Contact-metasomatic Magnetite Deposit, Medfra Quadrangle, Alaska

by

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Table of Contents

List of Illustrations

Abstract

A small contact-metasomatic magnetite deposit was discovered in the Medfra quadrangle, Alaska, in 1976. It occurs at the contact between a Cretaceous or early Tertiary quartz monzonite stock and Paleozoic limestone and dolomite. The ore is a magnetite-clinohumite-hematite rock that contains up to 60 volume percent magnetite and 76 weight percent total iron expressed as FeO. Computer modelling of data derived from a ground-level magnetometer survey yielded an estimate of the shape and volume of the deposit. The volume is grossly estimated at 11,600m^3.

Introduction

This paper describes a small magnetite deposit that was discovered during the 1976 field season. It is based on brief field studies including geologic mapping and a ground-level magnetometer survey, and on supplementary partial chemical and semiquantitative spectrographic analyses and petrographic studies. The deposit crops out on a small knoll in the NE¼NE¼NE¼ Sec. 20, T. 21 S., R. 25 E. (Kateel River Meridian) in the Medfra quadrangle (Figure 1).

Geologic Setting

The magnetite deposit occurs along the southern border of a Cretaceous or early Tertiary quartz monzonite stock, in a local zone (approximately 120m by 40m) of metasomatic rock between the stock and limestone-dolomite host rocks (Figure 1 and 2). In the immediate vicinity of the contact with the stock, the limestone and dolomite are metamorphosed to a white marble. The carbonate rocks are part of a northwest-trending belt of Ordovician, Silurian, and Devonian limestone and dolomite. The belt is bounded on the southeast by Quaternary unconsolidated deposits of the Kuskokwim River lowlands and on the northwest by Cretaceous marine clastic rocks.

Lithology and Mineralogy

The stock is primarily composed of an allotriomorphic inequigranular, clinopyroxene-hornblende-biotite quartz monzonite that contains about 20 volume percent quartz. The accessories are sphene, apatite, zircon, magnetite, and allanite. Hybrid monzonitic rocks occur near the border

Figure 1. Generalized geologic map of part of the Medfra quadrangle, and Alaskan index map indicating the location of the Medfra quadrangle. + indicates location of magnetite deposit.

