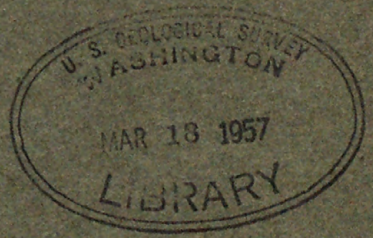

Reconnaissance study of the Marsh anticline, northern Alaska

By Robert H. Morris, 1921-

INTRODUCTION

The Marsh Creek area was first mapped by E. de K. Leffingwell (1919), as part of his study of the geology of the Canning River Region. Most of this region was restudied in 1948 through 1953 by the Geological Survey 1/ in support of the U. S. Navy's oil exploration program in northern Alaska. This restudy included interpretation of aerial photographs to supplement geologic field data.

In 1953, photogeologic studies of the lower Marsh Creek area indicated the presence of a large east-plunging anticline. Leffingwell mapped small exposures of Pliocene shale along Carter Creek and the Katakturuk River in that area, most of which is blanketed by Pleistocene (?) deposits. Geologic studies to the south indicate a regional north-trending high that may extend into the Marsh Creek area. Thus it seems probable that the Marsh anticline, within a few miles of the Arctic Coast, is a closed structure with Pliocene beds exposed at the crest.

With this information, the author field checked the lower Marsh Creek area in July 1953. A base camp was established about 5 miles from the coast on Marsh Creek. Field mapping was limited to the area accessible by daily traverses on foot. Photogeologic techniques were used to extrapolate data beyond this area.

GEOGRAPHY

The Marsh Creek area is in the Arctic Coastal Plain province. The northern boundary of the area is the shoreline of the Arctic Ocean, near the seventieth parallel North. The eastern boundary is defined by the Sadlerochit River which flows north into Camden Bay. The western part of the area is just west of the Katakturuk River.

Topography and drainage

The Marsh Creek area is typified by gently rolling linear hills formed by the dissection of unconsolidated Pleistocene (?) deposits and Miocene-Pliocene sandstone and shale. Relief does not exceed a few hundred feet. Marsh Creek and Carter Creek have fairly steep gradients for streams in the Arctic coastal plain. Courses of the streams are

---

1/ Investigations in NPR-4 and adjacent areas, northern Alaska, reports in open file, 1954, Washington, D. C.

Metcalf - Int. 2871

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington 25, D. C.

For Release JANUARY 31, 1957

GEOLOGIC REPORTS RELEASED FOR PUBLIC INSPECTION

The Geological Survey is releasing in open files the following reports on the geology of various parts of Alaska and Virginia. Copies are available for consultation at the Geological Survey Library, Room 1033, General Services Administration Building, Washington, D. C., and other places as listed.

1. Reconnaissance study of Marsh anticline, northern Alaska, by R. H. Morris. 6 p., 1 pl.

   On file at the Geological Survey libraries at Menlo Park, Calif. and Denver, Colo.; the Geological Survey offices at 157 Howard St., Spokane, Wash., 1031 Bartlett Bldg., Los Angeles, Calif., 724 Appraisers Bldg., San Francisco, Calif., 210 Glover Bldg., Anchorage, Alaska, Brooks Mem. Bldg., College, Alaska, 117 Federal Bldg., Juneau, Alaska; and Terr. Dept. of Mines, Terr. Bldg., Juneau, Alaska.

2. Regional aeromagnetic profiles in central-western Virginia, by R. W. Johnson, Jr. 3 figs.

   On file at the Geological Survey libraries at Menlo Park, Calif., and Denver, Colo.

marked by a succession of riffles and stretches of slower-moving, quiet waters. Each riffle drops about 1 foot in 100 feet. Carter Creek is much smaller than Marsh Creek and its stream bed is composed of sand, silt, and gravel. The bed of Marsh Creek is composed of much coarser debris, some of cobble size.

GEOLOGY

The oldest rocks exposed in the area are Tertiary in age. (See pl. 1). These rocks are so slightly indurated that outcrops are very scarce and bedding traces visible only where gravel lenses persist. In general, the strata tend to weather down into loose sand and clay mounds or thin soil mantles, thus obliterating the bedding. The strongly tilted Tertiary strata are truncated and overlain by a thin sequence of Pleistocene (?) sediments.

Tertiary rocks

The Tertiary strata include about 7,000 feet of sandstone and shale which are poorly exposed on the north flank of Marsh anticline along Carter Creek. The thickness of the upper 266 feet of the section was taped, and the rest was computed. Aerial photographs at 1:20,000 scale were used for horizontal control and Coast and Geodetic Survey bench marks for vertical control. The computed thicknesses are considered accurate within 15 percent. Details of the section are given below.

