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GRAVITY AND MAGNETIC PROFILES, AND ROCK PROPERTY DATA FOR THE SHAVIOVIK AND ECHOOKA RIVERS AREA, NORTH SLOPE, ALASKA

By

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INTRODUCTION

This report presents gravity and magnetic profiles, and rock property data collected from the northeastern Brooks Range and adjacent foothills region. An area 10 km wide and 65 km long in the Shaviovik and Echooka Rivers region was chosen for this study (location map, plate 1). This area includes the Kemik gas field. The geophysical data in this report is one phase of a study to gain a further understanding of the geology and tectonic style of the area and to determine the relationship of these features to hydrocarbon accumulations. The gravity and magnetic data in this report will be used in modeling basement structures after other phases of the study are completed. Other phases of the study will incorporate data from: (1) geologic maps and measured sections (Keller and others, 1961), (2) U.S. Navy seismic records, (3) wireline well logs and drill cuttings from four wells, and (4) low-angle oblique-view canyon photography obtained from Standard Oil of California (Reber, 1976).

Recently acquired field data include ground magnetic and gravity readings, and lithologic information on Mississippian and older rock units. Field work for the gravity and magnetic program was integrated with similar geophysical studies being conducted in the Arctic National Wildlife Range (Kososki and others, 1978). Work for the combined programs was conducted from August 2-9, 1976; data in the study area was collected on August 7 and 8, 1976. Gravity and magnetic readings were made at 48 stations (fig. 1) which

