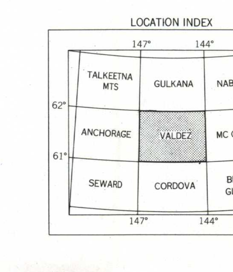
Base from U.S. Geological Survey, 1960

Aeromagnetic survey by LKB Resources, Inc., 1978, and Andreasen and others (1958)

SCALE 1:250 000

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



EXPLANATION

MAGNETIC CONTOURS-- Showing total intensity magnetic field of the Earth in gammas relative to arbitrary datum. Hachured to indicate closed areas of lower magnetic intensity; dashed where data are incomplete. Contour interval 10 and 50 gammas

53455 × MAXIMUM OR MINIMUM INTENSITY--Location measured within closed high or closed low

– – – – P-205 FLIGHT PATH--Showing location and spacing of data

DISCUSSION

INTRODUCTION

An aeromagnetic survey was flown in 1978 over a large part of the Valdez 1:250,000 quadrangle, Alaska (fig. 1), to provide magnetic data for the Alaskan Mineral Resource Assessment Program (AMRAP). Another aeromagnetic survey had been made of the north-central part of the quadrangle in 1954 and 1955 in connection with a topical study of the Copper River Basin (Andreasen and others, 1958, 1964). For the present interpretive report, the two aeromagnetic maps have been spliced and superimposed on the topographic base of the quadrangle (sheet 1). An interpretation map of the magnetic data has been combined with the topographic base and a simplified geologic map (sheet 2).

The earlier survey was flown at a barometric elevation of about 1,200 m above sea level except locally where topography required higher flight elevations. Continuous total-intensity magnetic data along flight traverses (flown about 1.6 km apart) were obtained from a modified fluxgate magnetometer (Andreasen and others, 1958, 1964). The data, which were hand contoured, were not corrected for the International Geomagnetic Reference Field (IGRF), which increases northward about 3 gammas per kilometer at this latitude. The newer magnetic data were obtained with a proton-precession total-intensity magnetometer. North- and north-northeast-trending flight lines, about 1.6 km apart, were flown at a nominal height of about 300 m above the ground surface (drape flown). The 1975 IGRF, updated to 1978, was removed from the total-intensity field, and the observations were computer contoured on a grid interval of 250 X 450 m.

In this report, we interpret the aeromagnetic map in terms of the main rock units causing the geophysical anomalies. Magnetic susceptibilities of various rock units were measured on a standard laboratory susceptibility bridge. Interpretations of aeromagnetic data to the east in the McCarthy quadrangle (Case and MacKevett, 1976), northeast in the Nabesna quadrangle (Griscom, 1975), northwest in the Talkeetna Mountains quadrangle (Csejtey and Griscom, 1978), west in the Anchorage quadrangle (Grantz and others, 1963), and southwest in the Seward and Blying Sound quadrangles (Case and others, 1979) have aided in this interpretation. An aeromagnetic survey also has been flown over most of the Cordova quadrangle to the south (U.S. Geological Survey, 1979). A detailed interpretation of the aeromagnetic data over the northern Chugach Mountains in the northwestern part of the quadrangle has been made by Burns (1982a, b).

SUMMARY OF GEOLOGY AND MAGNETIC PROPERTIES

Winkler and others (1981a, b, c) have divided the Valdez quadrangle into four geologic "domains," each characterized by different rock units or structural style.

