

# **Geological report to the Ahtna Corporation, Copper River basin, Alaska, 1975**

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GMC DATA REPORT 455

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Amoco Production Company

COPPER RIVER BASIN,  
ALASKA

**GEOLOGICAL REPORT TO  
THE AHTNA CORPORATION**

CF750040 NOVEMBER, 1975



GEOLOGIC REPORT

COPPER RIVER BASIN

ALASKA

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by

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November, 1975

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AMOCO PRODUCTION COMPANY  
COPPER RIVER BASIN, ALASKA

GEOLOGICAL REPORT TO THE AHTNA CORPORATION

Denver Division Geological  
Report No. 154

South-Central Alaska  
Project No. 74-26

November, 1975

INTRODUCTION

GENERAL DISCUSSION:

The Copper River Basin is an intermontane basin located in south-central Alaska (Fig. 1, Encl. 1). The basin is encircled by mountain ranges: the Alaska Range and its low foothills to the north, the Wrangell Mountains to the east, the Chugach Mountains to the south, and on the west by the Talkeetna Mountains.

Within the broadly defined region a much more restricted area is considered suitable for hydrocarbon exploration (outlined by red tape on Encl. 1). This area contains about 92 townships (2,119,680 acres) and averages about 42 miles wide, north to south; and about 82 miles in length. Black tape on Enclosure 1 encloses the Ahtna Corporation contract area which covers the approximate eastern half of the prospective basin area. The flat to rolling nature of the terrain within the contract area (west of the Copper River Valley) is shown by photos 1, 2, and 3.



Photo 1: Looking east along Glenn Highway  
Town of Glenallen at mid picture



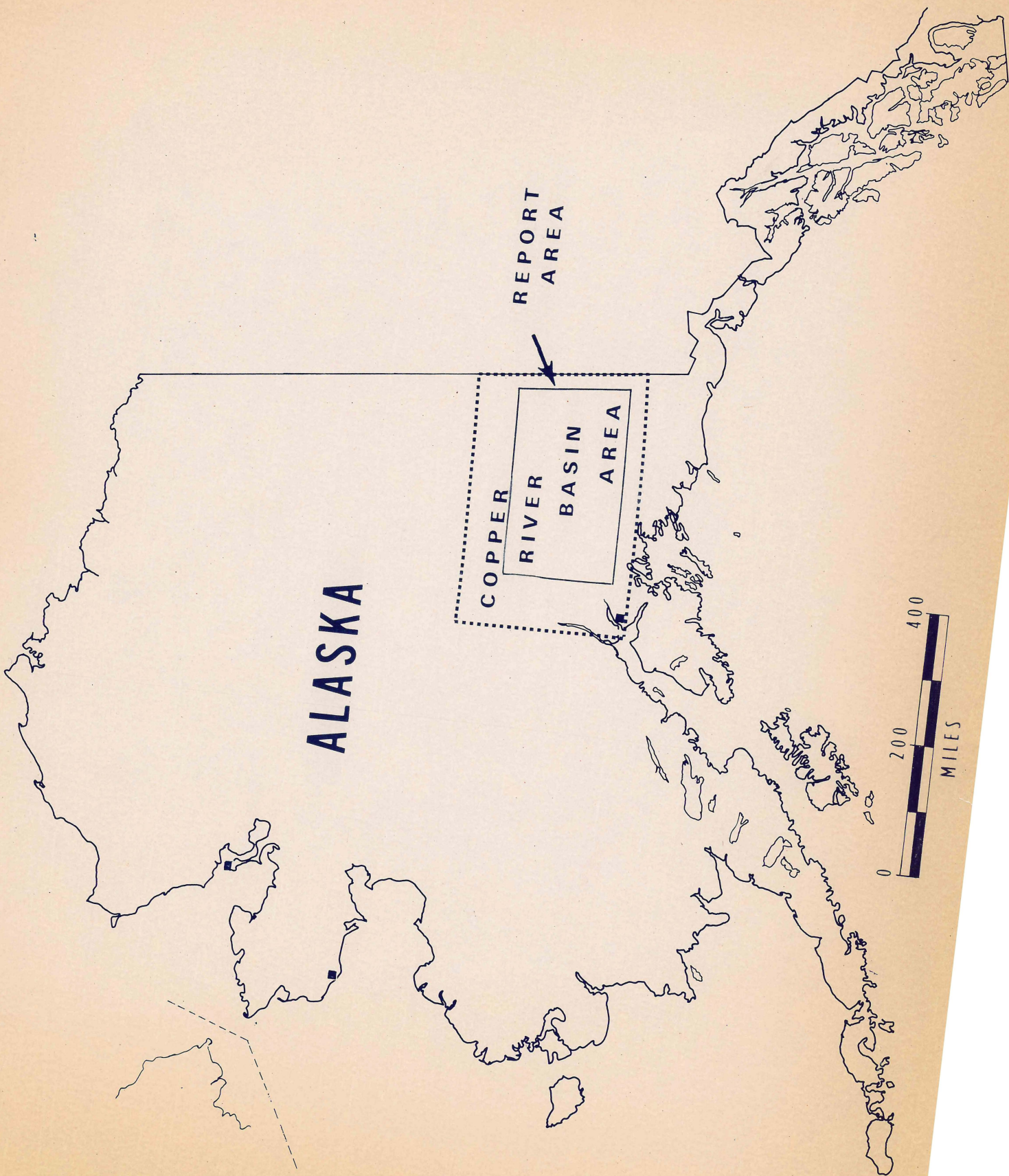
Photo 2: North along Richardson Highway  
from Gulkana Airport.



