



**SIMPLE BOUGUER GRAVITY ANOMALY MAPS OF THE NENANA BASIN AREA, ALASKA**

By

Zenon C. Valin, Jeffrey W. Bader, David F. Barnes, Michael A. Fisher, and Richard G. Stanley

1991

**DISCUSSION**

These maps show most of the gravity measurements now available to the public from the Nenana basin area, central Alaska. The initial data showing a small sedimentary basin beneath the Minto Flats were published by Barnes (1961) and were later extended for preparation of the gravity map of Alaska (Barnes, 1977a, b). These data were then augmented by M.A. Fisher, J. Blank, T.R. Bruns, and P.V. Woodward during 1983, 1984, and 1985.

The early data were gathered largely along river and road traverses supplemented by a few landings of float- and ski-equipped airplanes. Temperature-compensated World Wide gravimeter WW11 was used to acquire the early data along the Alaska Railroad and around the Minto Flats. Thermostatically controlled LaCoste and Romberg gravimeters G17 and G426 were used for the more recent data collection. Gravity datum for the initial survey was obtained from stations established by Thiel and others (1958), but this datum was later modified by Barnes (1968). For these maps the data have all been modified to agree approximately with IGSN-71 (Morelli and others, 1974) and the absolute measurement at Fairbanks by Hammond and Fuller (1971). A central base which can be used for future data collection is station "B-W4" at Nenana on the ground adjacent to USGS W4 at the northwest corner of the present railroad museum (former railroad station), and now obscured by a flower bed, where the gravity is 982,235.95 mGal on the IGSN-71 datum.

Elevation control was obtained from railroad surveys on the Alaska Railroad, from highway surveys on the principal highways, and from river gradients along the rivers. A few additional measurements were made at vertical angle benchmarks, and altimetry was used for the remaining measurements. Fisher, Blank, Bruns, and Woodward averaged the readings of three altimeters and used a recording base altimeter. The accuracy of the elevation control thus ranges from  $\pm 0.2$  m along the railroad to an estimated  $\pm 10$  m for the older altimetry data. The Bouguer anomalies were calculated with a reduction density of 2.67 g/cm<sup>3</sup> and the 1967 Geodetic Reference System (International Association of Geodesy, 1971), and have not been corrected for the effects of local terrain. Such corrections are probably unimportant in the flats that cover much of the mapped area, but may be large (5 mGal or more) in the Alaska Range and other highland areas.

The reduced data were initially gridded and contoured using a computer program known as Interactive Surface Modeling (ISM, a trademark of Dynamic Graphics, Inc.). The computer-generated contours were later modified by hand drafting for better agreement with individual station values. A few measurements have been omitted because of possible errors indicated by significant variations from nearby stations.

The maps were prepared as part of a U.S. Geological Survey effort to evaluate the undiscovered petroleum resources of central Alaska. The most promising area for oil and gas exploration is an elongate, northeast-trending gravity low with a maximum value of about -55 mGal in the area north of Nenana. This gravity low, first described by Barnes (1961), is believed to represent the deepest part of a subsurface sedimentary basin variously named the "Nenana basin" (Kirschner, 1988) and the "Middle Tanana basin" (Miller and others, 1959; Ehm, 1983). Gravity modelling and borehole records from two nearby wells, the Union Nenana No. 1 and the ARCO Tokok Hills No. 1, suggest that in the area of the gravity low the Nenana basin is fault-bounded on its eastern flank, and filled by up to 3,000 m of Cenozoic strata (Barnes, 1961; Kirschner and others, 1985; Kirschner, 1988), including nonmarine fluvial and lacustrine deposits of the Eocene to Miocene Usibelli Group (Stanley and others, 1990). Organic geochemical studies indicate that mudstones and coals in the Usibelli Group are potential sources of petroleum; calculations based on borehole temperatures from nearby wells suggest that, in the area of the Nenana gravity low, these rocks may have been buried deep enough to generate hydrocarbons (Stanley and others, 1990). Other gravity lows along trend to the southwest of Nenana may reflect additional Cenozoic sedimentary basins.

We thank T.R. Bruns and Andrew Griscorn for helpful reviews of the maps and text.

**REFERENCES CITED**

- Barnes, D.F., 1961, Gravity low at Minto Flats, Alaska: U.S. Geological Survey Professional Paper 424-D, p. D254-D257.
- Barnes, D.F., 1968, Alaska gravity base station network: U.S. Geological Survey Open-File Report 68-4, 30 p.
- Barnes, D.F., 1977a, Bouguer gravity map of Alaska: U.S. Geological Survey Geophysical Investigations Map GP-913, 1 sheet, scale 1:2,500,000.
- Barnes, D.F., 1977b, Preliminary Bouguer gravity map of central Alaska: U.S. Geological Survey Open-File Report 77-168-C, 1 sheet, scale 1:1,000,000.
- Ehm, Arlen, 1983, Oil and gas basins map of Alaska: Alaska Division of Geological and Geophysical Surveys Special Report 32, 1 sheet, scale 1:2,500,000.
- Hammond, J.A., and Fuller, J.E., 1971, Results of absolute gravity determinations at a number of different sites: Journal of Geophysical Research, v. 76, no. 32, p. 7850-7854.
- International Association of Geodesy, 1971, Geodetic Reference System, 1967: Paris, Bureau Central de l'Association Internationale de Geodesie Special Publication 3, 116 p.
- Kirschner, C.E., 1988, Map showing sedimentary basins of onshore and continental shelf areas, Alaska: U.S. Geological Survey Miscellaneous Investigations Map I-1873, 1 sheet, scale 1:5,000,000.
- Kirschner, C.E., Fisher, M.A., Bruns, T.R., and Stanley, R.G., 1985, Interior provinces in Alaska (abs.): American Association of Petroleum Geologists Bulletin, v. 69, no. 4, p. 667.
- Miller, D.J., Payne, T.G., and Gryc, George, 1959, Geology of possible petroleum provinces in Alaska: U.S. Geological Survey Bulletin 1094, 131 p.
- Morelli, Carlo, Gantar, C., Honkasala, Tauno, McConnell, R.K., Tanner, J.G., Szabo, Bela, Uotila, U.A., and Whalen, G.T., 1974, The international gravity standardization net 1971 (I.G.S.N. 71): Paris, Bureau Central de l'Association Internationale de Geodesie Special Publication 4, 194 p.
- Stanley, R.G., McLean, Hugh, and Pawlewicz, M.J., 1990, Petroleum source potential and thermal maturity of the Tertiary Usibelli Group at Sumnana, Alaska, in Dover, J.H., and Galloway, J.P., eds., Geologic Studies in Alaska by the U.S. Geological Survey, 1989: U.S. Geological Survey Bulletin 1946, p. 65-76.
- Thiel, Edward, Bonini, W.E., Ostenso, N.A., and Woollard, G.P., 1958, Gravity measurements in Alaska: Woods Hole Oceanographic Institution Technical Reports, Reference 58-54, 104 p.

T	L	65°
KR	F	64°
MM	H	63°

**QUADRANGLE LOCATION INDEX**  
 T-Tanana L-Livengood  
 KR-Kantishna River F-Fairbanks  
 MM-Mt. McKinley H-Healy

EXPLANATION	
— 0 —	CONTOUR INTERVAL—Hachures indicate direction of decreasing gravity values. Contour interval is 5 milligals
▲	SETTLEMENT
— — —	RIVER
■	LAKE
◇	ABANDONED OIL AND GAS TEST HOLE