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TEXT TO ACCOMPANY PRELIMINARY AEROMAGNETIC INTERPRETIVE MAP OF THE TALKEETNA MOUNTAINS QUADRANGLE, ALASKA

By

Béla Csejtey, Jr. and Andrew Griscom

To accompany

Open-File Report 78-558C

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature

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GENERAL STATEMENT

This report is a preliminary aeromagnetic interpretation of the Talkeetna Mountains quadrangle, Alaska, and it was prepared as a component of a series of multidisciplinary investigations to assess the mineral resource potential of the quadrangle. These multidisciplinary investigations are carried out under the auspices of the U.S. Geological Survey's Alaska Mineral Resource Assessment Program (AMRAP).

In this preliminary report, the aeromagnetic interpretation is based on an aeromagnetic map of the Talkeetna Mountains quadrangle, which was prepared in 1972 and subsequently published by the State of Alaska, Division of Geological and Geophysical Surveys (1973).

In addition to the aeromagnetic map of the Alaska Division of Geological and Geophysical Surveys (1973), there have been other aeromagnetic investigations in the Talkeetna Mountains quadrangle, but they cover only parts of the quadrangle or cover it only at a small scale. An effort to integrate the results of these investigations into the present report could not be made due to the lack of additional time the effort would have required. These other aeromagnetic investigations have already been reported as follows:

Andreasen and others, 1958, 1964--aeromagnetic studies of the Copper River Basin, including the eastern edge of the Talkeetna Mountains quadrangle;

Decker and Karl, 1977--aeromagnetic map compilation of the eastern part of southern Alaska, including the Talkeetna Mountains quadrangle, at a scale of 1:1,000,000;

Hackett, 1978a, 1978b--aeromagnetic studies of the Talkeetna-Kashwitna Rivers area, covering the southwest portion of the quadrangle; and

Texas Instruments Incorporated, 1978--a few aeromagnetic profiles across the quadrangle, obtained as part of radiometric reconnaissance.

The present report consists of an aeromagnetic interpretive map (plate 1), the aeromagnetic map of the Talkeetna Mountains quadrangle by the Alaska Division of Geological and Geophysical Surveys (1973; plate 2), and a text. A reconnaissance geologic map and an interpretive tectonic synthesis of the Talkeetna Mountains have already been published (Csejtey and others, 1978), and the aeromagnetic map should be used in conjunction with that report.

The aeromagnetic survey of the Talkeetna Mountains quadrangle, made on contract for the Alaska Division of Geological and Geophysical Surveys, was conducted from a fixed-wing aircraft flying at a nominal height of 300 m (approximately 1,000 ft) above the ground. The orientation of the flight lines is north and south with a spacing of about 1,200 m (0.75 mi). There are also four east-west tielines. Because of the extreme topographic relief in the quadrangle, a constant flying height above ground could not be maintained. This flying problem caused additional complexities of the magnetic field as measured at the aircraft, and caused areas of subdued magnetic amplitudes over deep valleys. Compilation of

the measured aeromagnetic data originally was at a scale of 1:63,360, and this compilation was reduced to form the aeromagnetic map at a scale of 1:250,000 (plate 2), with contour intervals of 10, 20, 100, and 500 gammas. Before contouring the map, the regional field (updated IGRF, 1965) was removed by computer from the data, and 5,000 gammas were added arbitrarily to all values.

The aeromagnetic anomalies in the Talkeetna Mountains quadrangle are many and varied in amplitude; the aeromagnetic map is one of the more complex in southern Alaska. This complexity is the result of many rock units in the quadrangle having large magnetic susceptibilities, of the effects of the extreme topographic relief, and of the already mentioned flying problem. For a more thorough interpretation of the aeromagnetic map, more detailed knowledge of the physical properties of the various rock units is needed. The final interpretation would also need considerably more time-consuming work by a geophysicist than was possible to spare for this report.

DISCUSSION OF AEROMAGNETIC ANOMALIES

There is a distinct difference in the overall aeromagnetic pattern of the northwest portion and the southeastern two-thirds of the Talkeetna Mountains quadrangle. The change occurs rather abruptly along a line trending approximately northeast and marked by a double line on plates 1 and 2. Except for near the western margin of the quadrangle, this aeromagnetic change coincides fairly well with a major northeast-trending fault which brings, on the south, upper Paleozoic and younger,

