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TWENTY MEASURED SECTIONS OF PERMIAN ECHOOKA FORMATION, NORTHEASTERN BROOKS RANGE, ALASKA

By
Gregg A. Hakkila

Department of Geoscience
University of Alaska
Fairbanks, Alaska 99775

INTRODUCTION

The Echooka Formation comprises the lower part of the Sadlerochit Group of the Ellesmerian Sequence. It has been dated as Wolfcampian to Guadalupean (Detterman et al., 1975) and consists of two members; the lower Joe Creek Member and the upper Ikiakpauruk Member. The Echooka rests disconformably on the Wahoo Limestone of the Lisburne Group, and appears to be the result of a northward transgressing sea in Permian time. It was likely derived from a low relief northern source area (Detterman, 1970) and appears to thin rapidly northward in the Sadlerochit Mountains. It is not present in the subsurface at Prudhoe Bay, to the northwest. Constraints on the lateral and vertical lithologic character of the Echooka Formation will be useful in predicting trends of this unit in the subsurface of the Arctic National Wildlife Refuge (A.N.W.R.).

The Joe Creek Member is predominantly a calcareous sandstone, with some localities containing a basal chert conglomerate. It also has horizons of highly abraded bivalve shells and other marine fossil fragments. The layers of fossil hash are sporadic and appear to be the result of storm deposits during Echooka time rather than fauna suited to the highly siliciclastic environment in which they occurred.

The Ikiakpauruk Member is composed of quartz arenite and siltstone with interbedded silty shale. Basal chert

conglomerates are found locally in this member as well. Glauconitic grains and phosphatic intervals are common throughout the formation, and are the predominant grain type in some horizons of the Ikiakpauruk Member.

SCOPE OF STUDY

This research project consisted of collection of detailed sedimentological, stratigraphic, and structural data in the vicinity of the Sadlerochit Mountains during the summer of 1986. Sedimentological study included analysis and description of primary and secondary sedimentary structures, size, sorting and rounding of grains, mineralogy of grains and cements, and paleocurrent indicators.

Stratigraphic study consisted of measuring the section in twenty critical localities. These measurements are detailed, bed-by-bed descriptions which incorporated the sedimentological criteria listed above as well as contact and thickness relations.

Structural data such as attitude of beds, faults, and folds were recorded where observable. These observations may prove useful in evaluating the character and displacement of east-west trending thrust faults and folds responsible for the topographic relief of the Sadlerochit Mountains and in determining which aspects of the Echooka vary laterally due to post depositional tectonics.

METHODS

This report presents data and generalized interpretations from twenty measured sections of the Echooka

Formation in and around the Sadlerochit Mountains. Outcrops were located over a large area in order to observe lateral as well as vertical variation in the Echooka. Brunton compass and Jacob's staff were employed. Localities where sections were measured are presented in figure 1. Data are presented graphically with descriptions and location information in the accompanying plates. Attitudes given are for the uppermost Wahoo Limestone (except where otherwise indicated) due to the incompetent nature and poor preservation of the beds of the Echooka.

OBSERVATIONS

The Upper Paleozoic and Lower Mesozoic sedimentary rocks of northeastern Alaska represent a transition from Carboniferous carbonate production to Permian and Triassic clastic deposition. Carboniferous Lisburne Group limestones were deposited on a stable platform as a series of upward shallowing cycles. Carbonate production ceased as the result of relative regression and subsequent erosion during Late Pennsylvanian and Early Permian time. Relative transgression then progradation ensued in Permian and Triassic time, and resulted in deposition of the clastic rocks of the Sadlerochit Group. Age and stratigraphic relations are shown in figure 2.

A regression, then a carbonate-to-clastic transition are recorded in the unconformity at the base of the Echooka formation and in the rocks of the lower member of the Echooka, the Joe Creek. Rocks of the upper Echooka member,

the Ikiakpauruk, record a Guadalupean transgression. This depositional episode ended with the large sand influx of the Ivishak Formation.

Notable observations include a significant disconformity at the base of the Echooka, the occurrence of localized, possibly fluvial channel conglomerates in the central Sadlerochit Mountains, documentation of calcareous to cherty rocks of the Joe Creek Member, and the apparently gradational upper contact from quartzose sand and silt deposits of the Ikiakpauruk Member into the overlying Kavik Shale of the Ivishak Formation.

Evidence clearly supports the hypothetical lacuna before Echooka deposition. The Wahoo Limestone immediately below the Lisburne-Sadlerochit contact varies from lime mudstone through wackestone and packstone to bioclastic grainstones. Outcrops typically show erosional relief on the order of five meters. Previous studies have shown the top of the Wahoo to contain Atokan (Middle Pennsylvanian) fossil assemblages, while the oldest Echooka assemblages imply a Wolfcampian (Lower Permian) age (Detterman and others, 1975).

