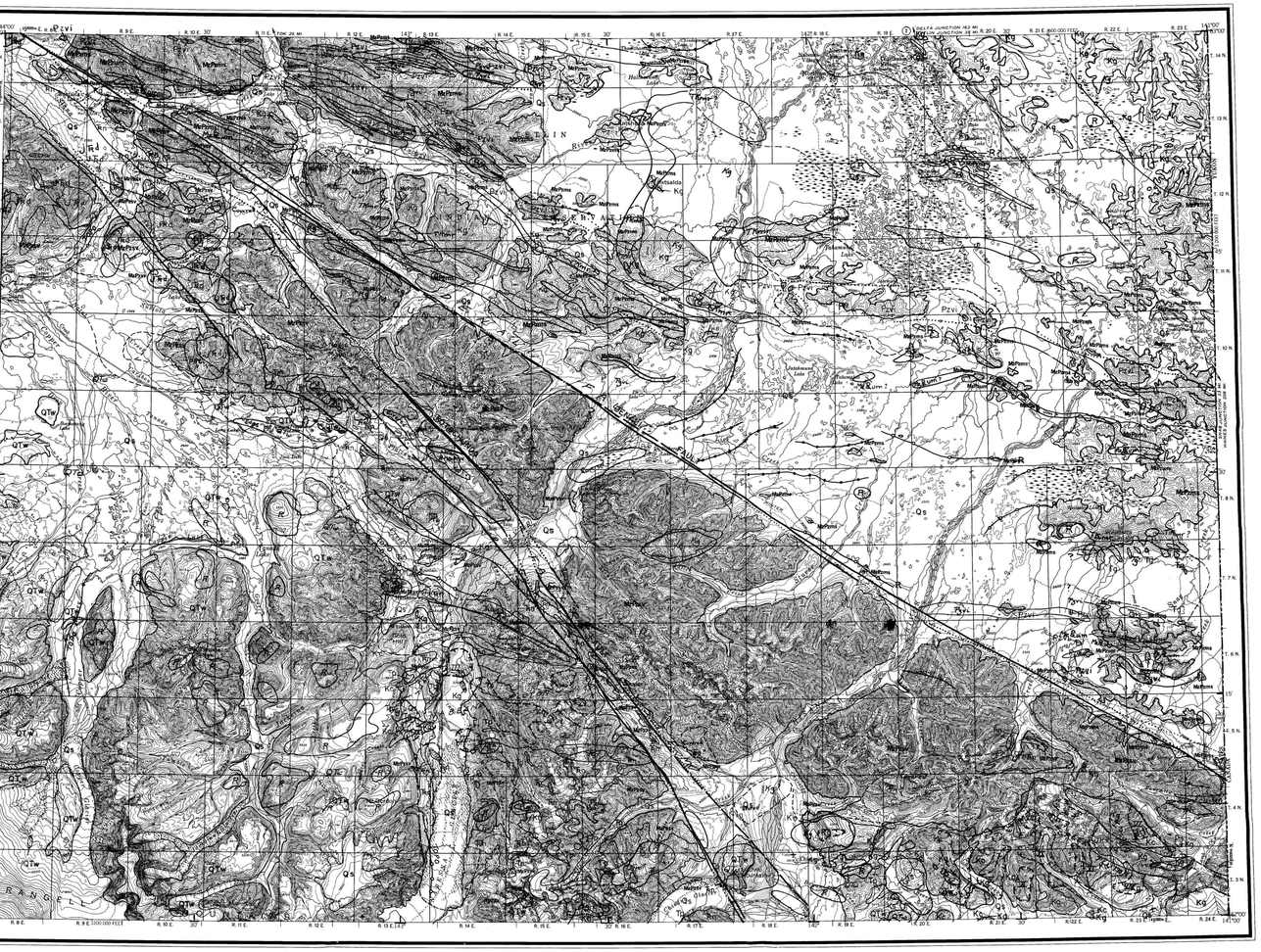
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCEL. NEOUS FIELD STUDIES MAP MF- 655H
SHEET 2 OF 2
FOLIO OF THE NABESNA QUADRANGLE, ALASKA



BASE BY U. S. GEOLOGICAL SURVEY, 1965

Background information for this folio is published as U.S. Geological Survey Circular 718, available free of charge from the U.S. Geological Survey, Reston, Va. 22092.

