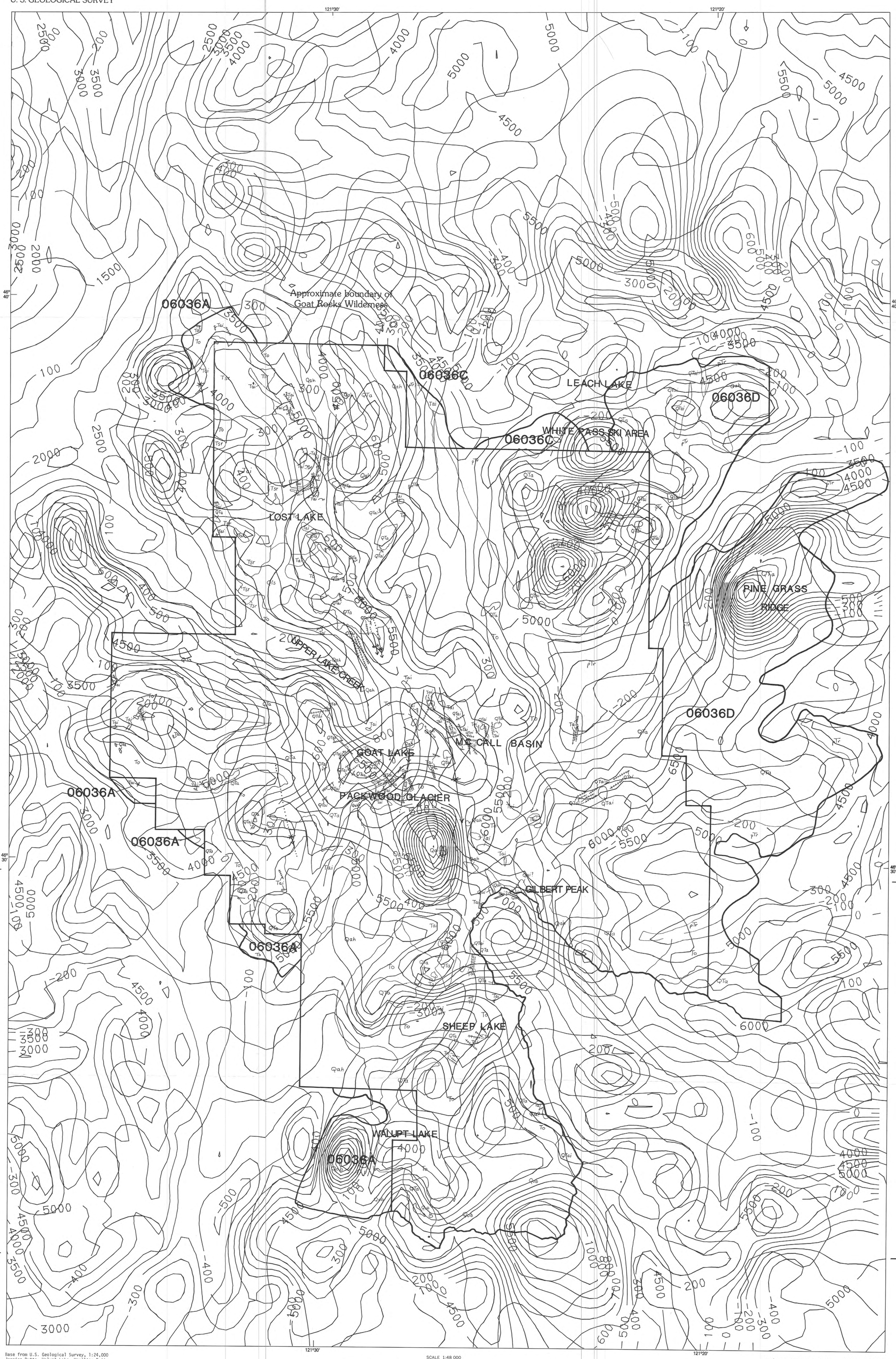
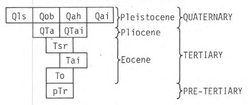


Base from U.S. Geological Survey, 1:24,000 Jennies Butte, Walupt Lake, Hamilton Butte, 1970; 1:62,500, Packwood, White Pass, 1962

SCALE 1:48 000

Geology modified from Swanson and Clayton (1983); gravity and aeromagnetic data mapped in 1983

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qls LANDSLIDE DEPOSIT (PLEISTOCENE)--Mapped only where contact relations of bedrock units are obscured

Qob OLIVINE BASALT (PLEISTOCENE)--Flows and tephra of gray, commonly diktytaxitic olivine and olivine-bearing basalt. Plagioclase phenocrysts present in most flows

Qah HORNBLENDE ANDESITE (PLEISTOCENE)--Light-gray, commonly oxidized flows and minor tephra of hornblende and hornblende-bearing andesite.

