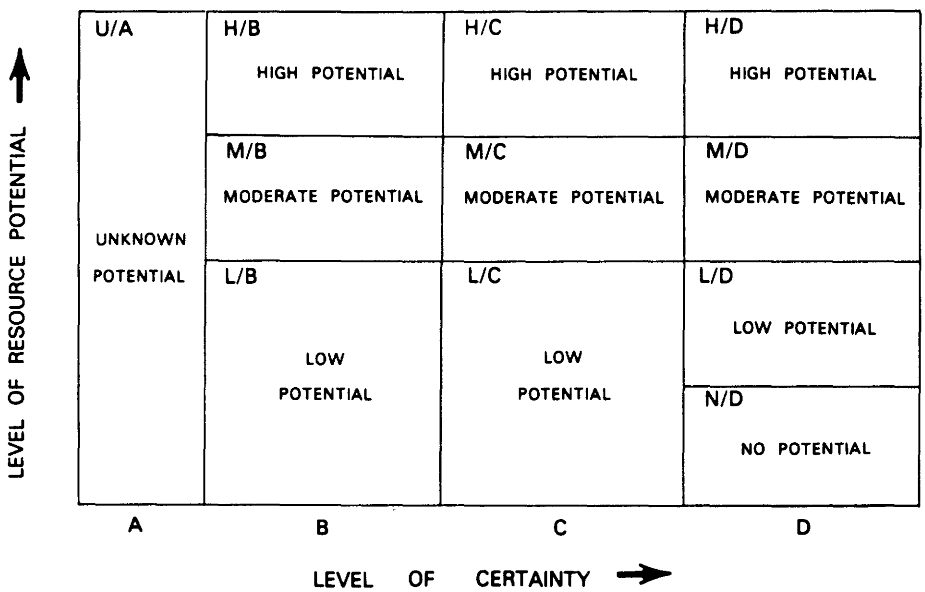
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application of mineral-deposit models indicates favorable ground for the specified type(s) of deposits.

HIGH mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a high degree of likelihood for resource accumulation, where data support mineral-deposit models indicating presence of resources, and where evidence indicates that mineral concentration has taken place. Assignment of high resource potential to an area requires some positive knowledge that mineral-forming processes have been active in at least part of the area.

UNKNOWN mineral resource potential is assigned to areas where information is inadequate to assign low, moderate, or high levels of resource potential.

NO mineral resource potential is a category reserved for a specific type of resource in a well-defined area.

Levels of Certainty



A. Available information is not adequate for determination of the level of mineral resource potential.
B. Available information suggests the level of mineral resource potential.
C. Available information gives a good indication of the level of mineral resource potential.
D. Available information clearly defines the level of mineral resource potential.

Abstracted with minor modifications from:

Taylor, R. B., and Steven, T. A., 1983, Definition of mineral resource potential: Economic Geology, v. 78, no. 6, p. 1268–1270.

Taylor, R. B., Stoneman, R. J., and Marsh, S. P., 1984, An assessment of the mineral resource potential of the San Isabel National Forest, south-central Colorado: U.S. Geological Survey Bulletin 1638, p. 40–42.

Goudarzi, G. H., compiler, 1984, Guide to preparation of mineral survey reports on public lands: U.S. Geological Survey Open-File Report 84–0787, p. 7, 8.

Table 3. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for gold deposits, Anchorage 1 ° by 3 ° quadrangle, southern Alaska. Areas shown on map A***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
G1a	HD	yes	yes	yes	yes	yes	yes
G1b	LB	no	yes	no	no	no	yes
G2	MD	no	yes	no	no	yes	no
G3a	LB	no	yes	no	yes	yes	no
G3b	LB	no	yes	no	yes	no	no
G3c	LB	no	yes	no	yes	no	no
G3d	LB	no	yes	no	yes	no	no
G4	LB	no	yes	no	yes	no	no
G5	LB	no	yes	yes	no	yes	no
G6	LB	no	yes	yes	no	yes	no
G7	HD	yes	yes	yes	yes	yes	no
G8	MD	yes	yes	yes	yes	yes	no
G9	MD	no	yes	no	yes	yes	no
G10	MC	no	yes	yes	yes	yes	no
G11	MC	no	yes	no	yes	no	no
G12-G58	MB	no	yes	no	yes	no	no
G59	LD	yes	yes	no	yes	yes	no
G60	LB	no	no	no	yes	no	no
G61	LB	no	no	yes	yes	no	no
G62	LB	no	no	yes	yes	no	no
G63	LB	no	no	yes	no	no	no
G64	LC	no	no	no	yes	yes	no
MG1	LC	no	yes	no	yes	yes	no
MG2-MG13	LB	no	yes	yes	yes	no	no

