cate a strong similarity to the fossil assemblage of the Tachilni Formation and the upper Bear Lake Formation, both assigned to the late Miocene Graysian Molluscan stage, approximately 12 Ma to 3 Ma.

Teeth of the desmostylian (sea cow) *Desmostylus* sp. cf. *D. hesperus* have been collected from the Cape Aliaksin beds. *D. hesperus* is known from North Pacific rocks assigned to the late early to early late Miocene, approximately 18 Ma to 10 Ma.

The Unga Conglomerate is in part typified by the middle Miocene pelecypod *Mytilus gratacapi* and an associated fauna unlike that of the Cape Aliaksin beds. It is suggested that the Cape Aliaksin beds are younger than the Unga Conglomerate, and are correlative to the upper Bear Lake Formation and Tachilni Formation rocks of early late Miocene age.

BAILEY, R. V., Aspen Exploration Corp., Denver, CO

Do Oil and Gold Mix in Alaska?

Excellent potential for sea-floor-placer heavy mineral deposits exists locally along the coast of Alaska within lands owned by the state. Aspen Exploration first applied for precious metal offshore prospecting permits (OPPs) from the state in 1980 for certain lands in Cook Inlet, including lands that are prospective for oil and gas production. Exploration to date has included geologic mapping, beach sampling at many locations, and a 6,400-mi low-level aeromagnetic survey. More than 20,000 ft of sediments underlie areas that appear most prospective for placer gold deposits, thereby facilitating geophysical interpretation of sea-floor magnetic anomalies. Work to date, now suspended, suggests large, linear, offshore heavy mineral concentrations, which likely include gold.

Obtaining permits in Alaska is difficult, frustrating, and expensive. After 5 years of effort, no permits have been issued to Aspen. Primary opposition has come from the Alaska Department of Fish and Game, which has taken the position that insufficient biological resource information is available in the prospect areas. These same offshore areas, however, are held under oil and gas leases from the state by various companies.

The difficulties encountered by smaller oil companies in attempting to carry out exploration in Alaska, which have forced virtually all of them to abandon their efforts in this state, are compared with difficulties hard-mineral companies are encountering. It is important to recognize that income to the state of Alaska from oil royalties and taxes is of such magnitude that needed support for hard-mineral exploration and mining is being suppressed by a hostile bureaucracy and by preservationists.

BARNES, D. A., Sohio Petroleum Co., San Francisco, CA

Sag River Formation, Prudhoe Bay, Alaska: Depositional Environment and Diagenesis

The Sag River Formation is a minor hydrocarbon reservoir in the Prudhoe Bay field, Alaska. It comprises bioturbated, glauconitic, argillaceous, quartzose fine to very fine-grained sandstone and siltstone and varies from 55 ft (17 m) to 20 ft (6 m) in thickness in the field. The formation is the upper part of a very fine-grained, upward coarsening, terrigenous, clastic-dominated sequence deposited in Late Triassic time. This sequence includes the upper part of the subjacent Shublik Formation. Lithofacies variation within the Sag River is minimal with stratigraphic thinning from the north-northeast to a south-southwest shaleout. The formation was deposited in a low-energy, offshore, marine-shelf environment basinward of a low-relief source area. Upward coarsening, as well as slightly older Sag River facies in more proximal areas, suggests regionally significant marine regression during deposition.

In the Prudhoe Bay field, diagenesis along with abundant primary detrital matrix significantly diminishes reservoir quality. Ductile grain deformation, authigenic clay-grain coatings, quartz overgrowths, and carbonate cementation have resulted in microporosity and associated low permeability, which is the primary shortcoming of the Sag River reservoir. Larger, interconnected secondary pores (and associated improved reservoir quality) were produced by the dissolution of carbonate cement and possibly other mineral phases.

Reservoir quality in the Sag River Formation is strongly influenced by proximity to its subcrop with the overlying Lower Cretaceous "Highly Radioactive Zone." Mineral leaching probably resulted from aggressive fluid incursion at that truncation surface. The source of those fluids is not presently known.