Domain 1

In the northeastern part of the quadrangle, within part of the Wrangellia terrane of Jones and others (1977, 1981), small outcrop areas of greenschist, amphibolite, and other metamorphic rocks of uncertain, perhaps Paleozoic, age occur. Paleozoic rocks of the Skolai Group are dominantly deformed greenstone with subordinate siltstone, shale, marble, and gabbro. Susceptibilities of only two samples of metavolcanic rocks of the Skolai were measured; values were 0.0042 and 0.0065 cgs units. One gabbro sample has a susceptibility of 0.0079 cgs units. From the adjacent McCarthy quadrangle, measurements of more than 50 samples ranged from 0.0001 to 0.00656 cgs units (Case and MacKevett, 1976). Triassic rocks consist of altered tholeiitic basalt of the Nikolai Greenstone and the Chitistone and Nizina Limestones. Susceptibilities of three samples of greenstone range from 0.0037 to 0.0046 cgs units. Values for more than 200 samples from the McCarthy quadrangle to the east range from 0.0005 to 0.00568 cgs units. In the McCarthy quadrangle the Nikolai Greenstone causes many magnetic anomalies. Triassic and Jurassic rocks consist of deformed limestone, shale, chert, conglomerate, sandstone, mudstone and siltstone. The sedimentary rocks are thought to be essentially nonmagnetic. Cretaceous strata consist of marine clastic and thin carbonate deposits; again, these rocks are nearly nonmagnetic. Tertiary and Quaternary calc-alkaline volcanic rocks compose the Wrangell Lava, which consists of flows and volcanogenic strata that are at least 2,000 m thick. The Wrangell volcanic rocks are moderately to strongly magnetic in some areas; no samples from the Valdez quadrangle were measured for susceptibility, but eight samples from the McCarthy quadrangle have susceptibilities that range from 0.0002 to 0.0023 cgs units.

Intrusive rocks in the domain include Permian gabbroic rocks mapped here as part of the Skolai Group, as mentioned above. The Chitina Valley batholith includes quartz diorite, tonalite, monzodiorite, and granodiorite of Jurassic age. Susceptibilities of three samples from the Valdez quadrangle are 0.0012, 0.0024, and 0.0030 cgs units, and susceptibilities of 10 samples from the McCarthy quadrangle range from 0.0001 to 0.0106 cgs units. Small undated granite and granodiorite stocks in the domain are probably of Tertiary age.

Domain 2

This domain, in the east-central part of the quadrangle, is characterized by a variety of ultramafic rocks of unknown, but apparent Jurassic, or older age and several groups of metamorphic rocks. Ultramafic rocks of the Tonsina block consist of dunite, harzburgitic dunite, wehrlite, websterite, and clinopyroxenite. Susceptibilities of eight samples from various Tonsina bodies are as much as 0.0035 cgs units but most values are less than 0.0005 cgs units. From the aeromagnetic expression of these rocks, the apparent susceptibility must be larger than 0.001 cgs unit. Layered hornblende gabbro, gabbronorite, garnet granulite, and leucogabbronorite occur in this domain. Metamorphic rocks of this domain occur in several fault-bounded blocks: they consist of greenschist- and transitional blueschist-facies metavolcanic and metasedimentary rocks; mylonitic greenschist; greenschist- and transitional blueschist-facies metasedimentary and metavolcanic rocks having a cataclastic fabric; and metaplutonic rocks that are dominantly diorite or quartz diorite but including trondjhemite, hornblende gabbro, and hornblendite. Only two samples have been measured for susceptibility: an amphibolite has a susceptibility of 0.0005 cgs units and a quartz-muscovite schist has a susceptibility of 0.0027 cgs units. Scant K-Ar isotopic data from the polymetamorphic sequences indicate ages of Jurassic to Paleogene for various thermal and (or) metamorphic events. Plutonic rocks in this domain consist of altered biotite and hornblende tonalite with Eocene K-Ar isotopic ages.

The Wrangell Lava also occurs as small distinct bodies in this domain.

Domain 3

This domain, in the north-central and northwestern parts of the quadrangle, comprises part of the Peninsular terrane of Jones and Silberling (1979) and Jones and others (1981) and a belt of mafic and ultramafic rocks that may constitute part of a separate terrane. A sequence of layered sedimentary and volcanic rocks of Mesozoic age is moderately folded and the faulted but is relatively unmetamorphosed except in contact zones around plutons.

The Early Jurassic Talkeetna Formation consists of marine and non-marine andesitic and basaltic tuff, tuff breccia, and volcanogenic sedimentary rocks containing mollusks and brachiopods. Susceptibilities of 11 samples of volcanic rocks from the Talkeetna range from nearly zero to 0.0054 cgs units. Six samples have susceptibilities greater than 0.001 cgs unit. According to Andreasen and others (1964): "Strong remanent magnetism is present in more parts of the Talkeetna Formation than in any other rock in the surveyed area, and magnetic-susceptibility measurements for this formation also showed a wide range (from less than 0.001 to more than 0.01 cgs unit). However, high values and a wide range of magnetic susceptibility are also found in many specimens of Paleozoic volcanic rocks, intrusive rocks, and Tertiary volcanic rocks. Almost all specimens of Jurassic and Cretaceous marine and Tertiary continental sedimentary rocks have susceptibilities below 0.005, and values below 0.001 predominate."