	Thickness (in feet)
Pleistocene (?) gravels.....	Thickness undetermined
Unconformity	
Top of Tertiary	
Unconsolidated, light-gray, fine- to medium-grained clean sandstone. Massive bedded in 3- to 4-foot units. Limestone and ironstone concretions and lenses. Fossils common in concretions, and at random throughout sandstone. Some light-gray clay shale streaks at top.....	50
Rubble traces of light-gray-weathering clay shale and silty shale.....	60
Blocky fracturing, slightly consolidate, medium-gray clay shale. Reddish-brown iron stains on bedding planes; even-bedded in 2- to 3-inch laminae. Shell fragments and fossil wood scattered throughout. Mineral encrustations on wood give bright yellow to reddish-brown stains. Fossil wood with worm borings. Calcite pseudomorphs after celestite common.....	100

Blocky to hackly fracturing, medium-gray clay shale. Joints perpendicular to bedding. Massive in beds 1-1½ feet thick. Local stringers 6 inches thick of 1/2-inch rounded pebbles of olive-gray, blue-gray, and black chert. Thin-shelled pelecypods common in upper part. Local ironstone and limestone concretions and lenses	48
Medium-gray slightly indurated silty shale. Blocky fracture perpendicular to bedding. Abundant dark-gray, blue-gray, and black chert, quartzite, and igneous rounded pebbles as much as 2 inches, in random orientation. Calcite pseudomorphs after celestite as much as 4 inches in float. Pelecypods in top of unit	8
Rubble traces of medium-grained, friable, light-gray sandstone with local long thin lenses of rounded chert, quartzite, and igneous pebble conglomerate. Sandstone interbedded with shale	2,500 ±
Intermittent outcrops and rubble traces of medium- to fine-grained sandstone. Friable with local iron cement. Thin, medium-gray silty shale interbeds. Occasional lenses 4-5 feet thick of blue-black, light-gray, and dark-gray rounded chert pebbles as much as 2 inches in diameter. Yellow streaks on bedding planes. Sandstone, thin-bedded to massive in beds 6 inches to 3 feet thick. Some sandstone units as much as 75 feet thick. Section predominantly sandstone	2,500 ±
Intermittent outcrops and rubble traces of clay shale and silty shale. Upper part of unit is light gray and weathers very light gray. Lower part of unit is medium gray with ironstone lenses and iron stains on bedding planes. Even bedded, 1/2 to 1 inch beds. At base of section is 10 feet of medium-grained, light-gray, clean friable sandstone	2,000 ±
Total	7,266 ±

Section incomplete, axis of anticline

Megafossils 2/ collected from the upper 210 feet indicate a late Tertiary age, either late Miocene or Pliocene. Megafossils from the next 56 feet indicate Miocene age, probably either late middle or upper. Microfossils are present in the upper 266 feet

2/ Age determined by F. Stearns MacNeil, U.S. Geological Survey

but add no definitive information as to the precise age of the beds 3/. Samples from the lower beds were examined for microfossils but were barren; these beds are believed to be Tertiary because of their stratigraphic position and because they compare favorably with known Tertiary rocks to the west.

Lenses of chert pebbles are as much as 5 feet thick, and commonly persist along strike for over a mile. In the measured section sandstone beds associated with the conglomerate lenses are fairly evenly bedded, but west of Marsh Creek where the lenses are more persistent, sandstone beds are irregular to cross bedded, contain considerable macerated plant remains and carbonaceous stringers, and locally are well indurated with limonite cement. These lithologic features imply that the strata were deposited in a beach or strandline environment.

The strata in this measured section can be traced westward from the Carter Creek area to the lowland west of Marsh Creek where the north-dipping conglomerate units form narrow whaleback ridges. Leffingwell (1919, p. 129-130) noted similar strata underlying the Pleistocene (?) cover in bluffs along the Katakturuk River. Here the beds also dip north. In one of these outcrops he noted numerous coal pebbles concentrated in a band several inches thick. West of the Katakturuk River the overlying gravel deposits have not been dissected enough to expose the Tertiary strata in such a way as to be recognized on aerial photographs. East of Carter Creek there are no known exposures of Tertiary rocks.

Correlation of the Tertiary rocks exposed on Carter Creek with the Sagavanirktok formation (Tertiary) farther west is suggested. Plant fossils in the lower part of the Sagavanirktok formation indicate a Paleocene-Eocene age, whereas the upper 266 feet of the strata at Carter Creek is Miocene and probably Pliocene, and is marine. No fossils upon which a correlation could be established have been obtained from the upper part of the Sagavanirktok formation or from the lower part of the Carter Creek section. However, considering regional structural trends and the geographical distribution of the two units, correlation of the Carter Creek section with the upper part of the Sagavanirktok formation as exposed in Franklin Bluffs seems probable.

Quaternary deposits

The Quaternary deposits may be divided into two units: 1) upland gravel deposits and 2) Recent alluvium along valley floors.