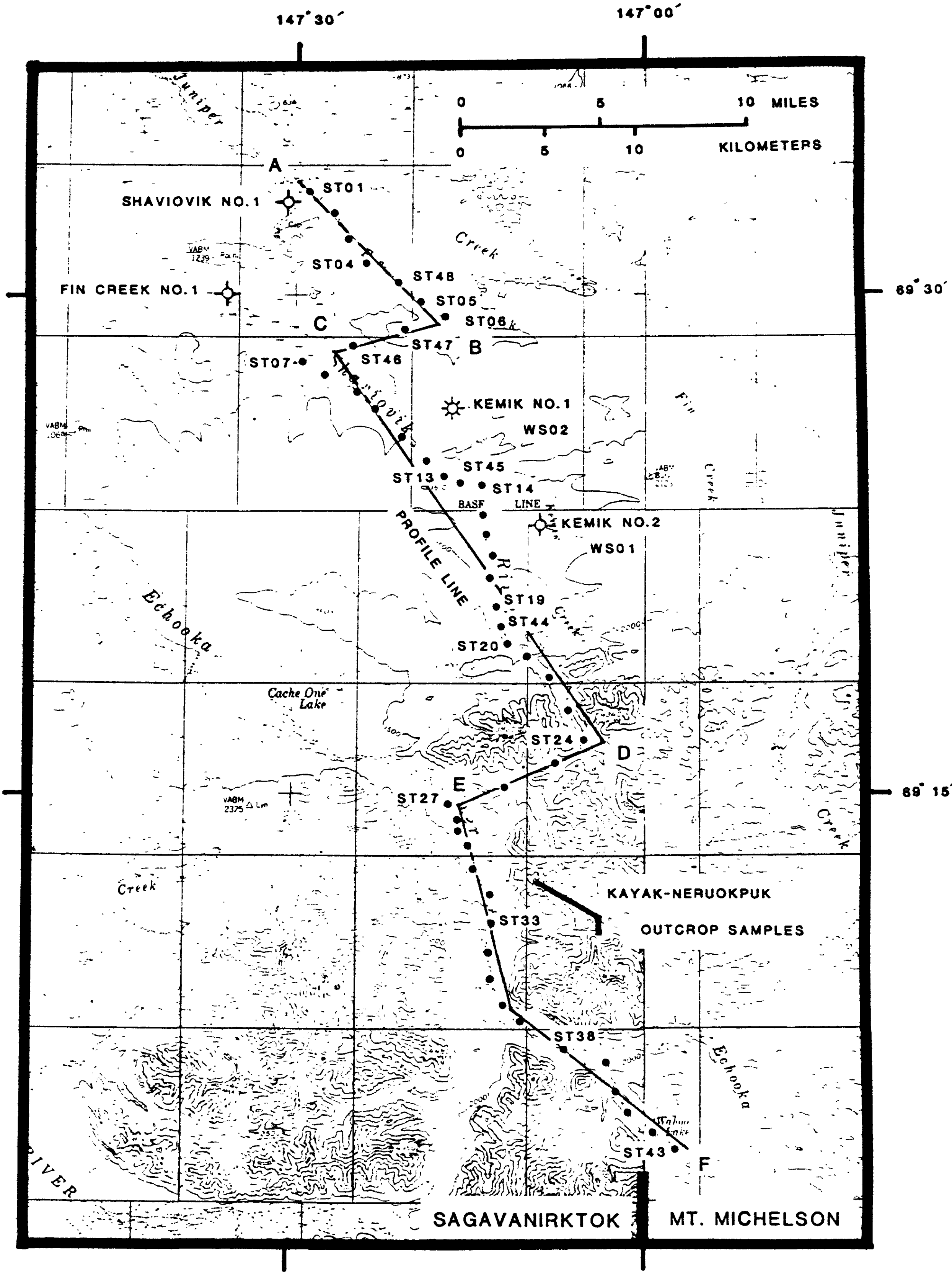

Figure 1.--Location of gravity and magnetic stations, profile line, wells, and outcrop sample locality in the Shaviovik and Echooka Rivers area, North Slope, Alaska.

were located on vertical aerial photographs (approximate scale 1:50,700) and standard U.S. Geological Survey topographic maps (scale 1:63,360). Stations were positioned on major drainages with a 0.8 to 2.4 km spacing. Station ST01 was used as a base station for gravity data reduction and stations ST01 and ST24 were used for magnetic data reduction. Time intervals between measurements range from 5 to 12 minutes with one exception of 32 minutes between stations ST43 and ST44. Readings were made at the base station (ST01) at the beginning and end of each day's work. These base station loops were completed in 3.5 hours the first day and 4 hours the second day. Field measurements and other information used in data reduction are included in table 1.

The profile line was picked to best fit the actual path of the traverse. Station locations were projected orthogonally onto the profile line with a maximum projection distance of 1.6 km (fig. 1). Well locations, stratigraphic boundaries, and geomorphic features are projected parallel to structural strike.

GRAVITY

Gravity measurements were made using LaCoste and Romberg geodetic meter G-22, borrowed from the University of California at Riverside. This meter has a reading accuracy of ± 0.01 millgal. Altimeters were read at every station. Wet and dry bulb temperatures were read at every other station and used in reducing the altimeter data.

Local base ST01 was tied to the principle gravity reference base station at Barter Island. The Barter Island base is referenced to the International Gravity Standardization Net and has an adopted value of 982,581.68 milligals (D. Barnes, pers. commun., 1977).

Gravity data reduction followed procedures outlined by Barnes (1972). The Geodetic Reference System 1967 (International Association of Geodesy, 1971) was used in calculating theoretical gravity values. River gradient plots were constructed as described by Barnes (1972) and 48 station elevations determined from them. River gradient derived elevations were compared to altimeter derived elevations and both checked for departures from a smooth river gradient. Altimeter elevations generally agree with river gradient elevations but are slightly more erratic and range up to 27 m higher than those picked from river gradients. Because of the slightly more erratic pattern of the altimetry, river gradient elevations are preferred and are used in computing the free air, simple Bouguer, and Bouguer (terrain corrected) anomaly values (table 1).

Station elevation accuracy is dependent on the accuracy of the topographic maps. Available topographic maps with a scale of 1:63,360 and contour intervals at 50 and 100 ft were used in constructing river gradient plots and probably have vertical errors of 15 m or less (C. Swanson, pers. commun., 1978). Corresponding errors in Bouguer gravity are $\pm$ 3.0 milligals.