Qai ANDESITIC INTRUSIONS (PLEISTOCENE)--Plugs and dikes of hornblende and pyroxene andesite. Feeders for unit Qah

QTa PYROXENE ANDESITE (PLEISTOCENE AND PLIOCENE)--Flows and minor tephra of porphyritic andesite and basaltic andesite. Includes olivine basalt flows erupted from vents on Hogback Mountain and interbedded with pyroxene andesite flows. Also includes several hornblende dacite domes overlain by the olivine basalt flows. Plagioclase, hypersthene, and clinopyroxene generally present as phenocrysts. Hornblende occurs in some rocks

QTai ANDESITIC AND BASALTIC-ANDESITIC INTRUSIONS (PLEISTOCENE AND PLIOCENE)--Plugs and dikes of pyroxene andesite, basaltic andesite, and hornblende andesite; at least in part related to pyroxene andesite of unit QTa. Dikes of pyroxene andesite and basaltic andesite in central part of area show radial pattern centered on Upper Lake Creek

Tsr STEVENS RIDGE FORMATION (EOCENE)--Light-colored, silicic ashflow tuff and associated bedded tuff and rhyolite flows. Quartz phenocrysts common. Secondary minerals, especially clay, calcite, quartz, and zeolites abundant

To OHANAPECOSH FORMATION (EOCENE)--Chiefly altered basaltic and andesitic lava flows and bedded volcaniclastic rocks. Also includes silicic flows and tuffs, as well as small intrusive bodies of mafic to silicic compositions. Unit consists predominantly of lithic tuffs, lapilli tuffs, and breccias in north half of area and of andesitic lava flows in south half of area. Zeolites, quartz, calcite, and clay minerals abundant; rocks commonly have a green or violet cast. Basaltic flows and rhyolite near base of formation along Clear Fork Cowlitz River and in McCall Basin area may be separated from overlying Ohanapecosh beds by an angular unconformity

Tai INTRUSIVE ROCKS OF MAFIC AND INTERMEDIATE COMPOSITIONS (TERTIARY)--Dikes, sills, plugs, and shallow-seated plutons, predominantly of porphyritic pyroxene andesite but including diorite and quartz monzonite. Age range unknown; includes feeders for flows and tuffs in the Ohanapecosh Formation as well as upper Tertiary bodies. Generally altered; clays and calcite especially common

pTr RUSSELL RANCH FORMATION (PRE-TERTIARY)--Graywacke, argillite, and less abundant basaltic flows, most of which have pillow structures. Sheared in most places. Most flows are metamorphosed to greenstone

CONTACT

ANTICLINE--Showing direction of plunge; dotted where concealed

SYNCLINE--Showing direction of plunge; dotted where concealed

DIKE

AEROMAGNETIC CONTOUR--Contour interval 100 gammas

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of geophysical surveys of the Goat Rocks Wilderness (NF032) and adjacent Goat Rocks Roadless Areas (RARE II 06036, Parts A, C, and D) in Gifford Pinchot and Snoqualmie National Forests, Lewis and Yakima Counties, Wash. Goat Rocks Wilderness was established by Public Law 88-577, September 3, 1964. The Goat Rocks Roadless Areas were classified as futher planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

INTRODUCTION

The Goat Rocks Wilderness (NF032) and adjacent Goat Rocks Roadless Areas (RARE II 06036, parts A, C, and D) hereafter referred to as the Goat Rocks study area, straddle the crest of the Cascade Range in Lewis and Yakima Counties, south-central Washington. The study area lies in the Gifford Pinchot National Forest west of the Cascade crest and in the Snoqualmie National Forest east of the crest. The Yakima Indian Reservation borders the southeastern and southern parts of the wilderness. Mount Rainier National Park is about 5 mi north of the area, and the Mount Adams Wilderness is about 6 mi south of the area. Elevations range from 2,930 ft along Upper Lake Creek to 8,184 ft at Gilbert Park. Access to the wilderness and roadless areas is provided by good unpaved roads leading south from U.S. Highway 12. Travel within the area is aided by the Pacific Crest National Scenic Trail and connecting trails.

The wilderness and adjacent roadless areas are underlain by pre-Tertiary marine sedimentary rocks (the Russell Ranch Formation), which comprise the southernmost known exposures of pre-Tertiary rocks in the Cascade Range of Washington and Oregon. The Russell Ranch is overlain by a thick sequence of Cenozoic volcanic rocks. The thickest and most extensive formation is the Eocene Ohanapecosh Formation, which consists of volcaniclastic rocks and lava flows predominantly of andesitic composition. The Ohanapecosh is overlain by silicic ash-flow tuff of the Eocene Stevens Ridge Formation. A major erosional unconformity separates these rocks from upper Pliocene rhyolitic tuff and flows that occur in the eastern part of the area. A thick sequence of pyroxene andesite lava flows was erupted in the late Pliocene and Pleistocene from a large volcano, the Goat Rocks volcano, centered in the core of the wilderness area; satellite vents fed andesite and basalt flows. The youngest volcanism, of late Pleistocene age, produced hornblende andesite from vents in the central and northern part of the wilderness area and olivine basalt in the southern part.