APPROXIMATE MEAN DECLINATION, 1965

SCALE 1:250 000

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

AEROMAGNETIC INTERPRETATION OF THE NABESNA QUADRANGLE, ALASKA

BY

ANDREW GRISCOM

1975

EXPLANATION FOR GENERALIZED GEOLOGIC MAP

[Geology generalized from Richter (1975)]

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

Qs	QUATERNARY

SEDIMENTARY AND VOLCANIC ROCKS		INTRUSIVE, METAMORPHIC, AND ULTRAMIFIC ROCKS	
QTw	QUATERNARY AND TERTIARY	Tp, Tg	TERTIARY
Ks, Kc	Upper(?) Cretaceous; Lower Cretaceous — CRETACEOUS	Kg	CRETACEOUS
		JTRd	JURASSIC AND TRIASSIC
TRn	Upper and(or) Middle Triassic — TRIASSIC	Mz a	MESOZOIC
MzPzsv	MESOZOIC AND PALEOZOIC	MzPzms, MzPzum	MESOZOIC AND PALEOZOIC
		Pzvt	PALEOZOIC

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qs — UNCONSOLIDATED SEDIMENTARY DEPOSITS (Quaternary)

SEDIMENTARY AND VOLCANIC ROCKS

QTw — WRANGELL LAVA (Quaternary and Tertiary)

Ks — CONTINENTAL SEDIMENTARY ROCKS (Upper? Cretaceous)

Kc — CHISANA FORMATION (Lower Cretaceous) Marine and subaerial volcanic rocks

TRn — NIKOLAI GREENSTONE (Upper and(or) Middle Triassic)

MzPzsv — UNDIVIDED SEDIMENTARY AND VOLCANIC ROCKS (Mesozoic and Paleozoic)

INTRUSIVE, METAMORPHIC, AND ULTRAMAFIC ROCKS

Tp — PORPHYRY (Tertiary) Porphyritic andesite to rhyodacite

Tg — UNDIVIDED GRANITIC ROCKS (Tertiary) Chiefly quartz monzonite

Kg — UNDIVIDED GRANITIC ROCKS (Cretaceous) Chiefly granodiorite and quartz monzonite

JTRd — DIORITE COMPLEX (Jurassic and Triassic)

Mz a — ANORTHOSITE (Mesozoic)

MzPzums — UNDIVIDED METAMORPHOSED SEDIMENTARY ROCKS (Mesozoic and Paleozoic)

MzPzum — UNDIVIDED ULTRAMAFIC ROCKS (Mesozoic and Paleozoic)

Pzvt — UNDIVIDED METAMORPHOSED MAFIC VOLCANIC AND INTRUSIVE ROCKS (Paleozoic)

Contact. Dotted where concealed

Fault. Dotted where concealed

EXPLANATION FOR AEROMAGNETIC INTERPRETATION MAP

Fault inferred from aeromagnetic data; dashed where approximately located

Boundary between magnetic and less magnetic rocks. Dashed where approximately located. Assumed to be near surface or to crop out unless labeled "covered". Labeled with symbol of rock unit believed to be causing the magnetic feature. Where not labeled, source of anomaly is unknown

R — Magnetic anomaly caused by rock possessing reverse remanent magnetization

Trend of axis of magnetic high. Labeled "TOPO" if believed caused by a topographic feature

Trend of axis of magnetic low. Labeled "TOPO" if believed caused by a topographic feature

T — Outline of magnetic low in area of Cretaceous plutonic rocks. Lows may be caused by topographic effects or by rock alteration involving destruction of magnetite during porphyry copper mineralization. Lows labeled with a roman numeral are discussed in text

DISCUSSION

AEROMAGNETIC DATA AND INTERPRETATION

The aeromagnetic map (sheet 1) of the Nabesna quadrangle was prepared in 1971 and subsequently released by the State of Alaska as an open-file map (Alaska Div. Geol. and Geophysics, 1973). The data were collected along north-south traverses spaced at 1.6 km intervals at an altitude of 300 m (1000 ft) above the ground. Compilation was originally in the form of 30' by 15' quadrangles at a scale of 1:63,360; these quadrangles have been combined and reduced to form the present map at a scale of 1:250,000. Contour interval is 10, 20, 100, or 500 gammas, depending upon the local range in the earth's magnetic field.

