PRELIMINARY BOUGUER GRAVITY MAP, SOUTHERN CASCADE MOUNTAINS AREA, WASHINGTON

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1981

WASHINGTON DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND EARTH RESOURCES

OPEN FILE REPORT OF 81-4

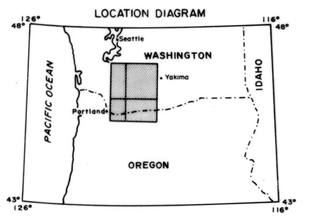
Datum: Sea level
Contour interval = 5 mgal

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

LOCATION DIAGRAM



Base from portions of the U.S. Geological Survey's, Hoquiam, The Dalles, Vancouver, and Yakima, 1:250,000 quadrangles

Prepared under U.S. Department of Energy contract number DE-AC03-79ET27014.

The present map encompasses an area of approximately 16,500 km^2. It extends from the Oregon-Washington border northward to the latitude of 47° N., and from 121°00' to 122°30' W. It is based on a total of 1,898 stations, of which 132 stations were taken from Stuart (1965); the rest have been observed by the present author and(or) his students at the University of Puget Sound. In particular, the area of Mount St. Helens and vicinity was surveyed by Goman (1967); Mount Adams and vicinity by Rawley [in progress]; the area between those two volcanoes, by Stricklin (1975); and the regional survey east of longitude 121°30' W. is due to Koníček (1974, 1975). Many other colleagues, students, explorers, relatives, and friends have helped with the field work in the mountainous terrain: to all of them, we here express our thanks.

All the above-mentioned surveys have been tied into the U.S. Army Map Service Gravity Base Network (Nilsen, 1976).

Most stations were surveyed by means of a Worden gravity meter No. 358; others by means of a LaCoste & Romberg Model G meter No. 209.

Latitude and longitude of each station was interpolated on the most detailed available topographic maps: the 7½-minute sheets, scale 1:24,000, where available; elsewhere, the 15-minute sheets, scale 1:62,500.

Wherever possible, stations were placed at points where elevations were reported on the topographic maps. Priority was given to bench marks. Second in desirability were road intersections, and third, mountain tops. In areas where no such elevation data are available, station elevations have been determined barometrically and checked against elevation contours. The latter method gave satisfactory results only under favorable weather conditions and within an elevation range with good available control. On several occasions, such was not the case, and the observations had to be discarded.

Base and subbase stations were occupied at the beginning and end of each loop, that is, within about 6 to 12 hours; that rule has been violated only a few times, for example, at the summit of Mount Adams, where the ascent required an overnight tie.

Instrumental drift and tidal effects were eliminated by a linear interpolation between base readings. The Free Air and the Infinite Plate correction for a density of 2.67 g/cm^3 were obtained by multiplying the station elevation by a factor of 0.06 mgal/ft.

For the "near terrain correction," (Hammer's Zone D), we developed a series of graphs based on the geometry of the immediate vicinity of the observation point: conical peak, slope, ridge, valley, etc.

The distant terrain correction and the latitude correction were determined at the Gravity Section of the Denver, Colorado office of the U.S. Geological Survey, by means of a computer program that unifies the procedure for the entire United States.

The probable error due to various factors is estimated as follows:

Instrumental reading	± 0.1 mgal
Drift and tides	± 0.3 mgal
Elevation bench mark	± 0.1 mgal
Elevation road intersection	± 0.5 mgal
Elevation mountain top	± 0.5 mgal
Elevation barometric	± 2.0 mgal
Latitude	± 0.02 mgal
Terrain near	± 0.3 mgal
Terrain distant	± 5 to 10 percent correction[1/]

[1/] That is, if terrain corrections amount to, say, 10 mgal, probable error is 0.5 to 1.0 mgal.

Obviously, the worst offenders are barometric elevations and distant terrain corrections, making up for an overall possible error on the order of a few milligals. It then means that, with a 5 mgal contour interval, the inaccuracies should be barely on the threshold of being noticeable. Nevertheless, there are between 50 and 100 stations where the error seems to be much higher. Some of those have been traced to typographical errors in key punching the data for computer reductions: others are still being checked. If error is not found, station will be re-occupied later in the season.

REFERENCES

Goman, T., 1967, Gravity survey of Mount St. Helens, Washington: University of Puget Sound Undergraduate Research Project.

Koníček, D. L., 1974, Geophysical survey in south-central Washington: University of Puget Sound M.S. thesis, 35 p.

Koníček, D. L., 1975, Geophysical survey in south-central Washington: Northwest Science, v. 49, no. 2, p. 106-117.

Nilson, Tor, 1976, Washington gravity base station network: Washington Division of Geology and Earth Resources Information Circular 59, 83 p.

Rawley, S., 1981, Geophysical investigation of Mount Adams area, Washington: [in progress].

Stricklin, C. R., 1975, Geophysical survey of the Lemei Rock-Steamboat Mountain area, Washington: University of Puget Sound M.S. thesis, 23 p.

Stuart, D. J., 1965, Gravity data and Bouguer gravity map for western Washington: U.S. Geological Survey Open-File Report, 7 p., 46 gravity sheets, 1 map.