Cretaceous rocks consist of marine siltstone, claystone, and sandstone and local conglomerates. In adjacent areas, these strata are several thousand meters thick and compose the Matanuska Formation. They are thought to be relatively nonmagnetic rocks. The Wrangell Lava also occurs in this domain.

Plutonic rocks consist of the major Tazlina mafic and ultramafic belt that is at least 170 km long and as much as 10 km wide that extends from east to west across two-thirds of the quadrangle. The belt continues westward to the Matanuska Glacier in the Anchorage quadrangle. It consists dominantly of layered gabbronorite, leucogabbronorite, and ferrogabbronorite, and minor ultramafic, pyroxene-hornblende gabbronorite, dioritic, and tonalitic rocks. It is bordered by fault zones on both south and north margins. K-Ar isotopic ages for these rocks are Jurassic. Gabbronorites, peridotites, dunites, and diorites of the Tazlina belt have susceptibilities that are as much as 0.0174 cgs units. Of 59 samples measured, 53 have susceptibilities greater than 0.001 cgs units (fig. 2). This unit causes the largest magnetic and gravity anomalies in the quadrangle (Burns, 1982).

Other plutons, probably of Jurassic age, include small stocks of medium-grained granite, biotite-hornblende granodiorite, and tonalite, which intrude the Talkeetna Formation.

Domain 4

This large area in the southern part of the quadrangle consists of major deformed units of flysch, volcanic rocks, several areas of melange, a variety of metamorphic rocks, and plutonic rocks. Metamorphic rocks, of apparent Jurassic or older age, consist of greenschist- and transitional blueschist-facies rocks that occur as blocks in melange along major faults and as a discrete, continuous belt 40 km long and as much as 4 km wide, which extends northeastward from Nelchina Glacier to Klutina Lake (Winkler and others, 1981c). Marble is locally present in some blocks. The McHugh Complex is a pervasively deformed assemblage of diverse lithologies between the Tazlina and Border Ranges faults. The unit consists of melange and broken formation with blocks of graywacke, basalt, argillite, phyllite, chert, and marble, commonly metamorphosed to prehnite-pumpellyite facies. Radiolarians from various chert localities range from Triassic to middle Cretaceous in age. The Valdez Group of Late Cretaceous age consists of flyschoid sedimentary rocks and mafic volcanic rocks that have been metamorphosed in the Eocene to lower greenschist facies, foliated metasandstone, phyllite, and greenschist. The rocks are commonly tightly folded, and superimposed folds occur at many localities. Susceptibilities of more than 30 specimens of sandstone, argillite, slate, phyllite, and schist from the Seward and Blying Sound quadrangles are less than 0.0001 cgs units (Case and others, 1979), and their low magnetization is reflected by the near absence of magnetic anomalies. The metavolcanic rocks are moderately magnetic; susceptibilities of mafic rocks from the Seward and Blying Sound quadrangles are as much as 0.004 cgs units (Case and others, 1979). Paleocene and Eocene(?) flyschoid sedimentary rocks, consisting of minor conglomerate, and tholeiitic volcanic rocks of the Orca Group crop out in the southwest corner of the quadrangle. The rocks are commonly highly folded. Magnetic properties are similar to rocks of the Valdez Group—the sedimentary rocks are nearly nonmagnetic and the volcanic rocks are moderately magnetic. In the northwestern part of the domain a melange occurs between the Nelchina Glacier and Tazlina Lake south of the Tazlina mafic plutonic belt. The melange includes serpentinite; dikelike bodies of rodingite, and blocks of layered gabbronorite, crossite schist, pillow basalt, marble, chert of Late Triassic or Early Jurassic age, and conglomerate. Some conglomerate that resembles the Paleocene or Eocene Chickaloon Formation in the Matanuska Valley to the west of the quadrangle is also present. The melange is inferred to have been emplaced in Late Cretaceous or early Tertiary time. Susceptibilities of three serpentinite samples were low, 0.0000, 0.0005, and 0.0007 cgs units, and the unit has little magnetic expression.

