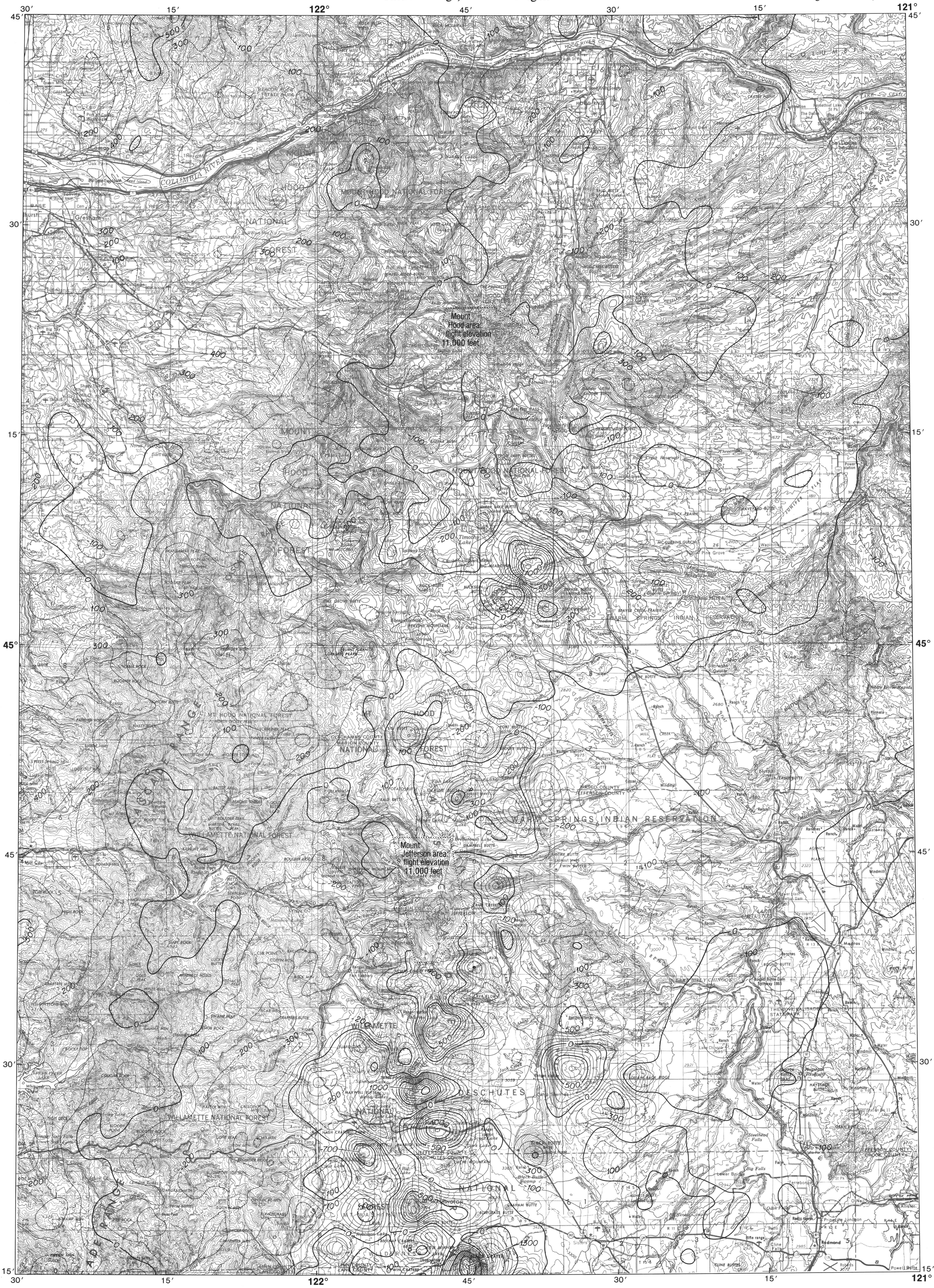
GMS-40

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

Total Field Aeromagnetic Anomaly Map
Cascade Range, Northern Oregon

Total Field Aeromagnetic Anomaly Maps
Cascade Mountain Range, Northern Oregon
By R.W. Couch, M. Gemperle, and R. Peterson