dominantly igneous and metamorphic rocks, all highly magnetic, against, to the north, mostly argillites and graywackes of Cretaceous age, which are generally nonmagnetic. On the basis of strong geologic evidence, this fault, the most significant structural feature of the quadrangle, has been interpreted as a steeply southeastward-dipping thrust, named the Talkeetna thrust, by Csejtey and others (1978). Near the northern edge of the Talkeetna Mountains quadrangle, however, the slope of the aeromagnetic anomaly patterns suggest that the fault dips steeply to the northwest. Along the interpreted southwestward, but subsurface, continuation of this fault in the Talkeetna quadrangle, Griscom (1978) has interpreted the aeromagnetic features as suggestive of a northwesterly dip. Possibly, the aeromagnetic patterns suggesting a northwesterly dip are the result of interference by posttectonic, mafic to intermediate plutonic or volcanic intrusives along or near the fault; indeed, there are Tertiary volcanic dikes along the fault near the northern edge of the Talkeetna Mountains quadrangle.

Within each of the two magnetically dissimilar major regions of the quadrangle, smaller areas of magnetic anomalies have been outlined on plates 1 and 2 and are discussed in the following sections.

Northwest portion of Talkeetna Mountains quadrangle

Area 1.--This area is predominantly underlain by the generally nonmagnetic Cretaceous sedimentary rocks and, to a lesser extent, by nonmagnetic to weakly magnetic plutonic and metamorphic rocks of Tertiary age. Magnetically, none of these rocks have sufficiently distinctive

patterns to separate them. The magnetic contours generally comprise a broad and nondescript pattern and usually have values less than the arbitrary 5,000-gamma background level.

Areas 2a, 2b, and 2c.--Broad magnetic patterns with amplitudes as much as 300 gammas, and values generally above the 5,000-gamma background level. Such anomaly patterns are indicative of weakly magnetic, felsic to intermediate plutonic rocks. The geologic map shows that these anomaly pattern areas are indeed associated with such rocks. These plutonic rocks, or at least portions of these plutons, are apparently more magnetic than the correlative plutonic rocks within area 1.

Areas 3a, 3b, and 3c.--Linearly positioned patches of magnetic lows in Cretaceous argillites and Triassic basalts. These lows are considered to be below the local background level of the magnetic field, which on the map is set arbitrarily at 5,000 gammas. In areas 3a and 3b, these anomalies are adjacent to Tertiary granitic plutons. Similar associations occur in the Talkeetna quadrangle where they have been interpreted to be caused by contact metamorphic reverse remanent magnetization (Griscom, 1978). The anomalies in area 3c do not so closely border a large pluton but are very similar to those in areas 3a and 3b, and are also interpreted to be the result of contact metamorphic reverse remanent magnetization, perhaps due to a large but mostly still unroofed, shallow granitic pluton.

Areas 4a, 4b, 4c, 4d, and 4e.--Typical irregular magnetic patterns of volcanic rocks in areas 4a, 4b, and 4c, clearly associated with mafic to felsic Tertiary volcanic rocks. The magnetic patterns in areas 4d

and 4e are very similar to the previous ones but are only in part or not at all associated with known volcanic rocks. Perhaps these latter anomalies are caused by Tertiary volcanic dikes and plugs cutting the granitic rocks.

Area 5.--Highest positive anomaly in quadrangle, more than 6,000 gammas above the 5,000-gamma background level. The steep and circular magnetic contours suggest that the highly magnetic but unexposed rock causing the anomaly must form a cylindrical-shaped body, having considerable depth. Most likely it is a plug of Tertiary basalt or diabase.

Area 6.--Elongate magnetic high above the 5,000-gamma background level but with a maximum amplitude of only about 100 gammas in the Susitna Valley. This feature is a continuation of a similar anomaly in the Talkeetna quadrangle, where it appears to be caused by deep-seated magnetic rocks (Griscom, 1978). The source of this anomaly is shallower in the Talkeetna Mountains quadrangle, although the rocks causing it are still not exposed. This anomaly may possibly be caused by a serpentinite mass which was either intruded into the Cretaceous argillites in situ or is a tectonically emplaced allochthonous block. The latter possibility would suggest considerable thrusting for the Cretaceous argillites which are considered to be, from a regional tectonic point of view, "semiautochthonous" (Csejtey and others, 1978).

Southeast portion of the Talkeetna Mountains quadrangle

Area 7.--A pattern of moderate highs and lows with magnetic values ranging from about 4,800 gammas to about 5,600 gammas. Apparently the pattern is caused by the more magnetic portion of a larger Tertiary

pluton. The dominant rock type of this pluton is biotite-hornblende granodiorite, hornblende being the chief mafic mineral (Csejtey and others, 1978). The Tertiary plutonic rocks in the northwest portion of the quadrangle are mostly biotite-granodiorites, biotite being their chief mafic mineral, and are generally less magnetic than the granodiorite of area 7. Thus, it appears that the magnetic characteristics of the Tertiary plutonic rocks are largely dependent upon their hornblende concentrations.

