DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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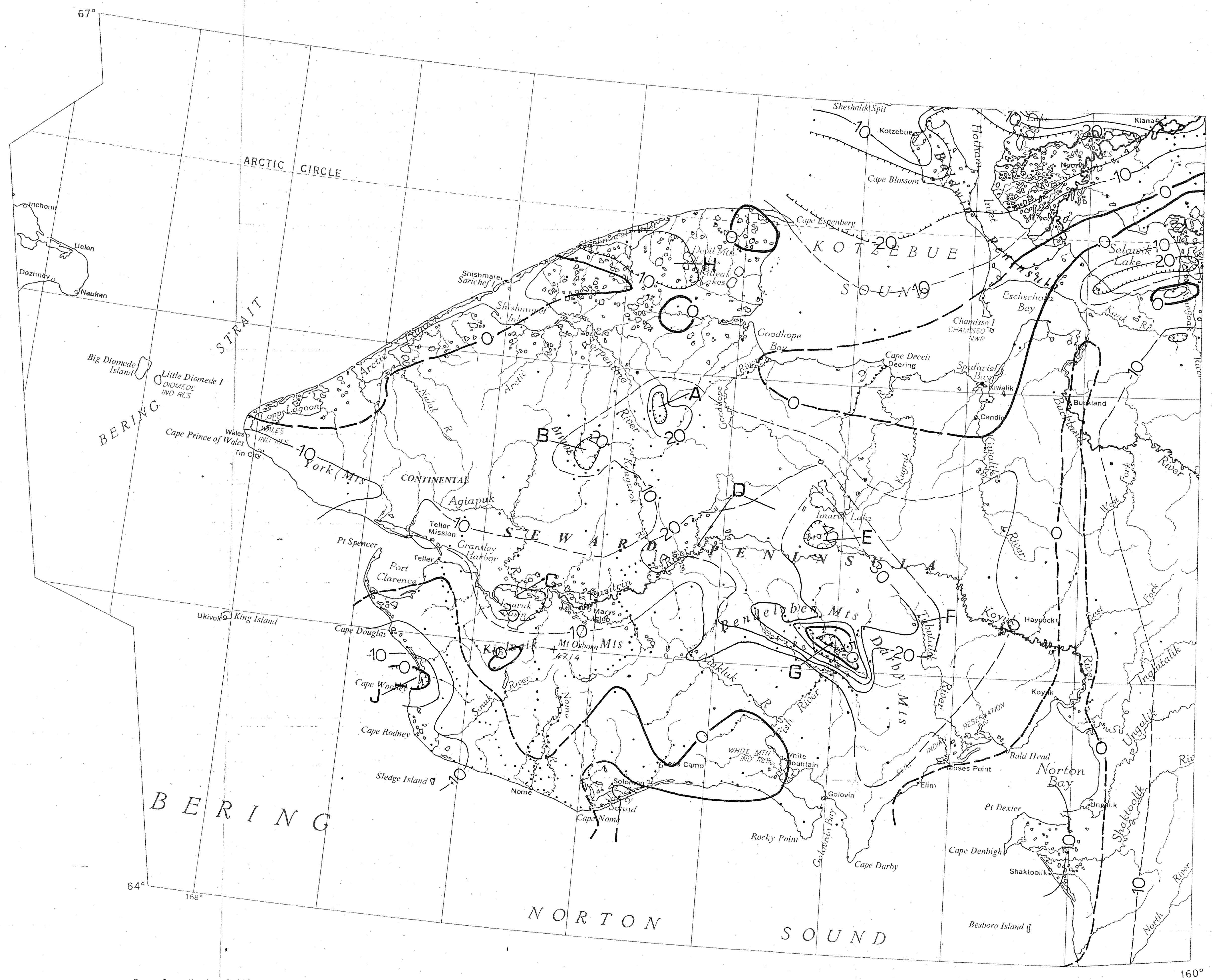


