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Menlo Park, California

# MAGNETIC SUSCEPTIBILITY MEASUREMENTS AND SAMPLE LOCATIONS OF GRANITIC ROCKS FROM ALONG A TRANSECT OF THE COAST MOUNTAINS NEAR JUNEAU, ALASKA

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## Abstract

The magnetic susceptibility of 194 granitic rock samples from along a transect of the Coast plutonic-metamorphic complex near Juneau, was measured using a Geoinstruments JH-8 model hand-held magnetic susceptibility meter. Variations in magnetic susceptibility are not only usefull in differentiating individual plutons for mapping purposes, but may aid in (1) delineating hydrothermally altered and mineralized areas, (2) determining changes in metamorphic grade, (3) interpretation of aeromagnetic data, and (4) interpreting the tectonic and petrogenetic history of pluton emplacement. The variations in magnetic susceptibility define and delineate individual plutons and plutonic units that are part of three major plutonic belts of the region. Plutons range from quartz diorite to granite in modal composition. Variations in magnetic susceptibility are due to variable abundance of magnetite in the rocks, but granitic rocks with very low magnetic susceptibility lack magnetite, but may contain ilmenite, sulfides, and secondary opaque oxides. We also experimented with a Exploranium KT-5 model susceptibility meter and found the results compatible to the JH-8 meter. Both meters can accurately measure magnetic susceptibility on slabbed hand samples of sufficient size that will duplicate outcrop values.


## INTRODUCTION

Magnetic susceptibility is a useful and easily obtained measurement in various types of geologic investigations, particularly in the discrimination and mapping of plutons and plutonic suites (Ross, 1989; Drinkwater and others, 1992). Magnetic susceptibility also may be used in delineating mineralized areas (Grant, 1985; Ishihara and others, 1987; Puranen, 1989), rock alteration zones (Lapointe and others, 1986; Criss and Champion, 1984), grade of metamorphism (Subrahmauyam and Verma, 1981; Hageskov, 1984; Grant, 1985), and aid the interpretation of aeromagnetic data (Criss and Champion, 1984; Ford and others, 1988; Tulloch, 1989). Differences in magnetic susceptibility have been used to interpret tectonic settings of pluton emplacement (Ishihara, 1977; Takahashi and others, 1980), and when used in conjunction with chemical and isotopic data aids in petrogenetic interpretations (Ishihara and Sasaki, 1989; Bateman and others, 1991). The development of hand-held, battery operated susceptibility meters, such as the Geoinstruments JH-8 model, and Exploranium KT-5 model, makes differences in magnetic susceptibility easily measured during routine field and laboratory work.

Variations in magnetic susceptibility combined with chemical data were used by Drinkwater and others, (1992) to help define 18 plutons and plutonic units that form three major belts and 7 subbelts of the Coast plutonic-metamorphic complex in the vicinity of Taku Inlet, near Juneau (fig. 1). The plutons range from diorite, quartz monzodiorite, and quartz diorite to tonalite, granodiorite, and granite in average modal composition (table 1). This report provides sample locations and the magnetic susceptibility data summarized in the report of Drinkwater and others (1992), plus 49 additional measurements from the Taku Inlet transect area. Additionally, it compares results from two different models of magnetic susceptibility meters and makes general recommendations for use of these hand-held meters. The purpose of our investigation is to obtain representative values for various plutonic units and suites of the Juneau area to aid future detailed mapping and interpretation of aeromagnetic survey data of the region. The Taku Inlet transect area is within the Juneau and Taku River 1:250,000 quadrangles, mapped in reconnaissance by Brew and Ford (1985). Additional sources of geologic information for this area are found in Brew and Ford (1977), Ford and Brew (1973, 1977), Brew and Grybeck (1984), and Drinkwater and others (1989, 1990, 1992).

Magnetic susceptibility is the measurement of the ratio of intensity of magnetization of a substance, to the magnetizing field (Lindsley and others, 1966, Dobrin, 1976), and as used in this report is defined with respect to unit volume. The magnetic susceptibility of most rocks is proportional to the amount and type of ferromagnetic minerals present, principally magnetite. Pyrrhotite, ferrian ilmenite, chromite, franklinite, and a few other iron-rich spinels may be slightly ferromagnetic, but are uncommon and occur in such small amounts as to contribute very little to magnetic properties of rocks (Lindsley and others, 1966; Dobrin, 1976; Thompson and Oldfield, 1986), and ilmenite is usually antiferromagnetic. Magnetite-free rocks rich in mafic silicate minerals (high iron content), especially biotite, may yield slightly positive or paramagnetic susceptibility (Vernon, 1961; Tullock, 1989; Puranen, 1989). The relatively high specific magnetic susceptibility of the paramagnetic ferromagnesian silicates (biotite, hornblende, chlorite, and garnet), is due to the concentrations of magnetic ions $Fe^{3+}$, $Fe^{2+}$, and $Mn^{2+}$, and to a lesser degree the magnetic ions of Co, Ni, and Ti (Vernon, 1961; Thompson and

Oldfield, 1986). Grain size and fabric of magnetite also influence the magnetic susceptibility of rocks (Lindsley and others, 1966; Tulloch, 1989) with coarser textures yielding higher magnetic susceptibility, and preferred orientation of magnetite or its magnetic domains generally giving anistropic susceptibility. Weathering and hydrothermal alteration may decrease magnetic susceptibility (Lapointe and others, 1986; Puranen, 1989)

## METHODS AND RESULTS

Magnetic susceptibility measurements were made with a Geoinstruments Model JH-8 hand-held volume susceptibility meter. The units of measurement in volume susceptibility are the commonly used dimensionless SI units (International Standard units), (Goldman and Bell, 1981), We report our measured values as $10^{-5}$ SI units. The older CGS system may be converted to SI units by using $4\pi$ CGS (Thompson and Oldfield, 1986). One percent magnetite in a rock produces a magnetic susceptibility of about 4000 x $10^{-5}$ SI units, which approximates 3000 x $10^{-6}$ emu/$cm^3$ (electromagnetic unit per cubic centimeter) of the CGS system (Ross, 1989). Magnetic susceptibility values were determined by taking several measurements from the surface of slabbed samples. We used the highest reading which, according to Tulloch (1989), reflects the closest approach to the actual value. The differences between high and low readings were generally less than 20 percent, and most were less than 10 percent. As suggested by the JH-8 manual, each measurement was multiplied by 2 to compensate for the use of hand samples rather than outcrops. The reading errors are $\pm$ 1 at 0-100, $\pm$10 at 100-1000, and $\pm$ 100 at 1000 to 10,000 scale. Samples yielding very heterogeneous readings were not used, and those giving anomalous high or low values were also discarded unless they represent a distinct part of a pluton such as a border or core zone. Samples with magnetite grains coarser than 1 mm were not used in averages or ranges. The size of magnetite in granitic rocks of the transect area, generally, are very uniform in size, most are less than .5 mm. The 194 measurements listed in table 2 are grouped according to pluton or unit, and for comparison, the mafic mineral content is also listed. Average magnetic susceptibility values and ranges for individual plutons and units are shown in table 3.

