

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

LITHOLOGIC LOGS OF LISBURNE GROUP IN
LAWRENCE LIVERMORE LABORATORY DRILL HOLES 1 AND 2,
CONFUSION CREEK, CHANDLER LAKE QUADRANGLE,
NORTHERN ALASKA

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Lithologic logs of Lisburne group in Lawrence Livermore

Laboratory Drill Holes 1 and 2, Confusion Creek,

Chandler Lake quadrangle, northern Alaska

By William P. Brosge¹ and Augustus K. Armstrong

Two shallow test holes were drilled in the foothills of the Brooks Range by the Lawrence Livermore Laboratory, University of California in 1972 in order to make measurements of the electrical properties of permafrost. Cuttings and cores were given to the U.S. Geological Survey for examination, and the holes were later made available to the Survey for subsurface temperature measurements.

Location and history

The holes are located in sec. 26, T. 12 S., R. 1 W., at an elevation of about 2,700 feet on the crest of a low ridge about 1 mile west of Confusion Creek in the Siksikuk River drainage (see fig. 1). Drill Hole 2 is about 550 feet east of Drill Hole 1.

The drilling contractor was Alaska Geological Consultants, Anchorage, Alaska. The two 6-inch holes were drilled with a DAMCO 2000 rig and air hammer mounted on a Nodwell vehicle. They were completed in November, 1972, cased near the surface, and were capped after the electrical measurements had been made. In Drill Hole 2, and probably in Drill Hole 1, PVC tubing 1 inch in diameter was hung from the surface casing to the bottom of the hole, capped at the bottom, and left partly filled with oil.

According to Lawrence Livermore Laboratory records, Drill Hole 1 (the west hole) hit fresh water at 592 feet and was drilled to a total depth of 600 feet. Nine days later a weak blow of gas was observed which continued for another 3 days. The nature of the gas was unknown, except that it would not burn and it extinguished matches. After the blow, 8 feet of water stood in the bottom of the hole.

Drill Hole 2 was drilled to a total depth of 570 feet. About 1 foot of fresh water stood in the bottom of the hole; no gas blow was noticed.

Geologic setting and correlations

The drill holes are at the crest of a low west-plunging anticline that is probably the slightly offset westward prolongation of the much larger Tiglukpuk Creek anticline mapped by Patton and Tailleir (1964). Beds in and near the holes dip 10° and less, so downhole measurements differ from true thickness of beds by less than 2 percent. The Lisburne Group crops out almost continuously along the crest of both anticlines, and the drill holes are entirely within the Alapah Limestone in the upper part of the Lisburne. A phosphatic zone at a depth of about 300 feet in each hole (fig. 2) can be correlated lithologically with the phosphatic black chert-shale member of the Alapah that is exposed in the section measured by H. N. Reiser on Tiglukpuk Creek about 5 miles east along strike (Patton and Tailleir, 1964, p. 420-423). The few microfossils found in the outcrops near the holes also indicate a correlation with the black chert-shale member and adjacent beds. These correlations suggest that a Mississippian supra-tidal environment was more persistent at the site of the drill holes than at the nearby exposed sections. If the correlation of the black chert-shale member is correct, many beds that are limestone at Tiglukpuk Creek are represented by dolomite at the drill site.

Microfossils

Thin sections were made of cuttings from each of the numbered samples from Drill Hole 2 except sample number 46. The foraminifera Earlandia sp., which ranges from Late Devonian to Early Permian, was found in two samples, number 9 (100 to 107 feet) and number 53 (490 to 495 feet). All other samples were barren.

Fifteen samples were also collected from the outcrops on the ridge crest east of Drill Hole 2, where the stratigraphic interval corresponding to the upper 200 to 300 feet of the hole is partly exposed. Brunsia sp., Archaediscus sp., Tetrataxis sp., and Endothyra? sp. were found in five samples near the top and bottom of this interval. This fauna probably represents the "Brunsia facies," which is also found in the Alapah Limestone section at Skimo Creek (fig. 1) and in the Alapah type section at Shainin Lake (Armstrong and others, 1970). In both those sections it occurs between the Upper Mississippian foraminiferal zones 13 and 16, and at Shainin Lake it includes the black chert-shale member of the Alapah and adjacent beds.