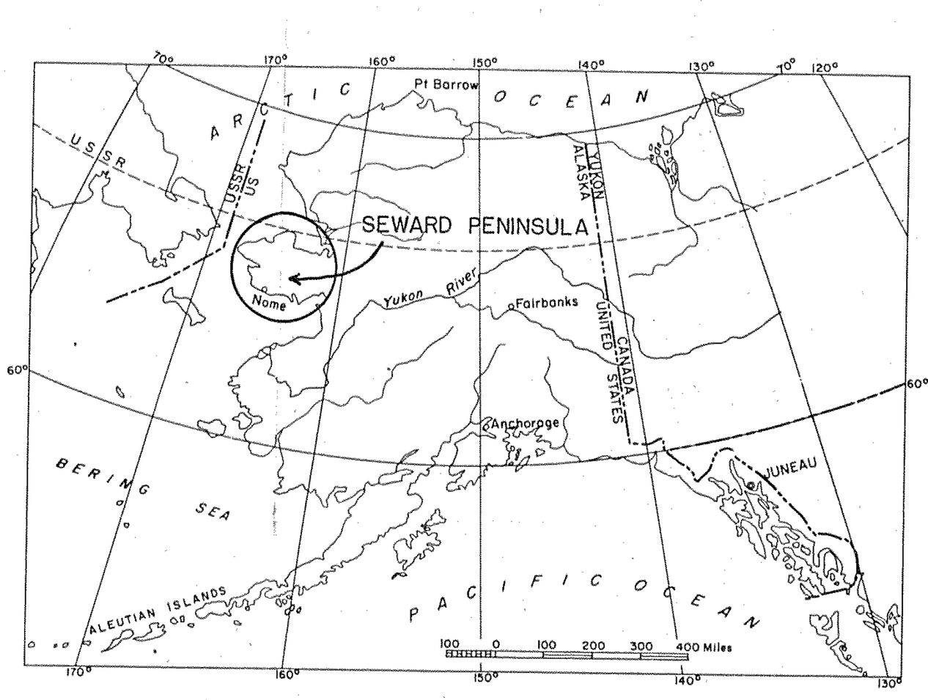
Base from National Atlas 1:2,000,000 series:
NORTHERN ALASKA, SHEET #40, 1970.

Gravity datum from IGSN 1971, reduction ellipsoid from 1967 geodetic reference system, reduction density 2670 Kilograms per cubic meter

SCALE 1:1 000 000

25 0 25 50 75 100 MILES

25 0 25 50 75 100 KILOMETERS



LOCATION OF SEWARD PENINSULA, ALASKA

BOUGUER GRAVITY MAP OF SEWARD PENINSULA, ALASKA

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EXPLANATORY NOTE

Introduction

This Bouguer gravity map is one of several data components prepared as a foundation for evaluating the mineral resource potential of Seward Peninsula, Alaska. The map differs from an earlier compilation (Barnes, 1971) in that new data from the McCarthy's Marsh area (area of anomaly G on map) have been incorporated and the older data have been converted to the 1971 International datum and the 1967 Geodetic Reference System. The gravity data have been obtained and processed by methods described elsewhere (Barnes, 1971, 1972, 1977). The purpose of this report is to suggest how some features of the Seward Peninsula gravity field contribute to an evaluation of the mineral resource potential of the area.

Gravity interpretation

The gravity field on the Seward Peninsula is more uniform than in many parts of Alaska. The Bouguer anomaly varies from about +15 mgal near the coast to a little less than -60 mgal in the lowlands south of the Bendeleben Mountains. As the extreme variations are caused by local geology, the fairly uniform field for Seward Peninsula as a whole suggests a similarly uniform crustal thickness of 30-35 km (Barnes, 1977).

Seven gravity anomalies (lettered A to G on the map) pertinent to mineral resource assessment have been identified, and three other anomalies (lettered H, I, and J on the map) may be related to offshore sedimentary basins with possible petroleum potential. Interpretations of these anomalies, in light of the known geology, are discussed separately below.

