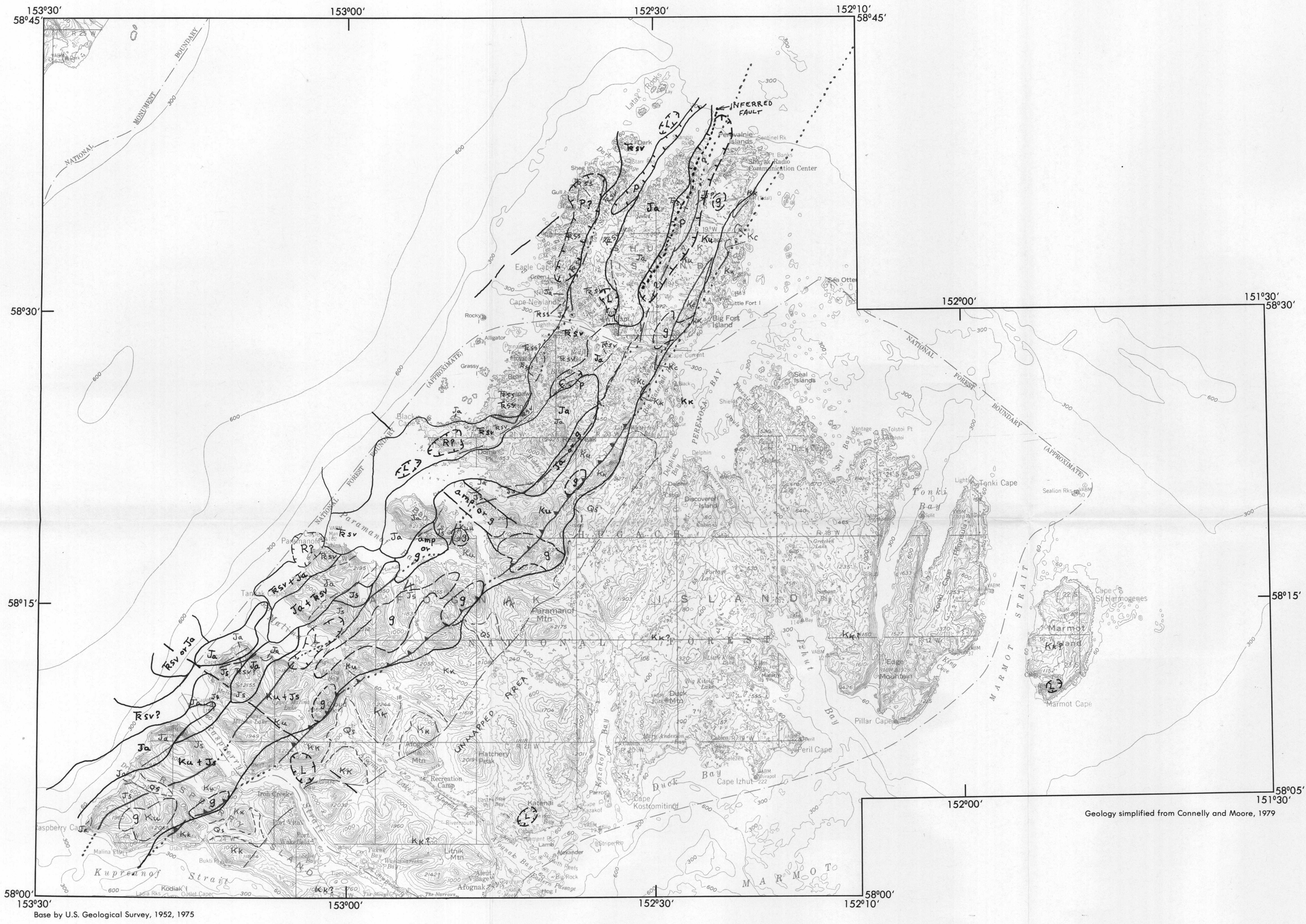


Base by U.S. Geological Survey, 1952, 1975

Geology simplified from Connelly and Moore, 1979

GEOLOGIC INTERPRETATION

CORRELATION OF MAP UNITS

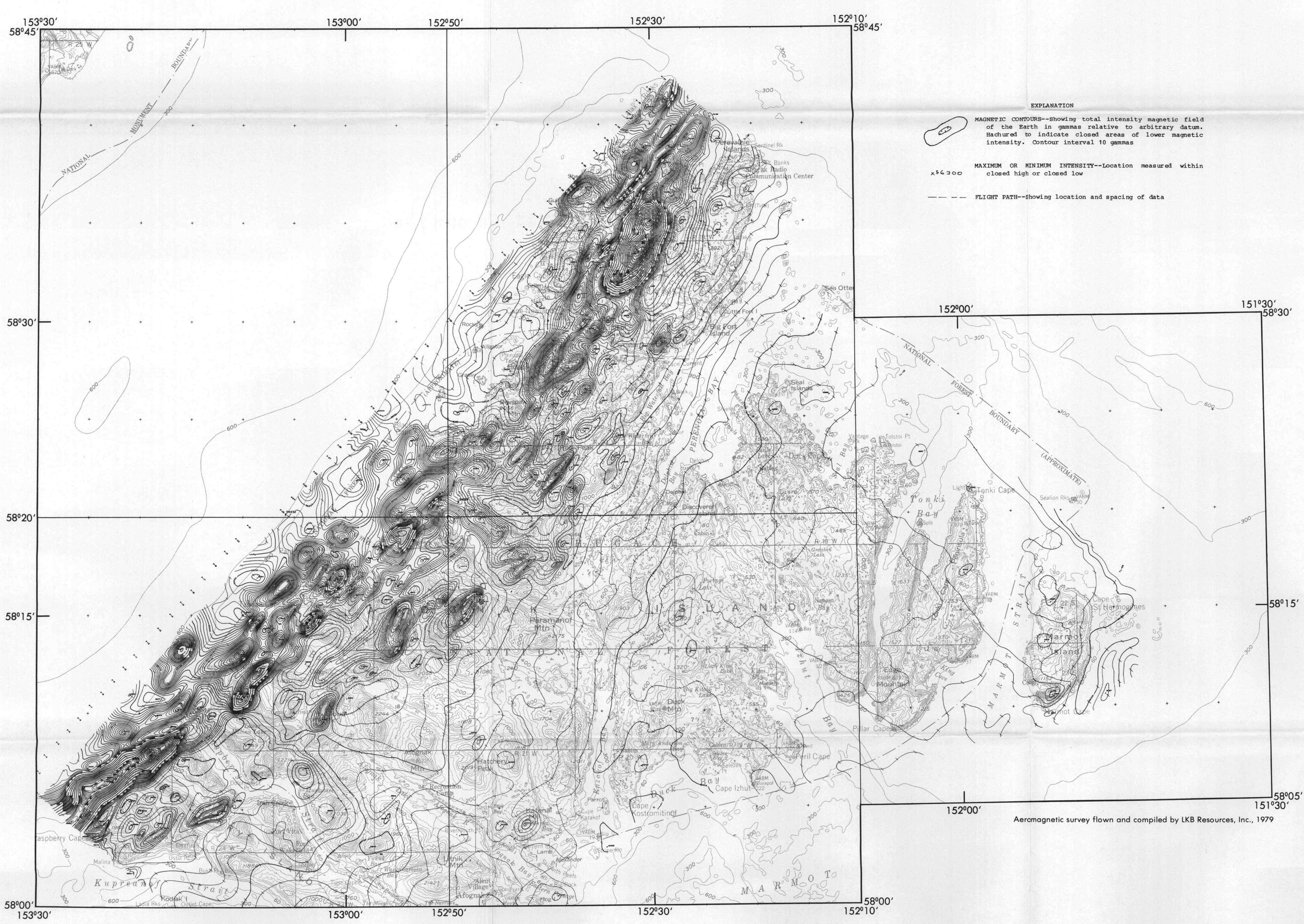
Unit(s)	Age	Period
Qs		QUATERNARY
Kk, Kc	Upper Cretaceous	CRETACEOUS
Ku, Kuu	Lower Cretaceous	CRETACEOUS
Ja, Js		JURASSIC
₨s, ₨sv	Upper Triassic	TRIASSIC
g, amp	Age Unknown	

DESCRIPTION OF MAP UNITS[1]

- **Qs** — SURFICIAL DEPOSITS (QUATERNARY)
- **Kk** — KODIAK FORMATION (UPPER CRETACEOUS)
- **Kc** — CAPE CURRENT TERRANE OF CONNELLY (1978) (UPPER CRETACEOUS)
- **Ku** — UYAK COMPLEX (LOWER CRETACEOUS)—As mapped, includes some blocks of pre-Cretaceous age
- **Kuu** — ULTRAMAFIC ROCKS
- **Ja** — AFOGNAK PLUTON (JURASSIC)
- **Js** — SCHIST OF KODIAK ISLAND (JURASSIC)
- **₨ss** — SHUYAK FORMATION (UPPER TRIASSIC)—In this area, divided into: Sedimentary member
- **₨sv** — Volcanic member
- **g** — GABBRO OF UNKNOWN AGE
- **amp** — AMPHIBOLITE OF UNKNOWN AGE

[1] For a more complete description of map units, see text and Connelly and Moore (1979).