Intrusive bodies of mafic and intermediate compositions are common. They range from narrow dikes to shallow plutonic bodies several miles in diameter. Ages are poorly constrained; it is likely that the dikes were intruded throughout much of the Cenozoic. Many of the bodies and adjacent country rocks underwent quartz-sericite-pyrite and propylitic alteration.

The Russell Ranch Formation is cut by major north-trending faults. Both the Ohanapecosh and Stevens Ridge Formations are only broadly folded along north-northwest trends. Rocks of Neogene age are not demonstrably deformed.

AEROMAGNETIC SURVEYS

Two aeromagnetic surveys cover the Goat Rocks study area. One was flown in 1974 (U.S. Geological Survey, 1975) at 8,000 ft barometric elevation on east-west flight lines spaced approximately 1 mi apart. The second was flown in 1981 (U.S. Geological Survey, 1982), draped at approximately 1,000 ft above the terrain on east-west flight lines spaced approximately 0.62 mi apart. Given the rugged terrain of the area and the limited performance of the surveying aircraft it is better to think of this survey as semidraped. There is good agreement between the two surveys, but the draped survey is used in this report because it is more detailed and is available as a digital data set. The data have had the International Geomagnetic Reference Field 1975 update removed and have been reduced-to-the-pole, a technique which attempts to account for the inclination of the Earth's magnetic field. The principal effect of the reduction-to-the-pole is to shift magnetic anomalies to a position directly above their source.

On inspection it is clear that the majority of aeromagnetic anomalies are related to topography. Most topographic highs are also aeromagnetic highs and most topographic lows are aeromagnetic lows. This is to be expected even when the aeromagnetic survey is semi-draped. This general pattern can be reversed for topographic features that are composed of rocks with a strong reversed remenant magnetization. Figure 1 show examples of profiles of aeromagnetic anomalies over terrain. A general correlation is clear in these profiles.

Significant deviations from this relation between topography and aeromagnetic anomalies can delineate features in the subsurface geology. To enhance our ability to identify these deviations, we created a set of synthetic aeromagnetic maps using the techniques of Blakely (1981). The synthetic aeromagnetic maps are calculated at the same elevation as the actual aeromagnetic map by assuming the topography is magnetized in the present direction of the Earth's magnetic field (Inclination = 69°, Declination = 20°) with magnetizations between 0.006 and 0.015 electromagnetic unit (emu)/cm³. The magnitude of magnetization of different topographic features is clearly quite variable so we created a series of maps at various magnetizations. Because of this known variability in magnetization it is not advantageous to create a residual field (subtract computed magnetic map values from the observed aeromagnetic field) as most of the resulting anomalies will simply reflect deviations from the assumed magnetization. It is better to keep the two maps intact, overlay them, and study each deviation individually to determine which anomalies are clearly not related to topography. By doing so we identified several anomalies unrelated to topography.

One area of anomalously low magnetization is near Packwood Glacier and western McCall Basin and coincides with a large area of mapped altered rock. Another is near the White Pass Ski Area, also an area of mapped altered rock. A third is on the northwest part of Pine Grass Ridge; this entire area is covered by andesite flows (QTa) that are reversely magnetized. Perhaps one or more of these flows are very thick in a paleovalley. There are several small areas of anomalously high magnetization. One high is near Walupt Creek. The geology offers no clue to the source of the anomaly. Another anomaly is located just north of the wilderness at Leach Lake. The anomaly corresponds reasonably well to outcrops of a normally magnetized Quaternary hornblende andesite (Deer Lake lava flow) that are surrounded by sediments of the Russell Ranch Formation.

REFERENCES

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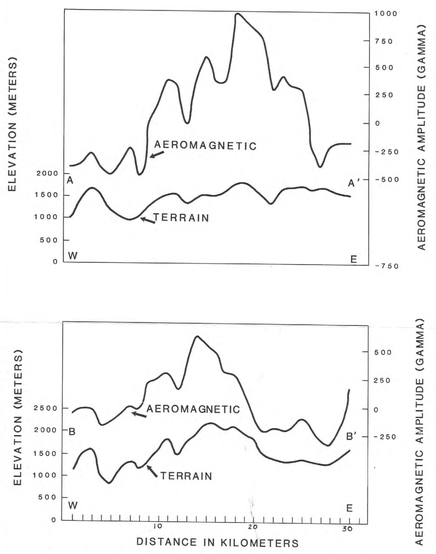

Figure 1.--East-west profiles of aeromagnetic and smoothed terrain data. Locations of profiles are identified on the aeromagnetic map as profiles A-A' and B-B'.

MAP B. AEROMAGNETIC MAP

GRAVITY AND AEROMAGNETIC MAPS OF THE GOAT ROCKS WILDERNESS AND ADJACENT ROADLESS AREAS, LEWIS AND YAKIMA COUNTIES, WASHINGTON

By
David L. Williams, Carol Finn, D. Randall Spydell, and Frank Daneš

1984

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