Anomaly A - Serpentine Hot Springs area

Anomaly A is a distinct low that coincides in part with the outcrop area of the granite complex of the Serpentine Hot Springs area. This granite complex is spatially and genetically associated with tin and related base and precious metal mineralization (Sainsbury and others, 1970; Hudson, 1977a, b). Principal tin mineralization of the Serpentine Hot Springs area may be localized near unexposed parts of the southeastern pluton margin (Hudson, in press). The broadening of the gravity anomaly to the area southeast of the exposed pluton supports the interpretation that the unexposed roof of the granite complex extends under this area.

Anomaly B - Kougarok Mountain area

Anomaly B is a distinct gravity low in an area where metamorphic rocks are exposed at the surface. Because of similarity to anomaly A and because of the continuity of low gravity values between anomalies A and B, anomaly B is thought to reflect the presence of a buried granite pluton at depth. Thermally metamorphosed rocks have been identified in the area of anomaly B, and the presence of tin mineralization here (Marsh and others, 1972) suggests that the buried pluton is composed of granitic rocks similar to those associated with tin mineralization elsewhere in northwestern Seward Peninsula, including the area of anomaly A. Anomalies A and B together help to define a broader region of low gravity which may indicate continuity between outcropping granite in the area of anomaly A and the suspected buried granite in the area of anomaly B.

Anomaly C - Imuruk Basin area

Anomaly C is a broad gravity low centered over a shallow lake and nearby alluviated lowlands known as Imuruk Basin. These lowlands are bordered to the south by an active normal fault that has uplifted the rugged and youthful Kigluaik Mountains relative to the lowlands. The area of low gravity suggests that the down-dropped lowlands have formed a restricted continental basin filled with low density sedimentary materials. The adjacent Kigluaik Mountains have probably been an important source of materials deposited in the basin. If uraniferous rocks are present in these mountains, sedimentary-type uranium deposits could be present in the basin.

Anomaly D - Upper Kuzitrin River area

Anomaly D is an area of low gravity measured along much of the upper Kuzitrin River drainage, and this low gravity extends north and east into an area covered by basalt flow rocks. The basalts are up to a few hundred meters thick, and one very youthful flow series probably occurred within the last 1,000 years. The flows are too thin and too dense to be the cause of the low gravity. The basalt flows flooded over the eastern side of an alluviated lowland bordered by uplands that contain metamorphic rocks to the northwest and granite and metamorphic rocks to the south and east. Coal-bearing sedimentary rocks have been identified locally along the northern margin of the lowland (Sainsbury, 1974, p. 12). The gravity low suggests the presence of sedimentary rocks beneath the lowland, including part of the area covered by basalt. These sedimentary rocks were probably deposited in a restricted continental basin, and, if uraniferous rocks are present in the uplands that border the basin, sedimentary-type uranium deposits could be present within it.

Anomaly E - Kuzitrin Lake area

Anomaly E is an apparent continuation eastward of anomaly D in that gravity values of the Upper Kuzitrin River area decrease eastward and reach values below -40 mgal near the divide between the Kuzitrin and Koyuk River drainages. Here the lowest values seem to be associated with outcrops of the Kuzitrin Lake batholithic rocks (Hopkins, 1963) rather than with sedimentary materials. The batholithic rocks could have low enough densities and sufficient thickness to explain the low gravity values. Mineralization is not known to be associated with the Kuzitrin Lake batholithic rocks, but they have not been studied in detail. The proximity of the sedimentary basin (anomaly D) to the batholithic rocks, both of which seem to cause low gravity anomalies, complicates the gravity interpretation and makes the boundary between the two areas difficult to define.

Anomaly F - Death Valley area

Anomaly F is defined by a low gravity measurement made in Death Valley and extension of the 30 mgal contour of the upper Kuzitrin River area to this area. Death Valley is an alluviated lowland surrounded by mountains, and the low gravity measurement may indicate a small sedimentary basin. However, there are not enough gravity data to show clearly the relation of the low to the topography of the area. Coal-bearing rocks have been reported near the south side of Death Valley (West, 1953, p. 3), and uraniferous rocks are present locally in uplands adjacent to the topographic basin (Miller and Bunker, 1976). If Death Valley does contain Cenozoic sedimentary deposits, it is a permissible area for the occurrence of sedimentary-type uranium deposits.