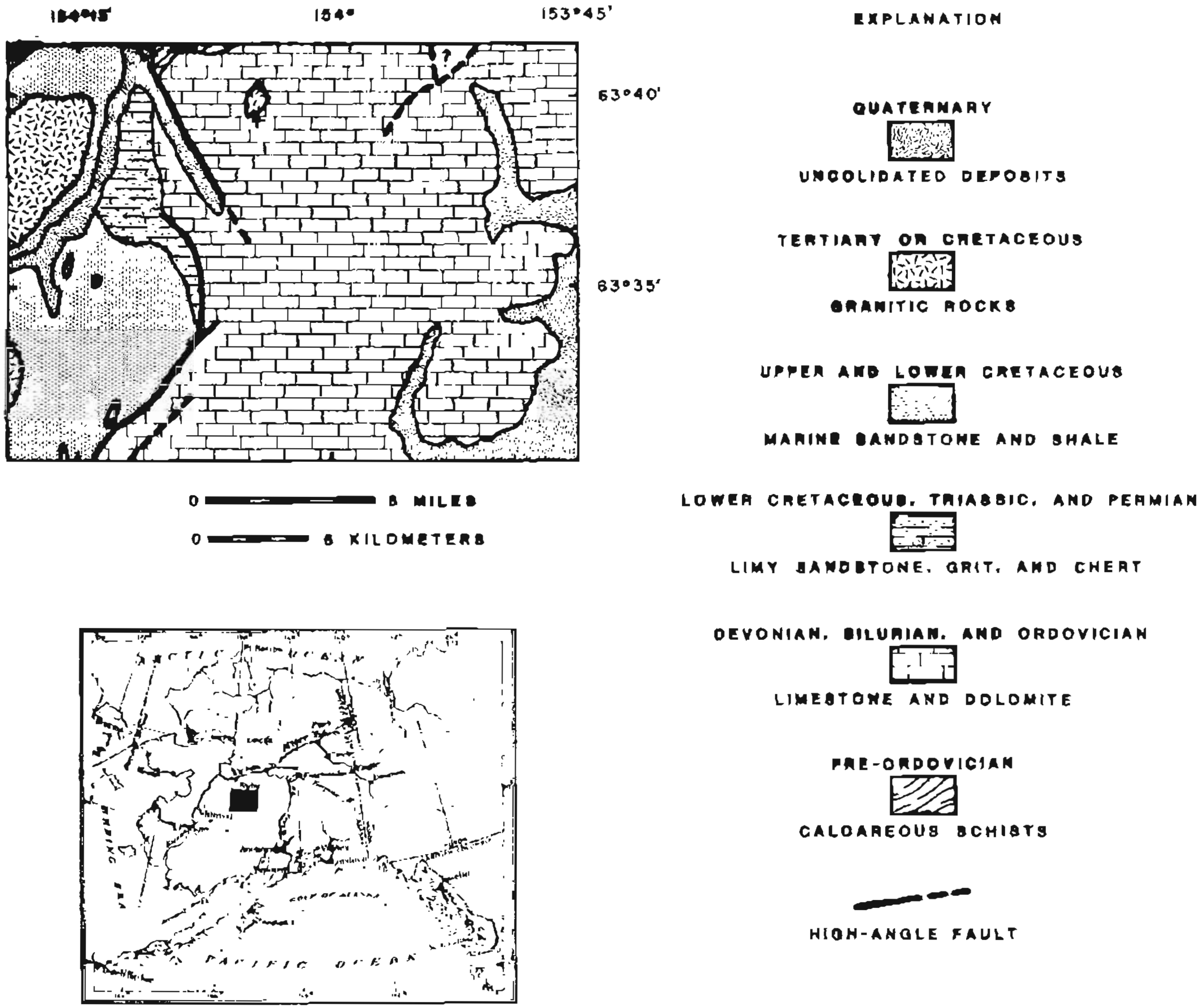
154°15'
154°
153°45'
63°40'
63°35'
0 5 MILES
0 5 KILOMETERS
PACIFIC OCEAN
EXPLANATION
QUATERNARY
UNCOLIDATED DEPOSITS
TERTIARY OR CRETACEOUS
GRANITIC ROCKS
UPPER AND LOWER CRETACEOUS
MARINE SANDSTONE AND SHALE
LOWER CRETACEOUS, TRIASSIC, AND PERMIAN
LIMY SANDSTONE, GRIT, AND CHERT
DEVONIAN, SILURIAN, AND ORDOVICIAN
LIMESTONE AND DOLOMITE
PRE-ORDOVICIAN
CALCAREOUS SCHISTS
HIGH-ANGLE FAULT

FIGURE 1

Figure 2. Geologic sketch map of part of the Medfra C-3 quadrangle, outlining the approximate boundary of the quartz monzonite stock and the area of the magnetic contour map (Figure 3).

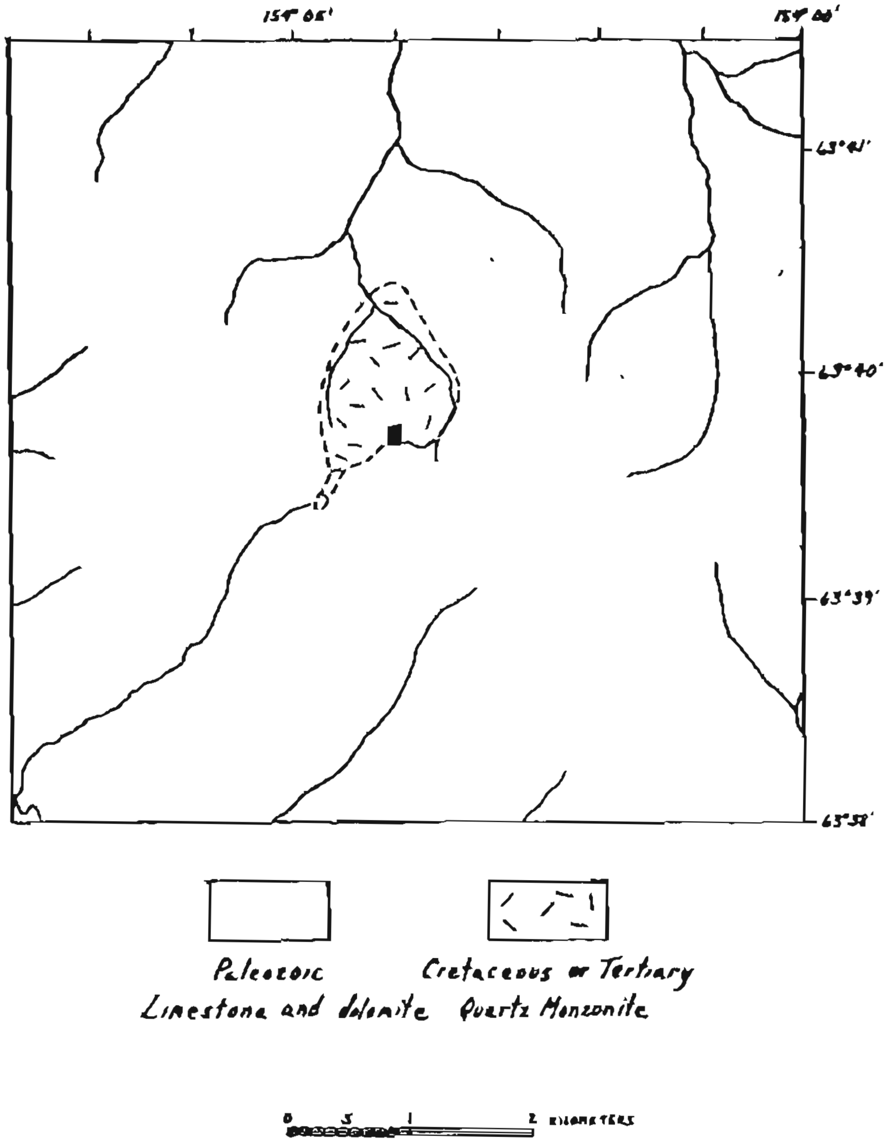
154° 05'
154° 00'
63° 41'
63° 40'
63° 39'
63° 38'
Paleozoic
Limestone and dolomite
Cretaceous or Tertiary
Quartz Monzonite
0 .5 1 2 KILOMETERS

