September 26, 1994 Price: $35.00

Division of Geological & Geophysical Surveys

PUBLIC-DATA FILE 94-45

COLUMNAR SECTIONS AND LITHOSTRATIGRAPHIC CORRELATION OF THE PERMIAN SIKSIKPUK AND ECHOOKA FORMATIONS, NORTHCENTRAL BROOKS RANGE, NORTHERN ALASKA

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September 1994

Released by

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
Division of Geological & Geophysical Surveys
794 University Avenue, Suite 200
Fairbanks, Alaska 99709-3645

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Introductory discussion

Reconstructing ancient depositional environments is a fundamental tool for unraveling the tectonic history of the Brooks Range fold-thrust belt of northern Alaska. In the north-central Brooks Range, original stratigraphic relations of Permian sedimentary rocks are key to illuminating the structural nature of the northern Endicott Mountains. In models of Mull (1982) and Oldow and others (1987), the northern Endicott Mountains have been thrust from south to north over the area of the present Mt. Doonerak high as part of the Endicott Mountains allochthon, interpreted as the lowest, thickest, and most extensive of the major allochthons in the northern Brooks Range (fig. 1). In an alternative model, suggesting little tectonic transport, Kelley and Brosgé (1989) envision the northern Endicott Mountains as basin fill thrust a short distance southward onto the northern flank of the Mt. Doonerak high.

To provide stratigraphic constraints for these opposing models, 10 columnar sections of Permian rock, depicted on the following sheets, were measured, described, and sampled in the north-central Brooks Range with tape, a Jacob's staff, and a Brunton compass during the 1984 and 1985 field seasons. The sections are situated within an area of 30 by 150 km in the Wiseman, Chandler Lake, and Philip Smith Mountains quadrangles. Seven of the sections are within the proposed Endicott Mountains allochthon, two are in the Mt. Doonerak area, and a tenth was measured in the Accomplishment Creek area, just north of the leading edge of the allochthon (fig. 1). Permian rocks were chosen for this study because they exhibit more lithologic variability than most surrounding units, contain marker horizons that can be correlated regionally, and comprise a relatively thin stratigraphic interval of 40-160 m.

Permian sections on the Endicott Mountains allochthon (sheets 1-7) comprise a variegated, overall fining-upward succession of interbedded silty shale and siltstone, concretionary shale, and siliceous mudstone correlative with informal lithostratigraphic units A - D of the Siksikpuk Formation. Although units A - D are recognizable throughout the central and western Brooks Range, they vary slightly in thickness and lithology. In the seven columnar sections of Siksikpuk on the Endicott Mountains allochthon, unit A consists of a thin, but conspicuous, interval of mostly red-brown- to orange-brown-weathering, pyritic siltstone. Unit B is mostly green-gray- and maroon-weathering mudstone, subdivided into a lower interbedded siltstone and silty shale (unit B_1) and an upper concretionary shale (unit B_2). Unit C is the most resistant of the units, comprising mostly rhythmically bedded siliceous shale, and unit D is made up of gray to black and minor variegated, concretionary shale. Overall, Permian sections on the Endicott Mountains allochthon record transgressive-regressive deposition within water depths no deeper than middle shelf. The base of the sections document storm-dominated deposition within shoreface environments; the remainder, mostly suspension sedimentation farther offshore.

Permian rocks in the Mt. Doonerak and Accomplishment Creek areas (sheets 8-10) are organized similarly to the Siksikpuk Formation, comprising an overall fining-upward succession of shelfal deposits, and can be correlated with units A, B_1, and D of the Siksikpuk Formation. However, in contrast with Permian sections on the Endicott