A large tectonic inclusion or klippe, surrounded by the McHugh Complex, occurs between the Tazlina and Nelchina Glaciers. Rocks within the klippe are layered gabbronorite and quartz gabbronorite(?), trondjhemite, amphibolite, and orthogneiss. These rocks are thought to be Jurassic or older. They are moderately magnetic, as determined from their expression on the aeromagnetic map.

Faults

Numerous faults of variable orientation and displacement occur in the quadrangle. Some of the larger faults include: the Tazlina fault, a north-dipping low-angle thrust between the Valdez Group and the overlying McHugh Complex; the Border Ranges fault, an apparently high-angle fault that separates rocks of domain 3 from those of domain 4; the Spirit Mountain fault that separates domain 2 from domain 1; and the high-angle Tebay and Taral faults that separate domain 1 from domains 2 and 3.

INTERPRETATION OF THE AEROMAGNETIC MAP

Because of the rugged steep terrain in much of the area, "drape flying" at a constant elevation of 300 m above the surface was impossible to achieve during the 1978 survey. Flight elevations were approximately 300 m over ridge crests and lakes, but over the narrow, deep glacial valleys the aircraft flew at a height greater than 300 m. Some apparent anomalies resulted from variation in aircraft height above the terrain. For example, apparent magnetic lows may appear over valleys eroded into a magnetic medium even though the magnetic properties of the medium do not vary laterally. On the other hand, buried magnetic basement may produce larger amplitude magnetic anomalies over valleys because the aircraft is actually closer to the magnetic basement there than over the ridges. A possible additional effect is related to the Earth's main dipole field: an increase in elevation of 1 km above sea level can decrease the main field by about 25 gammas. Griscom (1975) presented a more detailed discussion of the problems inherent in drape flying.

From combined analyses of the aeromagnetic map (sheet 1) and the regional geologic map (Winkler and others, 1981a), a generalized interpretive map (sheet 2) has been prepared. Subjective boundaries have been drawn around most of the major magnetic anomalies or groups of anomalies, generally along steepened magnetic gradients, and these areas are interpreted in terms of the associated rocks that probably cause the anomalies. Where a group of anomalies has composite or multiple sources, composite-unit symbols have been used on the interpretation map. Such composite units (Jc+TRn, for example) are treated as single "magnetic rock" units in subsequent discussions of mineral deposits and geochemical anomalies. The rock units that probably cause the anomalies are indicated by map symbols.

Domain 1

In the northeastern part of the Valdez quadrangle, the anomaly field is heterogeneous and includes numerous groups of high-amplitude, steep-gradient, positive anomalies separated by low-amplitude negative anomalies of generally flatter gradient. Most of the positive anomalies appear to be of composite origin as judged from careful inspection of the aeromagnetic map, topographic map, and geologic map and from very few measurements of magnetic properties obtained from the Valdez quadrangle and the similar terrane in the McCarthy quadrangle to the east (Case and MacKevett, 1976).

Most of the conspicuous positive anomalies in domain 1 are caused by volcanic rocks of the Wrangell field and by granodiorite and associated Jurassic plutons of the Chitina Valley batholith type. Some of the anomalies, however, correlate with the Nikolai Greenstone and with gabbroic plutons mapped here as part of the Skolai Group. A few anomalies may be caused by metavolcanic rocks of the Skolai Group. Much of the Skolai Group, however, appears to be non- or weakly magnetic.

Numerous magnetic lows in this domain are probably related to the topographic effects of the drape-flying process, but a few lows over the Wrangell Lava and Nikolai Greenstone at high topographic elevation may be caused by reversed remanent magnetization or by hydrothermal alteration of magnetite.

Steepened magnetic gradients coincide closely with mapped faults in domain 1, especially along the Tebay fault at its southern border. Magnetic discontinuities occur near, but not exactly on the north-trending Taral fault zone, which parallels the Copper River.

Domain 2

Magnetic basement appears to be moderately to deeply buried across a large part of domain 2. For the most part the metamorphic rock units, Kmr and Khc (of Cretaceous? and Cretaceous age? respectively), are non- to weakly magnetic. The most conspicuous positive anomalies occur over the mafic-ultramafic Tonsina belt, exposed above Bernard and Dust Creeks. We infer that a concealed segment of the belt lies immediately east of the community of Tonsina. Small aeromagnetic highs along the Second Lake fault zone correlate with small exposed ultramafic masses.