Photo 3: Looking southeast along Copper River - Edgerton Highway toward Lower Tonsina.

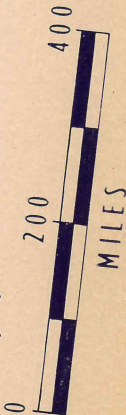


# ALASKA



REPORT  
AREA

COPPER  
RIVER  
BASIN  
AREA



PURPOSE:

The purpose of this report is to present the geology of the Copper River Basin area (Fig. 1, Encl. 1) of south-central Alaska and provide a stratigraphic interpretation of the prospective Ahtna Corporation contract area (Encl. 1) on which seismic program has been shot and current program is now in progress.

This study was conducted under Project No. 74-26 to evaluate the hydrocarbon possibilities of the area with primary emphasis on the stratigraphy of the Jurassic and Lower Cretaceous rock units.

METHODS OF INVESTIGATION:

A regional surface geology map (Encl. 1) was compiled primarily from U. S. Geological Survey data (see Reference list) to delineate the distribution of rock units within and around the Copper River Basin and to determine the outcrops available and accessible for field work.

During the summer of 1974, a two-month field program was undertaken in the Copper River Basin Area to study the stratigraphy of the prospective horizons. The data have been evaluated, with limited subsurface well data incorporated into the interpretation. Measured sections and field notes are included as an appendix to this report. Reconnaissance geophysical program during the 1974-1975 shooting season (lines shown by green tape on Encl. 1) discovered anomalies

within the Ahtna Corporation contract area that merited additional reconnaissance and detail seismic program for the 1975-1976 field season.

CONCLUSIONS:

The Ahtna contract area of the eastern Copper River Basin is prospective for oil and gas exploration of the Lower Cretaceous-Nelchina Formation because of the following qualities:

1. Favorable Nelchina Formation sand trends exist as shown on Enclosure 3.
2. Favorable reservoir qualities are present in the Nelchina sandstones.
  - (a) Outcrop samples on west and east side of the basin exhibit porosity and permeability and have strong oil odor. Possible oil stain was found on the west side at Limestone Gulch (Encl. 4).
  - (b) The Pan American No. 1 Moose Creek and Mobil No. 1 Salmon Berry Lake blew out and flowed appreciable amounts of water with slight gas shows.
3. Numerous seismic structural leads have been mapped in the contract area.
4. Basinal shales of the Middle and Upper Jurassic and the Lower and Upper Cretaceous should provide adequate source beds for hydrocarbons in the Copper River Basin.

## STRATIGRAPHY

### REGIONAL GEOLOGY

During the late Paleozoic Era, southern Alaska was a region of eugeosynclinal deposition (now being referred to as Volcanic Island Arc). A thick sequence of volcanic and volcanoclastic rocks was deposited during the Pennsylvanian Period (Richter and Jones, 1973), overlain by Permian limestones, shales, siltstones and sandstones. This sequence is overlain by subaerial basaltic lava flows, limestones, shales and cherts of Upper Triassic age, followed by volcanic and volcanoclastic rocks of the Lower Jurassic-Talkeetna Formation in the Talkeetna and northern Chugach Mountains. At the same time, shales, limestones, spiculites, cherts and argillites of the McCarthy and Lubbe Creek Formations were deposited in the Wrangell Mountains (Imlay and Detterman, 1973)

Near the end of the Lower Jurassic period the rocks of the eugeosyncline were deformed, intruded by the granitic "Kosina Batholith" in the Talkeetna Mountains (Grantz, et al, 1963) and metamorphosed by a period of orogeny which formed the Matanuska geosyncline (Payne, 1955), in which the prospective rocks of the Copper River Basin were deposited.

In the western part of the Copper River Basin over 17,000' of marine sediments were deposited in the Matanuska Geosyncline from Middle Jurassic to Upper Cretaceous time (Shaw, 1960). The source of these sediments was the emergent

area to the west and north in the Talkeetna Mountains and possibly around the northern part of the basin, with most of the clastics derived from early Mesozoic volcanics. After the quartz diorite batholith of the Talkeetna Mountains was unroofed in middle Upper Jurassic time, the sediments were dominantly quartz with a high feldspar content (Shaw, 1960).

