EXPLANATORY NOTES

to accompany

Geologic strip map of part of Kukpuk River, northwestern Alaska

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The field work upon which this map is based was done in August 1958 as a part of geologic studies by the U. S. Geological Survey on behalf of the Atomic Energy Commission in the vicinity of the proposed nuclear harbor site near Cape Thompson, Alaska. As no published information relative to the geology of this section of the Kukpuk River is available, it is believed the information gained during a rapid reconnaissance may be of some value.

The left bank of the Kukpuk River was traversed by foot, and a second traverse only a few miles long was made 2 miles south of the river at the west end of the map. Detailed though hurried sketches were made of most cutbank exposures on both banks of the river, although actual examination of outcrops was limited to the left bank.

The geologic structure sections A-A' to C-C' are plotted on the same scale as the strip map. Section D-D', at a larger scale, illustrates the complexity of the structure and also shows the impossibility of plotting all the variable dips and strikes on the strip map.

The structure sections are more accurate where the line of the section lies close to the river, but are generalized to show the major structures only. Owing to the structural complexities of the rocks the structure sections necessarily become more interpretive when the lines of the sections are not reasonably near the river. Where the structure section lines are at considerable distances from the river, the structure is not shown.

The main lithologic types are shown by pattern on parts of the map where there are significant variations. The pattern denotes the main lithology, but lesser amounts of other rock types may be included. All of the sandstone observed is of the graywacke type, and hereafter is called sandstone.

## Stratigraphy

The oldest rocks exposed are those of the Lisburne group, of Mississippian age. Parts of the Lisburne are lithologically similar to units of the Lisburne group mapped in other places in northern Alaska (Bowsher and Dutro, 1957). The Lisburne is in fault contact with the younger rocks, including the Shublik formation of Triassic age and the Tiglukpuk formation of Jurassic age, and the stratigraphic relations are too complex to permit the measurement of a complete section in the area traversed. However, some cutbanks expose thick units of the Lisburne that are in normal stratigraphic sequence, and from these exposures stratigraphic columns 1 and 2 have been constructed. The same general sequence of beds of the Lisburne as shown in column 2 was recognized in the sea cliffs between Cape Thompson and Ogotoruk Creek on the Chukchi Sea. The thin-bedded limestone and shale unit in column 1 is lithologically and stratigraphically equivalent to a unit found in the Lisburne limestone to the east (Sable, Dutro, and Mangus, written communication). The unit previously was recognized in the Cape Thompson area by Kindle (1909). The Lisburne rocks are generally fossiliferous.

The Lisburne group shown here contains rock sequences similar to some of the rock sequences described by Bowsher and Dutro (1957) in the

Wachsmuth and Alapah formations of the Lisburne group in the Shainin Lake area of the central Brooks Range. However, the stratigraphy of the Lisburne group shown here is not sufficiently well known to warrant the use of these formational names, and all the units are grouped under the Lisburne group.

Fault slices of the Shublik formation of Triassic age and of the basal part of the Tiglukpuk formation of Jurassic age crop out within the belt of Lisburne rocks. The included rocks of the Shublik formation are in part fossiliferous, carrying the diagnostic fossil Monotis subcircularis Gabb, which is widespread in northern Alaska (Smith and Mertie, 1930). Rocks of the Tiglukpuk formation exposed in fault slices within the belt of Lisburne rocks are greenish-gray siltstones equivalent to those that conformably(?) overlie the Triassic rocks near Cape Thompson.

Eastward from the Lisburne group progressively younger rocks crop out. These rocks are believed to be the stratigraphic equivalents of three formations described elsewhere in northern Alaska: the Tiglukpuk of Jurassic age, and the Okpikruak and Fortress Mountain formations of Early Cretaceous age (Gryc, and others, 1956).

The Tiglukpuk(?) formation, where exposed on the Kukpuk River, consists of at least three distinct lithologic units. The lower unit is siltstone with minor intercalated sandstone of the graywacke type. The basal siltstone has a distinct greenish cast. The middle unit consists of interbedded siltstone and sandstone rhythmically interbedded in approximately equal amounts; individual beds range in thickness from approximately one-half inch to as much as 8 inches. The upper unit consists predominantly of sandstone of the graywacke type in beds as much as several feet in thickness

with minor interbeds of siltstone. The units are gradational.