The distribution of magnetic susceptibility of all samples in the Taku Inlet transect area is shown in figure 2; and has a bi-modal pattern, one group with a very low susceptibility and a second group with a moderately high susceptibility (1000 to 4000 x $10^{-5}$ SI units). The distribution has a gap between 500 and 1000 x $10^{-5}$ SI units, and a steady decline in samples with magnetic susceptibility greater than 4000. A more thorough description and analysis of the distribution patterns of magnetic susceptibility in this area is provided by Drinkwater and others (1992). The two highest measured values of 7000 and 8000 ( table 1) are not included in figure 2 because they are unusual in containing abundant coarse-grained magnetite (> 2 mm). Samples yielding very low values (less than 300) generally lack opaque minerals, but where present the opaques are chiefly sulfides, ilmenite, or secondary magnetite or opaque oxides (goethite or limonite). Ilmenite was identified by its elongated and 6-sided forms, and skeletal grains, as compared to the more equant (4 and 3 sided) forms of magnetite.

We also scanned 30 of the samples with an Exploranium KT-5 model magnetic susceptibility meter to provide a comparison to the JH-8 model. The KT-5 measures volume susceptibility in SI units similar to the JH-8 model. It has a digital display readout (SI x $10^{-3}$), memory recall control that stores up to 12 measurements, and a scan mode that allows repeated measurements over a given outcrop area for rapid assessment of distribution of magnetic susceptibility. The KT-5 can accurately measure magnetic susceptibility on samples with surface diameters of as small as 100 mm and a minimum thickness of 50 mm. To compare the KT-5 and JH-8 models, we measured magnetic susceptibility of 30 samples previously measured by the JH-8 model, and the results are tabulated in table 4. The susceptibility values for 23 samples above 100 x $10^{-5}$ SI units from the JH-8 meter were consistently slightly higher than corresponding values measured by the KT-5 meter. For four samples below 100, the KT-5 meter recorded higher values. The differences and percent difference are shown in table 4 and graphically in figure 3. The majority of samples show a difference of less than 10 percent between susceptibility values measured by the two meters, and only two are greater than 16 percent difference. The large percent differences in these two samples, which have very low susceptibility values (less than 100), is probably not significant because the rocks in that range are basically non-magnetic.

## DISCUSSION

The differences in magnetic susceptibility allow us to divide intrusive rocks into magnetite-bearing granitoids, - those with values greater than approximately 300 x $10^{-5}$ SI units, - and magnetite-free granitoids (Ilmenite-bearing) with values less than 300. The two magmatic series of igneous rocks are considered to represent different tectonic settings, source rock compositions, and crystallization and emplacement histories (Ishihara, 1977; Takahashi and others, 1980; Ishihara and others, 1987; Piccoli and Hyndman, 1985; Tulloch, 1989; and Bateman and others, 1991). The differences in susceptibility also helped differentiate 3 major plutonic belts and 7 subbelts in the Taku Inlet transect area (Drinkwater and others, 1992). We also found significant differences in magnetic signatures between magnetite-bearing plutons of similar modal composition. We found no correlation between magnetic susceptibility and mafic mineral content (fig. 4) within subbelts, or individual units or plutons, indicating that the variations in susceptibility are due to local variations in abundance of magnetite or ilmenite.

Grant (1985) determined, from chemical and experimental data, that intrusive rocks of intermediate composition (quartz diorite to tonalite) should exhibit the highest magnetite content and magnetic susceptibility values. In our study area, the highest susceptibility values are found in tonalites and granodiorites, whereas the lowest values occur in all rock types from diorite to granite. The Speel River, Taku Cabin, and Mendenhall Glacier plutons are tonalites which exhibit very high susceptibility values, whereas the Mount Juneau, Grand Island, Carlson Creek, and Lemon Creek Glacier plutons are also chiefly tonalites, but exhibit very low susceptibility.

Finally, we note that the use of the multiplication factor of 2 for hand specimens as suggested by the JH-8 manual may not be necessary. James G. Moore (personal communications, 1992) indicates that test results on outcrops and hand specimens do not warrant the use of the multiplication factor., and that hand specimens of a certain minimum size will yield susceptibility values approximating those of outcrops. We suggest that, in future studies of this kind, it may be better to compensate for size of hand specimens by devising correction factors based on experimental comparisons between outcrops and hand samples for the specific study.

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Table 1. Average rock types of units and plutons of the Taku Inlet transect area.

| Diorite | Quartz Diorite | Tonalite |
|---|---|---|
| Irving Peak | Glass Peninsula | Speel River |
| | | Taku Cabin |
| | | Grand Island |
| | | Mendenhall Glacier |
| | | Mount Juneau |
| | | Carlson Creek |
| | | Lemon Creek Glacier |

| Quartz Monzodiorite | Granodiorite | Granite |
|---|---|---|
| Everett Peak | Annex Lakes | Turner Lake batholith eastern unit |
| Arthur Peak | Butler Peak | Wright Glacier 1 |
| | Wright Glacier 2 | |
| | Turner Lake batholith | |
| | northern unit | |
| | central unit | |
| | southern unit | |

Table 2. MAGNETIC SUSCEPTIBILITIES OF INDIVIDUAL ROCK SAMPLES FROM PLUTONIC UNITS OF THE TAKU INLET TRANSECT AREA. MAGNETIC SUSCEPTIBILITY (MS) REPORTED IN SI UNITS x 10-5