Figure 2

of the intrusion. They are similar to the quartz monzonite but contain xenocrystic diopside, less than 10 percent quartz, and have a porphyritic texture.

Three metasomatic rock types, including calc-silicate rock, biotite rock, and magnetite-rich rock, are found between the intrusion and the host rocks. Calc-silicate rocks occupy the greatest volume. They are composed of granular diopside, lesser amounts of tremolite, minor quartz, calcite, and magnetite, and accessory plagioclase, apatite, sphene, zircon, and epidote(?). Minor amounts of essentially monomineralic biotite-rock occur with the calc-silicates. They appear to be biotitized carbonate rocks or biotitized pelitic interlayers within the carbonate rocks.

Magnetite-rich rocks form a small lobate outcrop, less than $200 m^2$ in area. They are composed of magnetite, clinohumite, and hematite, and contain between about 10 and 60 volume percent of magnetite plus hematite. The rock is commonly banded, with darker, magnetite-rich laminae alternating with clinohumite-rich laminae. The laminae range from about 2 to 10mm and are commonly contorted. Non-banded rock contains clinohumite-richer regions and streaks. The mineralogic inhomogeneity of the banded and mottled magnetite-rich rocks suggests that carbonate rock was metasomatically altered by total replacement of calcite by magnetite, and alteration of dolomite to the magnesium silicate clinohumite.

Chemical and Spectrographic Analyses

Eight major and minor element, semiquantitative six-step spectrographic analyses are reported in Table 1. Ferric and ferrous iron were

This table contains the results of U. S. Geological Survey semiquantitative six step spectrographic analysis of eight specimens of the magnetite deposit and adjacent rocks. In addition, wet chemical analyses of six of the rocks for ferric and ferrous iron are supplied. Si, Al, Mg, Ca, Na, K, and Ti are reported in percent values; all others are reported in parts per million. Results are to be identified with geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.12, etc., but are reported arbitrarily as mid-points of these brackets, 1., 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, etc. The precision of a reported value is approximately plus or minus one bracket at 68%, or two brackets at 95% confidence. Symbols used are: 1) G, greater than 10%, or greater than value shown; 2) H, interference; 3) N, not detected at limit of detection or at value shown. Looked for but not found are: Ag, As, Au, Bi, Cd, Eu, Ge, Hf, In, Mo, P, Pb, Pd, Pt, Re, Sb, Sn, Ta, Te, Th, Tl, U, and W. The limits of detection by the semiquantitative spectrographic method used by the Geological Survey are, in percent: Si, .007; Al, .002; Mg, .00015; Ca, .001; Na, .01; K, .02; Ti, .0001; P, .15; and in parts per million; Ag, .7; As, .100; Au, 7; B, 2; Ba, 1; Be, .7; Bi, 7; Cd, 7; Ce, 50; Co, 1; Cr, .7; Cu, .7; Eu, 1; Ga, .7; Ge, 7; Hf, 50; In, 1.5; La, 7; Li, 100; Mn, .7; Mo, 2; Nb, 10; Nd, 20; Ni, .7; Pb, 7; Pd, 1; Pr, 20; Pt, 5; Re, 7; Sb, 20; Sc, .7; Sn, 2; Sr, 1; Ta, 50; Te, 300; Th, 150; Tl, 3; U, 150; V, 1; W, 10; Y, 7; Yb, .7; Zn, 15; Zr, 3.

