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CALCULATED GRAVITY ANOMALY PRODUCED BY POSSIBLE FAULT UNDER LINE 27-48

By

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The seismograph data from Line 27-48 of Party 47 indicates the possibility of a high angle fault with a displacement of roughly 1,000 feet under South Barrow Test Well No. 2. This fault was discussed in E. Wiancko's report for United Geophysical Company entitled "Report of Reflection Seismograph Survey in the Barrow Area During 1948".

Mr. Beltz and Mr. English recently expressed a desire to know the magnitude of the calculated gravity anomaly produced by this probable fault. Their purpose was to determine the feasibility of proving and locating this fault, if it exists, by several traverses with the gravimeter.

As interpreted in Wiancko's report, the fault is nearly east-west in strike and is a reverse fault with the up-thrust block on the north side. The assumptions made for the calculation of the theoretical anomaly were that the density of the basement rock was 2.7, the density of the overlying rocks was 2.2, and the fault itself was taken directly from Plate I, Drawing No. 2044, of Wiancko's report, simplified, and reduced by a factor of 2.

The calculated anomaly is shown in Fig. 1. A polar chart similar to the type described on pages 153-154 of Heiland's "Geophysical Exploration" was used in computing the value of the anomaly. It was assumed that the feature is two-dimensional. Broken lines indicate values of limited accuracy. It should be mentioned here that Mr. Roland Henderson and Mr. Isidore Zietz of the Section of Geophysics of the Geological Survey carried out the calculations and plotted Fig. 1.

The results indicate a gravity minimum of about - 1.5 milligals over the faulted area. This should be large enough to be mapped by the gravimeter providing that measurements were taken close enough and several traverses were run. However, for the sake of comparison the author went ahead and calculated the quantities for this structure that could be measured with the torsion balance.

For simplicity of calculation the fault was assumed to be a step fault with the face of the fault directly under Shot Point 10 of Line 27-48. The displacement along the fault was set at only 500 feet, however, and a comparison between the step fault postulated for calculation purposes and the fault as interpreted in Wiancko's report is drawn in Figure 2. Again, the calculations were carried on from the two-dimensional standpoint.

The results of the torsion balance calculations are presented in Fig. 2. A maximum of about 65 Eotvos units is reached in the gravity gradient directly over the fault. The maximum values reached by the curvature would be between 30 and 35 Eotvos units, positive and negative. It should be clear from the graph that such a fault, if it exists under South Barrow No. 2, could be easily mapped by means of the torsion balance.

The recommendation is therefore made that the torsion balance be used in Naval Petroleum Reserve No. 4 instead of the gravimeter if it is desired to map faults, particularly faults of small displacement, by means of gravitational prospecting. The quantities measured by the torsion balance are much more susceptible to anomalies produced by faulting than are those measured by the gravimeter. Also, the low relief in the Arctic Coastal Plain should produce no large topographic corrections that would have to be taken into consideration in the operation of the torsion balance. High winds may interfere with readings, but, if care is taken, instrument operation should be possible although slower than in more favorable climates. In support of this recommendation the following quotation from p. 284 of Heiland's "Geophysical Exploration" is included: "In oil exploration the torsion balance has been widely used for the location of faults."