The lack of microfossils from the suite of sections from Drill Hole 2 is clearly the result of environments of deposition and diagenetic events. The bulk of the thin sections are primarily lime mudstone (micrites) with little or no fossil bioclasts. They also are extensively dolomitized, and many of them have been dedolomitized. Even if microfossils had been present, these diagenetic changes would have destroyed them. Some thin sections contain bryozoan-echinoderm bioclasts and are wackestones and packstones. The rocks are extensively dolomitized. The dolomitization and silicification has occurred in the finer micritic material between the larger echinoderm and bryozoan fragments. Smaller microfossils such as foraminifera may have been destroyed by dolomitization.

Description of cuttings and cores

The cuttings were sieved, examined with hand lens and tested with acid, and were described in the same terms of color and grain size as were used to describe the measured section on Tiglukpuk Creek. The logs in figure 2 were drawn from these descriptions. The cuttings in each numbered sample were uniform in rock type regardless of chip size, and therefore appeared not to be contaminated by cuttings from above. Insoluble residues of three samples were measured to determine the amount of argillaceous material in the limestones assigned to the black chert-shale member; no true shale was found. Phosphate was detected by testing with ammonium molybdate. The phosphate content of representative portions of samples 32 through 36 from Drill Hole 2 was measured quantitatively by S. T. Neil, U.S. Geological Survey, Menlo Park, California.

Thin sections of chips from each numbered sample in Drill Hole 2 were again described briefly during the examination for microfossils. In the following descriptive log the hand lens description of each sample is given first, followed by the thin section description in capital letters.

References cited

- Armstrong, A. K., Mamet, B. L., and Dutro, J. T., Jr., 1970, Foraminiferal zonation and carbonate facies of Carboniferous (Mississippian and Pennsylvanian) Lisburne group, central and eastern Brooks Range, arctic Alaska: Amer. Assoc. Petroleum Geologists Bull., v. 54, no. 5, p. 687-698.
- Patton, W. W., Jr., and Tailleux, I. L., 1964, Geology of the Killik-Itkilik region, Alaska: U.S. Geol. Survey Prof. Paper 303-G, p. 409-500.

Description of cuttings and cores

LLL Drill Hole 1 (west hole), Confusion Creek, 1972

Sample	Depth in feet	
1	30-40	Dark gray fine-grained limestone; black chert
2	41-45	Dark gray fine-grained limestone
3	55-57	Same as above
4	65-73	Dark gray fine-grained limestone; medium gray medium-grained limestone
5	88-92	Dark to medium gray fine-grained limestone
6	100-107	Light gray fine and coarse-crystalline dolomite and dolomitic limestone
7	120-122	Medium brown medium-grained limestone and dolomitic limestone
8	125-131	Dark gray fine-grained limestone
9	146-151	Medium brown fine- to medium-grained limestone; black chert
10	162-167	Medium brown fine-grained limestone; black chert
11	175-180	Dark brown fine-grained fetid limestone; black chert
CORE	187.75- 188.55	Dark brownish gray medium-grained laminated bioclastic limestone; coral fragments; worm burrows; black chert. Beds horizontal
12?	219-220	Dark gray fine-grained thin-bedded limestone; black chert
13	232-237	Dark brown fine-grained limestone; brown argillaceous shaly limestone; black chert
14	240-243	Dark brown fine-grained limestone; black chert; pulverized rock is brown
15	282-286	Dark gray fine-grained platy limestone; black chert; pulverized rock is brown
16	291-296?	Same as above (Tag partly illegible)
17	296-298	Black fine-grained fetid shaly argillaceous limestone; a few clay shale partings; pulverized rock is dark brown
18	302-305	Same as above; a few chips are composed of 1 mm pellets of black phosphate rock
19	320-330	Dark brown fine-crystalline dolomite; 30 percent black chert
20	346-350	Medium brown medium- to fine-crystalline dolomite; black chert
21	351-362	Medium brown medium-crystalline dolomite
CORE	380.9- 381.25	Medium brown coarse-grained thick-bedded bioclastic limestone. Horizontal beds. Calcite-filled joints about 1 inch apart dip 60°
22	427-435	Light to medium brown fine- to medium-crystalline dolomite
23?	430-434	Light brown medium-crystalline dolomite
27	480-487	Light brown fine-crystalline dolomite. Sample is almost all pulverized rock
28	487-500	Medium brown medium-grained limestone
29	500-505	Medium brown medium-grained limestone; dark gray fine-crystalline dolomite