Table 4. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for placer gold and platinum deposits, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map B***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
PG1	HD	yes	yes	yes	yes	yes	no
PG2	MD (Au)	yes	yes	no	yes	no	no
PG2	LB (Pt)	no	?	no	yes	no	no
PG3	LC	yes	yes	no	yes	no	no
PG4	MC	yes	yes	no	yes	yes	no
PG4	LB (Pt)	no	?	no	yes	no	no
PG5	LC	no	yes	no	yes	yes	no
PG6	HD	yes	yes	yes	yes	yes	no
PG7	MB (Au)	yes	yes	yes	yes	yes	no
PG7	LB (Pt)	no	?	no	yes	no	no
PG8	LB	no	yes	yes	yes	yes	no

Table 5. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for podiform chromite and PGE deposits, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map B***

[SEDS, stream sediment; CONC, heavy mineral concentrate; PGE, platinum-group elements. See table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
C1	MD	yes	yes	yes	no	yes	yes
C2	MC	no	yes	yes	no	no	yes
C3	MD	yes	yes	yes	no	yes	yes
C4	MC	no	yes	yes	no	no	yes
C1-C4	LD(PGE)	no	yes	no	no	yes	no
C5-C11	LB	no	yes	yes	no	no	yes
C12-C13	LB	no	no	yes	yes	no	no
C14a	LD	no	no	no	no	no	no
C14a	LD(PGE)	no	yes	no	no	yes	no
C14b	LB	no	yes	no	no	no	yes

Table 6. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for porphyry deposits, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map C***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
PO1-PO5	LD	no	yes	no	no	no	no
PO6-PO10	MC	no	yes	no	no	yes	no
PO11-PO13	LC	no	yes	yes	yes	no	no

Table 7. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for skarn deposits, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map D***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
SK1-SK4	LD	no	yes	yes	yes	yes	no
SK5-SK9	LC	no	yes	no	yes	no	no

Table 8. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for base-metals in stratiform, stratibound, massive sulfides, and veins deposits; also, strategic metals, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map E***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
ST1-ST2	LD	yes	yes	no	no	yes	no
ST3	MC	yes	yes	yes	no	yes	no
ST4-ST9	LD	yes	yes	no	no	yes	no
ST10-ST11	MC	no	yes	no	no	yes	no
ST12	Rated MD on gold map, not rated on base-metal map.						
ST13	LD	yes	yes	no	no	yes	no
BM1	MD	yes	yes	no	yes	yes	no
BM2	LC	yes	yes	no	yes	no	no
BM3	LB	no	yes	no	yes	no	no
BM4	MC	no	yes	no	yes	yes	no
BM5	LC	no	yes	no	yes	no	no
BM6-BM7	LB	no	yes	no	yes	yes	no
BM8	Described and assigned a potential on map A, area G2.						
SM1	MD	yes	yes	no	no	yes	no

Table 9. ***Areas of mineral-potential, ratings, and presence or absence of geologic, geochemical, and geophysical evidence for uranium deposits, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map F***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
U1-U2	LB	no	yes	yes	yes	no	no
U3	LC	no	yes	yes	no	no	no
U4-U5	LB	no	yes	yes	yes	no	no
U6	LC	no	yes	yes	yes	no	no
U7-U8	LB	no	yes	yes	no	no	no

Table 10. ***Areas, mineral-potential ratings, and presence or absence of geologic evidence for coal, Anchorage 1° by 3° quadrangle, southern Alaska. Areas shown on map G***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviations]

AREA	RATING	MINES OR PROSPECTS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
				SEDS	CONC	ROCKS	
CO1-CO2	HD	yes	yes	no	no	yes	no
CO3	LB	no	maybe	no	no	no	no
CO4	HD	yes	yes	no	no	yes	no
CO5	HD	yes	yes	no	no	yes	no
CO6	HD	yes	yes	no	no	yes	no
CO7	MD	yes	yes	no	no	yes	no
Unlabeled[1]	MC, LC	no	yes	no	no	yes	no

[1] Subsurface coal deposits in the Matanuska Valley.

Table 11. ***Areas of resource potential and presence or absence of geologic evidence for oil and gas in uppermost Cook Inlet, Anchorage 1° by 3° quadrangle, southern Alaska***

[SEDS, stream sediment; CONC, heavy mineral concentrate; see table 2 for explanation of rating abbreviation. Leaders (--) indicate not applicable.]

RATING	TEST WELLS	FAVORABLE GEOLOGIC SETTING	GEOCHEMICAL ANOMALIES			GEOPHYSICAL ANOMALIES
			SEDS	CONC	ROCKS	
LB	yes	yes	--	--	yes	--

*U.S. G.P.O.:1994-301-077:80066