| Sample no | Unit | Map no. | MS | % mafics | Mafic mins | Notes |
|---|---|---|---|---|---|---|
| ADMIRALTY-REVILLAGIGEDO BELT | | | | | | |
| 83DB041 | Glass Pen. | 1 | 32 | 13 | hbl, bio, ga | epidote |
| 83DB043 | " | 2 | 56 | 09 | hbl, sp, ilm | epidote, sulfides |
| 83DB044 | " | 3 | 64 | 12 | hbl, bio, ga, sp | epidote, sulfides |
| 83DB045 | " | 4 | 54 | 13 | hbl, sp | epidote, ilmenite |
| 83DB054 | " | 5 | 160 | 13 | bio, hbl, ga | sulfides, epidote |
| 83DB055 | " | 6 | 128 | 14 | bio, hbl, ga, sp | epidote, ilmenite |
| 83DB057 | " | 7 | 86 | 14 | hbl, bio, sp | sulfides |
| 83DB058 | " | 8 | 64 | 13 | hbl, bio, ga | sulfides |
| 83DB065 | " | 9 | 84 | 11 | hbl, bio, sp | sulfides, epidote |
| 83DB066 | " | 10 | 168 | 15 | hbl, bio, sp | sulfides, ilmenite |
| 83DB056 | " | 11 | 88 | 34 | hbl, sp, bio | sulfides |
| 83DB047 | Grand Is. | 12 | 70 | 15 | hbl, sp | epidote |
| 83DB059 | " | 13 | 300 | 16 | hbl, bio, sp, ep, ilm | sulfides, secondary ma |
| 83DB060 | " | 14 | 240 | 35 | hbl, bio, sp, ep, ilm | sulfides, secondary ma |
| 87SK040 | Irving Pk. | 15 | 74 | 44 | hbl, bio, sp | sulfides, epidote |
| 87SK042 | " | 16 | 190 | 39 | hbl, bio, sp, | sulfides, ilmenite |
| 82SK411 | | 17 | 237 | >25 | hbl, bio, sp | sulfides, secondary ma |
| 82SK414 | | 18 | 70 | >25 | hbl, ox | sulfides, ilmenite |
| 87DB016 | Butler Pk. | 19 | 20 | 10 | bio, ga | epidote |
| 87DB012 | " | 20 | 300 | 7 | bio, sp | sulfides, epidote |
| 87DB023 | " | 21 | 30 | 11 | bio, ga, ilm | epidote |
| 83EL106 | Everett Pk. | 26 | 1740 | 15 | hbl, bio, sp, ma | epidote |
| 83RK138 | " | 27 | 1600 | 18 | hbl, sp, ma | sulfides |
| 87RK141 | " | 28 | 2400 | 16 | hbl, ma, sp | sulfides |
| 87RK127 | " | 29 | 1180 | 22 | hbl, ma | epidote |
| 87RK143 | " | 30 | 4200* | 22 | hbl, sp, ma | epidote |
| 87RK140 | " | 31 | 2200 | 19 | hbl, sp, ma | |
| 87RK137 | " | 32 | 3000 | 23 | hbl, sp, ma | sulfides |
| 87RK139 | " | 33 | 1000 | 20 | hbl, sp, ma | sulfides |
| 87RK135 | " | 34 | 3000 | 19 | hbl, sp, ma | epidote |
| 87SK030 | " | 35 | 4000* | 18 | hbl, sp, ma | epidote |
| 87AF046 | Arthur Pk. | 22 | 480 | 17 | hbl, sp, ma | |
| 82PB173 | " | 23 | 2000 | 8 | hbl, ma | sulfides |
| 85EL105 | " | 24 | 1670 | 14 | hbl, ep, ma | sulfides |
| 87JS004 | " | 25 | 3400* | 12 | hbl, ma | |

| Sample no | Unit | Map no. | MS | % mafics | Mafic mins | Notes |
|---|---|---|---|---|---|---|
| GREAT TONALITE SILL | | | | | | |
| 87DB028 | Speel R. | 36 | 4400 | 23 | hbl, bio, ma | |
| 87SK045 | " | 37 | 2200 | | hbl, bio | |
| 87DB033 | " | 38 | 4900 | 22 | hbl, bio, ma | |
| 87DB035 | " | 39 | 3000 | 21 | hbl, bio, sp, ma | |
| 87DB027 | " | 40 | 3800 | 27 | hbl, bio, ma, sp | |
| 82RK956 | " | 41 | 2000 | 13 | hbl, bio, ma | |
| 87SK052 | " | 42 | 2200 | 23 | hbl, bio, ma | |
| 82RK165 | " | 43 | 1200* | 31 | hbl, bio, ma | near border zone |
| 82RK957 | " | 44 | 3200 | 16 | bio, hbl, ma | |
| 87RK148 | " | 45 | 4800 | 19 | hbl, bio, ma | |
| 87SK043 | " | 46 | 1060* | 18 | bio, hbl, sp, ma | near border zone |
| 87SK044 | " | 47 | 3200 | 28 | hbl, bio, ma, sp | |
| 87AF048 | " | 48 | 1600 | 28 | hbl, bio, sp, ma | |
| 87AF058 | " | 49 | 1700 | 27 | hbl, bio, ma | |
| 87DB029 | " | 50 | 3000 | 21 | bio, hbl, ma | |
| 87RK128 | " | 51 | 4000 | 29 | hbl, bio, ma | |
| 87AF059 | " | 52 | 4000 | 30 | hbl, bio, ma | |
| | | | | | | |
| 87DB038 | border zone | 53 | 140 | 30 | hbl, bio, sp | ilmenite |
| 82RK164 | " | 54 | 300 | 23 | bio, hbl, sp | ilmenite |
| 87RK147 | " | 55 | 68 | 32 | hbl, bio, sp | no opaques |
| | | | | | | |
| 85EL065 | Taku Cabin | 56 | 3000 | 17 | hbl, bio, sp, ma | |
| 85EL069 | " | 57 | 4000 | 23 | hbl, bio, sp, ma | |
| 85SD108 | " | 58 | 2000 | 22 | hbl, bio, sp, ma | |
| 85SD067 | " | 59 | 3000 | 11 | bio, sp, ma | |
| 86RK085 | " | 60 | 4000 | 21 | hbl, bio, sp, ma | |
| | | | | | | |
| 86SK363 | Annex Lakes | 115 | 3800 | 18 | hbl, bio, ox | |
| 88DB031 | " | 116 | 3200 | 17 | bio, hbl, ox | |
| 88SK142 | " | 117 | 5200 | 8 | hbl, sp, ox | |
| 88DB034 | " | 118 | 3200 | 14 | bio, ox | |
| 88SK143 | " | 119 | 3000 | 6 | hbl, bio, ox | |
| 88SK144 | " | 120 | 4000 | 6 | hbl, bio, ox | |
| 88SK146 | " | 121 | 3600 | 27 | hbl, bio, sp | opaque oxides trace |
| 86AF099 | " | 122 | 2800 | 9 | hbl, bio, ox | |
| 88DB032 | " | 123 | 600* | 26 | hbl, bio | trace of magnetite |
| 88DB033 | " | 124 | 4000 | 14 | bio, sp, ox | |
| 88DB035 | " | 125 | 7000* | 13 | bio, hbl, ox | c-gr magnetite (>2mm) |
| 87DB011 | " | 126 | 3800 | 12 | bio hbl, ox | |
| 88DB030 | " | 127 | 8000* | 20 | bio, hbl, ox | abundant c-gr magnetite |
| 86SK374 | " | 128 | 5200 | 12 | hbl, bio, ox | |
| 88SK141 | " | 129 | 3200 | 3 | bio, ox | |