The Okpikruak formation is difficult to distinguish from the underlying Tiglukpuk formation. On the Kukpuk River, a fossil identified as Aucella crassicollis(?) (Imlay, R. W., oral communication) is found in a sequence of overturned beds that range from medium-bedded sandstone with minor amounts of interbedded siltstone to thin-bedded sandstone and siltstone. These fossiliferous beds are at least 2,000 feet thick, but form only part of the rocks assigned to the Okpikruak(?) formation. As Aucella crassicollis is found elsewhere in northern Alaska in rocks of the Okpikruak formation (Imlay, R. W., oral communication) the fossiliferous beds on the Kukpuk River are assigned to the Okpikruak formation with some confidence. Other rocks which are lithologically similar to the Aucella-bearing beds but unfossiliferous are included in the Okpikruak(?) formation on the Kukpuk River. Beneath the Aucella-bearing beds is a thick dark shale or siltstone which may belong either to the Tiglukpuk or Okpikruak formations, and is shown on the map and sections as Okpikruak. Rocks which cannot be assigned definitely to either the Tiglukpuk or Okpikruak formations crop out for several miles southeastward.

Rocks believed to be the equivalent of the Fortress Mountain formation crop out at the east end of the area traversed, and probably continue eastward for some distance. They consist of interbedded sandstone, much of which is calcareous, and argillaceous siltstone. Carbonized plant fragments are very common, and bottom markings are extremely well developed. The weathered siltstone has a distinct but faint bluish to greenish tinge.

## Structure

The structural grain along this section of the Kukpuk River trends northeastward, owing to its position between opposing tectonic elements. The Lisburne limestone has been thrust southeastward toward the western Brooks Range some 50 miles distant where thrusting is northwestward. Fold axes in the Tiglukpuk(?) and Okpikruak(?) formations trend northeastward, approximately parallel to the thrusts, and the larger folds are overturned to the southeast. Minor folds in the thin-bedded units of these two formations are extremely complex, but generally plunge southwestward. Section D-D' illustrates the complexity of small-scale folding and faulting. Faulting undoubtedly is much more complex than illustrated on the sections, and probably all the folds in these formations are tight and broken by faults. The fact that the thick Aucella-bearing beds are overturned, and crop out in but one place, demonstrates the structural complexity.

The Fortress Mountain(?) formation is exposed in the southeast part of the mapped area around the nose and flanks of a large anticline plunging steeply westward. The nose of the anticline is outlined by the river, which has cut around it. Dragfolds on the flanks of the major fold are complex, but in general the Fortress Mountain(?) formation appears to be less deformed than the Tiglukpuk(?) and Okpikruak(?) formations. This lack of deformation may be due to the greater competency of the thick sandstone beds of the Fortress Mountain(?) formation.

## Petroleum possibilities

No petroleum residues were observed in the field in any of the rocks traversed. Thin sections of some of the sandstone disclose that the clastic grains of quartz, plagioclase feldspar, and chert are angular and poorly sorted, and that the matrix is choked with clay minerals whose degree of diagenesis is great enough to develop some chlorite and to cloud grain boundaries by reaction between matrix and larger grains. Primary permeability and porosity of these rocks presumably are low; however, some secondary porosity could be developed by fracturing and (or) folding.

No igneous rocks were found, and in the thin sections examined the percentage of mafic minerals is significantly lower than in sections of similar rocks 175 miles to the east (Tailleur, I. L., oral communication). Furthermore, the conglomerate beds found on the Kukpuk River, as well as near Ogotoruk Creek, are significantly barren of igneous rocks, although some of the coarse sandstone contains a few fragments of altered rock that could be felsite. The apparent westward decrease of igneous material in the rocks of Early Cretaceous age may be useful in deciphering regional facies changes.

References cited

Bowsher, A. L., and Dutro, J. T., Jr., 1957, The Paleozoic section in the Shainin Lake area, Central Brooks Range, Alaska: U. S. Geol. Survey Prof. Paper 303-A, 39 p., 6 pls., 4 figs.

Gryc, George, and others, 1956, Mesozoic sequence in Colville River region, northern Alaska: Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 209-254, (see especially papers by W. W. Patton, Jr.).

Kindle, E. M., 1909, The section at Cape Thompson, Alaska: Am. Jour. Sci., ser. 4, v. 28, p. 520-528.

Smith, P. S., and Mertie, J. B., Jr., 1930, Geology and mineral resources of northwestern Alaska: U. S. Geol. Survey Bull. 815, 351 p., 34 pls., 22 figs.