A Bouguer reduction density of 2.53 g/cm^3 was used in calculating the three anomaly values. For contrast, simple Bouguer anomaly values using the standard density of 2.67 g/cm^3 are also reported in table 1. The 2.53 g/cm^3 value was determined by evaluating rock density data and the distribution of rock units along the traverse. Subsurface rock density data was obtained from seven nearby wells using compensated formation density and neutron logs (table 2). Log response was visually blocked into average density segments. This process averages the high and low log readings and results in numerous segments with a single density value. This method reduces but does not

USGS GRAVITY DATA FROM: SAGAVANIRKTOK-ECHOOKA RIVER REGION PROJ CHIEF: BIRD DATE: 08/07/76
GRAV MTR: G-22 OBSERVERS: GIOV KOS MAIN BASE: BRIT VALUE: 982581.70 DRIFT: .04 AUX AND MAG BASE: ST01

STAT NUMB	LATITUDE	LONGITUDE	LOC. TYPE	HT-REF	ELEV FEET	ELEV TYPE	OBSV TIME	OBSV GRAV MILLIGALS	GRAV TYPE	FAA MGALS	SBA 2.53	SBA 2.67	BA 2.53	T COR 2.53	UNCOR MAG	COR MAG	STAT NUMB
BRIT	70 8.08	143 35.48	A	0	5	C	802	982581.70	A	-34.4	-34.6	-34.6	-34.6	< 0.4			BRIT
ST01	69 33.01	147 29.60	A	0	662	J	1326	982504.78	B	-15.2	-36.6	-37.8	-36.6	< 0.4			ST01
ST01	69 33.01	147 29.60	A	0	662	J	1700	982504.78	B	-15.2	-36.6	-37.8	-36.6	< 0.4			ST01
BRIT	70 8.08	143 35.48	A	0	5	C	1840	982581.70	A	-34.4	-34.6	-34.6	-34.6	< 0.4			BRIT
BRIT	70 8.08	143 35.48	A	0	5	C	802	982581.76	A	-34.3	-34.5	-34.5	-34.5	< 0.4			BRIT
ST01	69 33.01	147 29.60	A	0	662	J	1326	982504.76	B	-15.2	-36.6	-37.8	-36.6	< 0.4	57637	57637	ST01
ST02	69 32.52	147 26.70	A	0	686	J	1337	982501.29	C	-16.0	-38.1	-39.4	-38.1	< 0.4	57644	57642	ST02
ST03	69 31.60	147 25.40	A	0	701	J	1343	982492.91	C	-22.0	-44.7	-45.9	-44.7	< 0.4	57650	57647	ST03
ST04	69 30.90	147 23.60	A	0	756	J	1353	982468.97	C	-20.1	-44.5	-45.9	-44.5	< 0.4	57648	57644	ST04
ST05	69 29.75	147 19.60	A	4	834	J	1402	982488.51	C	-12.1	-39.0	-40.5	-39.0	< 0.4	57648	57642	ST05
ST06	69 29.25	147 17.60	A	4	854	J	1408	982488.89	C	-9.3	-36.9	-38.5	-36.9	< 0.4	57653	57646	ST06
ST07	69 27.93	147 29.70	A	4	854	J	1420	982465.46	C	-11.4	-39.0	-40.6	-39.0	< 0.4	57628	57619	ST07
ST08	69 27.50	147 27.20	A	5	906	J	1425	982483.67	C	-7.9	-37.2	-38.8	-37.2	< 0.4	57627	57617	ST08