Anomaly G - McCarthy's Marsh area

Anomaly G is better defined and of greater magnitude than any other on Seward Peninsula. It is a distinct triangular low that coincides exceptionally well with an alluviated lowland known as McCarthy's Marsh. This lowland is bounded to the north and east by parts of the Bendeleben and Darby Mountain ranges and to the southwest by a less distinct upland. The northern boundary coincides closely with the active Bendeleben fault, and the eastern boundary is probably also fault controlled. Young coal-bearing rocks outcrop locally in the lowland (Smith and Eakin, 1910, p. 351-352), and the gravity low must reflect a relatively thick sedimentary fill within a restricted continental basin. This basin is probably at least 1 km deep and may be as deep as 3 km, depending on the density of the sedimentary fill within it. Uraniferous rocks are present locally within the Darby Mountains and may be present within the Bendeleben Mountains; sedimentary-type uranium deposits may be present within the basin.

Anomaly H - Devil Mountain area

Anomaly H is an area of low gravity values near the northern tip of the Seward Peninsula, south of Cape Espenberg. A petroleum exploration well was reported to have been drilled to a depth of over 2,500 m in this area (Petroleum Pubs. Inc., 1975). The gravity low extends east-west across the northern tip of the Peninsula, and minimum anomalies were measured at Devil Mountain Lake. This lake is a volcanic maar, and volcanic ejecta in this area contain chunks of peat and petrified wood, suggesting the presence of underlying Tertiary sedimentary rocks (D. M. Hopkins, oral commun., 1977). The gravity decreases offshore where thicker sedimentary deposits are probably present.

Anomalies I and J - Safety Sound and Feather River areas

Anomalies I and J are small gravity lows along the southern coast of the Seward Peninsula. The lows occur at the deltas of the Eldorado River (Safety Sound area) and the Feather River. They may indicate areas underlain by sedimentary deposits, and these deposits could be extensions of larger offshore sedimentary basins. Nothing is known about the age or thickness of the suspected sedimentary deposits or the size and extent of the corresponding offshore basins.

Summary and conclusions

Seven gravity anomalies pertinent to mineral resource assessment of Seward Peninsula have been identified. Three of the anomalies are gravity lows over granite plutons, either known to be present (anomalies A and E) or inferred at depth (anomaly B). Two of these areas (anomalies A and B) contain tin mineralization, and the granite pluton inferred in the area of anomaly B is probably similar to other granite complexes associated with tin mineralization on northwestern Seward Peninsula. Four gravity anomalies (anomalies C, D, F, and G) are lows over topographic and structural basins known or suspected to contain continental sedimentary deposits derived from the adjacent highlands. Most parts of these highlands are poorly known, but uraniferous rocks and minerals have been identified in parts of the Darby Mountains (West, 1953; Miller and Bunker, 1976; Miller and others, 1977). The geologic settings of these basins indicate that they are permissible for the occurrence of sedimentary-type uranium deposits. Little is known about these basins, and there is no direct evidence for sedimentary-type uranium deposits. Three additional anomalies (anomalies H, I, and J) appear to reflect onshore extensions of offshore sedimentary basins that may contain petroleum.

More detailed gravity surveys would help to delineate the geometry of the restricted continental basins, and such surveys might be useful in identifying the subsurface location and extent of the tin-granite complexes of northwestern Seward Peninsula.

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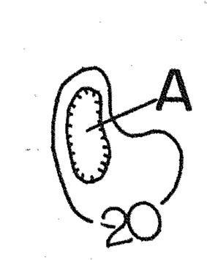
MAP SYMBOLS



Simple Bouguer anomaly, contour interval is 10 milligals except for omissions in areas of poor control, dashed where approximately located, hachures show gravity minima, 50 milligal contours emphasized, letter indicates anomaly discussed in text

Location of U.S. Geological Survey gravity measurement (locations of some supplementary industry data not shown)