Uplift and erosion followed the deposition of the Tuxedni Formation, but folding was apparently not pronounced, as the Chinitna Formation lies on the Tuxedni Formation with no angular discordance. The Upper Jurassic-Naknek Formation unconformably overlies the Chinitna Formation. *reference?*

Uplift and folding occurred at the end of the Jurassic followed by deposition of sandstones, limestones, siltstones and shales of the Lower and Upper Cretaceous rocks.

At the end of Upper Cretaceous time, uplift and erosion occurred, followed by deposition of Continental fluviatile deposits of conglomerate, sandstone, shale and coal.

In Late Tertiary time, the region was again deformed and the basin edges uplifted. Quaternary deposits have concealed most of the Tertiary and Upper Cretaceous deposits in the Copper River Basin.

#### WESTERN COPPER RIVER BASIN

On the west side of the basin, the composite stratigraphic section attains a thickness of about 20,000' of Middle

Jurassic through Tertiary sediments (Fig. 2). Due to truncation and non-deposition, the thickness of the geologic column ranges considerably around the basin margins so that an average figure of about 10,000' is anticipated for the deeper portions of the basins.

#### AHTNA CORPORATION CONTRACT AREA

The geologic column for this area is shown by the Pan American #1 Moose Creek Unit (Fig. 3). Only 7020' of Lower Cretaceous to Tertiary are present above the Lower Jurassic(?) - Talkeetna Formation. The Middle Jurassic-Tuxedni sandstones, and Upper Jurassic-Chinitna and Naknek sandstones which are prospective on the west side of the basin have been removed by pre-Lower Cretaceous erosion. Information concerning the Jurassic sands was submitted in the first report to the Ahtna Corporation (Amoco, 1974). The Nelchina Formation in the Moose Creek well is 1083' thick, containing upper and lower sand zones totaling 480-550' sandstone. The well blew out at 6074' while drilling and flowed some gas and water at the rate of 848 BWP<sup>H</sup>D. 20,252 BWP<sup>D</sup>D

The primary objective horizon in the Eastern Copper River Basin is the Nelchina Formation. See Enclosure 3 for trends of the gross sand isopach across the Ahtna Corporation contract area.

#### LOWER CRETACEOUS

##### NELCHINA FORMATION (Neocomian Age)

The Nelchina Formation crops out the west and east sides

of the basin (Encls. 1 & 3) and is present in the subsurface at the Pan American #1 Moose Creek Unit and the Mobil #1 Salmon Berry Lake Unit. It ranges in thickness from 70' to 1900'. At Limestone Gulch (Encl. 4), the Nelchina is 1238' <sup>1135'?</sup> thick consisting of three Units, a lower sandstone 520' thick overlain by 120' of bioclastic limestone (Calcarenite composed mostly from pulverized Inoceramus shells), and an upper sandstone 495' thick. The sandstones are arkosic, and poorly cemented to friable. Measured porosities from the better cemented samples vary from 14.8% to 24.3%, with permeabilities from .34 to 669 mds. The upper 700' of the Upper, Middle and Lower Nelchina have a strong petroleum odor, and possible olive-brown oil stain. These sands were derived predominantly from a quartz diorite batholith to the west and north which became a source for sediments about the middle of the Upper Jurassic (Shaw, 1960). For additional details see Geologic Report by Amoco (1974).

#### ENVIRONMENT OF DEPOSITION:

The Nelchina Formation is a shelf deposit, more specifically nearshore shoals and bar deposits which onlap the eroded surface of the Upper Jurassic-Naknek Formation (Encl. 3 & 4).

At Bubb Creek (Limestone Gap) section (Encl. 4), a subaqueous distributary system is evidently the conduit which brings much of the clastics into the system. The pulverized Inoceramus shells, of which the limestone is composed,

and the wave ripples attest to the strong wave action.

Cross Sections F-F' and G-G' (Encls. 5 & 6) provide the control data for the sand isopach and trends (Encl. 3) of the Nelchina Formation in the southwest Wrangell and north Chugach Mountains. Several evidences for subaqueous distributary systems are present.

The Chetaslina River and Cheshnina River sections (Nos. 40 & 41 respectively, in pocket), originally considered of Upper Jurassic Age (Grantz, 1966), are now new points of control for the Lower Cretaceous-Nelchina Formation. Approximately 1000'+ calcareous sandstone is present at the Cheshnina River Section. Core analysis of a sample at bottom of the section shows 9.9% porosity and permeability of 55.8 mds. Sandstones are grey to brownish grey with scattered pebble conglomeratic lenses, carbonates, and are fine to coarse grained. A few plant (fern) fossils, carbonized wood and part of an Ammonite was found. Only 520' of sandstone was measured on the Chetaslina River. About 120' of silty limestone to limy siltstone with Inoceramus prisms and possible abundant crushed pelecypod shells overlies the sandstones. Both sections are dipping about 25° SW, basinward.