- CONTACT - Includes both intrusive and tectonic contacts; dashed where approximately located
- FAULT - Approximately located except at coastline; dashed where existence doubtful; queried where uncertain; dotted where concealed
- THRUST FAULT - Approximately located except at coastline; dotted where concealed; sawteeth on upper plate
- AREAS OF NEGATIVE ANOMALIES - R, Possibly caused by reversed remanent magnetization; P, Possibly caused by polarization or "edge" effects; L, Unspecified origin



Base by U.S. Geological Survey, 1952, 1975

Aeromagnetic survey flown and compiled by LKB Resources, Inc., 1979

EXPLANATION

- MAGNETIC CONTOURS—Showing total intensity magnetic field of the Earth in gammas relative to arbitrary datum. Hachured to indicate closed areas of lower magnetic intensity. Contour interval 10 gammas
- MAXIMUM OR MINIMUM INTENSITY—Location measured within closed high or closed low
- FLIGHT PATH—Showing location and spacing of data

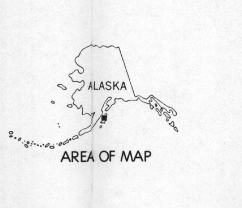
AEROMAGNETIC MAP

SCALE 1:250 000

0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETERS

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



AREA OF MAP

PRELIMINARY GEOLOGIC INTERPRETATION OF THE AEROMAGNETIC MAP OF AFOGNAK AND SHUYAK ISLANDS, ALASKA

By
J.E. Case, M.A. Fisher, George W. Moore, J. Casey Moore, and Steven W. Nelson
1986

INTRODUCTION

An aeromagnetic survey was flown over Afognak and Shuyak Islands and vicinity (fig. 1) in 1979 as part of the Chugach RARE II Wilderness mineral assessment program, but the area was subsequently deleted from that Wilderness program. [illegible]

[illegible]

SUMMARY OF GEOLOGY

[illegible]

Shuyak Formation

[illegible]

Schist of Kodiak Island

[illegible]

Afognak Pluton

[illegible]

Uyak Complex

[illegible]

Kodiak Formation and Cape Current terrane of Connelly (1978)

[illegible]

FAULTS

[illegible]

INTERPRETATION OF AEROMAGNETIC MAP

[illegible]

Anomaly groups are discussed below, from southeast to northwest across the islands. The southeastern two-thirds of the map area is almost magnetically featureless. Magnetic anomalies over the Kodiak Formation are small in extent and of low amplitude (less than about 30 gammas). Small positive anomalies may be related to isolated volcanic bodies (unmapped or not exposed). This subdued magnetic expression characterizes most of the flysch deposits here, as it does in the Chugach terrane in the Seward and Blying Sound quadrangles, in the Prince William Sound region (Case and others, 1979). Gentle magnetic gradients indicate relatively great depth to magnetic basement (5 km or more). A closed low of 30 gammas near Katenai Hill, north of Afognak Bay, remains unexplained because the geology has not been mapped there.

The melange of the Uyak Complex, which is bounded by two major northwest-dipping reverse or thrust faults, has a subdued magnetic pattern nearly identical to that of the McHugh Complex of the Seward quadrangle (Case and others, 1979). Although most of the magnetic pattern over the Uyak Complex is subdued, a series of small oval highs, having steep magnetic gradients, are discontinuously distributed across the outcrop area (g). Many of these highs have a close spatial correlation with greenstone bodies (shown on detailed inset maps of Connelly and Moore, 1979), and we infer that most of them are caused by greenstone or ultramafic blocks, similar to relations in the McHugh Complex of the Seward quadrangle. The southeast limit or envelope of the oval anomalies closely parallels the major fault mapped between the Uyak Complex and Kodiak Formation. But locally, this limit diverges from the previously mapped trace of the fault contact with the Kodiak Formation. This divergence is greatest near 58°17' N., 152°42' W., where anomalies of steep gradient extend over rocks mapped as part of the Kodiak Formation, but the geology is poorly known where these discrepancies occur.

Unfortunately, where the Uyak Complex and the schist of Kodiak Island are in contact, these rocks have little difference in magnetic expression. Small, low-amplitude highs over the schist belt may be caused by (1) magnetic rocks (amphibolite?) within the belt, (2) concealed masses of the Afognak pluton, (3) ultramafic bodies, or (4) greenstone layers below the northwest-dipping reverse fault.