A general gravity high of about +20 to +30 mGals occurs over the Tonsina mafic-ultramafic belt (Barnes, 1977, Burns, 1982a), which indicates that its thickness is probably 5 km or more. In the southern part of domain 2, small positive magnetic anomalies occur over the metaplutonic rocks of this terrane (Khcm) and, perhaps, locally over the metavolcanic rocks of the Haley Creek terrane. A zone of steepened magnetic gradient occurs on the trend of the Second Lake fault system, which trends about east-west. Another zone trends northeast, just northwest of the main exposures of the Tonsina mafic-ultramafic belt. A poorly defined, intermittent zone of steepened magnetic gradient lies between, but subparallel, to the traces of the O'Brien Creek and Spirit Mountain fault zones.

Domain 3

The most conspicuous aeromagnetic anomalies of the Valdez quadrangle occur over the Tazlina mafic-ultramafic plutonic belt, which is exposed best between Tazlina Lake and the terminus of Nelchina Glacier. Anomalies over this terrane were discussed as "the Northern Chugach Mountains anomaly" by Andreasen and others (1964). Magnetic anomalies attain amplitudes of several thousand gammas, and relative positive gravity anomalies (20-30 mGals) occur over the belt. Continuity of magnetic and gravity anomalies, outcrops, and steep gradients indicate that the mafic belt extends as far east as the Copper River but in places it is buried at very shallow depth east of Klutina River. The Tazlina plutonic belt is variable in composition and magnetization. As described by Winkler and others (1981a) and Burns (1982a), it consists of gabbronorite, gabbro, and leucogabbronorite but also includes ultramafic, pyroxene-hornblende gabbronorite, dioritic, and tonalitic rocks. Ferrogabbronorites with 10 - 15 percent magnetite and ilmenite are also abundant. Evidence for injections of magmas of diverse composition has been observed in a few localities, and cumulate textures are not uncommon. Susceptibilities are as much as 0.017 cgs units (fig. 2), and many samples have values greater than 0.004. At many localities, a compass cannot be used in the field because of the high magnetite content of the Tazlina rocks.

Five north-south magnetic profiles across the complex have been modeled by Burns (1982a). Geologic mapping and the geophysical anomalies suggest that two-dimensional modeling is valid to determine the basic shape of the body. The extreme variability of magnetization (fig. 2) within the gabbroic body produces local magnetic anomalies (figs. 3-7) that are not two-dimensional. No attempt to match the models with these minor magnetic features has been made. Note that apparent magnetizations in the models are the product of apparent susceptibility times the Earth's field (0.5-0.53 oersted).

The assumption was generally made that the rocks are magnetized in the direction of the present Earth's field (inclination, 75°; declination, 28°; Earth's field =0.5 oersted. The assumption is probably not correct, as some samples have a large component of remanent magnetization. A systematic field and laboratory study of remanent magnetization of these rocks has not yet been conducted. Various inclinations and declinations were modeled, but the alternate directions of magnetization generally changed the contact angles of the gabbroic body by less than 10 degrees (Burns, 1982a).

Large edge effects generally occur when the model includes only one magnetization contrast (fig. 7); therefore, the gabbroic body was generally modeled by using several zones differing in magnetization contrasts. The zones should only be viewed as possible models; detailed mapping, petrography, and magnetic susceptibility studies are necessary to determine if simple magnetic zones are actually present.

The observed magnetic anomalies can be modeled by bodies having apparent magnetization contrasts (with respect to nonmagnetic adjacent rocks) of 0.002 to 0.006 emu/cm^3—values consistent with measured values of susceptibility. Depending on the particular profile, these bodies have thicknesses of 3 - 6 km (poorly constrained), breadths of 5 - 10 km, and tend to widen at depth from the exposures at the ground surface (figs. 3-7).

An aeromagnetic model, profile C-C' located near Tazlina Lake, is shown in figure 5. The most plausible explanation for the low amplitude, because both the south and north edges of the body are commonly intensely sheared, is that most of the magnetite along this profile has been oxidized to hematite. A gravity high of about 30 mGals occurs along the line of profile (Burns, 1982a).