The local topographic relief in the Wrangell Mountains in the southern part of the quadrangle is as great as 1500 m, and under such circumstances the fixed-wing aircraft that performed the survey did not maintain a constant altitude of 300 m (1000 ft) above ground. In areas of large local relief, the aircraft flew approximately 300 m above the ridgetops, but it flew much closer to the ground than 300 m in the vicinity of the Nabesna River and Chisana River. Where an area of high relief is underlain by magnetic rocks, a local magnetic anomaly is generated by the topography. Magnetic anomalies caused by topography are superimposed upon even larger magnetic anomalies generated by the underlying magnetic rocks that extend to unknown depths below the surface. Thus, within large magnetically high areas there are local magnetic highs and lows over ridges and valleys, respectively. Another effect produced by the greater height of the aircraft over the floors of the larger valleys is a local smoothing of the magnetic field along the valleys. This smoothing is a result of the attenuation of magnetic anomalies with shorter wavelengths with increasing distance from the magnetic source. Such effects are observable over the larger valleys such as those of Cross Creek, Jack Creek, Sunlina Creek, Nabesna Glacier, and Chisana Glacier.

The magnetic anomalies and patterns on the aeromagnetic map are caused by variations in the percentages of magnetic minerals, commonly magnetite, in the various rock units and are closely related to geologic features. Most of the major anomalies are caused by igneous rocks, plutonic and volcanic, or by serpentinized ultramafic rocks. At these magnetic latitudes, boundaries between magnetic and relatively nonmagnetic rock units are located on the flanks of magnetic highs and immediately adjacent to magnetic lows. Magnetic lineaments, commonly marked by lows, delineate many such interpreted boundaries drawn around characteristic magnetic anomalies. Many boundaries correspond approximately to geologic contacts and are especially useful in increasing our understanding of the geology of the area north of the Denali fault where most of the bedrock geology is concealed by younger surficial deposits. If the anomalies are narrow and of low amplitude, the interpretation map shows a lineament symbol. Long linear magnetic boundaries, which may truncate other magnetic lineaments, are interpreted as major faults and are so indicated on the interpretation map. The interpretation map is superimposed on a generalized geologic map, which together with most of the geologic information contained in this report are derived from Richter (1975). Minor discrepancies (up to 2 km) between mapped geology and aeromagnetic interpretation are expectable at this map scale and may result from errors in aircraft location as well as from the oversimplification inherent in the magnetic interpretation.

Certain of the magnetic lows on the map are interpreted to be the result of reverse remanent magnetization of the underlying rock units and are indicated by a capital letter "R". These lows are relatively isolated and are considered to be below the local background level of the magnetic field. Other magnetic lows, especially those on the north and northeast sides of magnetic highs, are the result of normal polarization effects at these magnetic latitudes (field inclination 76°) and have nothing to do with reverse remanent magnetization.

For the reader's convenience, table 1 compares the generalized geologic and magnetic interpretation units on this map with those on Richter's (1975) detailed geologic map.

AREA NORTH OF THE DENALI FAULT

Undivided metamorphosed Paleozoic mafic volcanic and intrusive rocks (Pzvt)

Metamorphosed Paleozoic igneous rocks are associated with a linear magnetic high having moderate amplitude. The magnetic highs clearly do not correspond well to the mapped distribution of the geologic units, and it is suggested that perhaps only the most massive and low or intermediate units have managed to preserve their magnetite from alteration by the pervasive relatively low grade regional metamorphism. At least half of the map unit is relatively nonmagnetic.

Undivided ultramafic rocks (MzPzum)

Ultramafic rocks cause major elongate magnetic highs with local amplitudes in excess of 1000 gammas. Magnetite causing these anomalies was probably formed during the serpentinization of these rocks. The anomalies have maximum amplitudes over outcrops of the ultramafic rocks in the northwest corner of the quadrangle. Although the bulk of the three areas of ultramafic rocks, the southeastern one is different because the anomalies are smaller, both in amplitude and lateral extent, and in addition are also associated with a leucocratic gabbro. This ultramafic and gabbro unit is constrained by Richter (1975) to be petrographically distinct from and probably older than the other ultramafic bodies.

The northerly ultramafic masses are much more extensive. The three eastern outcrops are connected by a linear magnetic anomaly 35 km long, and the easternmost of the three is 10 km long and 5 km wide. This anomaly is associated with massive chromitite float (chromite is very weakly magnetic and is not the cause of the anomaly). The substantial lateral extent of the large magnetic anomaly of the Mirror Creek body suggests the possibility of prospecting for chromite along a distance of at least 5 km to the west of the outcrop.