Sample	Depth in feet	
29	515-523	Medium brown medium-crystalline dolomite
30?	507-520	Light gray coarse-grained bioclastic limestone (Tag partly illegible)
31	? -556	Medium brown medium-grained limestone; dark brown dolomite (Tag partly illegible)
32	562-567	Dark grayish brown fine- to medium-grained limestone
33	580-584	Dark gray fine- to medium-grained limestone
34	577-587	Carbonate and black chert. Sample is 90 percent gray dust
35	590-594	Medium brown coarse-grained bioclastic limestone; light brown medium-crystalline dolomite

TOTAL DEPTH 600 FEET

Description of cuttings and cores

LLL Drill Hole 2 (east hole), Confusion Creek, 1972

Sample	Depth in feet	
1	11-14	Dark gray fine-grained limestone. CALCITIC DOLOMITE AND CHERT; DOLOMITE RHOMBS 50 MICRONS IN SIZE. RELIC STRUCTURE IN THE CHERT SUGGESTS THE ROCK WAS A PELLETOID LIME MUDSTONE.
2	15-21	Same as above. DOLOMITE, WITH 50 MICRON-SIZE RHOMBS, SOME DEDOLOMITIZATION AND INTERCRYSTALLINE CALCITE.
3	36-40	Same as above. SILICIFIED CALCITIC DOLOMITE AND CHERT.
4	56-57	Dark gray fine-grained shaly limestone; black chert; pulverized rock is black. ARGILLACEOUS CALCITIC DOLOMITE.
5	63-67	Medium gray and brown medium- to coarse-grained limestone; black chert. DOLOMITIC-SILICEOUS-BRYOZOAN-ECHINODERM WACKESTONE.
6	84-87	Light brown fine-grained dolomite and dark gray fine-grained limestone. PELLETOID-SILICEOUS-LIME MUDSTONE.
7	90-95	Dark to medium gray fine-grained limestone. SILICEOUS-SPICULITIC-PELLETOID-BRYOZOAN WACKESTONE.
8	95-99	Dark gray medium-grained bioclastic limestone; black chert. BRYOZOAN-ECHINODERM PACKSTONE.
9	100-107	Medium gray calcilutite; white chert. BRYOZOAN-ECHINODERM WACKESTONES AND PACKSTONES.
10	110-115	Light to medium gray fine-grained platy, siliceous? limestone. DOLOMITIC AND NEOMORPHIC CALCITE--PROBABLY WAS LIME MUDSTONE.
11	120-123	Same as above; gray chert. ECHINODERM-WACKESTONE; VERY FINE FOSSIL FRAGMENTS AND NEOMORPHIC CALCITE CRYSTALS IN THE MICRITIC LIME MUD.
12	126-128	Dark gray fine-crystalline dolomite and silicified limestone; white chert. SPICULITIC CHERT AND DOLOMITE.
13	128-130	Light to dark gray very fine to fine-grained limestone. SILICEOUS LIME MUDSTONE.
14	130-137	Medium gray calcilutite; dark gray fine-grained limestone. SILICEOUS-PELLETOID-LIME MUDSTONE.
15	150-156	Medium gray fine-grained limestone. DOLOMITE; WITH 50 TO 100 MICRON-SIZE RHOMBS, EXTENSIVE DEDOLOMITIZATION.
16	165-167	Dark gray fine-grained argillaceous limestone; black chert; pulverized rock is black. DOLOMITE; IDIOTOPIC, WITH 50 MICRON-SIZE RHOMBS; DEDOLOMITE; CHERT; CLAY.
17	168-171	Gray limestone; white crystalline calcite; black chert. ECHINODERM-PELLETOID PACKSTONE; WELL SORTED.
18	175-183	Medium gray fine-grained limestone. CHERT AND SILICEOUS-CALCITIC DOLOMITE.
19	183-189	Dark gray fine-grained limestone; calcite crystals. CHERT AND DOLOMITIC-LIME MUDSTONE.
20	189-205	Light gray fine-grained limestone; few chips; mostly pulverized rock. CHERT AND SILICEOUS DOLOMITE; DOLOMITE RHOMBS ARE 50 TO 150 MICRONS IN SIZE AND ARE HYPIDIOTOPIC AND COMMONLY IDIOTOPIC; CALCITE VEINS