ST09	69 27.35	147 24.90	A	5	937	J	1432	982481.58	C	-6.6	-36.9	-38.6	-36.9	< 0.4	57628	57617	ST09
ST10	69 26.45	147 23.00	A	2	959	J	1440	982479.42	C	-6.2	-37.2	-38.9	-37.2	< 0.4	57630	57618	ST10
ST11	69 25.79	147 20.50	A	4	1014	J	1445	982474.64	C	-5.1	-37.9	-39.7	-37.9	< 0.4	57628	57615	ST11
ST12	69 25.00	147 16.90	A	4	1064	J	1452	982468.31	C	-5.9	-40.3	-42.2	-40.3	< 0.4	57626	57612	ST12
ST13	69 24.58	147 17.10	A	4	1102	J	1501	982464.37	C	-5.9	-41.5	-43.5	-41.5	< 0.4	57646	57630	ST13
ST14	69 24.28	147 14.00	A	0	1151	J	1507	982461.35	C	-4.0	-41.2	-43.3	-41.2	< 0.4	57635	57618	ST14
ST15	69 23.46	147 13.90	A	0	1191	J	1516	982456.08	C	-4.7	-43.2	-45.3	-43.2	< 0.4	57631	57613	ST15
ST16	69 22.53	147 13.70	A	4	1234	J	1523	982452.32	C	-3.8	-43.7	-45.9	-43.7	< 0.4	57630	57610	ST16
ST17	69 22.14	147 12.90	A	0	1280	J	1528	982447.98	C	-3.1	-44.5	-46.8	-44.5	< 0.4	57634	57614	ST17
WS01	69 23.19	147 9.40	A	0	1287	J	1537	982450.61	C	-0.9	-42.5	-44.8	-42.5	< 0.4	57632	57610	WS01
ST18	69 21.40	147 13.20	A	0	1328	J	1546	982443.33	C	-2.5	-45.4	-47.8	-44.9	0.5	57634	57610	ST18
ST19	69 20.57	147 13.40	A	0	1405	J	1555	982438.75	C	1.0	-44.6	-47.0	-43.9	0.7	57635	57610	ST19
ST20	69 19.46	147 12.30	A	0	1497	J	1602	982432.25	C	4.2	-44.2	-46.8	-42.2	2.0	57632	57606	ST20
ST21	69 19.11	147 10.30	A	0	1555	J	1610	982427.27	C	5.0	-45.2	-48.0	-42.3	2.9	57640	57604	ST21
ST22	69 18.46	147 8.20	A	0	1630	J	1616	982420.51	C	6.0	-46.7	-49.6	-43.2	3.5	57646	57603	ST22
ST23	69 17.41	147 6.50	A	0	1750	J	1626	982409.84	C	7.6	-48.9	-52.0	-44.7	4.2	57656	57602	ST23
ST24	69 16.52	147 5.40	A	0	1866	J	1634	982404.95	C	14.5	-45.8	-49.1	-43.1	2.7	57581	57591	ST24
ST01	69 33.01	147 29.60	A	0	662	J	1700	982504.76	B	-15.2	-36.6	-37.8	-36.5	< 0.4	57673	57637	ST01
BRIT	70 8.08	143 35.48	A	0	5	C	1840	982581.59	A	-34.5	-34.7	-34.7	-34.7	< 0.4			BRIT
BRIT	70 8.08	143 35.48	A	0	5	C	804	982581.75	A	-34.3	-34.5	-34.5	-34.5	< 0.4			BRIT
ST01	69 33.01	147 29.50	A	0	662	J	935	982504.76	B	-15.2	-36.6	-37.8	-36.6	< 0.4	57625	57637	ST01
ST25	69 15.90	147 7.50	A	0	1300	J	1014	982403.13	C	7.1	-51.0	-54.3	-47.8	3.2	57574	57584	ST25
ST26	69 15.06	147 12.30	A	5	1505	J	1020	982420.39	C	-2.5	-51.1	-53.8	-49.3	1.6	57561	57571	ST26
ST27	69 14.57	147 16.50	A	5	1333	K	1030	982427.51	C	-11.0	-54.1	-56.5	-52.6	1.5	57541	57550	ST27