The asymmetric form of the magnetic anomaly associated with the western ultramafic mass (west of Little Tok River) indicates that it is a sheetlike mass dipping gently to the south.

Undivided metamorphosed sedimentary rocks (MzPzms)

The metamorphosed sedimentary rocks consist primarily of phyllite and quartz-mica schist. The magnetic character of this unit is one of very small amplitude, short wavelength anomalies. Several magnetic lineaments are evident, some of which have an unusual northeast trend in the center of the map (sheet 2) and which are cut off along their southwest ends by the Denali fault. Local magnetic lows are believed to be the result of reverse remanent magnetization. The magnetic anomalies are much stronger than those of the metamorphosed sedimentary unit strongly suggests that it is in fact the one that causes the observed anomalies. A rather surprising result because it is extremely unusual for a metamorphosed sedimentary rock to have a remanent magnetization larger in amplitude than the induced magnetization.

Undivided Cretaceous granitic rocks (Kg)

Three Cretaceous plutons consisting primarily of quartz monzonite or granodiorite are located to the north of the Denali fault. These plutons are in general only weakly magnetic and their relatively flat magnetic expression contrasts strongly with the intensely magnetic plutons located south of the Denali fault.

The Gardiner Creek pluton in the northeast corner of the quadrangle is characterized by broad moderate-amplitude magnetic anomalies having a relatively distinctive pattern on the magnetic map. The boundary of this patterned area is not especially distinctive, which precludes accurately delineating the inferred limits of the pluton. Two sharp magnetic highs, one of 1000 gammas and the other of 500 gammas, are located near the pluton's northwest margin. Two reverse remanent magnetization, are probably not caused by the plutonic rocks and judging by their shape more likely reflect small plugs that may be related to Tertiary volcanic rocks to the north in the Tanacross quadrangle (Foster, 1970).

The Chesina pluton crops out in a relatively small area in the center of the north half of the quadrangle. The pluton is magnetically nearly flat where exposed but is bounded to the west and south by a distinctive curvilinear magnetic high. This high is interpreted to be caused by contact metamorphism of the country rock. Superimposed on this curvilinear feature by developing minor amounts of magnetite in the rocks near the pluton. Using this interpretation, a large magnetically flat area north of the exposed pluton is deduced to be a concealed extension of the Chesina pluton. This flat area is surrounded by curvilinear magnetic anomalies probably caused by contact metamorphosed country rock, the metamorphism having developed magnetite in the country rock. It is possible that some of the highest amplitude magnetic anomalies associated with the curvilinear features may be caused by small amounts of magnetite-rich mafic border rocks of the Chesina pluton itself.

The Tok-Tetlin pluton is the large elongate pluton in the west half of the area just north of the Denali fault. The pluton is magnetically rather flat but is surrounded by linear low-amplitude magnetic anomalies in the country rock. These magnetic anomalies are believed to be caused by contact metamorphism in a fashion similar to those associated with the contacts of the Chesina pluton and are so labeled on the interpretation map (sheet 2). At least two internal masses of country rock (roof pendants?) are also associated with magnetic anomalies. The two narrow linear magnetic features within the Tok-Tetlin pluton are not explained.

Undivided Tertiary granitic rocks (Tg)

The Soap Creek pluton is a poorly exposed subcircular mass in the southeast part of the quadrangle north of the Denali fault. The characteristic flat magnetic pattern associated with this pluton demonstrates it to be a continuous mass at least 20 km in diameter. Some of the magnetic highs around the borders of this pluton are probably caused by contact metamorphism.

AREA SOUTH OF THE DENALI FAULT

Undivided sedimentary and volcanic rocks (MzPzsv)

This rock unit mainly is magnetically flat and is composed of nonmagnetic sedimentary rocks and small amounts of magnetic volcanic rocks. The largest magnetically flat area, a wedge-shaped mass between the Denali and Totschunda faults, contains outcrops of a thick sequence of Mesozoic marine sedimentary rock. A few unexplained magnetic lineaments and anomalies (labeled "covered") are indicated within this generally flat area and are most likely caused by small Cretaceous plutons at a shallow depth below the surface or concealed by the younger sediments of the Nabesna River. Near the south edge of this flat area some broad low-amplitude magnetic features are caused by magnetic rocks at depths of 1-2 km below the surface by overlying sedimentary rocks. These anomalies may be caused by the Nikolai Greenstone, which is exposed in cores of anticlines further east, and the features are accordingly labeled "covered Mzn?".