It is believed that the aeromagnetic anomaly over the Tazlina belt extends intermittently westward into the Anchorage quadrangle and turns southward, near Palmer, to form the Knik Arm anomaly described by Grantz and others (1963) (anomaly IV, fig. 1). Fisher (1981) and Case and others (1986) have further proposed that a similar anomaly and its causative plutonic complex may extend intermittently southwest across the northwestern side of Afognak and Kodiak Islands and offshore (anomaly III, fig. 1). If these inferences are correct, this plutonic complex extends as a long, but very narrow semicontinuous belt for more than 800 km and thus constitutes a major geologic feature of southern Alaska.

Andreason and others (1964) postulated that the anomaly was mainly caused by volcanic rocks of the Talkeetna Formation and associated plutonic rocks. And, indeed, in a few localities Talkeetna volcanic rocks underlie parts of the main anomaly. They suggested that the Twin Lakes anomaly is caused by volcanic rocks in the core of a faulted anticline, so that sources in the Tazlina mafic-ultramafic belt or Talkeetna volcanic rocks are both possible.

North of the main anomaly belt in domain 3, rather isolated high-amplitude anomalies overlie Talkeetna volcanic rocks in the belt of outcrops between the north flank of the Chugach Mountains and the Copper River Basin. The Durham Creek anomaly was analyzed by Andreasen and others (1964) and they concluded that the anomaly is caused by a shallow, dense, and magnetic rock mass that is less than 1 km deep. The source rock is most likely igneous, possibly volcanic rocks of the Talkeetna Formation.

Cretaceous sedimentary rocks in the Copper River Basin are thought to be virtually nonmagnetic, and a great depth to the magnetic basement is indicated by the huge lows having flat gradients that extend from south of Copper Center to northern Tazlina Lake.

Domain 4

Most sedimentary rocks in the southwest part of the Valdez quadrangle, including the Orca and Valdez Groups and the McHugh Complex, are essentially nonmagnetic. Mafic and ultramafic rocks (mum, most concealed) in the McHugh Complex cause several small positive anomalies of a few tens of gammas in amplitude. The ovoid complex of amphibolite, gabbro, and ultramafic masses between the Nelchina and Tazlina Glaciers produces a few small anomalies of as much as 200 gammas in amplitude. A few small positive anomalies over the Valdez Group in the southwest corner of the quadrangle are caused by thin sequences of mafic volcanic rocks. The absence of substantial anomalies over most of the outcrop areas of the Orca and Valdez Groups, and the gentle magnetic gradients found there indicate great depth, 5-10 km or more, to magnetic basement. No significant magnetic lineaments were identified in most of domain 4.

MAGNETIC ANOMALIES AND RESOURCES

For the following brief discussion, the report by Winkler and others (1981b), provides locations and descriptions of mines, prospects, and occurrences.

Domain 1

In the northeastern part of the quadrangle, small deposits of Cu and Cu(Ag,Au) are found mainly in the Triassic Nikolai Greenstone and overlying Triassic limestones. Because the mafic volcanic rocks of the Nikolai were a source for the copper in the overlying limestones, the Nikolai and adjacent formations are prospective for copper. The magnetic highs commonly produced by the Nikolai may, thus, constitute an indirect exploration guide.

Small deposits of Cu-Mo, and Pb(Ag) are found in the Skolai Group, but the magnetic expression of the Skolai is so variable that regional magnetic data appear to be of limited value as an exploration guide for these deposits.

Domain 2

In this domain, deposits of Ni-Cu, Ni-Cu(Co-Pt-Ag), Au, and Zn(Pb-Ag) occur in various units of the Haley Creek terrane. The Ni-Cu deposits are in mafic or ultramafic units that have moderate magnetic expression. The Au and Zn(Pb-Ag) deposits are associated with schists having little or no magnetic expression. Deposits of Au(Ag-Pb-Zn); Au(Ag-Pb); and Cu(Ba-Mn) are found in schists and other rocks of the metamorphic sequence (Kmr) that have virtually no magnetic expression.