ST28	69 14.19	147 15.80	A	6	1357	K	1037	982427.18	C	-6.7	-52.6	-55.0	-51.0	1.5	57552	57561	ST28
ST29	69 13.76	147 15.40	A	0	1376	K	1045	982425.46	C	-6.2	-52.7	-55.2	-51.0	1.7	57550	57558	ST29
ST30	69 13.41	147 15.20	A	0	1394	K	1052	982423.51	C	-8.1	-53.2	-55.7	-51.5	1.7	57543	57551	ST30
ST31	69 12.63	147 14.60	A	0	1427	K	1058	982420.38	C	-7.4	-53.5	-56.0	-51.8	1.7	57541	57553	ST31
ST32	69 11.97	147 12.80	A	4	1476	K	1103	982415.45	C	-7.0	-54.7	-57.4	-52.9	1.6	57539	57546	ST32
ST33	69 11.09	147 12.80	A	0	1512	K	1110	982410.57	C	-7.7	-56.5	-59.2	-54.9	1.6	57551	57558	ST33
ST34	69 10.26	147 13.20	A	6	1562	K	1116	982405.44	C	-7.3	-57.7	-60.5	-56.1	1.6	57545	57551	ST34
ST35	69 9.33	147 13.00	A	0	1606	K	1123	982399.50	C	-8.1	-60.0	-62.9	-58.2	1.9	57544	57550	ST35
ST36	69 8.64	147 12.00	A	0	1650	K	1128	982395.20	C	-7.6	-60.9	-63.9	-58.9	2.0	57550	57556	ST36
ST37	69 8.15	147 10.10	A	0	1702	K	1139	982389.05	C	-8.4	-63.4	-66.4	-60.5	2.9	57554	57559	ST37
ST38	69 7.22	147 6.80	A	0	1767	K	1145	982380.27	C	-10.1	-67.2	-70.4	-64.3	2.9	57556	57561	ST38
ST39	69 6.90	147 3.20	A	0	1676	K	1152	982373.75	C	-6.1	-66.7	-70.0	-64.3	2.4	57560	57564	ST39
ST40	69 6.02	147 2.50	A	0	1970	K	1157	982367.75	C	-2.3	-66.0	-69.5	-63.9	2.2	57552	57556	ST40
ST41	69 5.38	147 1.40	A	0	2057	K	1207	982357.68	C	-3.6	-70.1	-73.7	-67.1	3.0	57555	57559	ST41
ST42	69 4.79	146 59.50	A	0	2150	K	1212	982351.82	C	-0.1	-69.6	-73.4	-66.2	3.4	57561	57564	ST42
ST43	69 4.27	146 57.60	A	0	2242	K	1217	982344.80	C	2.0	-70.4	-74.4	-67.8	2.6	57560	57563	ST43
ST44	69 20.00	147 13.30	A	0	1446	J	1250	982435.99	C	2.8	-44.0	-46.6	-43.3	0.8	57597	57598	ST44
ST45	69 24.30	147 15.80	A	0	1125	J	1300	982462.37	C	-5.5	-41.8	-43.8	-41.6	< 0.4	57606	57607	ST45
WS02	69 26.45	147 16.20	A	1	1221	D	1310	982463.43	C	2.5	-37.0	-39.2	-37.0	< 0.4	57611	57611	WS02
ST46	69 28.35	147 25.60	A	0	937	J	1326	982483.01	C	-6.5	-36.8	-38.5	-36.3	< 0.4	57617	57628	ST46
ST47	69 28.80	147 20.40	A	0	950	J	1329	982481.01	C	-7.7	-38.4	-40.1	-38.4	< 0.4	57633	57632	ST47
ST48	69 32.98	147 27.40	A	0	676	J	1338	0.00		0.0	0.0	0.0	0.0	0.0	57641	57641	ST48
ST01	69 33.01	147 29.60	A	0	662	J	1346	982504.76	B	-15.2	-36.6	-37.8	-36.6	< 0.4	57639	57637	ST01
BRIT	70 8.08	143 35.48	A	0	5	C	804	982581.70	A	-34.4	-34.5	-34.6	-34.5	< 0.4			BRIT