| Sample no | Unit | Map no. | MS | % mafics | Mafic mins | Notes |
|---|---|---|---|---|---|---|
| TURNER LAKE BATHOLITH | | | | | | |
| 85DB132 | Northern Gd | 61 | 1820 | 13 | bio, hbl, ma | |
| 85DB136 | " | 62 | 1740 | 10 | bio, hbl, ma | |
| 85WN093 | " | 63 | 1480 | 7 | bio, hbl, ma | |
| 85WN069 | " | 64 | 1960 | 10 | bio, hbl, ma | |
| 85SD078 | " | 65 | 1600 | 11 | bio, hbl, ma | |
| 85WN089 | " | 66 | 1820 | 5 | bio, ma | |
| 85DB134 | " | 67 | 1320 | 9 | bio, hbl, ma | near sulfide zone |
| 85DB133 | " | 68 | 2200 | 9 | bio, hbl, ma | |
| 85DB096 | " | 69 | 1800 | 11 | bio, hbl, ma | |
| 85EL078 | " | 70 | 1700 | 10 | bio, hbl, ma | |
| 88SK148 | " | 71 | 2400 | 6 | bio, hbl, ma | |
| 85DB097 | " | 72 | 1840 | 14 | bio, hbl, ma | |
| 85WN074 | " | 73 | 1520 | 13 | bio, hbl, ma | sulfides |
| 86RK086 | " | 74 | 2400 | 8 | bio, hbl, ma | |
| 85WN091 | " | 75 | 1600 | 6 | bio, hbl, ma | |
| 85WN067 | " | 76 | 1620 | 7 | bio, hbl, ma | |
| 85DB098 | " | 77 | 2000 | 9 | bio, hbl, ma | |
| 85DB128 | " | 78 | 2400 | 9 | bio, hbl, ma | |
| 85SD080 | " | 79 | 2400 | 12 | bio, hbl, ma | |
| 85DB120 | Central Gd | 80 | 4200 | 10 | hbl, bio, ma | |
| 85SD072 | " | 81 | 3000 | 6 | hbl, bio, ma | |
| 85DB127 | " | 82 | 3820 | 14 | hbl, bio, ma | |
| 85DB118 | " | 83 | 4200 | 11 | hbl, bio, ma | |
| 85DB121 | " | 84 | 4000 | 11 | hbl, bio, ma | |
| 85DB122 | " | 85 | 3000 | 11 | hbl, bio, ma | |
| 85DB119 | " | 86 | 3000 | 8 | bio, hbl, ma | |
| 85DB115 | " | 87 | 2800 | 11 | bio, hbl, ma | |
| 85EL067 | " | 88 | 4400 | 12 | bio, hbl, ma | |
| 85WN064 | " | 89 | 4600 | 19 | hbl, bio, ma | |
| 75DB080 | " | 90 | 4000 | 14 | bio, hbl, ma | |
| 75AF123 | " | 91 | 3000 | 16 | hbl, bio, ma | |
| 75BJ015 | " | 92 | 4800 | 11 | hbl, bio, ma | |
| 87DB031 | " | 93 | 3000 | 16 | bio, hbl, ma | |
| 75DG106 | " | 182 | 3660 | 11 | hbl, bio, ma | |
| 75DB088 | " | 183 | 3480 | 14 | hbl, bio, ma | |
| 75DB090 | " | 184 | 4620 | 11 | hbl, bio, ma | |
| 75AF103 | " | 185 | 3000 | 16 | hbl, bio, ma | |
| 75CC033 | " | 186 | 4740 | 16 | hbl, bio, ma | |
| 75DB046 | Southern Gd | 94 | 2000 | 15 | bio, hbl, ma | |
| 75AF019 | " | 95 | 1480 | 15 | hbl, bio, ma | |
| 75CN013 | " | 96 | 1300 | 11 | bio, hbl, ma | |
| 75CN035 | " | 97 | 1800 | 17 | hbl, bio, ma | |
| 75CN061 | " | 98 | 440* | 20 | bio, hbl, ma | border phase |
| 87RK149 | " | 99 | 840 | 10 | bio, ma | |
| 75BJ008 | " | 181 | 1760 | 17 | bio, hbl, ma | |
| 75DB104 | " | 187 | 1830 | 16 | hbl, bio, ma | |
| 75CN241 | " | 193 | 1740 | 21 | hbl, bio, ma | |

| Sample no | Unit | Map no. | MS | % mafics | Mafic mins | Notes |
|---|---|---|---|---|---|---|
| 75CN074 | Eastern Gr | 100 | 1060 | 9 | bio, hbl, ma | |
| 75DB069 | " | 101 | 1360 | 7 | bio, hbl, ma | |
| 75DG069 | " | 102 | 1780 | 9 | bio, hbl, ma | |
| 75AF099 | " | 103 | 1340 | 9 | bio, ma | |
| 75CC036 | " | 104 | 1120 | 8 | bio, ma | |
| 75AF062 | " | 105 | 1200 | 8 | bio, hbl, ma | |
| 75AF087 | " | 106 | 1620 | 8 | bio, hbl, ma | |
| 75CN037 | " | 107 | 1720 | 9 | bio, hbl, ma | |
| 75DB087 | " | 108 | 1460 | 1 | bio, ma | |
| | | | | | | |
| 85WN104 | Wright Glacier 1 | 109 | 66 | 8 | bio, hbl | |
| 85DB154 | " | 110 | 114 | 10 | bio, hbl | |
| 85WN105 | " | 111 | 172 | 10 | bio | |
| | | | | | | |
| 85WN102 | Wright Glacier 2 | 112 | 2400 | 36 | hbl, bio, ma | |
| 85EL096 | " | 113 | 2600 | 14 | hbl, bio, ma | |
| 85EL094 | " | 114 | 840 | 20 | bio, hbl, ma | |
| | | | | | | |
| 86SU008 | Undivided | 156 | 3620 | 7 | bio, hbl, sp, ma | |
| 86SK370 | " | 157 | 3800 | 14 | bio, hbl, sp, ma | |
| 86SK373 | " | 158 | 3980 | 8 | bio, hbl, sp, ma | |
| 86SK367 | " | 159 | 2840 | 8 | bio, hbl, sp, ma | |
| 86RK089 | " | 160 | 4040 | 15 | bio, hbl, sp, ma | |
| 86SK368 | " | 161 | 3160 | 7 | bio, hbl, sp, ma | |
| 86SV009 | " | 162 | 2220 | 6 | hbl, bio, ma | |
| 85SD102 | " | 163 | 2600 | 9 | bio, hbl, ma | |
| 86SK369 | " | 164 | 5000 | 8 | hbl, bio, ma | |
| 86SU007 | " | 165 | 4420 | 13 | bio, hbl, sp, ma | |
| 86AF098 | " | 166 | 4860 | 17 | bio, hbl, ma | |
| 86SU006 | " | 167 | 4000 | 15 | bio, hbl, sp, ma | |
| 85WN066 | " | 168 | 2380 | 10 | bio, hbl, ma | |
| 87AF097 | " | 169 | 4100 | 17 | bio, hbl, ma | |
| 80DB020 | " | 170 | 4880 | 11 | bio, sp, ma | |
| 80SK127 | " | 171 | 2870 | 6 | bio, hbl, ma | |
| 86RK092 | " | 172 | 3070 | 8 | bio, sp, ma | |
| 87DB050 | " | 173 | 2000 | 3 | bio, ma | |
| 80DB024 | " | 174 | 2640 | 18 | bio, hbl, sp, ma | |
| 87AF101 | " | 175 | 5880 | 15 | bio, hbl, sp, ma | |
| 86AF103 | " | 176 | 4500 | 12 | bio, hbl, ma | |
| 86AF104 | " | 177 | 3120 | 8 | bio, hbl, sp, ma | |
| 86RK090 | " | 178 | 2690 | 3 | bio, ma | |
| 87RK166 | " | 179 | 3580 | 13 | hbl, bio, sp, ma | |
| 85SK081 | " | 180 | 3400 | 15 | bio, hbl, ma | |
| | | | | | | |
| 74DB436 | Southeast part | 188 | 2360 | 8 | bio, ma | |
| 74CN239 | " | 189 | 1880 | 9 | bio, ma | |
| 74CN237 | " | 190 | 1460 | 10 | bio, ma | |
| 74DB351 | " | 191 | 2140 | 6 | bio, ma | |
| 74CC199 | " | 192 | 1560 | 12 | bio, hbl, ma | |
| 74DB352 | " | 194 | 2080 | 4 | bio, ma | |