Domain 3

Small deposits and shows of Cr(Ni,Pt) have been found in mafic and ultramafic rocks (Jmp) of the Tazlina and Tonsina belts. This rock belt has major magnetic expression, which enables it to be traced beneath glacial, alluvial, and water cover. In addition to Cr(Ni,Pt), some of these rocks also contain substantial amounts (5 percent or more) of magnetite. Small, but probably noneconomic, magnetite deposits are suspected in the vicinity of the larger magnetic highs.

A few small deposits of Zn(Cu); Au; and Mo-Cu(Zn) occur in or near the Talkeetna Formation. Most of these are located on steep magnetic gradients on the flanks of magnetic highs, which suggests that the deposits are in part controlled by faults.

Domain 4

Small lode and placer deposits of Au, Au(Pb), Au(Ag-Zn), Au(Cu-Pb), Au(As-Fe), Au(Cu-Pb-Zn), Au(Pb-Zn-Ag), Au(Sb), and others, are scattered across much of the outcrop area of the Valdez and Orca Groups. This flysch terrane is virtually nonmagnetic, and no significant aeromagnetic anomalies were identified over specific deposits, which are very small. Deposits of Cu(Ag-Au-Zn), Cu(Zn-Pb-Ag), and Cu(Zn-Pb) in or associated with volcanogenic units of the Valdez Group in the southern part of the area, are likewise not accompanied by significant aeromagnetic anomalies.

Energy resources - Copper River Basin

Aeromagnetic data and regional gravity data (Barnes, 1977) suggest that basement beneath the southern part of the Copper River Basin lies about 1 km beneath the surface near the Durham Creek anomaly (T. 2 N., R. 4 W.) to perhaps as much as 10 km deep near Copper Center (T. 2 N., R. 1 E.). Continuation of the northeast-trending Twin Lakes anticline, in the northwest corner of the quadrangle, into the subsurface is indicated by the pattern of magnetic anomalies, and this faulted structure might provide a trap for oil or gas if suitable source and reservoir rocks are present in the subsurface. If the Durham Creek feature is anticlinal rather than an intrabasement feature, it, too, might constitute an exploration target.

CONCLUDING COMMENT

Data derived from geologic mapping and geophysical surveys in the Valdez quadrangle indicate that minor modifications could be made in the map of tectonostratigraphic terranes of Alaska compiled by Jones and others (1981). Specifically, the boundary between Wrangellia on the east and the Peninsular and Chugach terranes on the west and south coincides closely with the boundary between domains 1 (Wrangellia), 3 (Peninsular terrane) and 4 (Chugach terrane). The Tazlina mafic-ultramafic belt lies between the Peninsular terrane on the north and the Chugach terrane on the south. Whether it should be regarded as a separate terrane is an open question requiring much additional regional research. Similarly, the terrane assignment for domain 2 remains an open question. Burns (1985) postulates that the mafic-ultramafic belt is a counterpart of the Talkeetna volcanic rocks, and, thus is part of the Peninsular terrane.

Acknowledgments

We are grateful for many helpful discussions with colleagues in the U.S. Geological Survey and Alaska Division of Geological and Geophysical Surveys, especially Arthur Grantz and Gar Pessel.

REFERENCES

Andreasen, G. E., Dempsey, W. J., Henderson, J. R., and Gilbert, F. P., 1958, Aeromagnetic map of the Copper River Basin, Alaska: U.S. Geological Survey Geophysical Investigations Map GP-156, scale 1:125,000.

Andreasen, G. E., Grantz, Arthur, Zietz, Isidore, and Barnes, D. F., 1964, Geologic interpretation of magnetic and gravity data in the Copper River Basin, Alaska: U.S. Geological Survey Professional Paper 316-H, p. 135-153.

Barnes, D. F., 1977, Bouguer gravity map of Alaska: U.S. Geological Survey Geophysical Investigations Map GP-913, scale 1:2,500,000.

Burns, L. E., 1982a, Analysis of gravity and magnetic anomalies over a layered gabbro complex, Chugach Range, Alaska: U.S. Geological Survey Open-File Report 82-460, 96 p.

_____1982b, The Border Ranges mafic complex; base of a Jurassic island arc? abs.: Eos, American Geophysical Union, Transactions, v. 63, no. 45, p. 1114.

_____1985, The Border Ranges ultramafic and mafic complex, south-central Alaska: cumulate fractionates of island arc volcanics: Canadian Journal of Earth Science.