Table 1.--Gravity and magnetic data for the Shaviovik and Echooka Rivers area, North Slope, Alaska. Location, elevation, and gravity type codes are after Barnes (1972). Gravity values are in milligals; magnetic values are in gammas.

completely eliminate the effect of borehole washouts and the resulting low density. The segments were then weighted according to their interval thickness and a weighted average density value determined. An average density was determined for each formal rock unit. Table 2 reports these subsurface density values as well as measured densities from outcrop samples of rock units not encountered in the wells.

Hammer zone charts (Hammer, 1939) and extended terrain correction tables (Douglas and Prahl, 1972) were used in making topographic corrections. Inner zone corrections (E-I) were determined on 1:63,360 scale topographic maps. Outer zone corrections (J-M) were made using 1:250,000 scale maps. Corrections were applied to all stations south of ST18 where terrain effects are greater than 0.4 milligal and reach a maximum of 4.2 milligals.

The Bouguer gravity profile shows a 0.7 milligal southerly decrese in gravity and a few low amplitude anomalies (plate 2). This decrease is similar to the regional trend indicated by Barnes (1976) and probably is due to gradual crustal thickening from the Alaskan coast to the axis of the Brooks Range (Kososki, 1978). The 8 milligal gravity low (ST02-ST05) is coincident with a syncline containing Tertiary(?) rocks with an average density of 2.33 g/cm^3. These rocks are flanked by Cretaceous rocks with an average density of 2.47 g/cm^3. Low amplitude anomalies of less than 4 milligals characterize the gravity profile south of ST06. Elevation inaccuracies may cause errors in Bouguer gravity of a similar magnitude. Whether these anomalies result from geologic conditions, rather than problems in elevation control, will depend on their correlation with mapped geologic features. Updating of existing geologic maps with additional data from canyon photography is in progress.

Table 2.--Well and outcrop density values for stratigraphic units in the Shaviovik and Echooka Rivers area, North Slope, Alaska.

		Density in g/cm^3; interval thickness in feet									
Rock Unit	Age	Arco Susie No. 1	Home Bush Federal No. 1	Colorado Shaviovik No. 1	McCulloch Fin Creek No. 1	Forest Kemik No. 1	BP Alaska Kemik No. 2	Arco Kavik No. 2	Northeast Brooks Range Outcrop	Range	Average
Sagavanirktok Fm.	Tertiary	2.39 (200-1,650)	2.27 (100-2,600)							0.12	2.33
Colville Gp.	U. Cretaceous			2.47 (1,060-6,050)	2.47 (3,000-9,400)					0.00	2.47
Kongakut Fm.	L. Cretaceous										
Pebble Shale Mbr.		2.20 (12,720-12,930)	2.27 (10,880-11,140)							0.07	2.24
Kemik Sandstone Mbr.		2.55 (12,930-13,100)	2.50 (11,140-11,210)							0.05	2.53
Kingak Shale	Jurassic		2.44 (11,210-13,400)					2.40 (4,430-5,120)		0.04	2.42
Karen Creek Sandstone	U. Triassic		2.55 (13,400-13,430)					2.63 (5,670-5,750)		0.08	2.59
Shublik Fm.	M. to U. Triassic		2.58 (13,430-13,600)		2.54 (14,200-14,320)		2.60 (6,186-6,280)	2.66 (5,750-5,930)		0.12	2.60
Sadlerochit Gp.											
Ivishak Fm.	L. Triassic		2.42 (13,600-14,630)		2.37 (14,320-15,710)		2.53 (6,280-7,814)	2.65 (3,930-6,770)		0.28	2.49
Echooka Fm.	L. to U. Permian		2.53 (14,630-14,930)		2.50 (15,710-15,850)	2.61 (10,250-10,950)	2.60 (7,814-8,304)	2.67 (6,770-7,120)		0.17	2.58
Lisburne Gp.	Mississippian and Pennsylvanian		2.61 (14,930-15,880)			2.63 (10,950-15,970)	2.65 (8,308-8,898)			0.04	2.63
Kayak Shale	Mississippian								2.58 (11 smpls.)	0.19	2.57
Neruokpuk Fm.	Pre-Mississippian								2.65 (9 smpls.)	0.20	2.64

MAGNETICS

Ground magnetic measurements were routinely made at each gravity station using a geoMetrics G-819 proton precession magnetometer. Measurements were made 75 m from the helicopter with the instrument sensor mounted on the end of a 2.5-m staff.

Magnetic data was corrected for apparent long period diurnal field variations and instrument drift. Corrections were made by standard methods (Nettleton, 1976) using linear diurnal variation curves constructed from base ST01 loop data. This method is insensitive to short period diurnal fluctuations, which may be present in the data. The second base, ST24, read at the end of the first day and beginning of the second day was used to correct first day stations ST20-ST24 for a 22 gamma increase in the diurnal field. Data collected on the second day were adjusted to compensate for a 12 gamma decrease in magnetic field strength, relative to the first day's readings.

Studies of high latitude geomagnetic activity by Morley (1953) indicate that the distance between College Observatory at Fairbanks and the study area (515 km) is too great to allow for direct correction of the data from magnetogram events. Morely found phase and amplitude differences in magnetic records (total field measurements) between stations 140 to 209 km apart, however, magnetic curve shapes were similar. Quiet or disturbed conditions at one locality corresponded to similar conditions at other localities.