Southwest of the Totschunda fault system a unit within the sedimentary and volcanic rocks, the Tetelna Volcanics (PPt), consists in part of massive andesite flows that probably cause the pattern of irregular small-amplitude magnetic anomalies associated with this unit. Two magnetic features are labeled on the interpretation map as caused by the Tetelna Volcanics (Tr,Mz,a;Ir.; T.10N.,R.11E.).

Nikolai Greenstone (Mzn)

The Nikolai Greenstone consists of basalt flows and subordinate volcaniclastic rocks and is one of the more magnetic rock units of the Nabesna quadrangle. Many major magnetic anomalies are ascribed to the Nikolai Greenstone on the interpretation map. As is customary in the case of volcanic rocks, the unit is not uniformly magnetic, and present within the Nikolai are areas of massive flows producing the large anomalies. The Nikolai becomes substantially more magnetic where intruded near the contact by the Nabesna Glacier and the Cretaceous granodiorite to the large Nabesna pluton (just to the north of the area of this map). The Nabesna Glacier pluton is a large magnetic high west of the Totschunda fault is a large east-trending anomaly caused by metamorphosed Nikolai Greenstone. Another similar anomaly extends across the Nabesna River on the north side of the pluton and is also especially intense because of metamorphism of the greenstone. This magnetic anomaly continues eastward beyond the limits of the greenstone into a magnetite-rich skarn developed in a limestone unit near the contact with the Nabesna pluton. Magnetic properties of metamorphosed and unmetamorphosed Nikolai Greenstone are listed in table 2. The results indicate the wide variation in magnetic properties of the greenstone as well as the intense magnetization of metamorphosed samples. The large values of Q (greater than 1) show the importance of remanent magnetization.

Chisana Formation (Kc)

Much the Chisana Formation is composed of andesite and basaltic andesite flows that predictably cause substantial magnetic anomalies distributed irregularly through the area underlain by the rock unit. The Chisana Formation is found in two areas: near the southeast corner of the quadrangle, and west of the Nabesna pluton. Both areas contain added magnetic anomalies not predictable from the mapped distribution of the Chisana Formation. It is suspected that it is not possible to determine the boundaries of the Chisana Formation from the patterns on the magnetic map.

Continental sedimentary rocks (Ks)

Continental sedimentary rocks occur in a few small areas near Chisana, close to the south edge of the quadrangle. They are nonmagnetic and are associated with a distinctive area of very flat magnetic field; the nonmagnetic rocks are of sufficient thickness to attenuate any magnetic anomalies generated by the underlying Chisana Formation.

Wrangell Lava (QTw)

The highly irregular magnetic pattern over the Wrangell Lava is typical of the magnetic expression of young volcanic rocks. Many of the pronounced magnetic lows are evidently caused by reverse remanent magnetization of the flow rocks, but because of the difficulty of distinguishing some of these lows with certainty, only the more evident examples of lows resulting from reversals are indicated on the interpretation map. Many of the individual magnetic anomalies are strongly influenced by local topography and edge effects of the volcanic units so that detailed interpretation is unwarranted. There is no clear evidence that vent areas, domes, or rhyolite units can be distinguished by their magnetic expression.

Plutonic rocks

The vast majority of plutonic rocks south of the Denali fault are extremely magnetic and cause pronounced magnetic anomalies. Their magnetic expression stands in strong contrast with that of the relatively nonmagnetic plutonic rocks north of the Denali fault.

Anorthosite (Mza). Anorthosite is located high on the side of a major magnetic anomaly but is probably not especially magnetic.

Diorite complex (JTRd). The diorite complex is a relatively heterogeneous unit that generally is moderately magnetic but locally is strongly magnetic. These latter anomalies are indicated on the interpretation map, and all lie in the northwest quarter of the quadrangle. The largest such anomaly is about 30 km long and 5 km wide and is in an area that is mostly covered by younger sedimentary rocks. The cause of this large anomaly is not certain, but at least one small area of the diorite complex crops out at the southeast end of the anomaly maximum.