| Sample no | Unit | Map no. | MS | % mafics | Mafic mins | Notes |
|---|---|---|---|---|---|---|
| JUNEAU SILLS | | | | | | |
| 85WN070 | Mount Juneau | 130 | 60 | 16 | hbl, bio, sp | sulfides |
| 87SK066 | " | 131 | 100 | | bio, ga, sp | sulfides & altered |
| 85SD119 | " | 132 | 100 | 20 | bio, hbl | sulfides |
| 80DB022 | | 133 | 110 | 21 | bio, ep, ga | sulfides, ilmenite |
| 80DB023 | | 134 | 356 | 16 | hbl, bio, ep | sulfides, alt. magnetite |
| | | | | | | |
| 85EL113 | Carlson Creek | 135 | 40 | 19 | bio, hbl | secondary magnetite |
| 85SD118 | " | 136 | 60 | 33 | hbl, bio | sulfides |
| 86DB053 | " | 137 | 60 | 36 | hbl, bio, ox | ilmenite |
| 86DB054 | " | 138 | 50 | 17 | hbl, bio, ga | sulfides |
| 86DB055 | " | 139 | 60 | 22 | hbl, bio | secondary magnetite |
| 87RK164 | " | 140 | 140 | 32 | hbl, bio, ox | sulfides & ilmenite |
| 87SK089 | " | 141 | 50 | 30 | hbl, bio | no opaques |
| 87DB010 | " | 142 | 70 | 32 | hbl, bio, ox | sulfides & ilmenite |
| 85SD116 | " | 143 | 50 | 23 | hbl, bio | no opaques |
| 80SK126 | " | 144 | 80 | >25 | | |
| | | | | | | |
| 86DB049 | Lemon Creek Gl. | 145 | 800 | 11 | hbl, sp, ox | border phase rock |
| 82DB305 | " | 146 | 230 | 10 | hbl, bio, ox | sulfides & alt. magnetite |
| 82DB298 | " | 147 | 90 | 36 | hbl, bio | ilmenite |
| 82DB299 | " | 148 | 56 | 38 | hbl, bio | ilmenite |
| 82DB307 | " | 149 | 110 | 31 | hbl, bio | ilmenite ? |
| | | | | | | |
| 87AF102 | Mendenhall Gl. | 150 | 680 | 32 | hbl, bio | border phase rock |
| 87RK173 | " | 151 | 530 | 28 | hbl, bio, sp | border phase rock |
| 87RK172 | " | 152 | 3500 | 23 | hbl, bio, ma | |
| 87SK096 | " | 153 | 4560 | 23 | hbl, bio, ma | |
| 87Sk097 | " | 154 | 3400 | 24 | hbl, bio, sp, ma | |
| 80DB104 | " | 155 | 5860 | 25 | bio, hbl, ma | |

Abbreviations: hbl, hornblende; bio, biotite; ga, garnet; sp, sphene; ilm, ilmenite; ep, epidote, ma, magnetite; ox, opaque oxides

* sample measurement not used in averages

Table 3. Magnetic susceptibility averages and ranges for plutons and granitic units from the Taku Inlet transect. Magnetic susceptibility reported in SI units (International standard units), x 10-5

| Unit or pluton | No. of samples | Average | Range | Comments |
|---|---|---|---|---|
| Glass Peninsula | 11 | 89 | 32-168 | |
| Grand Island | 3 | 203 | 70-300 | |
| Butler Peak | 3 | 117 | 20-300 | |
| Irving Peak | 4 | 143 | 70-237 | |
| Everett Peak | 10 | 2015 | 1000-4000 | only two greater than 3000 |
| Arthur Peak | 4 | 1330 | 500-3400 | |
| Speel River | 17 | 3200 | 1100-4900 | only two less than 1500 |
| *border zone* | 3 | 170 | 68-300 | |
| Taku Cabin | 5 | 3200 | 2000-4000 | |
| Annex Lakes | 15 | 3750 | 2800-5200 | |
| Mount Juneau | 5 | 145 | 60-356 | |
| Carlson Creek | 10 | 70 | 40-140 | only one greater than 100 |
| Lemon Creek Glacier | 5 | 122 | 56-800 | |
| Mendenhall Glacier | 6 | 3090 | 530-5860 | border phase < 1000 |
| <u>Turner Lake batholith</u> | | | | |
| northern granodiorite | 19 | 1810 | 1320-2400 | only 5 greater than 2000 |
| central granodiorite | 19 | 3750 | 2800-4800 | only one less than 3000 |
| southern granodiorite | 9 | 1595 | 840-2000 | |
| eastern granite | 9 | 1407 | 1060-1780 | |
| Wright Glacier stock 1 | 3 | 117 | 66-172 | |
| Wright Glacier stock 2 | 3 | 1950 | 840-2600 | |
| Southeast part | 6 | 1913 | 1500-2400 | |
| Undivided | 25 | 3590 | 2200-5800 | 16 greater than 3000 |
| *sum* | *194* | | | |