The most highly magnetic rock unit of the area is the Afognak pluton. Magnetic susceptibility of 41 specimens of igneous rocks from western Afognak and Shuyak Islands were measured to determine variation in susceptibility as comapred with bulk composition. Samples were supplied through the courtesy of Dr. M. D. Hill, Earth Sciences Department, Northeastern University, Mass. Seventeen specimens have susceptibilities of 0.001 to 0.004 cgs units (moderately to strongly magnetic). Six specimens have susceptibilities greater than 0.004 cgs units. The more mafic specimens, which are amphibole gabbro, tend to be more magnetic than the tonalite, diorite, and quartz diorite. Anomalies over exposed parts of the pluton range from a few hundred to more than 1,000 gammas, indicating the variability of magnetization. Steep gradients on the flanks of most of the anomalies indicate that the source rocks crop out or are buried at relatively shallow depth below the surface, generaly within 1 km of the surface.

The near-continuity of anomalies over the pluton is interrupted near Shuyak Strait in the northern part of the map area and near Raspberry Strait in the southern part. On Shuyak Island, the steep gradient on the southeast flank of the magnetic high lies considerably west of the trace of the fault that lies between the pluton and the Uyak Complex. This may be evidence that the fault dips northwest, as inferred from geologic mapping , or that an unmapped subparallel fault occurs on the northwest side of Shangin Bay. The large negative anomalies on the flanks of the high on Shuyak Island are probably polarization lows (or edge effects).

In several areas it is difficult to distinguish anomalies caused by the Afognak pluton from those caused by the Triassic volcanic rocks unit ₨sv especially adjacent to Malina Bay. Resolution of the origin of such composite anomalies will require more detailed geologic mapping.

Conspicuous magnetic highs and lows occur over the Triassic mafic volcanic rocks. In the absence of available measurements of remanent magnetization, it is unknown whether or not some of the lows are caused by reversed remanent magnetization. Some of the lows, especially the one on the northeast side of Foul Bay (near VABM Black Cape), have an inverse correlation with high topography, and we suspect that either reversed remanent magnetization or alteration of original magnetite causes the anomaly.

Steep gradients caused by Triassic volcanic rocks bound the northwest side of the northern belt of anomalies, and these gradients are close to the mapped contact between the volcanic sequence and the relatively nonmagnetic Triassic sedimentary sequence.

Both positive and negative aeromagnetic anomalies were detected offshore along the margin of Shelikof Strait. The positive anomalies could be caused by either the Afognak pluton or the Triassic volcanic sequence.

Marine magnetic data were obtained by the U.S. Geological Survey in fiords along the northwest coast of Kodiak Island and over the continental shelf between Kodiak and Sutwik Islands (Fisher and others, 1981a, 1981b). The dominant marine magnetic anomaly in these data, called the Shelikof anomaly (Fisher, 1981), appears to coincide closely with the aeromagnetic anomaly at mouth of Kupreanof Strait, and is most likely caused by plutonic rocks that correlate with the Afognak pluton. Magnetic data obtained over offshore strike extensions of the Uyak Complex and Kodiak Formation show only minor anomalies, and are in agreement with aeromagnetic data obtained over equivalent rocks on Afognak and Shuyak Islands. South of the map area the Shelikof anomaly extends southwest of Kodiak Island; about 25 km southwest of this island, the anomaly attains its largest observed value of 1,100 gammas. Southwest of this peak value, the anomaly abruptly decreases in average peak value and increases in width but continues to the southwest limit of the magnetic data southwest of Sutwik Island.

A single trackline passes between Shuyak Island and the Barren Islands to the north, and magnetic data obtained along this trackline show that the Shelikof anomaly extends northeast of Shuyak Island (Fisher, 1981). Rocks correlative with the Afognak pluton crop out on the Barren Islands (Cowan and Boss, 1979); magnetic data along this isolated trackline suggest that the plutonic rocks underlie the offshore area between Shuyak Island and the Barren Islands.

Several zones of steepened magnetic gradients trend northwest, especially north of both Raspberry Strait and Foul Bay. Similar zones have been identified on the Alaska Peninsula in the Chignik and Sutwik Island quadrangles, where they are interpreted to reflect a rather fine-scale segmentation of the magmatic arc that is related to convergence across the Aleutian trench (Case and others, 1981; Fisher and others, 1981a). These zones on Afognak Island may also reflect topographic effects of drape flying.