Plate 1: Flight elevation 9,000 feet



Estimated RMS uncertainty in measurements 4 nanoteslas

IGRF 1980, updated to survey time

Flight elevations 5,000 feet and 7,000 feet, both upward continued to 9,000 feet

Survey flown July-October 1982

East-west flightline spacing 1 mile
North-south flightline spacing 5 miles

Base map from USGS 1:250,000 series: NL 10-8, Vancouver; NL 10-9 The Dalles; NL 10-11, Salem; NL 10-12 Bend

Topographic contour interval 200 feet with supplementary contours at 100 foot intervals

SCALE 1:250,000

0 5 10 15 Miles

0 5 10 15 20 Kilometers

Magnetic Anomaly Contour Interval 100 Nanoteslas

TRANSVERSE MERCATOR PROJECTION

OREGON

Map Location

by R. W. Couch, M. Gemperle, and R. Peterson

Data from GEOPHYSICS GROUP
OREGON STATE UNIVERSITY

February 1984

Total Field Aeromagnetic Anomaly: Northern Oregon Cascades

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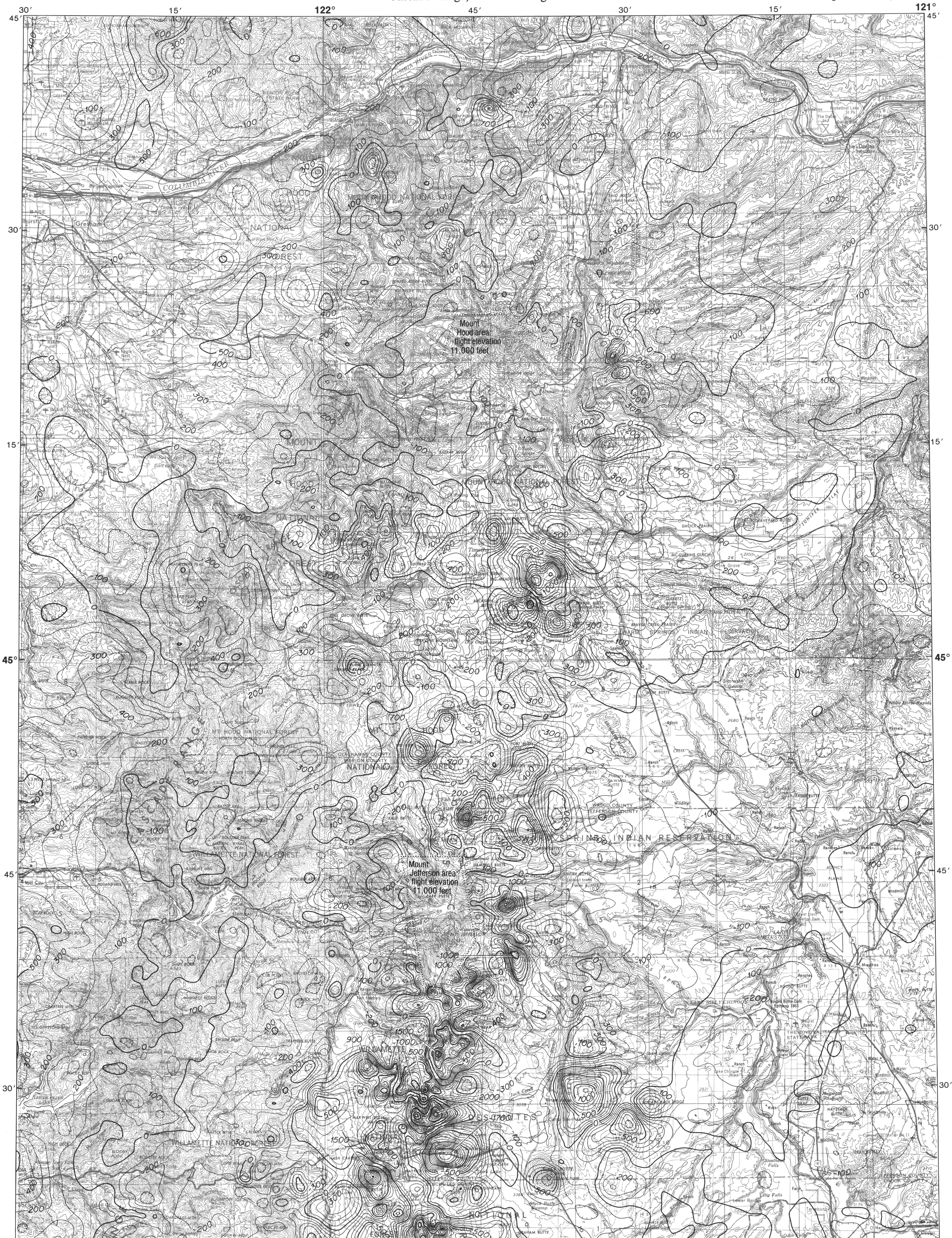
Plate 2: Flight elevation 7,000 feet