TABLE 1. Chemical and Spectrographic Analyses

SAMPLE[1]	1	2	3	4	5	6	7	8
Si	2	5	2	5	5	7	10	7
Al	.2	.5	.3	.5	.5	.05	.7	5
Fe_2O_3	57	48	52	40	45	69	-	-
FeO	25	23	23	22	22	7.3	-	-
Mg	5	G	5	G	G	.7	10	10
Ca	.015	.03	.02	.02	.03	.05	10	1
Na	N	N	N	N	N	N	.1	.2
K	N	N	N	N	N	N	N	G5
Ti	.02	.02	.02	.02	.02	.007	.02	.15
B	N	50	N	100	70	N	N	N
Ba	3	5	5	5	10	7	70	300
Be	N	N	N	N	N	N	2	N

Ce	N	N	N	N	N	N	N	500
Co	20	30	20	30	30	50	15	5
Cr	3	5	3	7	5	N	10	30
Cu	10	10	30	3	50	10000	20	20
Ga	N15	N15	N15	N15	N15	N15	5	20
La	N	N	N	N	N	N	N	700
Li	N	N	N	N	N	N	N	700
Mn	3000	5000	2000	5000	5000	200	5000	500
Nb	10	15	7	10	15	5	N	N
Nd								100
Ni	N	N	N	N	N	N	10	N
Sc	N	N	N	N	N	N	10	15
Sr	10	10	10	10	10	7	30	15
V	7	N	7	N	N	5	50	20
Y	20	20	20	20	20	10	10	20
Yb	H	H	H	H	H	H	3	3
Zn	500	1000	500	500	700	150	200	N
Zr	150	200	150	150	150	70	N	200

[1]Samples 1-5 are magnetite-clinohumite rocks; sample 6 is from limonitic gossan; sample 7 is a diopside-tremolite rock; sample 8 is a biotite rock.

analyzed by wet chemical methods. Total iron (expressed as FeO) ranges between 57 and 76 percent in the magnetite-rich samples.

Significantly high values of copper and zinc were detected in several samples. Sample 6, which contains 1 percent copper, represents a homogenized mixture of five samples of gossan, including one that was weakly copper stained. Zinc contents of five magnetite-rich samples were between 500 and 1000 ppm. Since magnetite does not generally contain significant amounts of zinc, the zinc may occur in fine, disseminated sphalerite grains. However, sphalerite was not identifed in any of our samples.

Magnetic Survey

A magnetic survey (Figure 3) was performed to delimit the size of the magnetite deposit. Vertical field magnetic measurements were obtained by an operator-held, Jalander magnetometer. Figure 3 is the resulting contour magnetic map of the terrain underlain by magnetite-rich rock. The instrument was zeroed over the carbonate country rock; thus, positive and negative magnetometer readings were respectively above and below this arbitrary zero.

Computer modelling utilizing the observed magnetism over the magnetite body yielded an estimate of the shape and orientation of the magnetite deposit. Assuming an intensity of magnetization of .455, the body appears to be approximately 150m long, and roughly triangular in cross section. The triangle is nearly equilateral, with one apex directed vertically upward. The base of the triangle is approximately 18m wide at its maximum depth of 15m. The body probably narrows before

Figure 3. Magnetic contour map of the terrain underlain by the magnetite deposit. Values are multiples of 1000 gammas.