Table 4. Magnetic Susceptibility comparisons between the Helsinki meter (JH-8 model) and Exploranium meter (KT-5 model) in SI units x 10-5

| Sample | JH-8 | KT-5 | difference | % + or - | KT-5/JH-8 |
|---|---|---|---|---|---|
| 85SD058 | 1700 | 1700 | 0 | 0.00 | 1.00 |
| 85DB121 | 2000 | 1940 | 60 | 3.00 | 0.97 |
| 85DB132 | 910 | 824 | 86 | 9.50 | 0.91 |
| 85DB136 | 870 | 832 | 38 | 4.37 | 0.96 |
| 85DB127 | 1800 | 1620 | 180 | 10.00 | 0.90 |
| 87DB028 | 2200 | 2030 | 170 | 7.73 | 0.92 |
| 87DB033 | 2450 | 2230 | 220 | 8.98 | 0.91 |
| 87RK141 | 1200 | 1130 | 70 | 5.83 | 0.94 |
| 87RK143 | 2100 | 1910 | 190 | 9.05 | 0.91 |
| 85EL106 | 820 | 836 | -16 | -1.95 | 1.02 |
| 82PB173 | 1000 | 1040 | -40 | -4.00 | 1.04 |
| 87AF046 | 240 | 214 | 26 | 10.83 | 0.89 |
| 88SK143 | 1500 | 1360 | 140 | 9.33 | 0.91 |
| 88DB031 | 1600 | 1480 | 120 | 7.50 | 0.93 |
| 86SK363 | 1850 | 1600 | 250 | 13.51 | 0.86 |
| 75DB056 | 960 | 930 | 30 | 3.13 | 0.97 |
| 88DB030 | 4000 | 3420 | 580 | 14.50 | 0.86 |
| 87AF058 | 850 | 832 | 18 | 2.12 | 0.98 |
| 75CN061 | 220 | 212 | 8 | 3.64 | 0.96 |
| 75AF099 | 670 | 621 | 49 | 7.31 | 0.93 |
| 75AF087 | 810 | 743 | 67 | 8.27 | 0.92 |
| 87SK066 | 50 | 53 | -3 | -6.00 | 1.06 |
| 86DB049 | 400 | 336 | 64 | 16.00 | 0.84 |
| 87RK164 | 70 | 78 | -8 | -11.43 | 1.11 |
| 85SD118 | 30 | 38 | -8 | -26.67 | 1.27 |
| 87DB010 | 35 | 44 | -9 | -25.71 | 1.26 |
| 88SK142 | 2600 | 2320 | 280 | 10.77 | 0.89 |
| 88DB035 | 3500 | 3410 | 90 | 2.57 | 0.97 |
| 85WN105 | 86 | 95 | -9 | -10.47 | 1.10 |
| 85EL090 | 1300 | 1180 | 120 | 9.23 | 0.91 |

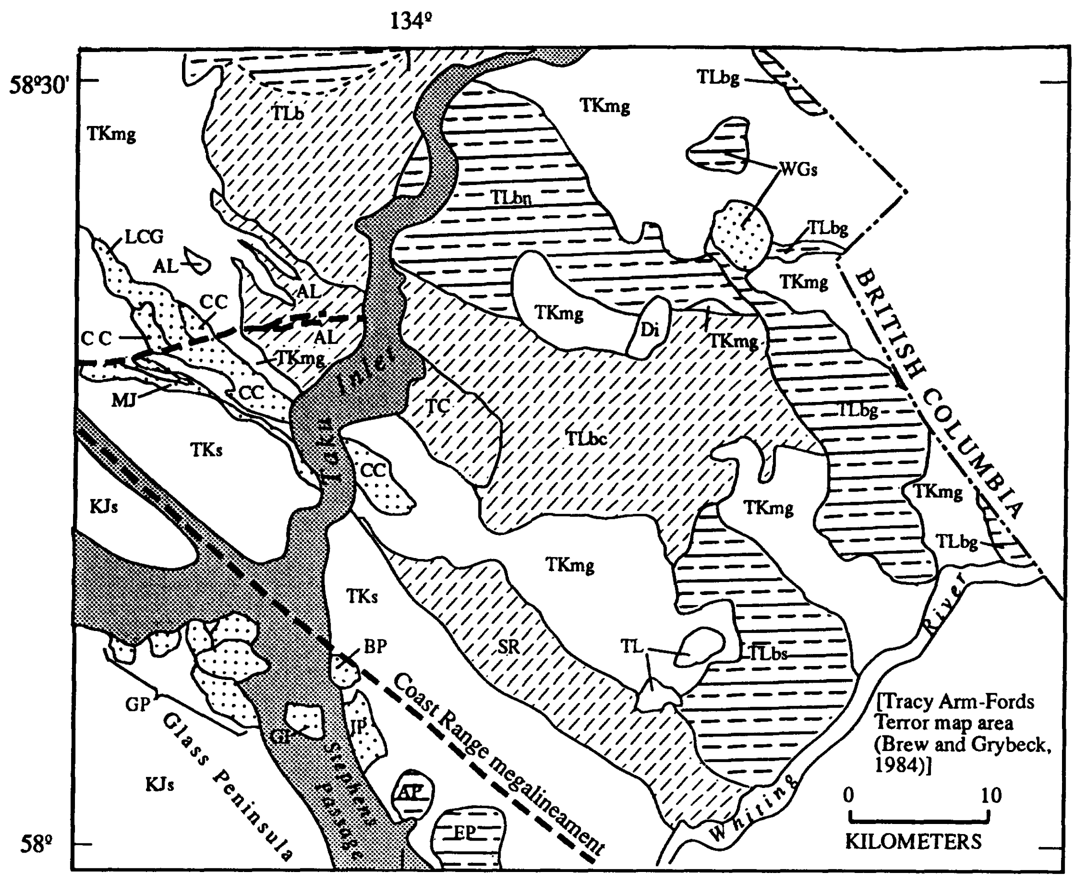
# FIGURE CAPTIONS

**Figure 1**. - Geologic sketch map and sample location map of the Taku Inlet Transect area. *A*. Generalized geologic map showing individual plutons and plutonic units and their average magnetic susceptibility (modified from Drinkwater and others, 1992). *B*. Sample locality map of expanded area of figure 1A. Refer to figure 1-A for unit and geographic names. Additional area is labled. Some contacts have been modified from figure 1-A. Abbreviations: GR, granite; GD, granodiorite; TO, tonalite; and DI, diorite.

**Figure 2**. - Distribution of magnetic susceptibility values of plutonic rocks from the Taku Inlet transect area.

**Figure 3** - Differences in magnetic susceptibility values from samples measured by the JH-8 (series 1) and KT-5 (series 2) meters. Magnetic susceptibility in SI units x $10^{-5}$.

**Figure 4**.- Magnetic susceptibility versus modal percent mafic minerals for granitiac rocks from five major subbelts (Drinkwater and others, 1992) of the Taku Inlet transect area.