Estimated RMS uncertainty in measurements 4 nanoteslas

IGRF 1980, updated to survey time

Flight elevations 7,000 feet and 5,000 feet (upward continued to 7,000 feet)

Survey flown July-October 1982

East-west flightline spacing 1 mile
North-south flightline spacing 5 miles

Base map from USGS 1:250,000 series: NL 10-8, Vancouver; NL 10-9 The Dalles; NL 10-11, Salem; NL 10-12 Bend

Topographic contour interval 200 feet with supplementary contours at 100 foot intervals

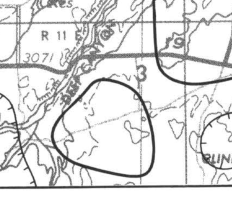
SCALE 1:250,000

0 5 10 15 Miles

0 5 10 15 20 Kilometers

Magnetic Anomaly Contour Interval 100 Nanoteslas

TRANSVERSE MERCATOR PROJECTION



Map Location

by R. W. Couch, M. Gemperle, and R. Peterson

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Plate 3: Flight elevation 5,000 feet

TOTAL FIELD AEROMAGNETIC ANOMALY MAP
Cascade Range, Northern Oregon

MEASUREMENTS AND PROCESSING

Personnel of the Geophysics Group at Oregon State University conducted an aeromagnetic survey of the Cascade Range in northern Oregon during the summer and fall of 1982. The surveyed area covers approximately 18,400 square kilometers (km^2) and includes the Western and High Cascades between the Santiam Pass and the Columbia River. The flightlines of the survey, oriented east-west, were spaced at 1-mile (mi) intervals; and tie lines, oriented north-south, were spaced at 5-mi intervals. Measurements made with a total field proton-precession magnetometer were spaced at approximately 140-meter (m) intervals along the survey lines. The survey was flown at constant barometric elevations of 5,000, 7,000, and 11,000 feet (ft). These elevations were selected to yield planar surfaces at a minimum elevation consistent with topography.

A microwave range-range navigation system, consisting of two ground-based radar transponders and a receiver-transmitter in the aircraft, provided horizontal position control for the survey. The navigation system determined the range to each transponder every 2 seconds. The transponders were placed on or within 30 m of a geodetic station. The State Plane Coordinates and the latitude and longitude of the triangulation station, obtained from the U.S. Coast and Geodetic Survey and based on the North American Datum of 1927 (Swick, 1932), give the horizontal coordinates of the transponders with an uncertainty of less than a meter. The elevation uncertainty is less than 3 m. The determination of the aircraft's horizontal position was not sensitive to errors in elevation. A 300-millisecond delay between the aircraft location determination and the corresponding magnetic reading corrected for the distance between the aircraft and the magnetic sensor towed 20 m behind the aircraft. The estimated root-mean-square uncertainty in the horizontal position of the measurements is 15 m.

During the entire survey, a base station recorded the outputs of a proton-precession magnetometer and a pressure altimeter identical to those in the aircraft. The base station data provided corrections for the magnetic and pressure altitude measurements. The estimated root-mean-square uncertainty in the data is 6 nanoteslas. Larger uncertainties are noted near Three-Fingered Jack. Gemperle and Bowers (1977), Gemperle and others (1978), and Couch (1978) describe the measurement and data acquisition procedures.