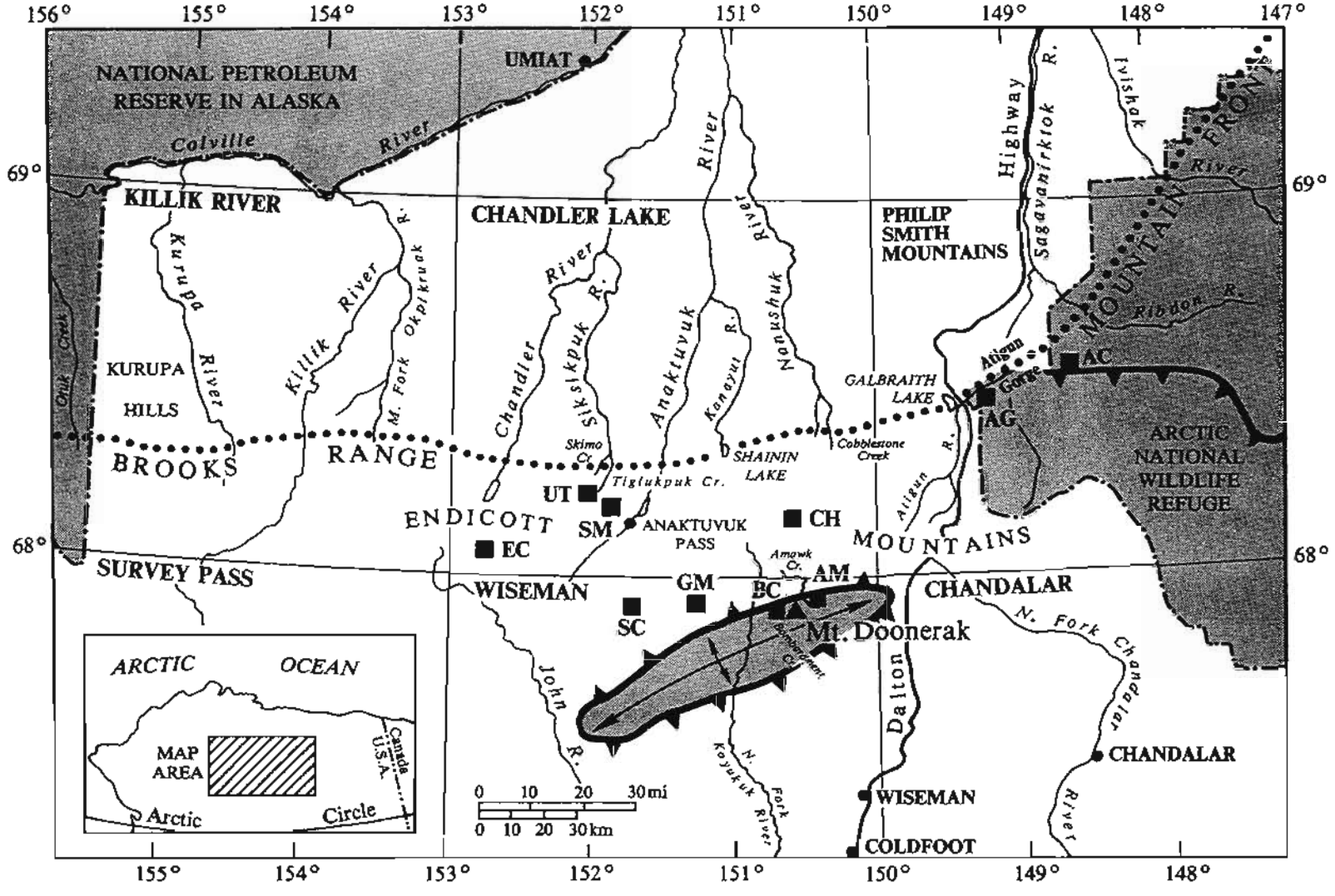

Figure 1. Index map of north-central Brooks Range, Alaska, showing location of columnar sections: AC, Accomplishment Creek area; AG, Atigun Gorge; UT, upper Tiglukpuk Creek; SM, Soakpak Mountain; CH, Cockedhat Mountain; EC, Ekokpuk Creek; SC, Savioyok Creek; GM, Gray Mountain; BC, Bombardment Creek; AM, Amawk Creek. Northern boundary of Endicott Mountains allochthon is coincident with Brooks Range mountain front from western border of map area to northeastern end of Atigun Gorge. From northeastern end of Atigun Gorge to eastern border of map area, northern boundary is marked by sawteeth.

Mountains allochthon, those in the Mt. Doonerak and Accomplishment Creek areas are darker, less siliceous, and more carbonate rich, features characteristic of the Siksikpuk's proximal equivalent, the Echooka Formation. In addition, storm beds in the Mt. Doonerak and Accomplishment Creek areas exhibit more proximal features than those on the allochthon, including thicker, coarser, and more closely spaced beds, and contain generally larger, more robust, and more diverse megafauna than those on the allochthon. Notably, the megafaunal assemblage in the Accomplishment Creek area is slightly younger than any of the other assemblages collected from the Permian sections.

When the Endicott Mountains allochthon is restored a minimum of 80 km to a position south of the Mt. Doonerak area (sheet 11), Permian rocks grade systematically from younger, more proximal facies in the northeast (Echooka Formation), in the direction of an inferred sourceland, to older, more distal facies in the southwest (Siksikpuk Formation). From northeast to southwest within the reconstructed basin, Permian storm beds become increasingly isolated and progressively finer grained, thinner bedded, and less carbonate rich. Megafauna preserved within the storm beds grade from an abundant crinoid-dominated assemblage of late Early Permian (Leonardian) age in the northeast to an older (early Early Pemian--Wolfcampian), impoverished brachiopod-dominated assemblage to the southwest. Shales within the Permian succession grade systematically from thicker, darker, clay-rich intervals in the northeast to thinner, variegated, siliceous packages in the southwest. Microfossils within the shale also increase in age toward the southwest, in keeping with the time-transgressive trend of the megafaunal assemblage. These systematic changes in lithology and fauna within the reconstructed basin imply that rocks of the northern Endicott Mountains are allochthonous and now structurally overlie a proximal stratigraphic succession similar to that exposed in the Mt. Doonerak area and northeastern Brooks Range (fig. 1). If rocks of the Endicott Mountains were deposited originally north of the Mt. Doonerak area, Permian facies relations in the north-central Brooks Range appear inconsistent with existing depositional models.

Supporting data for these conclusions are presented and discussed in Adams (1991) and summarized in Adams and others (1991). Preliminary results of this study have been published by Adams and Mull (1985), Adams and others (1987), Mull and others (1987), and Adams and Siok (1989). In addition to a graphic representation of the 10 columnar sections measured in the north-central Brooks Range, the following sheets include age and fossil data, vitrinite reflectance (R_o) values, thermal and conodont indices (TAI and CAI, respectively), and an inset map of the generalized geology of the area surrounding each measured section.

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