Sample	Depth in feet	
22	205-213	Light gray coarse?-grained limestone; almost all pulverized. NO THIN SECTION.
22	213-220	Medium gray fine-grained dolomitic or silicified limestone. NEOMORPHIC CALCITE, WITH RHOMBS 20 TO 70 MICRONS IN SIZE; RECRYSTALLIZATION HAS DESTROYED ALL FORMER SEDIMENTARY FABRICS.
23	219-227	Medium dark gray fine-grained limestone. NEOMORPHIC CALCITE AS ABOVE.
24	227-235	Dark gray fine-grained shaly limestone. NEOMORPHIC CALCITE AS ABOVE; BUT WITH WHAT APPEARS TO BE SILT-SIZE QUARTZ SAND GRAINS IN THE 30 TO 50 MICRON-SIZE RANGE BETWEEN SOME OF THE NEOMORPHIC CALCITE CRYSTALS. THE ROCK WAS PROBABLY ONCE AN ARENACEOUS LIME MUDSTONE.
25	230-235	Same as above. ARENACEOUS-BRACHIOPOD-ECHINODERM WACKESTONE TO LIME MUDSTONE. THE MICRITIC FRACTION HAS UNDERGONE NEOMORPHIC CRYSTAL GROWTH AS IN ABOVE SAMPLES.
25	235-240	Same as above. IDIOTOPIC DOLOMITE RHOMBS IN CHERT AND NEOMORPHIC-ARENACEOUS CALCITE.
26	240-245	Same as above. Pulverized rock is dark gray. NEOMORPHIC CALCITE, WITH 30 TO 60 MICRON RHOMBS--ROCK WAS PROBABLY ONCE AN ARENACEOUS LIME MUDSTONE.
28	245-250	Dark gray fine-grained limestone; black chert. DOLOMITIC- NEOMORPHIC CALCITE. THIS THIN SECTION HAS EXTENSIVE EVIDENCE OF DEDOLOMITIZATION, AND THAT MUCH OF THE CALCITE HAS REPLACED DOLOMITE.
29	250-255	Dark gray fine-grained thin-bedded limestone; black chert. DOLOMITIC CALCITE; NEOMORPHIC; AS ABOVE. THIN SECTION IS AN EXCELLENT EXAMPLE OF DEDOLOMITIZATION.
30	255-260	Same as above; black chert abundant. NEOMORPHIC CALCITE; AS ABOVE.
31	260-265	Medium gray fine-grained thin-bedded limestone; black chert. NEOMORPHIC CALCITE; AS ABOVE.
CORE	266	Dark gray fine-grained laminated limestone. Apparent dip 10°. Vertical and oblique calcite-filled joints 1 to 2 inches apart
32	268-275	Medium gray fine-grained limestone; black chert. LIME MUDSTONE.
32	275-283	Medium gray fine-grained thin-bedded dolomitic? limestone; black chert. 0.74 percent P ₂ O ₅ . DOLOMITIC-NEOMORPHIC CALCITE AS ABOVE.
33	283-287	Black fine-grained shaly argillaceous limestone consisting of about 80 percent CaCO ₃ and 20 percent insoluble clay and silt; black chert. 0.97 percent P ₂ O ₅ . ARGILLACEOUS-LIME MUDSTONE; VERY FINE-GRAINED WITH A FEW SMALL, CRINOID FRAGMENTS.
34	293-296	Same as above. About 1 percent of chips are composed of black phosphatic pellets about 1 mm in diameter. 5.92 percent P ₂ O ₅ . LIME MUDSTONE.
35	301-303	Dark gray fine-grained thin-bedded limestone consisting of about 95 percent CaCO ₃ and 5 percent insoluble material; black chert. 2.14 percent P ₂ O ₅ . NEOMORPHIC CALCITE; FORMED BY 50 TO 70 MICRON RHOMBIC PSEUDOMORPHS OF CALCITE AFTER DOLOMITE-A DEDOLOMITE.