In order to further study the correspondence of diurnal variations over long distances, magnetograms from Point Barrow were compared to those from College Observatory. Point Barrow is approximately 805 km northwest of College Observatory. Barrow records were not available for the period of

Shaviovik-Echooka field work. therefore, records for October 31 to November 5, 1974 were arbitrarily chosen for comparison. Some phase and amplitude dissimilarities were noted. In general, the magnitudes of the quiet day, short period (less than 20 minutes) low amplitude (10 gammas) fluctuations for Point Barrow and College Observatory records were similar.

The general similarity of magnetograms from College and Point Barrow Observatories and the observations by Morley (1953) suggest that our magnetic readings were made under conditions similar to those recorded at Fairbanks on August 7 and 8 (magnetograms, plate 1). College Geomagnetic Observatory in Fairbanks recorded relatively quiet magnetic conditions for this period. Micropulsations of as much as 10 gammas with periods of 3 to 20 minutes occurred as well as longer period diurnal effects up to 22 gammas. Assuming that similar micropulsations occurred in the study area certain limitations in our data become apparent. Anomalies with mangitudes of 10 gammas or less and defined by 3 or fewer station readings may represent micropulsations rather than geologic features. For this reason a cautious approach should be taken in placing any significance on these anomalies without additional supporting data. Longer period anomalies and trends may indicate geologic sources. The data show a southwesterly decreasing regional gradient of 3 to 5 gammas per kilometer.

The overall low amplitude of the magnetic profile is indicative of weakly magnetic rock or the lack of significant susceptibility contrast within the basement and overlying sediments. Magnetic susceptibility measurements (table 3) of 26 selected outcrop samples from the general region of the traverse show that the rocks are weakly magnetic. A Soiltest MS-3 magnetic susceptibility bridge and oscilloscope were used to determine susceptibilities. In addition,

Table 3.--Measured volume susceptibilities for samples collected in and adjacent to the Shaviovik-Echooka area. Sample 72 Arr 218a (*) was measured in a superconducting susceptometer. All other measurements utilized a Soiltest MS-3 susceptibility bridge.

Field Sample No.	Stratigraphic Unit	Lithology	Magnetic Susceptibility, K (10^{-6} cgs)
51 ADt 12	Kongakut Formation	Sandstone	0
51 ADt 13	Kongakut Formation	Shale	0
51 ADt 14	Kongakut Formation	Shale	0
51 ADt 16	Kongakut Formation	Shale	37
51 ADt 19	Kongakut Formation	Siltstone	0
51 ADt 2	Sadlerochit Group	Siltstone	0
76 Arr 67	Sadlerochit Group	Limestone	22
72 Arr 123h	Lisburne Group	Limestone	28
72 Arr 218a	Lisburne Group	Mafic intrusive	2,991 1,426 (*)
72 Arr 218b	Lisburne Group	Basalt	59
72 Arr 218d	Lisburne Group	Limestone	33
72 Arr 218x	Lisburne Group	Basalt	41
75 Arr 123g	Lisburne Group	Basalt	54
76 Arr 62	Lisburne Group	Calcareous sandstone	0
76 Arr 62x	Lisburne Group	Mafic tuffaceous limestone	22
76 DG 9b	Kayak Shale	Quartzite	0
76 DG 11	Kayak Shale	Banded argillite	18
76 DG 21	Kekiktuk Conglomerate	Quartzite	0
76 DG 17	Neruokpuk Formation	Chert	0
76 DG 18	Neruokpuk Formation	Quartzite	0
76 DG 18b	Neruokpuk Formation	Quartzite	0
76 DG 19	Neruokpuk Formation	Chert	0
76 DG 22	Neruokpuk Formation	Calcareous siltstone	14
76 DG 20b	Neruokpuk Formation	Siltstone	8
76 DG 20c	Neruokpuk Formation	Calcareous siltstone	12

four samples were powdered and remeasured in a superconducting susceptometer (Superconducting Technology, Inc.). This instrument measures total magnetic moment with a high degree of accuracy. Sample volume and the magnetic field used during measurement are used to convert moment measurements to volume susceptibilities. At low vertical magnetic field strengths (.36 oersted--field utilized by the Soiltest MS-3) only one sample (72 Arr 218a) gave quantitatively reliable results in the superconducting equipment. Comparisons between the MS-3 and superconducting susceptometer measurements on this sample indicate a significant discrepancy in susceptibility values between the two instruments. Because of this, the absolute accuracy of the susceptibilities reported in table 3 are questionable. The MS-3 values reported, however, are considered to represent the relative susceptibilities of the samples measured.