## EXPLANATION

Average magnetic susceptibility values of units —

- High (>3,000 SI units)
- Medium (1,000-3,000 SI units)
- Low (<1,000 SI units)

### Map Unit Abbreviations

WGs - Wright Glacier stocks
TLbg - Turner Lake batholith eastern unit
TLbn - Turner Lake batholith northern unit
TLbc - Turner Lake batholith central unit
TLbs - Turner Lake batholith southern unit
TLb - Turner Lake batholith undivided
TLs - Tease Lakes stocks
SR - Speel River pluton
TC - Taku Cabin pluton
AL - Annex Lakes pluton
CC - Carlson Creek pluton

LCG - Lemon Creek Glacier pluton
MJ - Mount Juneau pluton
EP - Everett Peak pluton
AP - Arthur Peak pluton
BP - Butler Peak pluton
IP - Irving Peak pluton
GI - Grand Island pluton
GP - Glass Peninsula stocks

TKmg - Migmatitic gneiss (Tertiary and Cretaceous)
TKs - Schist (Tertiary and Crtaceous)
KJs - Metasedimentary and metavolcanic rocks (Cretaceous and Jurassic)
DI - Diorite

Figure 1A

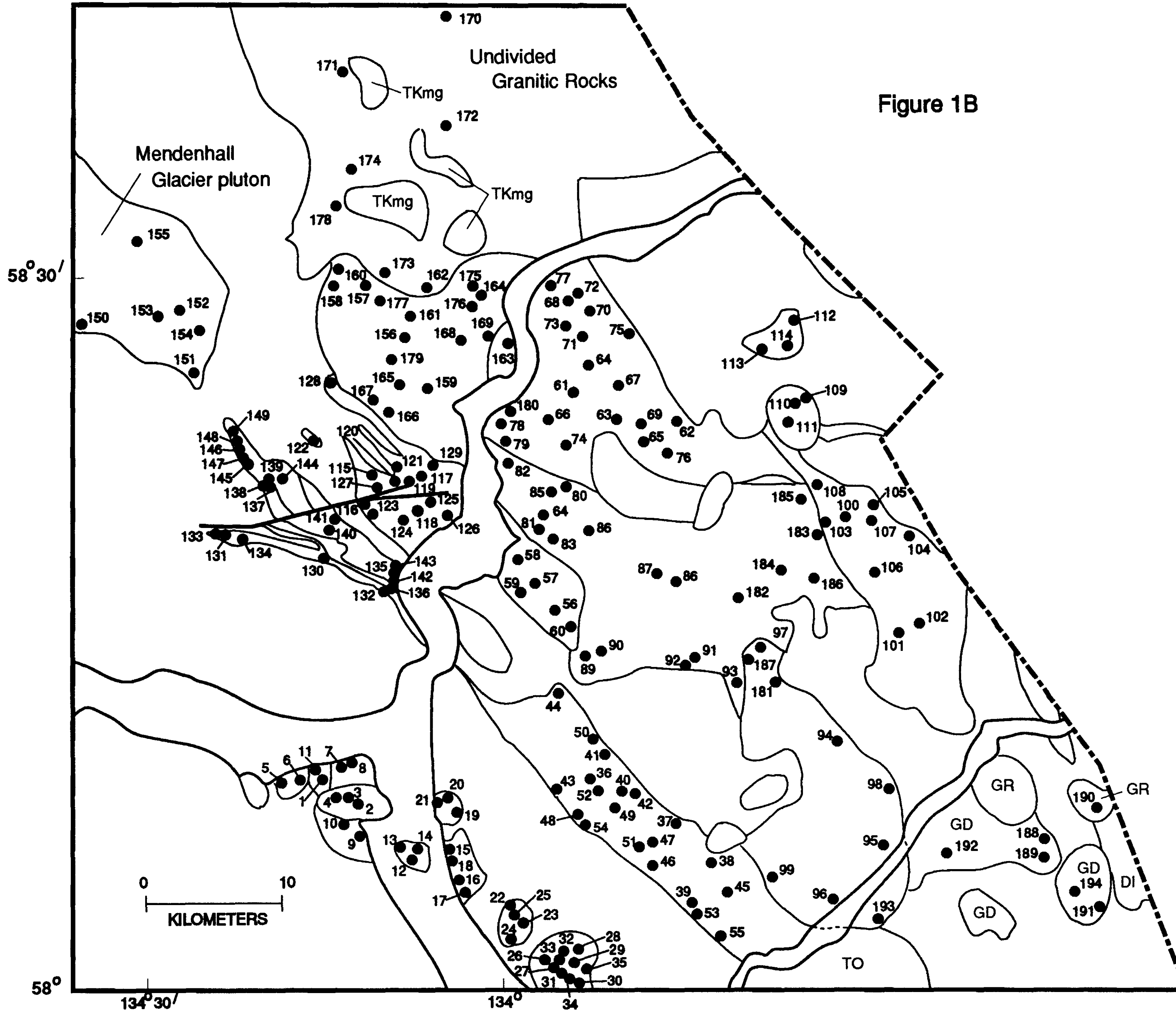
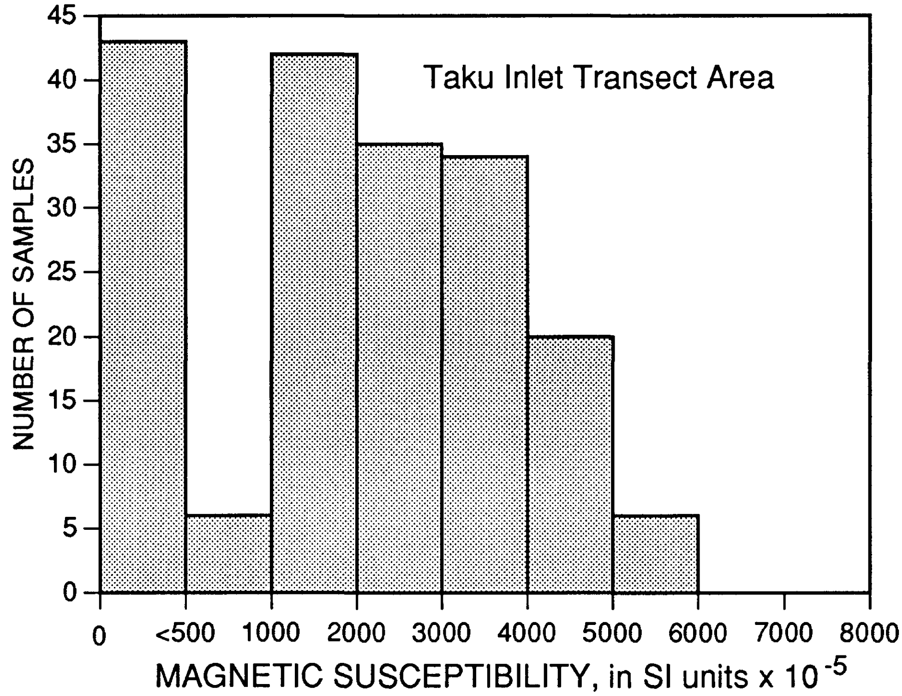