Undivided Cretaceous granitic rocks (Kg)

Among the most striking and significant magnetic anomalies are those associated with Cretaceous plutons. These rocks are consistently very magnetic as shown by the magnetic properties measurements for fresh granodiorite and diorite in table 2. The quartz-poor plutons, composed primarily of diorite, are the most magnetic and give rise to the most intense magnetic highs. The Cretaceous plutons are of two petrographic types, the Nabesna pluton (T.8N., R.17E.) which is quartz-poor (T.8N., R.17E.) and the Chisana pluton (T.6N., R.16E.), and the Nabesna pluton (T.8N., R.17E.) which becomes richer in quartz at its less magnetic southeast end, the Chisana pluton (T.6N., R.16E.), and the diorite-rich part (T.6N., R.23E.) of the Klein Creek pluton with the anomaly outlined separately from the rest of the pluton on the interpretation map.

The two largest plutons, the Nabesna and Klein Creek, are indicated on the interpretation map and have the most complex magnetic patterns. These two plutons are zoned from mafic margins to felsic centers (Richter and Matson, others, 1975). Because local magnetic lows are apparently associated with these zoned and mineralized areas, magnetic-property measurements were made on selected rock samples of both fresh and altered plutonic rocks. The results (listed in table 2) clearly demonstrate that with increasing alteration the magnetic properties of the plutonic rocks decrease by more than an order of magnitude, taking into account both the remanent and induced (susceptibility) magnetizations.

The irregular topography over these plutons causes an additional problem because some of the valleys generate local magnetic lows by their topography alone. The magnetic lows outlined on the interpretation map correlate in part with topographic lows, and therefore some of them are not necessarily caused by rock alteration. However, it is this reasonable to expect that the altered areas may correlate in part with topographic lows because of the more rapid erosion of altered rocks. In this area, local magnetic lows over plutonic rocks are a possible sign of porphyry copper mineralization, and careful prospecting of such lows is warranted, while simultaneously keeping in mind the magnetic effects of irregular topography.

In the Nabesna pluton, magnetic low I (shown on the interpretation map) probably results from both topography and rock alteration. The northern extension of this low follows a deep valley and may well be primarily caused by topography. The southern extension of the low is over the area of the Bond Creek deposit where intense rock alteration is known, and the eastern extension of the low also occurs over an area of known rock alteration. Magnetic low II corresponds precisely to the Orange Hill deposit, also an area of intense rock alteration, and cannot be caused by topography because the aircraft flight lines extend north-south, parallel to the Nabesna River valley. The cause of magnetic low III is totally concealed by the young sediments of the Nabesna River, but topography is not likely to be the cause of this feature in the northeastern part of the pluton. Low III might possibly be caused by reverse remanent magnetization, but it is more likely that it is caused by topography and rock alteration. The part of the Nabesna River valley displays no such magnetic expression. The low on three flight lines causes a substantial northward deflection in the linear magnetic high generated by the metamorphosed Nikolai Greenstone on the north side of the Nabesna pluton. The contact of the Nabesna pluton, although concealed in the critical area at the center of the valley, gives no indication of this northward deflection. There remains a slight possibility that the Nabesna Glacier, when more extensive than at present, excavated a basin in the bedrock floor of the valley in the area of low III. The effect of this topographic low could contribute to the magnetic low. It is concluded that low III may be caused by topography and(or) reverse remanent magnetization. Low IV, especially at its west end, is poorly defined by the magnetic data. The magnetic low is not the result of topography and at the west end is only about 1 km distant from an area of rock alteration and molybdenum mineralization.

The Klein Creek pluton near the extreme southeast corner of the map contains numerous associated magnetic lows that may be related to porphyry copper mineralization. Low V is associated with known mineralization and rock alteration at the head of Jack Creek. Low VI is on the flank of an anomaly and is associated with known mineralization and rock alteration at the head of Hurricane Creek. Low VII and low VIII are associated with known mineralization and rock alteration at the head of Hurricane Creek. Low IX and low X are associated with known mineralization and rock alteration at the head of Yerkovich Creek. Low XI is closely follows the major valley of Klein Creek and is most probably a topographic effect. Small amounts of rock alteration are known near lows X and XI, which are also associated with minor topography lows, so that the cause of these two magnetic lows is uncertain, although rock alteration seems to be a reasonable possibility.