Sample	Depth in feet	
36	305-310	Dark brownish gray fine-grained shaly argillaceous limestone consisting of about 55 percent CaCO_3 and 45 percent insoluble particles; black chert. About 1 percent of chips are black pelletal phosphate rock. 9.41 percent P_2O_5 . SPICULITIC ARGILLACEOUS LIME MUDSTONE.
37	330-335	Medium gray medium-crystalline dolomite; black chert. DOLOMITE; HYPIDIOTOPIC, WITH 100 TO 200 MICRON-SIZE RHOMBS.
38	335-348	Medium brown medium-crystalline dolomite; black chert. DOLOMITE; HYPIDIOTOPIC, WITH 100 TO 300 MICRON-SIZE RHOMBS; POOR SPACE BETWEEN RHOMBS FILLED IN PART WITH SPARRY CALCITE.
40	352-355	Light brown medium-crystalline dolomite; black fine-grained thin-bedded limestone; black chert. CHERT AND HYPIDIOTOPIC DOLOMITE.
40	357-361	Light brown medium-crystalline dolomite. DOLOMITE; HYPIDIOTOPIC, WITH 100 TO 300 MICRON-SIZE RHOMBS.
42	369-372	Light brown coarse-grained platy dolomitic limestone; black chert. ECHINODERM PACKSTONE; EXTENSIVE SECONDARY GRAIN GROWTH ON THE LARGE ECHINODERM FRAGMENTS.
42	370-376	Light brown coarse-grained platy dolomitic limestone; black chert; minor white silicified dolomite. SILICEOUS-ECHINODERM-BRYOZOAN PACKSTONE.
43	376-387	Light brown coarse-grained dolomitic limestone; black chert. ECHINODERM-BRYOZOAN PACKSTONE.
44	387-397	Light brown coarse-crystalline dolomite. CHERT AND LIME MUDSTONE.
45	397-407	Medium gray fine-crystalline dolomite. SILICEOUS AND RECRYSTALLIZED LIME MUDSTONE AND PELLETOID-CRINOID WACKSTONE.
46	407-417	Medium brown fine-crystalline dolomite. NO THIN SECTION.
47	417-427	Light brown fine-crystalline thin-bedded dolomite. CHERT AND COARSE-GRAINED ECHINODERM PACKSTONE.
48	427-447	Light brown coarse-grained bioclastic dolomitic limestone; black chert. DOLOMITIC-COARSE-GRAINED-ECHINODERM PACKSTONE.
49	450-460	Light to medium brown medium to coarse-crystalline dolomite. DOLOMITE; HYPIDIOTOPIC, WITH 300 TO 500 MICRON-SIZE RHOMBS.
50	465-470	Same as above. LIME MUDSTONE AND DOLOMITE.
51	470-475	Light brown medium-crystalline dolomite; medium brown fine-crystalline dolomite. CHERT AND DOLOMITE; HYPIDIOTOPIC, WITH 100 TO 150 MICRON-SIZE RHOMBS.
52	475-485	Same as above; gray chert. CHERT AND DOLOMITIC COARSE-GRAINED ECHINODERM PACKSTONE.
53	490-495	Medium brown medium-crystalline dolomitic limestone. CHERT AND COARSE-GRAINED HYPIDIOTOPIC DOLOMITE.
54	495-517	Medium brown coarse-grained bioclastic limestone; medium brown fine-crystalline dolomite. DOLOMITIC-ECHINODERM BRYOZOAN PACKSTONE.
55	522-525	Medium brown fine to medium-crystalline dolomite. DOLOMITE; HYPIDIOTOPIC, WITH 50 TO 100 MICRON-SIZE RHOMBS.
56	525-531	Same as above. DOLOMITE; HYPIDIOTOPIC, WITH 150 TO 200 MICRON-SIZE RHOMBS.
57	532-533	Medium gray medium-grained crinoidal limestone. CALCITE-DOLOMITE; HYPIDIOTOPIC, WITH 300 TO 500 MICRON-SIZE RHOMBS. EXTENSIVELY DEDOLOMITIZED.

Sample	Depth in feet	
58	555-565	Medium gray fine-crystalline dolomite. SILICEOUS-CALCITIC-DOLOMITE; A VERY COMPLEX ROCK THAT HAS BEEN SILICIFIED IN PART, DOLOMITIZED, AND PARTLY DEDOLOMITIZED.
59	565-569	Light brown fine- to medium-grained limestone and dolomitic limestone. DOLOMITIC-ECHINODERM PACKSTONE.