Moderately magnetic ($K = 146 \times 10^{-6}$ cgs) mafic intrusive rocks are associated with Mississippian carbonates at Flood Creek, 40 km to the southwest (Keller and others, 1961). The lack of any significant anomaly along the eastern projection of these rocks (ST22-ST31) implies their absence, or alteration to nonmagnetic minerals. Brosge and Reiser (pers. commun., 1977) collected a mafic tuff (76 Arr 62x; $k = 22 \times 10^{-6}$ cgs) from a locality 3 km north of ST27. The low susceptibility of this sample is due to the alteration of the mafic minerals to clays and their partial replacement by dolomite. If mafic intrusive rocks are present near the mountain front, they are limited in extent and have no measurable net magnetization.

Three widely spaced north-south reconnaissance aeromagnetic profiles were flown in 1965 over much of northeastern Alaska (Brosge and others, 1970). The eastern profiles indicate a 30 to 40 gamma anomaly coincident with the Brooks Range front. Pre-Mississippian mafic extrusive and intrusive igneous rocks in a west-trending belt are interpreted to be their source (Brosge and others, 1970). No magnetic expression of this trend is observed in line 70 (westernmost of the three) which was flown over the Shaviovik-Echooka study area. This lack of expression may indicate burial depth greater than the sensitivity of the aeromagnetic data, or absence of this rock type. Well data (B.P. Kemik No. 2, located 3 km east of ST15) indicates that basement rock is deeper than 2,700 m. If the mafic belt extends into the Shaviovik-Echooka area at a depth of about 2,750 m, a 9 to 17 gamma anomally might be expected. The location most likely would be between stations ST11 and ST22. A 20 gamma anomaly occurs at ST13. This anomaly, if not a diurnal effect, has an estimated source depth of 1,830 m or less which is too shallow to be caused by basement rock. The west-trending mafic belt either does not extend into the Shaviovik-Echooka River area or is at a depth too deep for magnetic detection. The 20-gamma anomaly may be caused by one of four sources: (1) a short period diurnal fluctuation, (2) the surficial fluvial accumulation of magnetic minerals, (3) pyroclastic rocks logged at 390 m in Kemik No. 1, or (4) diagenetically produced ferromagnetic minerals concentrated along a fault plane or anticlinal crest (Donovan and others, 1977).

Diagenetically produced ferromagnetic minerals (magnetite and maghemite) have been reported to cause low amplitude high frequency anomalies. These anomalies are superimposed on larger basement induced anomalies detected over the Cement oil field, Oklahoma (Donovan and others, 1979). In the Cement field ferric oxide and hematite grain coatings and cements were reduced to the more soluble ferrous iron. This iron was mobilized in water and eventually crystallized to the ferromagnetic mineral magnetite. Hydrocarbons and their associated compounds played an important role in the chemical reduction process. At the Brooks Range front Triassic rocks are apparently rich in iron. Surface exposures are stained bright red and adjacent stream waters are highly colored. These same rocks underlie the anomaly at ST13 at a depth of approximately 1,000 m. Hydrocarbons may also be present or at least have passed through these rocks as indicated by a good gas test from this horizon in Kemik No. 1. Conditions seem favorable in the area of ST13 for the mobilization of ferrous iron and its concentration and crystalization as magnetite. The possible concentration of fermagnetic minerals in a fault zone or structural trap in this area could produce an anomaly like the one detected. Since the basement complex is essentially nonmagnetic (table 3, Neruokpuk Formation) this mechanism may be applicable in explaining this and other low amplitude, short wave length anomalies along the profile.

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