Area 8.--High, positive anomalies with magnetic values from about 5,500 gammas to over 7,300 gammas, fairly closely associated with a portion of the same hornblende granodiorite pluton as the anomalies of area 7. The magnetic values of area 8 are higher than those of area 7, suggesting a higher concentration of magnetic minerals, primarily hornblende.

Area 9.--Irregular patches of predominantly negative anomalies, similar in irregularity to those in areas 4a and 4b, thus suggesting the presence of unexposed Tertiary volcanic rocks. If Tertiary volcanic rocks indeed are present in this area, they must either be flows lapping onto or dikes and plugs intruding the older Tertiary granodiorite which is exposed along the southern edge of area 9.

Area 10.--Complex and highly anomalous, mostly positive, magnetic patterns. Magnetic values range from about 4,300 gammas to as high as 7,300 gammas. Area is underlain by moderately to strongly magnetic mafic volcanic, metamorphic, and plutonic rocks chiefly of units Pzv, Tbgd, and Jpm. Because of similar magnetic characteristics, the major rock

units cannot be easily separated by means of aeromagnetic pattern analyses. This difficulty is further complicated by the effect of the considerable local relief, locally as much as 1,300 m (about 4,300 ft), on the magnetic anomaly patterns.

Area 11.--High, positive anomalies, over 8,600 gammas in maximum value, surrounding a magnetic low of about 6,000 gammas. The magnetic patterns are suggestive of an unexposed pluton, probably of a hornblende-rich granodiorite as in area 8, beneath the Quaternary surficial deposits.

Area 12.--A dominantly magnetic low area which coincides well with the boundary of an apparently weakly magnetic adamellite pluton (granite with K-feldspar and plagioclase in roughly equal proportions).

Area 13.--This area is underlain by weakly to moderately magnetic tonalite and granodiorite of unit TKt. The anomalies are less intense, and their patterns differ in comparison with the surrounding rocks in area 10. The mapped boundaries of unit TKt coincide fairly well with the subdued anomalies of area 13.

Area 14.--A magnetically high area, from about 6,000 gammas to 7,300 gammas, suggestive of a pluton partly covered by the mafic flows and tuffs of unit Tv.

Areas 15a and 15b.--Variable magnetic patterns with anomalies somewhat lower in amplitude than those over mafic volcanic, metamorphic, and plutonic rocks of surrounding regions. Areas 15a and 15b coincide fairly well with the northern part, consisting chiefly of mafic volcanic rocks, of a large outcrop area of unit Tv.

Area 16.--Broad magnetic patterns of lows and highs with a maximum amplitude of about 1,000 gammas but with average amplitudes of only a few hundred gammas. Much of the area displays a relatively flat magnetic field. Area 16 coincides quite well with the distribution of unit Pzv in the northern part of the quadrangle. Rocks of unit Pzv consist dominantly of severely deformed metamorphosed mafic volcanic and volcaniclastic rocks with subordinate sedimentary rocks, and a number of thick diabase sills (Csejtey, 1974; Csejtey and others, 1978).

Area 17.--Several small, discontinuous, mostly linear areas of moderately high positive anomalies within area 16. The amplitudes of these positive anomalies are small, only a few hundred gammas, magnetic values ranging from about 4,900 gammas to 5,500 gammas. The narrowly linear anomaly patterns most likely are caused by more magnetic layers or diabase sills within unit Pzv, while the broader anomaly areas are suggestive of minor anticlines or diabase stocks.

Area 18.--Strong, dominantly positive magnetic anomalies caused by intensely magnetic basalts of unit TRv. In northeast corner of the map, the magnetic trend does not follow the known distribution of the basaltic rocks. Perhaps the discrepancy is the result of feeder dikes and sills of the Triassic basalts in the underlying Paleozoic volcanic rocks (unit Pzv).

Area 19.--Subcircular magnetic "doughnut" anomaly of a poorly exposed granitic pluton of Late Cretaceous or Tertiary age. This granitic body is probably zoned compositionally in a concentric manner, causing the magnetic pattern of a central low surrounded by magnetic highs.

Areas 20a, 20b, and 20c.--Broadly circular, moderately strong positive anomalies, suggestive of plutonic rocks. Areas 20a and 20b are clearly associated with known exposures of granitic rocks (granodiorite and tonalite of unit TKgr in Csejtey and others, 1978). No granitic rocks are known to occur within area 20c, but there is a small exposure of trondhjemite(?) just a few miles south of it (Csejtey and others, 1978).