The regional geomagnetic field, subtracted from the measurements to yield the magnetic anomalies, was determined from the International Geomagnetic Reference Field of 1980, updated to the survey time, and then modified to allow anomaly values in this survey to match anomaly values in the survey of Connard and others (1983) adjacent to the southern boundary. The minimum-curvature gridding algorithm of Briggs (1975) was used to reduce the aeromagnetic measurements to an equally spaced grid. The gridded data subsequently were upward-continued, where appropriate, by operations in the frequency domain and machine-contoured to yield the aeromagnetic anomaly maps of Plates 1, 2, and 3. Gemperle and others (1978), Boler (1979), Couch (1979), and McLain (1981) describe the processing and reduction of aeromagnetic measurements.

MAGNETIC ANOMALY SOURCES

Local extrusive and intrusive bodies of the Cascade Range cause prominent magnetic anomalies with small spatial dimensions and high amplitudes. These anomalies, described as short-wavelength anomalies, outline surface features such as cones, plugs, lava flows, and near-surface hypabyssal bodies. Regional, or long-wavelength, magnetic anomalies are attributable to the magnetization of surface and subsurface flows or other lithologic horizons that cover large areas.

The magnetic anomalies in and about the Cascade Range in northern Oregon are associated predominantly with the remanent magnetization of volcanic rocks ($Q \geq 1$) and, in some locales, to the viscous magnetization of deeper rocks. Generally, in the mapped region, magnetic bodies that exhibit marked positive anomalies are normally magnetized, and bodies that exhibit marked negative anomalies are reversely magnetized. Magnetic sources showing reversed magnetization are more than 730,000 years old. Because of the superposition of fields from different magnetic sources and because of the uncertainty in the amplitude of the regional magnetic field, the boundary between normally magnetized rocks and reversely magnetized rocks only approximately coincides with the zero-anomaly contour on the total field aeromagnetic anomaly maps.

The north/south-trending High Cascade Range exhibits many short-wavelength magnetic anomalies of high amplitude. These anomalies, which are associated with relatively young volcanic features of the mountain range, indicate predominantly normal magnetization. Only a few topographic features, such as Black Butte, located southeast of Three Fingered Jack at lat 44°23' N. and long 121°38' W., show reversed magnetization. Other short-wavelength negative anomalies, such as the anomaly near lat 44°23' N. and long 121°38' W. reflect old volcanic centers now eroded and largely buried.

The regional magnetic field, composed of long-wavelength magnetic anomalies, shows components of both normal and reversed magnetization. In the western and northwestern sectors of the maps, positive magnetic anomalies derive mainly from late Miocene-age lavas of the Western Cascades and Eocene-age lavas that underlie the Willamette Valley and the Western Cascades.

In the northwesternmost and northeastern sectors of the map, about and beneath Mount Hood, and in the western area near lat 45° N., flows of the Columbia River Basalt Group cause the observed positive magnetic anomalies. Positive anomalies between Mount Hood and Mount Jefferson suggest that flows of the Columbia River Basalt Group extend across the Cascade Range beneath the younger pyroclastic deposits of the High Cascades. Along the trend of the High Cascades, short-wavelength positive anomalies due to relatively young volcanic structures are superimposed on a negative regional magnetic anomaly field. The negative anomaly field is due to, and approximately outlines, the Plio-Pleistocene basalt flows that form the platform rocks of the High Cascades.