The Joe Creek Member is typically a medium grained sandstone with 80% quartz and 20% detrital calcite. It contains some thin limestone and chert beds locally and frequently has thin layers of abraded bivalve shell fragments. In the central Sadlerochit Mountains, this "basal" member is underlain by a siliceous chert

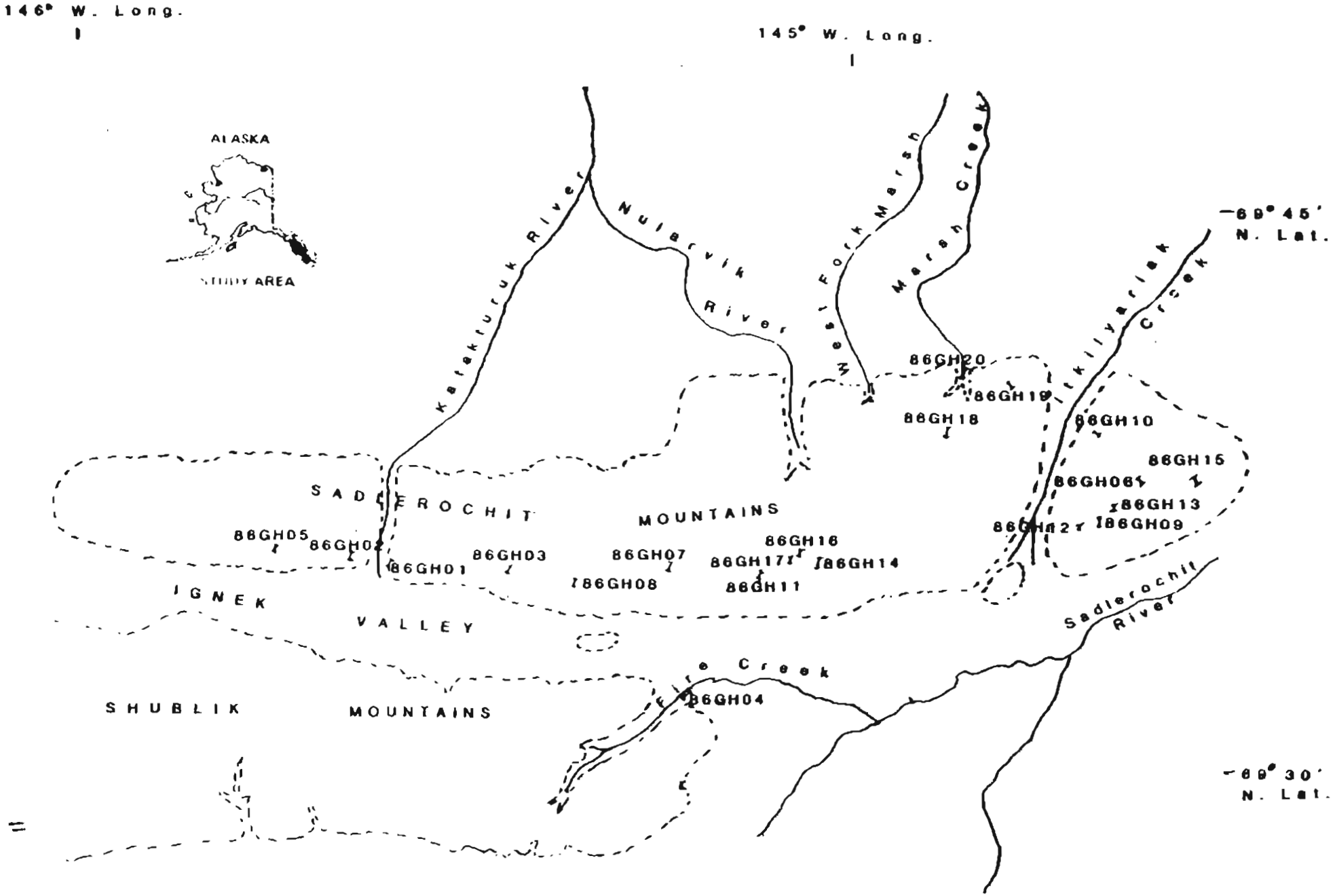

Figure 1. Locations of Echooka Formation measured sections. Inset shows study area location. Scale 1:250,000