Case, J. E., Fisher, M. A., Moore, G. W., Moore, J. C. and Nelson, S. W., 1986, Preliminary geologic interpretation of the aeromagnetic map of Afognak and Shuyak Islands, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1718, scale 1:250,000, 2 sheets.

Case, J. E., and MacKevett, E. M., Jr., 1976, Aeromagnetic maps and geologic interpretation of aeromagnetic map, McCarthy quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-773-D, scale 1:250,000, 2 sheets.

Case, J. E., Tysdal, R. G., Hillhouse, J. W., and Grommé, C. S., 1979, Geologic interpretation of aeromagnetic map of the Seward and Blying Sound quadrangles, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-880-D, scale 1:250,000, 2 sheets.

Csejtey, Béla, Jr., and Griscom, Andrew, 1978, Preliminary aeromagnetic interpretive map of the Talkeetna Mountains quadrangle, Alaska: U.S. Geological Survey Open-File Report 78-558-C, 14 p., scale 1:250,000, 2 sheets.

Fisher, M. A., 1981, Location of the Border Ranges fault southwest of Kodiak Island, Alaska: Geological Society of America Bulletin, v. 92, no. 1, p. 19-30.

Grantz, Arthur, Zietz, Isidore, and Andreasen, G. E., 1963, An aeromagnetic reconnaissance of the Cook Inlet area, Alaska: U.S. Geological Survey Professional Paper 316-G, p. 117-134.

Griscom, Andrew, 1975, Aeromagnetic map and interpretation of the Nabesna quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-665-H, scale 1:250,000, 2 sheets.

Jones, D. L., and Silberling, N. J., 1979, Mesozoic stratigraphy—The key to tectonic analysis of southern and central Alaska: U.S. Geological Survey Open-File Report 79-1200, 37 p.

Jones, D. L., Silberling, N. J., Berg, H. C., and Plafker, George, 1981, Map showing tectonostratigraphic terranes of Alaska, columnar sections, and summary description of terranes: U.S. Geological Survey Open-File Report 81-792, 20 p., 2 sheets.

Jones, D. L., Silberling, N. J., and Hillhouse, John, 1977, Wrangellia—a displaced terrane in northwestern North America: Canadian Journal of Earth Sciences, v. 14, no. 11, p. 2565-2577.

Plafker, George, Jones, D. L., and Pessango, E. A., Jr., 1977, A Cretaceous accretionary flysch and melange terrane along the Gulf of Alaska margin, in Blean, K. M., ed., The United States Geological Survey in Alaska: Accomplishments during 1976: U.S. Geological Survey Circular 751-B, p. B41-B43.

U.S. Geological Survey, 1979, Aeromagnetic map of parts of the Cordova and Middleton Island 1° X 3° quadrangles, Alaska: U.S. Geological Survey Open-File Report 79-223, scale 1:250,000.

Winkler, G. R., Silberman, M. L., Grantz, Arthur, Miller, R. J., and MacKevett, E. M., Jr., 1981a, Geologic map and summary geochronology of the Valdez quadrangle, southern Alaska: U.S. Geological Survey Open-File Report 80-892-A, scale 1:250,000, 2 sheets.

Winkler, G. R., Miller, R. J., MacKevett, E. M., Jr., and Holloway, C. D., 1981b, Map and summary table describing mineral deposits in the Valdez quadrangle, southern Alaska: U.S. Geological Survey Open-File Report 80-892-B, scale 1:250,000, 2 sheets.

Winkler, G. R., Miller, R. J., and Case, J. E., 1981c, Blocks and belts of blueschist and greenschist in the northwestern Valdez quadrangle, in Albert, N.R.D., and Hudson, Travis, eds., The United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. B72-B74.

AEROMAGNETIC MAP

MAPS SHOWING AEROMAGNETIC SURVEY AND GEOLOGIC INTERPRETATION OF THE VALDEZ QUADRANGLE, ALASKA

By

J.E. Case, Laurel E. Burns, and G.R. Winkler

1986

Interior—Geological Survey, Reston, Va.—1986

For sale by Distribution Section, U.S. Geological Survey, Federal Bldg., Box 12, 101 Twelfth Avenue, Fairbanks, AK 99701, and Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225