The magnetic data indicate large magnetic anomalies over certain small exposures of Cretaceous plutonic rocks. These anomalies show that substantial stocks at least 2-4 km in diameter underlie the area of the anomalies at shallow depth. Such anomalies are outlined on the interpretation map and the symbol "Kg" is added. The anomaly at Nabesna (T.7N., R.13E.) is associated with known deposits of disseminated gold as well as massive sulfides, and it is therefore suggested that such anomalies may be worth prospecting for mineral deposits.

One anomaly that has been labeled JTRd (T.10N., R.10E.) is unusual; it is approximately equidimensional and of large amplitude, thus resembling the magnetic anomalies of the Cretaceous plutonic rocks. The specific rock causing this anomaly is not known.

A major magnetic high, about 5 km by 10 km in size, has its source concealed by the young sediments of the Chisana River at a location (T.4N., R.18E.) approximately 12 km northwest of Chisana. This anomaly is interpreted from its form and amplitude to be caused by a Cretaceous pluton similar to the Chisana pluton, 10 km to the east.

Tertiary porphyry (Tp)

Tertiary porphyritic rocks generally lack characteristic magnetic expression. Two samples of porphyry from bodies that cut the Nabesna pluton are moderately magnetic (table 2). The porphyry within the Nabesna pluton cannot be distinguished from the intruded magnetic plutonic rocks, nor can the unit be distinguished from the associated Tetelna Volcanics in T.4N., R.16E. One porphyry intrusion (T.4N., R.14E.) has an associated sharp distinct magnetic low that is indicated with an "R" on the interpretation map. This low demonstrates that the Tertiary porphyry can possess a reverse remanent magnetization more intense than its induced magnetization, and the high Q of one sample in table 2 confirms this deduction.

MAGNETIC EXPRESSION OF MAJOR FAULTS

The Denali fault does not possess very strong magnetic expression because in the Nabesna quadrangle the fault in general does not juxtapose magnetic rocks against nonmagnetic rocks. Weakly magnetic rocks occur on both sides of the fault, except in the extreme northwest corner of the quadrangle, but the marine sedimentary rocks to the south display a much smoother magnetic pattern than the metamorphic rocks to the north. The major magnetic evidence for the fault is to the termination of certain magnetic features such as: the anomalies of the northeasternmost Buck Creek pluton (T.8N., R.11W., R.10E.), the northeast-trending lineaments in T.9N., R.17E., and the lineament labeled Mz d in T.7N., R.13E.

The Totschunda fault system is much more evident in the magnetic data because the fault throughout much of its length juxtaposes strongly magnetic rocks against nonmagnetic rocks. The magnetic data when used in conjunction with the geologic data provide an estimate of the maximum possible amount of strike-slip offset on the Totschunda fault. Evidence from offset drainages indicates a maximum right-lateral offset of 10 km (Richter and Matson, 1971). Evidence described below from the combined geologic and geophysical data indicates that the maximum offset may be as much as 20-25 km. The geologic data suggest that the two major plutons, Nabesna and Klein Creek, once formed a belt that extended across the present fault system. If the reconstructed belt (now offset 20-25 km), the northern limits of the Chisana Formation (Kc) to the east, and the southern limits of the marine sedimentary rocks (Ks) on both sides of the fault (Richter, 1975) also form a belt, then the reconstructed belt would be about 5 km wide and 50 km long. This belt trends comes from the gravity map of Barnes and Morin (1975), which shows, at the north edge of the Nabesna pluton, an east-west steepened gravity gradient extending to the west a distance of more than 50 km, unaffected by the overlying Wrangell Lava. This gravity gradient is also apparently offset 25-30 km by the Totschunda fault system. A final piece of evidence comes from the magnetic data over the Devils Mountain pluton (T.8N., R.14E.). This pluton is cut off on its eastern edge by a major strand of the Totschunda fault system. On the other side of this fault, located about 20 km to the southeast, is a strong magnetic anomaly (labeled Mz d on the interpretation map) at T.8N., R.16E. This anomaly is caused by a Cretaceous pluton similar in size and magnetic character to the Devils Mountain pluton. The eastern extension of the Devils Mountain pluton that is T.8N., R.16E. is barely exposed through the overlying Mesozoic rocks. Thus, by combining the evidence from the geology, the gravity, and the magnetic data, a relatively convincing case can be made for 20-25 km maximum offset on the Totschunda fault.