#### UPPER CRETACEOUS

##### MATANUSKA FORMATION

A secondary objective horizon in the Ahtna contract area is the Upper Cretaceous - Matanuska Formation. The sand zones



encountered at the Pan American #1 Moose Creek Well between 3783-4759' are not clean in the Moose Creek area, but may be more prospective northward toward its source area (see Amoco, 1974, for more detailed information.)

## STRUCTURE

### REGIONAL

The Copper River Basin is a large structural and topographic basin covered by Quaternary glacio-alluvial deposits and surrounded by mountain ranges composed of folded Paleozoic and early Mesozoic sedimentary and igneous rocks. It was formed by a major orogeny in Early Jurassic time as a depression in the folded and metamorphosed contents of an older eugeosyncline.

### WEST COPPER RIVER BASIN

Structures of the Nelchina area, such as the Sheep and Horn Mountains are large anticlinal features that plunge northeastward. Structural cross-section A-A' (Encl. 2) shows the NW-SE interpretation from the Talkeetna Mountains across the Nelchina area on to the Chugach Mountains (Grantz, 1965).

The Castle Mountain and Caribou Faults are two right-lateral strike-slip fault systems which trend easterly across the Nelchina area and divide it into three blocks (Grantz, 1965). These two faults merge in the Central Matanuska Valley and form the north bounding fault of the lower Matanuska Valley.

### EAST COPPER RIVER BASIN

Structures of the southwest Wrangells trend northwestward parallel to the strike of the beds with much high angle

reverse faulting, see structural sections B-B' and C-C' (Encl. 2). Southwest basinward dips of 20° - 25° SW were noted at the Lower Cretaceous-Snider Peak, Chetaslina and Cheshnina River Sections.

The structural grain of the McCarthy area - Upper Chitina Valley is also northwestward. The structural interpretation of the eastern Wrangells is shown by Section D-D' (Encl. 2).

#### CENTRAL COPPER RIVER BASIN

Seismic program indicates an east-west alignment of the structures in the Ahtna Corporation contract area as does the alignment of the Permo-Pennsylvanian meta-volcanics and the Triassic-Nikolai Greenstone along the north flank of the basin.

#### SOUTH COPPER RIVER BASIN

Along most of the north flank of the Chugach Mountains, southern Wrangells, and along the entire Chinitna Valley there is evidence to support a major uplift and folding in Late Jurassic time followed by southward truncation of the geologic column down to the Permo-Pennsylvanian meta-volcanics and meta-sediments. Subsequently, the Wrangell positive was formed in latest Jurassic time. The Lower Cretaceous sea transgressed northward depositing the Nelchina Formation, progressively onlapping the highly dissected older formations. In turn, the Albian Age-Kennicott Formation onlapped the Nelchina Formation. This continued into the Upper Cretaceous

with numerous oscillations of the sea recorded by the geologic section. In Late Campanian-Maestrichtian time, the MacColl Ridge Formation represents a regressive series caused by the rejuvenation of the Wrangell Positive. There is no record of the early Tertiary periods. In Miocene time, the continental fluviatile sediments of the Frederika Formation, up to 2000' thick, were deposited and in places intercalated with flows of Wrangell lavas. Igneous intrusives were common.

The Wrangell lava superceded the Frederika Formation, building the gigantic Wrangell pile from Miocene time to Recent. A period of regional folding and faulting apparently took place in Late Tertiary time.

#### SUMMARY:

The Matanuska geosyncline was formed in Early Jurassic time. Throughout Middle and Upper Jurassic time, nearshore and rather shallow basin sediments were deposited along an unstable shelf as evidenced by unconformities within the column. In Late Jurassic time, major uplift and folding occurred along the southern Wrangells, Chitina Valley and Chugach Mountains at least along the eastern portion of the southern flank of the Copper River Basin. The sedimentary column down to the Early Paleozoics <sup>was</sup> were stripped along the southern Wrangell and Chugach Mountains. Subsequently, the Wrangell positive developed as well as the emergent Talkeetna High. The Lower Cretaceous seas transgressed northward depositing nearshore sediments of Neocomian and Albian age

on the unstable shelf. This continued into the Upper Cretaceous with numerous oscillations of the sea. <sup>When</sup> The more basinal Matanuska Formation and coeval rock were deposited. Regression and uplift with folding occurred at the end of Cretaceous time. This resulted in a depositional and structural belt which essentially parallels the present arcuate coast line.

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