BEHRMAN, P. G., R. K. WOIDNECK, C. H. SOULE, and J. L. WU, Sohio Petroleum Co., San Francisco, CA

Reservoir Description of Endicott Field, Prudhoe Bay, Alaska

Located about 2 mi offshore and several miles east of Prudhoe Bay, the Endicott field contains about 1.4 billion reservoir bbl of oil and 0.5 billion reservoir bbl of gas.

Hydrocarbons occur within Mississippian fluvial sandstones of the Kekiktuk formation, which unconformably overlies the Neruokpuk Formation and grades upward into the Kayak and Itkilyariak formations. Stratigraphy is subdivided into three lithofacies that, from the base upward, reflect deposition in a swamp/lacustrine/flood plain environment (zone 1), a braided stream system (zone 2), and a meandering stream system (zone 3). Sediment dispersal was from a northerly source.

Endicott field structure defines a southwesterly plunging antiform that is bounded to the north, northeast, and southwest by major normal faults and is truncated to the northeast by the Lower Cretaceous Unconformity (LCU). Shales overlying the LCU and shales of the Kayak and Itkilyariak formations form the reservoir cap.

Reservoir properties within the hydrocarbon column vary by zone with zones 3 and 2 typified by an average net/gross-porosity-water saturation-permeability of 37%-18%-22%-500 md and 88%-22%-13%-1,100 md, respectively. In contrast, zone 1 quality is very poor. Reservoir sands are compositionally very mature and exhibit an enhanced pore network. Diagenetic minerals include quartz along with lesser kaolinite and carbonate.

Gas is present from about 9,500 ft (2,850 m) to 9,855 ft (2,958 m), oil is down to 10,180-10,200 ft (3,054-3,060 m), and tar accumulations are down to 10,400 ft (3,120 m) subsea. Average oil gravity is 23° API. Geochemical data indicate that the tar accumulations originated through a physical deasphalting process. Cenozoic imbibition resulted in water overriding tar.

BIRD, K. J., U.S. Geol. Survey, Menlo Park, CA

North Slope Oil and Gas: The Barrow Arch Paradox

In the 40-year history of hydrocarbon exploration on the Alaskan North Slope, about 21 accumulations with a total in-place volume of more than 60 billion bbl of oil and 35 trillion ft^3 of gas have been discovered. Although the density of exploratory drilling in this region is not uniform, enough drilling has been done to show a distinct concentration of oil and gas in the Prudhoe Bay area between the Colville and Canning Rivers. This concentration is also evident when the Prudhoe area resources are compared with the USGS estimates of undiscovered in-place oil and gas resources of the adjacent areas, the National Petroleum Reserve in Alaska and the Arctic National Wildlife Refuge. Most oil and gas in the Prudhoe area accumulated near the present coastline in reservoirs that overlie a southeasterly plunging basement ridge, the Barrow arch. The location of these accumulations, in low-relief structural-stratigraphic traps midway along the arch and downdip from its apex at Point Barrow, is the paradox.

An answer to this paradox is provided by analysis of two cross sections, one along the Barrow arch and one perpendicular, showing their original structural positions for the beginning, middle, and end of Cretaceous time. In the Early Cretaceous (mid-Neocomian), the crest of the Barrow arch was near sea level along its entire length. Because of northeasterly sediment progradation during later Cretaceous time, the Barrow area became more deeply buried than the Prudhoe area, thus making the Prudhoe area the focal point for migrating oil and gas. Beginning in the early(?) Tertiary, the Barrow area was slowly uplifted while the Prudhoe area subsided, thus beginning the process that resulted in the reversal of their relative elevations and the focus for migrating oil and gas. Studies show that the Prudhoe Bay field was tilted during the Tertiary, and some oil and gas escaped, migrated toward Barrow, and was trapped in the Kuparuk, West Sak, and Ugnu fields. This analysis suggests that most North Slope oil and gas were generated during the Cretaceous.

BOAK, J. L., ARCO Alaska, Inc., Anchorage, AK, D. L. TURNER, Univ. Alaska, Fairbanks, AK, W. K. WALLACE and T. E. MOORE, ARCO Alaska, Inc., Anchorage, AK

K-Ar Ages of Allochthonous Mafic and Ultramafic Complexes and Their Metamorphic Aureoles, Western Brooks Range, Alaska