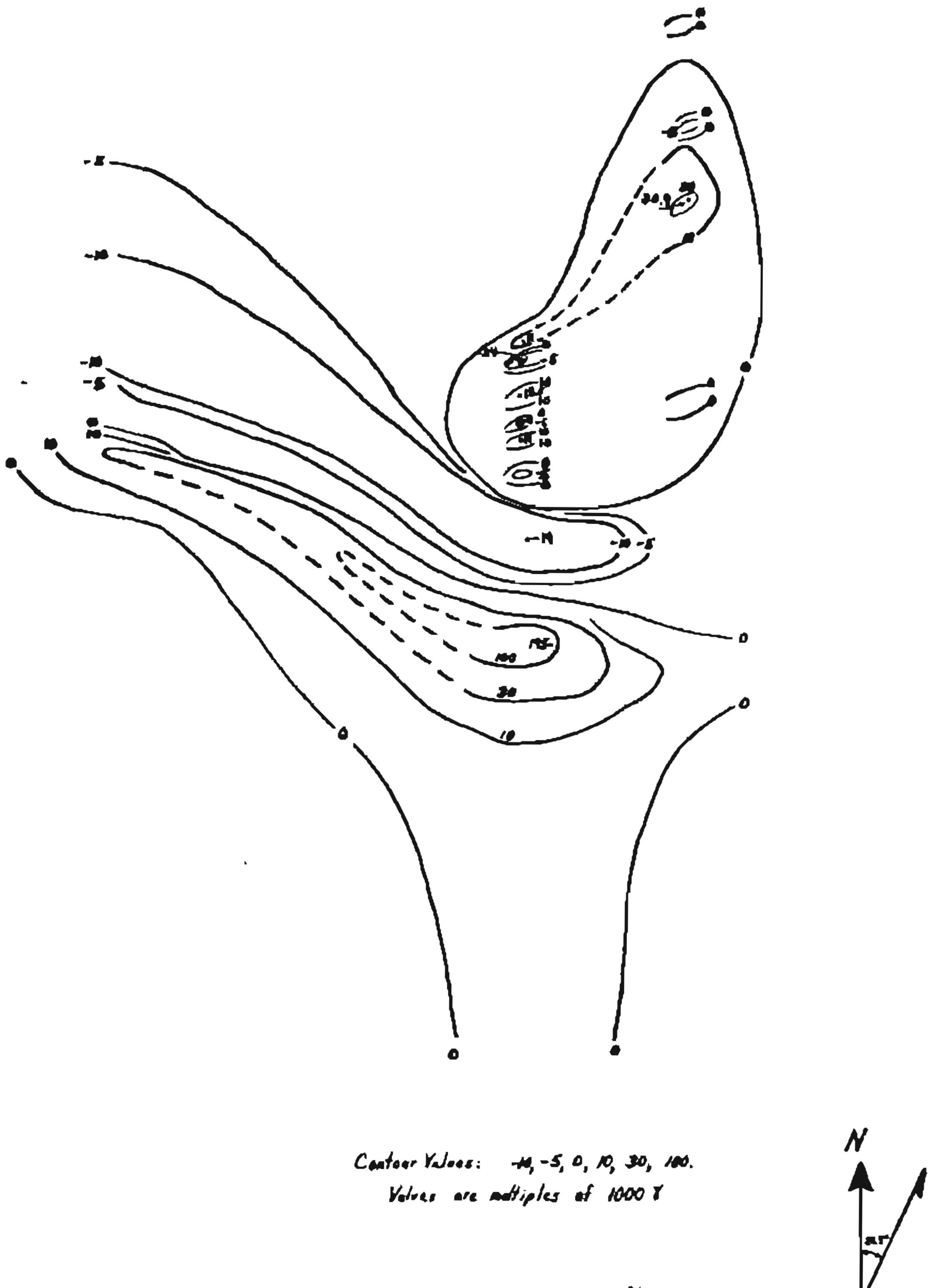
Contour Values: -10, -5, 0, 10, 30, 100.
Values are multiples of 1000 γ
N
0 50 100 ft.
0 10 20 30 m.

Figure 3

pinching out laterally. The volume of the body is grossly estimated at 11,600m^3.

The modelled size of the body is dependant upon the estimate of the magnetism of the magnetite-rich rock. No measurements of magnetism were made, but the figure .455 is reasonable for this type of deposit. Should the actual intensity of magnetization be smaller, the necessary size of the body that would produce the observed anomaly, would be compensatingly larger.

Summary

The Medfra magnetite deposit is of contact-metasomatic origin. It occurs at the contact between a small quartz monzonite stock and calcareous and dolomitic marble, metamorphosed from limestone and dolomite host rock. Magnetite occupies between 10 and 60 percent by volume of the magnetite-rich rocks, which can contain up to 76 percent by weight of total iron (expressed as FeO). Beside magnetite, other common minerals in the contact silicate rocks are diopside, tremolite, and clinohumite. This magnetite deposit is small, estimated at only 11,600m^3.

Acknowledgments

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