TOTAL DEPTH 570 FEET

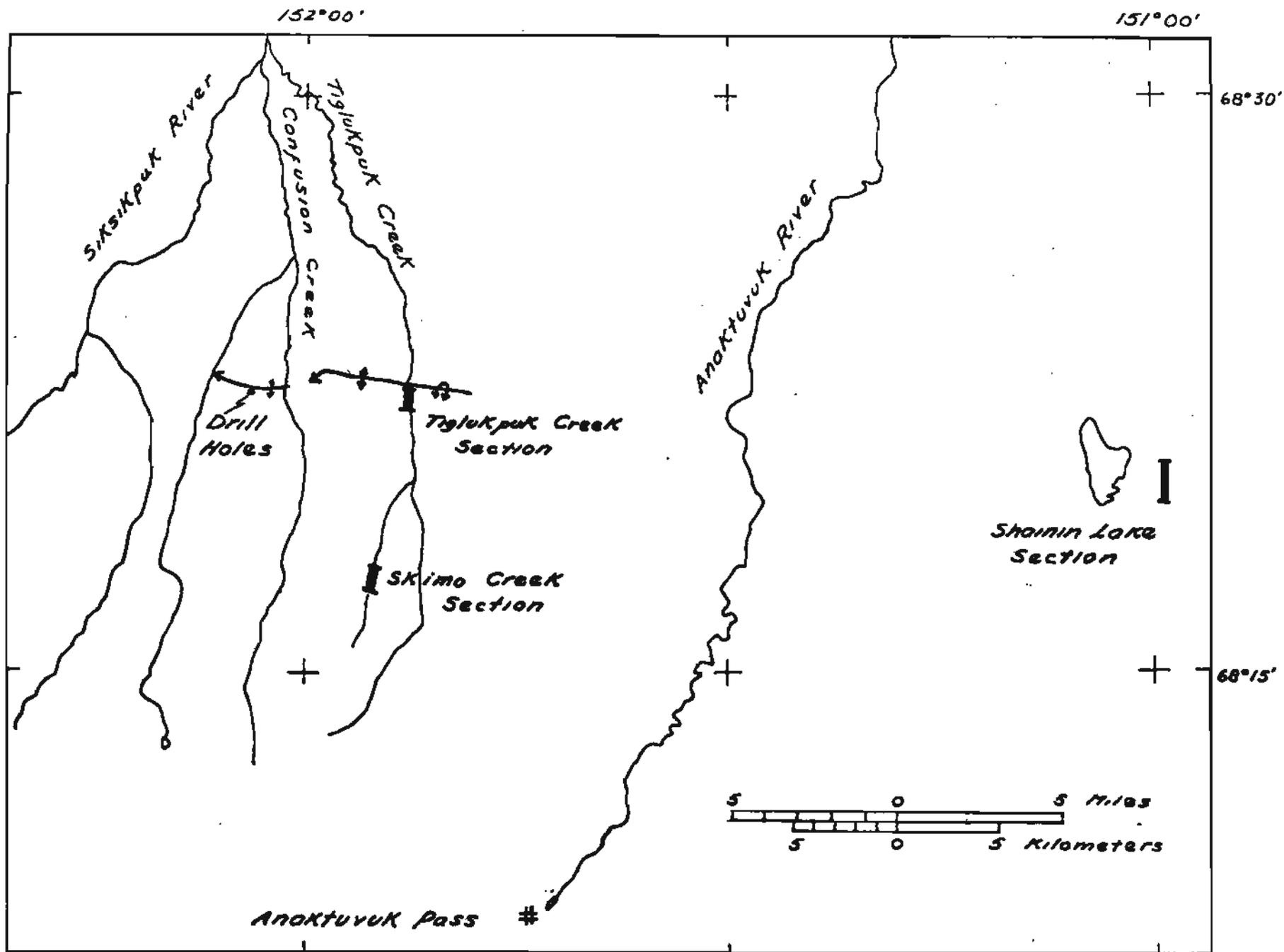


Fig. 1. Index map showing location of Lawrence Livermore Laboratory Drill Holes and of measured sections of Lisburne Group at Tigliukpak Creek, Skimo Creek and Shainin Lake. Base from Chandler Lake Quadrangle, scale 1:250,000.