

**SMECTITE DIAGENESIS IN BENTONITES OF THE SHALE WALL MEMBER OF THE SEABEE FORMATION,
NORTH SLOPE, ALASKA**

J. R. Glasmann
Union Oil Research
Box 76
Brea, CA 92621
714-528-7201

ABSTRACT

The Upper Cretaceous Colville Group is present over much of the north-central North Slope and includes the Seabee Formation, a part of a progradational clastic wedge derived from the ancestral Brooks Range. The lower member of the Seabee Formation, the Shale Wall Member, contains thin to moderately thick bentonite beds. Biotite separated from bentonite from the Shale Wall Member in the northwestern subcrop area yielded K/Ar ages of about 92 Ma (Lanphere and TAILLEUR, 1983), dating the origin of these pyroclastic deposits as early Turonian. In the northern part of the National Petroleum Reserve in Alaska (NPRA) and in the vicinity of Prudhoe Bay Field, the <2 millimicron fraction of Shale Wall bentonites consists predominantly of smectite with trace to minor amounts of kaolinite. Eastward along the Barrow Arch, the depth of burial of the Shale Wall Member increases from <1,000 feet (300 m) in the NPRA to >12,500 feet (4000 m) in the vicinity of Mikkelsen Bay as a result of downwarping of the Barrow Arch and thick Tertiary deposition. At a depth of burial of ~2 miles (3600 m) the smectite-rich bentonites are replaced by rectorite, an ordered mixed-layer illite/smectite (I/S). With increasing depth of burial, the percentage of expandable layers in the ordered I/S decreases from about 45 to 20 percent. K/Ar dating of the ordered I/S phase places the time of formation in the mid-Miocene, in close agreement with predicted timing of clay diagenesis based on burial history/thermal gradient considerations.

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**THE CANNING RIVER REGION
NORTHERN ALASKA**

BY
ERNEST DE K. LEFFINGWELL



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PREFACE.

By ALFRED H. BROOKS.

Prior to the explorations whose results are set forth in this volume the Canning River region of Arctic Alaska was almost unknown. The adjacent seas had been visited by whalers, and the coast had been hastily traversed by several explorers, but the detailed features of the coast line were unknown and the inland region had been visited by only a few prospectors and fur hunters, so that only its larger geographic features were known. The region as a whole therefore presented an almost complete hiatus in the scientific knowledge of Alaska, and Mr. Leffingwell has performed a most valuable service in mapping its geography and geology. However, as this report will show, his researches were by no means limited to these subjects, for he has recorded facts and made interpretations relating to many problems in other fields of science.

Nearly all parties that have undertaken exploration in Alaska and polar regions have been large enough to permit both the scientific observations and the physical labor incident to travel to be divided among several men. Not so with Mr. Leffingwell's party, for most of the time after the departure of Mikkelsen, in 1907, he had only one white man to help him, and he one who could take no part in the scientific observations. In fact, he made many of his journeys with only one or two Eskimo companions, and he made some entirely alone.

The field was one of his own choice, and the explorations were made at his own initiative and expense. Therefore the results here set forth are in every sense of the word entirely Mr. Leffingwell's own contribution to science and to a better understanding of Arctic Alaska.

The modest narrative of his explorations here presented gives but a very inadequate conception of the self-sacrifice and hardships he endured during the years of his exploration. The reader of this volume should, however, constantly bear in mind the very adverse conditions under which the field work was done, for only thus can he understand why it was not possible to obtain the full information necessary to a complete analysis of all the problems presented.

Mr. Leffingwell's cartographic work on the coast, the results of which are shown on the maps in this report (Pls. I-V, in pocket), was based on accurate mensuration and determination of geodetic positions. He presents the first accurate chart of the north Arctic coast of Alaska, and his coastal maps are a valuable contribution to the knowledge of shore-line topography in the polar regions. It was not possible with his facilities to map the inland region with the same degree of refinement. In this part of the field, however, Mr. Leffingwell has made a valuable contribution to our knowledge of Alaska's larger geographic features, and this work, together with his geologic reconnaissance surveys, will be an important link between the investigations made along the international boundary on the east and Colville River on the west.

Not the least of Mr. Leffingwell's contributions to science is his detailed study of the ground ice, the results of which are set forth in this volume. He has also not only discussed the physiography of the region, including both past and present glaciation, but has analyzed in detail the processes of erosion and deposition under polar climatic conditions.

Mr. Leffingwell has, I think, been wise in his form of presentation. He has given not only his deductions and generalizations but also a detailed record of the observed facts. This complete record is especially valuable as to those subjects in which it was not possible

to make the field studies exhaustive, for it enables those who do not accept his conclusions to put their own interpretations on the facts presented. In my opinion, some of his conclusions can be called in question on the evidence presented, but this fact does not detract from the value of the report as a whole.

INTRODUCTION.

OUTLINE OF WORK DONE.

In the spring of 1906 a small expedition was organized by Capt. Ejnar Mikkelsen and the writer for the purpose of exploring Beaufort Sea, which lies north of Alaska. This expedition received the rather pretentious name of Anglo-American Polar Expedition, owing to the fact that the Royal Geographical Society of London and the American Geographical Society of New York were contributors to the funds. Mikkelsen and the writer were joint commanders, and consequently the name Mikkelsen-Leffingwell Expedition has been sometimes used by the press. The arrangement made provided that each should furnish half the funds. The writer obtained his share from private sources, and Capt. Mikkelsen obtained his half from societies and individuals.

The expedition was to go to Banks Land, northeast of the mouth of the Mackenzie, and spend one year in scientific work on the southeast side of that island. In the second summer it was to advance along the west side of Banks Land as far as possible and then spend a year in explorations farther west over the Arctic Ocean, in search of the land predicted by Harris from the behavior of the tides.

The expedition sailed from Victoria, British Columbia, in the spring of 1906 in a sealing schooner without power, renamed the *Duchess of Bedford*, after one of the contributors to the funds. The party numbered eight, and included the two commanders, a doctor, a naturalist, and four sailors.

The *Duchess of Bedford* arrived at Point Barrow ahead of the United States revenue cutter *Thetis* and several steam whale ships. The ice was close along the beach east of the point, and the schooner could not make headway by beating among the floes against the constant head wind and current.