The upland gravels, as defined by Leffingwell (1919) include all the deposits of coarse gravel, cobbles, and locally mud and silt which rest unconformably on Tertiary. The maximum thickness of the upland gravels is estimated to be about 50 feet. The upland gravels consist of well-rounded pebbles (some polished), cobbles, and boulders of sandstone, chert, igneous rocks, and limestone. The matrix is a

---

3/ Ruth M. Todd, personal communication, U. S. Geological Survey

mixture of coarse sand and silt. Percussion marks are best developed on chert cobbles. No glacial striae were observed by the author, but Leffingwell (1919, p. 131) reports isolated striae on sandstone cobbles at the head of Marsh Creek.

Boulders as much as 2½ feet in diameter are present in the southern part of the area. The average size decreases gradually northward and at the northernmost location observed west of Marsh Creek the average size was 2-3 inches. Locally silt and mud are incorporated in the deposits but do not appear to be extensive. The upland gravels are well exposed in bluffs along Marsh Creek, Carter Creek, Katakturuk River, and Tamayariak Creek.

No fossils have been found in the upland gravels and the age assignment is based on geological relationships. As the gravels rest unconformably on Pliocene strata and are truncated by Recent deposits of alluvium, their age is assumed to be Pleistocene.

Recent deposits

In Carter Creek valley the alluvial material ranges in size from silt to small cobbles. In Marsh Creek valley the deposits are conspicuously coarser and range up to boulder size. The river bed in the vicinity of camp 1 contains fragments which average about 3 inches but also contains chert and quartzite boulders as much as 2 feet in maximum dimension. Shapes vary from angular to rounded. Many platy-bedded sandstone fragments form round discs 2-3 inches in diameter and 1/2 to 3/4 inch thick. Quartzite, sandstone, limestone, chert, and igneous rock fragments are present. Quartzite and sandstone are the most abundant.

Stream valleys are marked by several terraces and those along Marsh Creek may be considered as typical. The oldest terrace level is about 20 feet above the present river bed and forms a bench extending back to the valley slopes. In some places the bench is as much as half a mile in width; elsewhere the bench is dissected and only remnants may be observed. A second terrace occurs about 10 feet below the first. A small scarp generally marks the boundary between the first and second terraces. The boundary between the second and third level is also a small scarp but generally is less pronounced. In places the present river has cut back into the second level. The third and lowest terrace level is about 3 feet above normal water level and is the level which generally supports growths of scrub willows. Spring floods may inundate this terrace. The river is actively lowering this level as its braided coarse swings across the valley floor.

STRUCTURE

The major structure in the Marsh and Carter Creeks area is Marsh anticline, which trends north 70° E. More than 7,000 feet of upper Tertiary rocks is exposed in the north flank along Carter Creek. Beds near the axis are steeply folded and dips range from vertical to 23° N. and 24° S. Farther out on the north limb dips average 60°. The most northern part of the north limb dips 15°. The south limb is apparently less steep one mile south of the axis where a dip of 10° S. was observed. On Marsh Creek east of camp 1 shale beds in several outcrops dip 40° N. Several miles west of Marsh Creek over 7,000 feet of section is poorly exposed in outbanks along a small creek. Here north dips average 40°. In outbanks along the Katakturuk River dips of 25° - 30° N. on the east side and 40° N. on the west side were measured by Leffingwell (1919, p. 129-130). These dips have been plotted as accurately as possible on plate 1 according to his location descriptions.

On the basis of the available data, Marsh anticline is about 20 miles long. The north flank exposes over 7,000 feet of steeply dipping late Tertiary strata which are unconformably overlain by gently dipping early Pleistocene (?) upland gravels. East plunge of the anticline is indicated by two structurally controlled streams between Carter Creek and Sadlerochit River. The course of each of these streams forms a 180° arc, convex east, and exposes crescent-shaped traces of the upland gravels. The available vertical control on these traces indicates that the Marsh anticline plunges east about 200 feet in a distance of about 9 miles. However, these are bedding traces of upland gravels and therefore reflect only the latest stage of folding.

The Sadlerochit Mountains to the south are formed by a complex anticlinal fold which plunges both to the east and west. Mississippian rocks, exposed along the crest of the structure, plunge beneath Cretaceous rocks at both ends of the mountains, along the Canning River to the west and the Sadlerochit River to the east. It is estimated that at least 3,000 feet of "closure" would be required to satisfy these stratigraphic relationships. Thus, if Marsh anticline is genetically related to the same structural high a closure of similar magnitude may be present. The highest point would probably be in the vicinity of Marsh Creek.

LITERATURE CITED

Gryc, George, Patton, W. W., Jr., and Payne, T. G., 1951, Present Cretaceous Stratigraphic Nomenclature of Northern Alaska, Washington Acad. Sci. Jour., Vol. 41, pp. 159-67.

Leffingwell, E. de K., 1919, The Canning River region, northern Alaska: U. S. Geological Survey Prof. Paper 109.

Payne, T. G., and others, 1951, Geology of the Arctic Slope of Alaska: U. S. Geological Survey Oil and Gas Inv. Ser., OM 126.