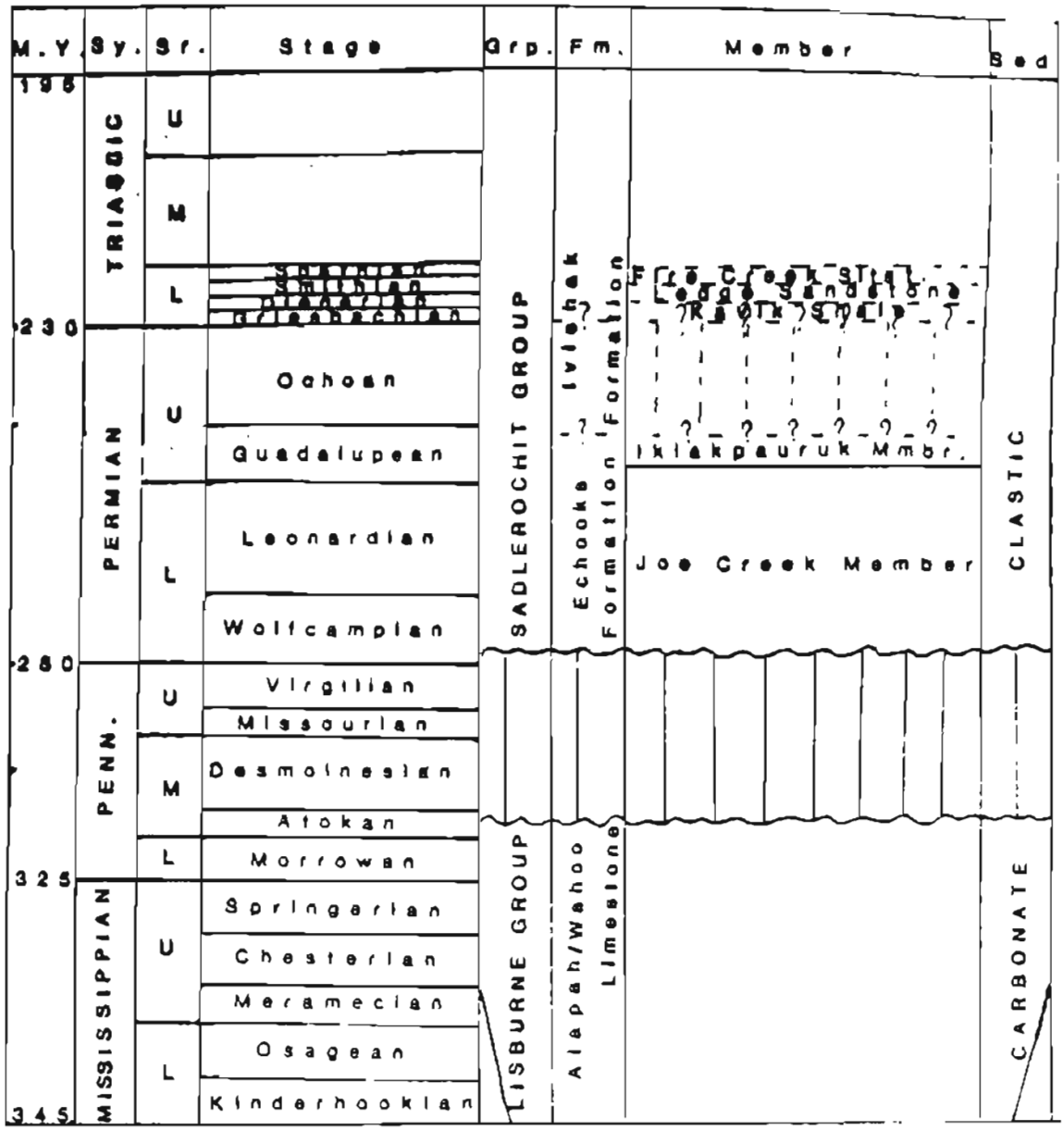

Figure 2. Age and stratigraphic relations for the Echooka Formation.

conglomerate complexly intertongued with cross-bedded siliceous quartz arenite. Although the clasts in this conglomerate are similar to those of conglomeratic layers in the overlying Joe Creek, the cement mineralogy is not. This lowest Echooka has silica cement and lacks detrital calcite and shell fragments. It occurs in erosional troughs scoured into the Wahoo Limestone and appears to be a deposit suggestive of braided river deposition. This unit is best observed in sections 86GH08, 86GH11, and 86GH14. The calcareous sandstone of the Joe Creek is present in all localities except 86GH10 and 86GH20 at the northeastern edge of the study area.

The Ikiakpauruk member, which is a medium quartz arenite to siltstone, appears to grade upward into the lithologically similar but finer grained Kavik Shale. The units both contain abundant black matrix material which appears to be disseminated organic detritus. The Ikiakpauruk member is itself a sequence of upward fining units. Both units contain abundant glauconite and pyrite, indicating similar diageneic histories that would be expected in a gradationally related sedimentary package. Where the top contact of the Echooka is clearly exposed in the Sadlerochit Mountains it seems to indicate that the Kavik shale is a gradationally finer version of the Ikiakpauruk. There is no apparent break in deposition between the two units.

CONCLUSIONS

The Echooka Formation contains previously undocumented deposits at the base which are indicative of a fluvial environment. The interbedded sandstones and conglomerates present in the central Sadlerochit Mountains indicate an important transition from erosional to depositional setting during Early Permian time. Depositional settings range from fluvial to nearshore and into the highly bioturbated sands of the shallow shelf.

The nature of the contacts of the Echooka formation were assessed. The lower contact apparently represents moderate erosion along the Wahoo Limestone during Late Pennsylvanian time. The upper contact seems to represent a gradation without an obvious break in deposition from Ikiakpauruk Member of the Echooka into Kavik Shale Member of the overlying Ivishak Formation. The transgressive upward deepening Echooka Formation environment culminated in the deepest water deposition of the Kavik Shale.

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