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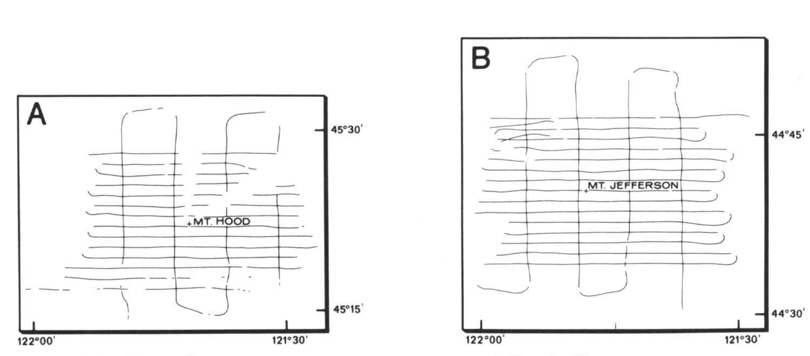
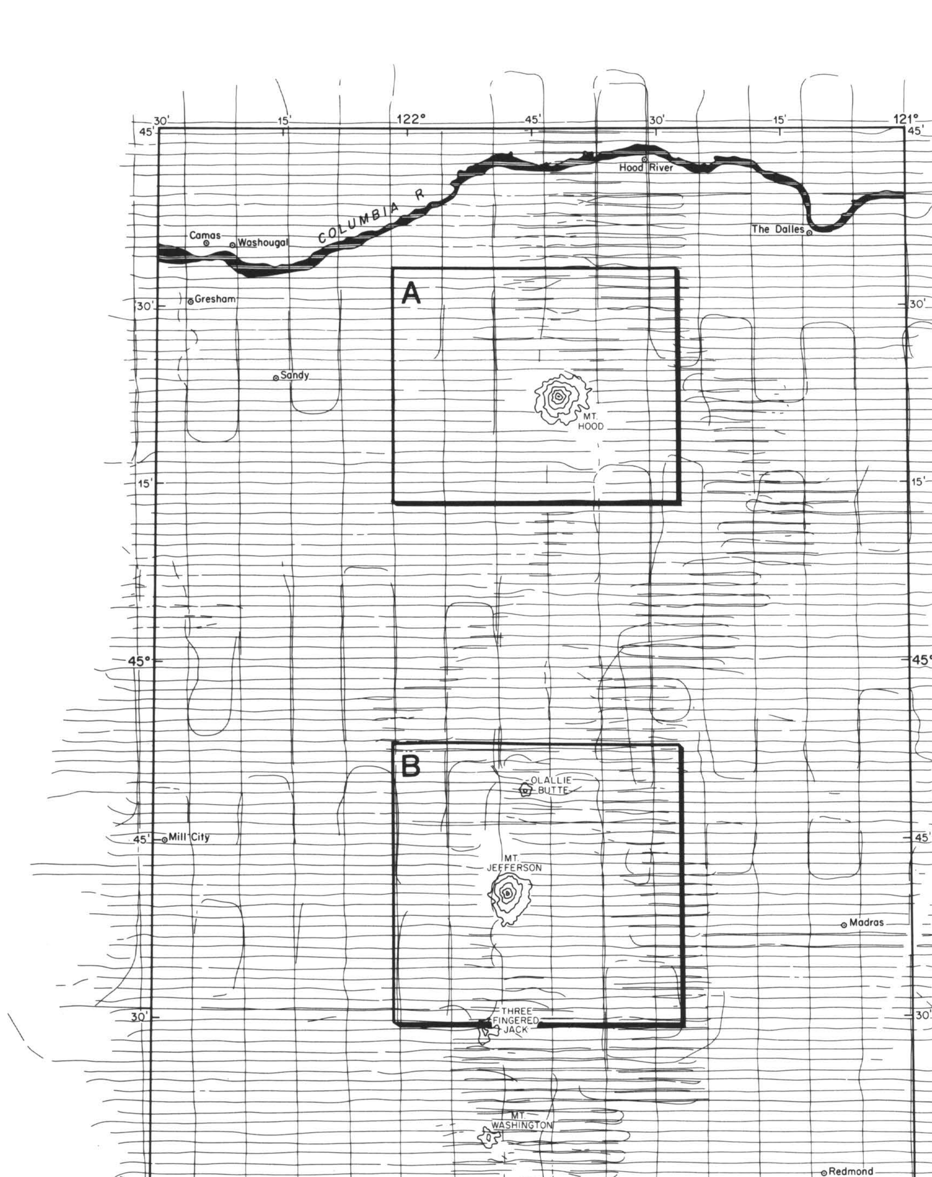
AEROMAGNETIC SURVEY FLIGHTLINES