Area 21.--Strongly positive magnetic anomalies with amplitudes of nearly 2,000 gammas; suggestive of a mafic plutonic or subvolcanic intrusive. There is a mafic subvolcanic intrusive just north of area 21 (Csejtey and others, 1978), and perhaps the anomalies in area 21, as well as in nearby area 5, are caused by the unexposed portions of this intrusive.

Area 22.--Strongly negative anomaly, with a low magnetic value of nearly 3,800 gammas, within the exposure area of unit Pzv. No rocks of unit Pzv are known to exhibit such magnetic lows. Perhaps this negative anomaly is caused by an unexposed felsic volcanic intrusive with reverse remanent magnetization.

Area 23.--A broad belt of generally circular, moderately strong positive and negative magnetic anomalies, with values ranging from about 4,700 gammas to 5,800 gammas. Area 23 coincides well with a belt of Jurassic plutonic and metamorphic rocks ranging from granodiorite to quartz diorite and amphibolite.

Areas 24a, 24b, 24c, 24d, 24e, 24f, and 24g.--Moderately to strongly positive magnetic anomalies with amplitudes of nearly 1,000 gammas. The

patterns are characteristic of plutonic rocks. Areas 24a, 24b, 24c, 24d, and 24e are located within a large Jurassic pluton, dominantly of granodiorite. Clearly, these areas outline more magnetic parts of this pluton. Areas 24f and 24g are not associated with exposed plutonic rocks but perhaps indicate the presence of still unroofed plutons.

Area 25.--An elongate area of low gradients and weak magnetic anomaly patterns which coincide rather well with a weakly magnetic to nonmagnetic trondhjemite pluton (unit Jtr). Near the eastern edge of the map, area 25 narrows and curves around to an approximately east-west trend, indicating that the trondhjemite pluton continues eastward under the Quaternary surficial deposits.

Area 26.--Magnetic patterns similar to those in areas 23, and 24a to 24g. Exposed bedrocks of area 26 also consist chiefly of the same Jurassic granodiorite as in the above areas. The magnetic patterns further indicate that these Jurassic plutonic rocks continue eastward under the extensive Quaternary surficial deposits.

Area 27.--Strongly positive magnetic anomalies with amplitudes of about 2,000 gammas. Patterns suggest a mafic intrusive body. Within area 27 there is only a small outcrop of bedrock which was mapped as probable amphibolite (Jam(?) in Csejtey and others, 1978). Perhaps it is an altered diorite or gabbro intrusive instead.

Area 28.--Somewhat irregular patterns of moderate magnetic highs and lows, with maximum amplitudes of about 1,000 gammas, suggestive of volcanic rocks. Exposed bedrocks in area 28 mostly consist of mafic volcanic rocks of the Jurassic Talkeetna Formation (unit Jtk), and to

a lesser extent, of unit Tv.

Areas 29a and 29b.--Fairly strong magnetic highs and a few lows with values from about 5,800 gammas to almost 6,400 gammas. The patterns are suggestive of mafic intrusive rocks within the Talkeetna Formation, although none were found in the field. However, exposures are poor, and any intrusive bodies which may be present may not be unroofed.

Area 30.--Smooth magnetic patterns of moderate highs and lows with values between 4,900 gammas and 5,600 gammas. This area is dominantly underlain by volcanic rocks, mostly felsic and apparently only weakly magnetic, of unit Tv.

Areas 31a and 31b.--Irregular patterns of moderate to strong magnetic anomalies, with relatively short wavelengths, typical of volcanic rocks. The magnetic values range between 4,800 gammas and 7,400 gammas. Both areas are underlain by mafic volcanic rocks of unit Tv.

Area 32.--The magnetic patterns of this area are very similar to those of adjacent area 28. However, area 32 is underlain mostly by non-volcanic sandstones and conglomerates of unit Jnc which rest unconformably on the mafic volcanic rocks of the Talkeetna Formation. Apparently the magnetic patterns in this area are caused by the underlying rocks of the Talkeetna Formation which must lie at shallow depths below the surface.

Area 33.--Moderate- to low-amplitude magnetic anomalies forming rather broad patterns, typical of weakly magnetic sedimentary rocks. The subdued anomaly patterns in this area are not primarily caused by

the weakly magnetic to nonmagnetic exposed sedimentary rocks, dominantly of unit Jnc, but by the underlying volcanic Talkeetna Formation, which is at sufficient depths to subdue the shorter wavelength features.

Area 34.--Magnetic patterns very similar to those of area 28. Area 34 is underlain by andesitic rocks of the Talkeetna Formation just like most of area 28.

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