Undivided
Granitic Rocks
Mendenhall
Glacier pluton
TKmg
TKmg
TKmg
GR
GR
GD
GD
GD
DI
TO
58° 30′
58°
134° 30′
134°
0
10
KILOMETERS

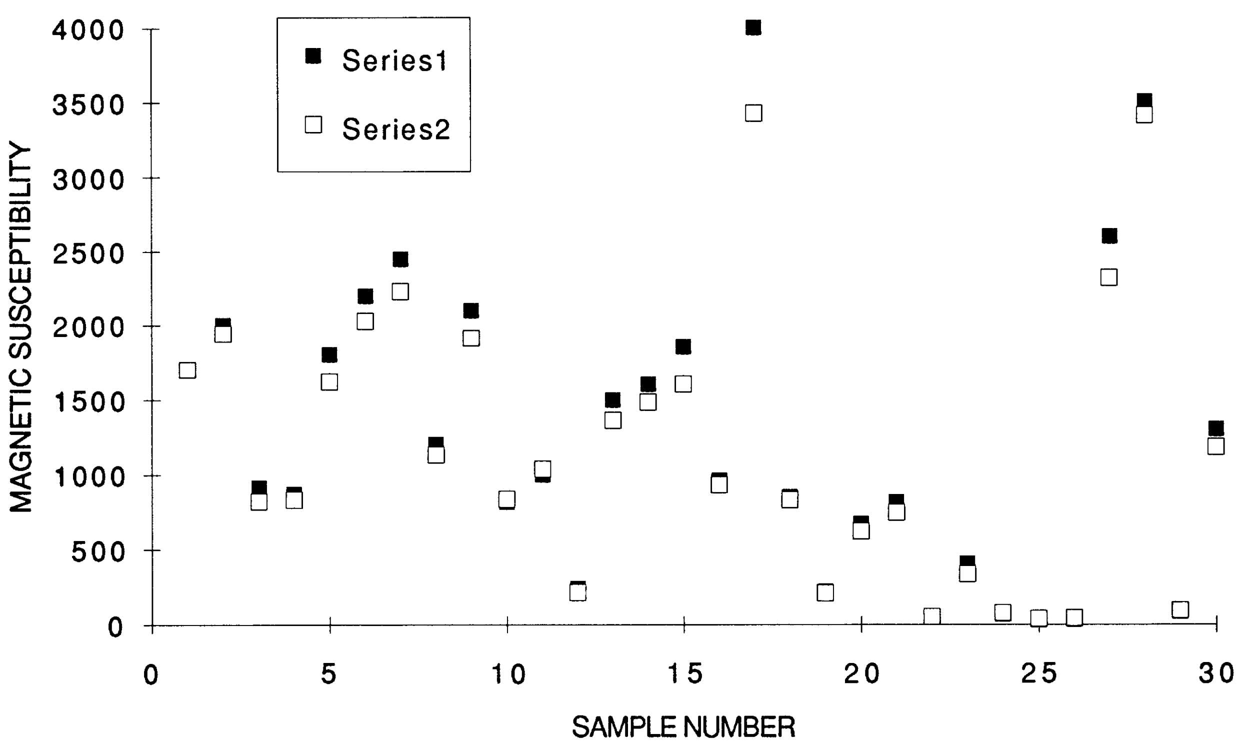
Figure 1B



Taku Inlet Transect Area
NUMBER OF SAMPLES
45
40
35
30
25
20
15
10
5
0
0
<500
1000
2000
3000
4000
5000
6000
7000
8000
MAGNETIC SUSCEPTIBILITY, in SI units x 10 -5


Figure 2.

Figure 3


4000
3500
3000
2500
2000
1500
1000
500
0
MAGNETIC SUSCEPTIBILITY
Series1
Series2
0
5
10
15
20
25
30
SAMPLE NUMBER

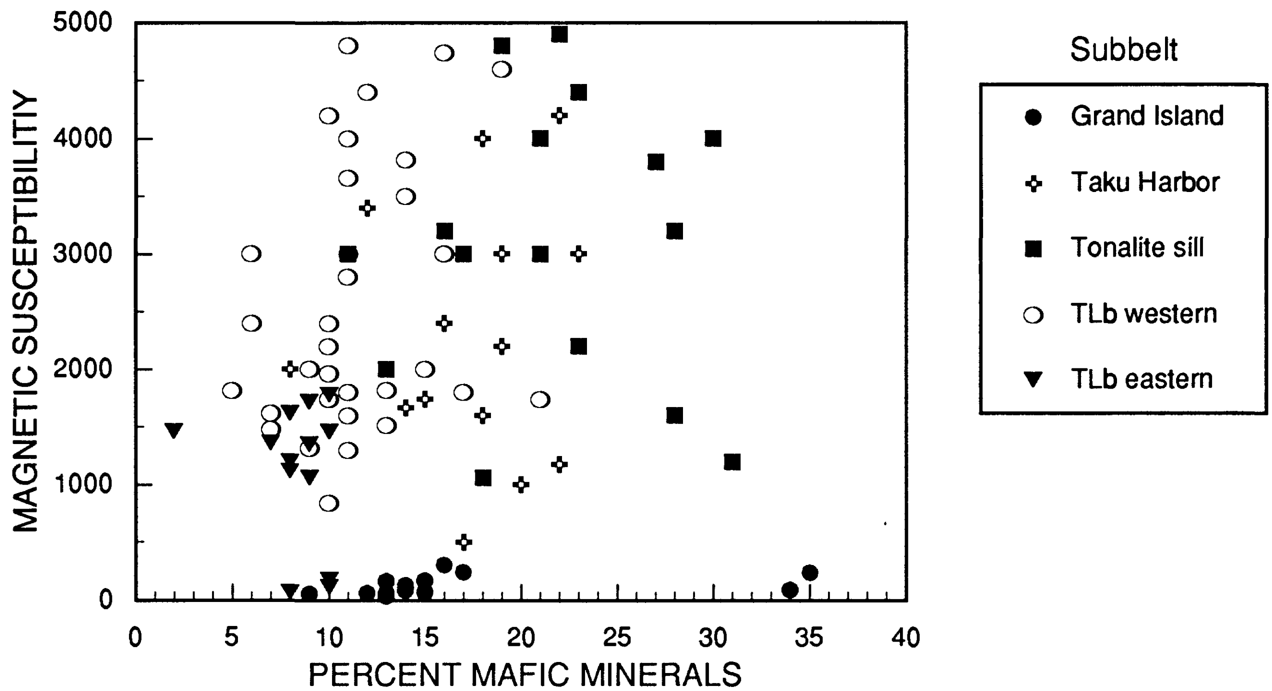

5000
4000
3000
2000
1000
0
MAGNETIC SUSCEPTIBILITIY
0
5
10
15
20
25
30
35
40
PERCENT MAFIC MINERALS
Subbelt
Grand Island
Taku Harbor
Tonalite sill
TLb western
TLb eastern

Figure 4.