DISCUSSION

The belt of magnetic highs over the Afognak pluton and the Triassic mafic volcanic rocks is essentially on trend with the "Knik Arm anomaly" discussed by Grantz and others (1963). Indeed, as more data accumulate, it becomes apparent that an intermittent magnetic high may extend from the central part of the Valdez quadrangle (U.S. Geological Survey, 1979), along the margin between the Chugach terrane and the south flank of the Copper River Basin (Andreasen and others, 1964), through the Anchorage quadrangle, and across the Kenai Peninsula to the latitude of Homer. From there the high appears to extend south across Afognak and Kodiak Island and beyond. This seemingly continuous anomaly is caused by a diverse suite of intrusive rocks ranging from layered gabbro to quartz diorite (Valdez quadrangle, Winkler and others, 1981, Case and others, 1985), with ultramafic rocks (near Anchorage) and tonalite, quartz diorite, and gabbro on Kodiak, Afognak, and Shuyak Islands. Available K-Ar ages for these intrusive bodies fall between 154-171 m.y. for the northeastern part of the belt (Winkler and others, 1981) and 160-190 m.y. for the southwestern part (Connelly and Moore, 1979). This age difference may indicate that the magmatism shifted geographicaly with time.

The geologic environment of such a long but relatively narrow belt of intrusive rocks of such diverse composition, located along a major suture zone (Border Ranges fault and associated faults), is an enigma for which no generally accepted geologic model exists at the present time. However, numerous investigations of the problem were underway by several governmental and academic groups in 1982. The problem is compounded by the question of which accreted terrane was the original site of magmatism: the Peninsular terrane, the Kachemak terrane, or Wrangellia (as defined by Jones and others, 1981; and Coney and others, 1980), or an independent magmatic terrane.

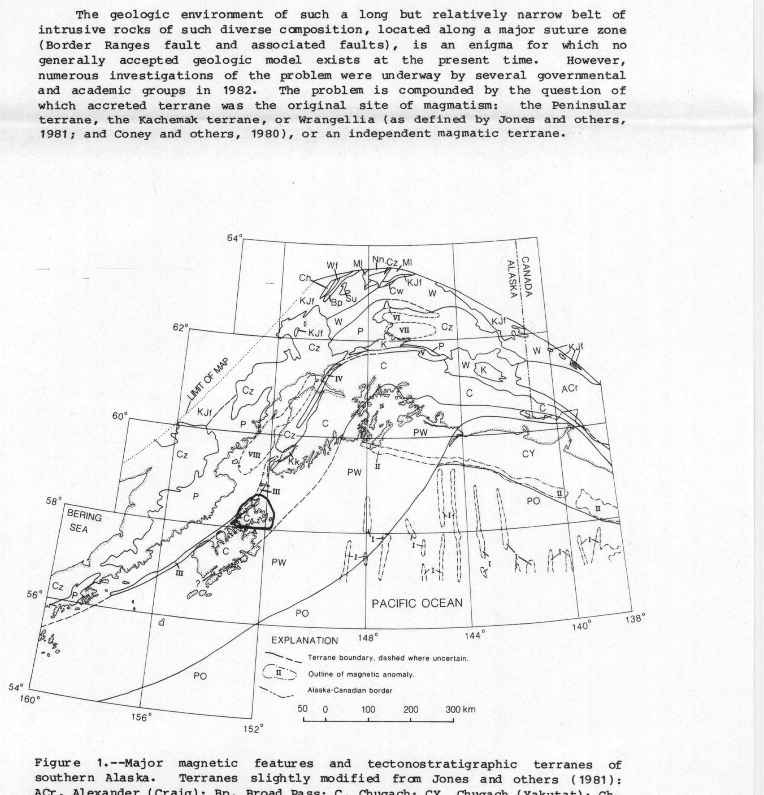


Figure 1.--Major magnetic features and tectonostratigraphic terranes of southern Alaska. Terranes slightly modified from Jones and others (1981): ACr, Alexander (Craig); Bp, Broad Pass; C, Chugach; CY, Chugach (Yakutat); Ch, Chulitna; Cw, Clearwater; KJf, deformed upper Mesozoic flysch; Nn, Nenana; P, Peninsular; PO, Pacific ocean floor; PW, Prince William; Su, Susitna; W, Wrangellia; Wf, West Fork. Postaccretionary rocks: K, middle and upper Cretaceous sedimentary rocks; Cz, Cenozoic sedimentary and volcanic rocks. Note that plutonic rocks are not shown except for magnetic features III, IV, and V. Magnetic features: I, linear magnetic anomalies of Pacific Ocean floor; II, continental slope anomaly; III, Shelikof anomaly; IV, Knik Arm anomaly; V, North Chugach Mountains anomaly; VI, North Fork anomaly; VII, Copper River Basin anomaly; VIII, Cook Inlet anomaly. Afognak and Shuyak Islands shown by heavy line.

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