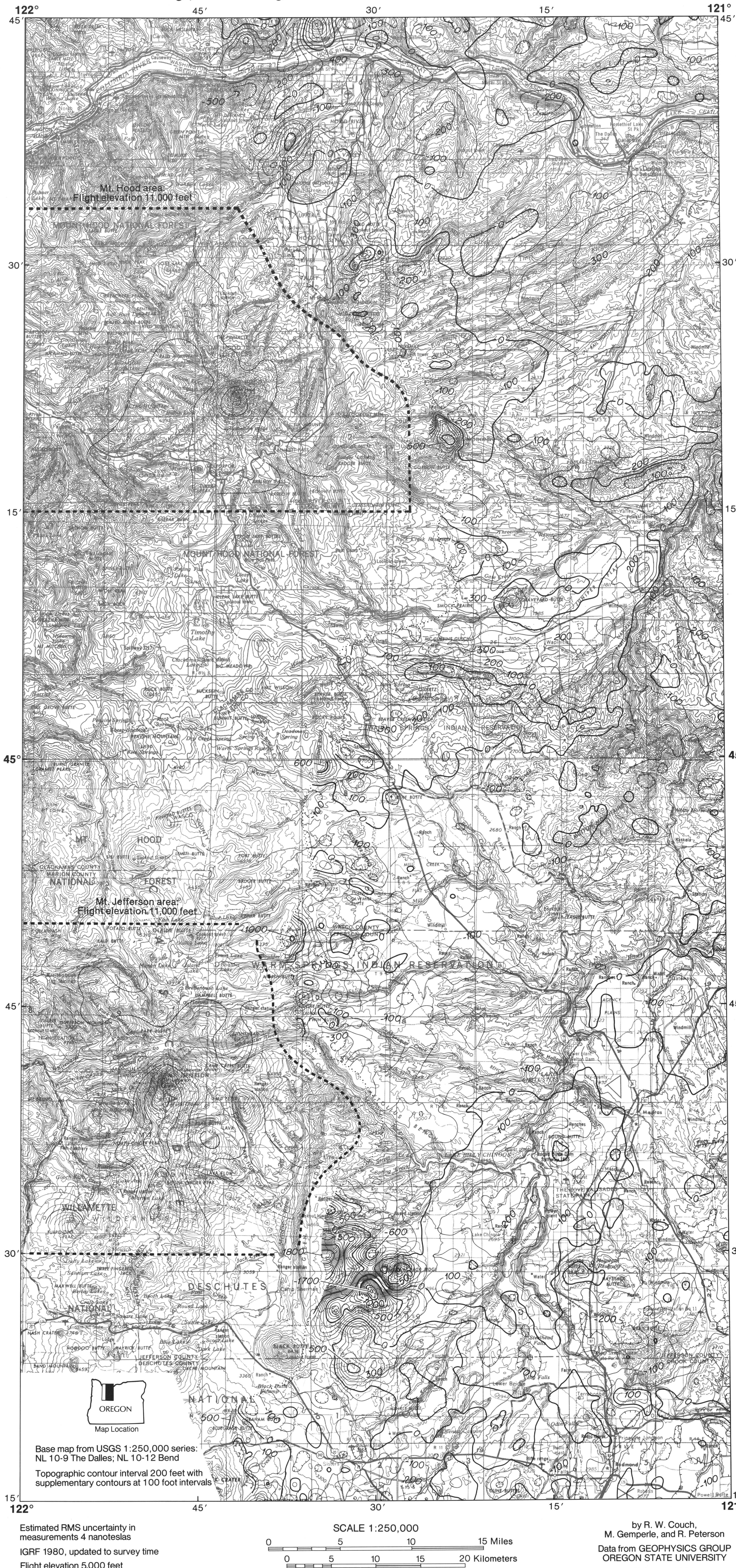


Mt. Hood area:
Flight elevation 11,000 feet

Mt. Jefferson area:
Flight elevation 11,000 feet



Combined flightlines from 5,000 foot and 7,000 foot flight elevations



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