REFERENCES CITED

Alaska Division of Geology and Geophysics, 1973, Aeromagnetic survey, east Alaska Range, Nabesna quadrangle: Alaska open-file report 13, scale 1:250,000.

Barnes, D. F., and Morin, R. L., 1975, Gravity map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655J, 1 sheet, scale 1:250,000.

Foster, H. L., 1970, Reconnaissance geologic map of the Tanacross quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-593, scale 1:250,000.

Richter, D. H., 1975, Geologic map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655A, 1 sheet, scale 1:250,000.

Richter, D. H., and Matson, N. A., Jr., 1971, Quaternary faulting in the eastern Alaska Range: Bull. Geol. Soc. America, v. 82, p. 1529-1540.

Richter, D. H., Singer, D. A., and Cox, D. P., 1975, Mineral resource map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655E, 1 sheet, scale 1:250,000.

Table 1. Definition of rock unit symbols on accompanying generalized geologic and aeromagnetic interpretation maps in terms of symbols on detailed geologic map (Richter, 1975)

Rock unit name	Symbol on generalized geologic map	Symbol on aeromagnetic interpretation map	Symbols on detailed geologic map
		North of Denali fault	
Undivided Tertiary granitic rocks	Tg	Tg	Tg
Undivided Cretaceous granitic rocks	Kg	Kg	Kgg, Kcg, Ktg, Ktg, Kmg, Kug
Undivided metamorphosed sedimentary rocks	MzPzms		Rvc Dp, Dl, Dms, Rts
Undivided ultramafic rocks	MzPzum	MzPzum	Kum, Rsum, Rrg
Undivided metamorphosed Paleozoic mafic volcanic and intrusive rocks	Pzvt	Pzvt	Rtv, Dp, MzRtl
		South of Denali fault	
Quaternary sediments and ice	Qs		Qm, Qa, Qau, Qfl, Qmg, Qr, Qlt, Qc, Qdl, Qwg, Qmg
Wrangell Lava	QTw	QTw	Qw, Qwr, QTw, QTwr
Tertiary porphyry	Tp	Tp	Tp
Continental sedimentary rocks	Ks	Ks	Ks
Undivided Cretaceous granitic rocks	Kg	Kg	Tbp, TKg, TKd, Kgg, Kdd, Kbd, Kac, Kah, Kkd, Kcs, Kmg, Kmt, Kmp, Kbg, Kbd
Chisana Formation	Kc		Kc
Tetelna Volcanics		PPt	PPt
Undivided sedimentary and volcanic rocks	MzPzsv		Kds, Ms1, Pm, Pe, Pel, Ps
Diorite complex	JTRd	JTRd	JTRd, JTRg, JTRg, JTRs
Nikolai Greenstone	TRn	TRn	TRn
Anorthosite	Mza	Mza	Mza

Table 2. Magnetic properties of some rocks from the Nabesna quadrangle

	No. of samples	Remanent magnetization emu/cm³	Susceptibility emu/cm³	Q[1]
Nikolai Greenstone	1	9.69×10^{-4}	3.97×10^{-3}	.43
Do	1	3.60×10^{-3}	5.55×10^{-3}	1.14
Do	1	5.43×10^{-4}	4.68×10^{-4}	1.97
Do	1	1.09×10^{-3}	1.27×10^{-3}	1.51
Do	1	2.71×10^{-3}	3.86×10^{-3}	1.23
Nikolai Greenstone (amphibolite)	1	3.52×10^{-4}	4.35×10^{-3}	.14
Do	1	4.09×10^{-3}	7.10×10^{-3}	1.01
Cretaceous granodiorite and diorite (fresh)	6	1.14×10^{-3}	2.61×10^{-3}	.77
Cretaceous granodiorite and diorite (altered)	6	3.90×10^{-4}	1.76×10^{-3}	.39
Cretaceous granodiorite and diorite (very altered)	4	4.24×10^{-5}	2.40×10^{-4}	.31
Tertiary porphyry	1	1.19×10^{-4}	1.99×10^{-3}	.11
Do	1	2.53×10^{-3}	1.76×10^{-3}	2.55

[1] Q is the ratio between the remanent and the induced magnetization. The induced magnetization is the product of the susceptibility and the earth's total field, which is approximately 0.57 gauss (57,000 gammas) in this quadrangle.