The potential occurrence of middle Cretaceous source beds beneath a steadily thickening pile of Cenozoic basin-plain and rise-prism deposits can be viewed as increasing the chances that deep-water reservoirs in the Aleutian basin have been charged by migrating hydrocarbons.

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Investigation of Source Rock–Crude Oil Relationships in North Slope Hydrocarbon Habitat

Carbon isotopic studies of kerogen assemblages and petroleums from the North Slope–Colville trough area of Alaska have permitted firmer source-oil correlation assignments. As a section, the Mesozoic contains a suite of potential source beds including the Shublik Formation, Kingak Shale formation, and Lower Cretaceous units and, most notably, a post-Neocomian, highly radioactive zone (HRZ). The maturation and generation history of these sediments has been broadly controlled by the Brookian orogeny.

Using well data, trends in generalized source richness, hydrocarbon proneness, and organofacies have been recognized. In projecting these data into the deeper Colville trough, a considerable variation in hydrocarbon generating potential was noted over the Mesozoic section. Several particularly attractive oil-prone units were recognized.

The generic relationship of a wide range of North Slope petroleums—including early, normal, and post-mature or biodegraded examples—was established. A majority of the principal accumulations could be assigned to the previously defined Barrow-Prudhoe oil family. This widespread generic series included petroleums from Upper Cretaceous, Kuparuk River, Ivishak, and Lisburne reservoirs. Lesser, but distinct, Simpson/Seabee-type oil groupings were also recognized.

Effective source-to-oil correlation was achieved by a comparison of the carbon isotopic compositions of the kerogen pyrolyzates and the crude oils. The possible contributions of the various source units were assessed in terms of isotopic match, source potential, and volumetrics. Assuming continuity of source characteristics into the deeper Colville trough, a Triassic/Jurassic combination constituted the closest source match to the major oil accumulations.

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Lateral Continuity of the Blarney Creek Thrust, Doonerak Window, Central Brooks Range, Alaska

The contact between Carboniferous and lower Paleozoic rocks, exposed along the northern margin of the Doonerak window in the central Brooks Range, is a major thrust fault called the Blarney Creek thrust (BCT). The BCT has been traced over a distance of 25 km, from Falsoola Mountain to Wien Mountain. The tectonic nature of this contact is demonstrated by: (1) omission of stratigraphic units above and below the BCT; (2) large angular discordance in orientation of first-generation cleavage at the BCT; (3) numerous thrust imbricates developed in the upper-plate Carboniferous section that sole into the BCT; and (4) truncation of an upper-plate graben structure at the BCT. Lack of evidence for pre-Carboniferous deformation in the lower plate casts doubt on the interpretation of the contact as an angular unconformity. However, the localized presence below the BCT of Mississippian Kekiktuk Conglomerate and Kayak Shale, in apparent depositional contact with lower Paleozoic rocks, suggests that the BCT follows an originally disconformable contact between the Carboniferous and lower Paleozoic rocks. The juxtaposition of younger over older rocks at the BCT is explained by calling upon the BCT to act as the upper detachment surface of a duplex structure. Duplex development involves initial imbrication of the Carboniferous section using the BCT as a basal decollement, followed by formation of deeper thrusts in the lower Paleozoic section, which ramp up and merge into the BCT.

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Tectonic Evolution of the Transverse Ranges of Southern California

The Transverse Ranges of southern California trend anomalously east-west in a tectonic regime otherwise dominated by the northwest-southeast trending San Andreas fault system. Plate tectonics theory offers an explanation for the origin of the Transverse Ranges. Convergence of the North American Plate (NAP) with the East Pacific Rise (EPR) and the overriding of the EPR by the NAP south of the Mendocino Fracture Zone led to development of northwest-trending, right-lateral faults on the leading edge of the NAP in southern California. Subsequent deflection of the NAP to the southwest by the still active Gorda–Juan de Fuca Ridge segment of the EPR resulted in southwesterly deflection of the San Andreas fault (SAF) forming the big bend in that fault.

These plate movements are responsible for the east-west trend and juxtaposition of major components of the Transverse Ranges. The east-west-trending Santa Ynez Range represents northward-moving rocks on the south side of the SAF, which were deflected westerly and did not negotiate the big bend in that fault. The elevated central part of the Transverse Ranges from the big bend southeasterly to Cajon Pass is under compression as northwesterly moving blocks on the south side of the SAF converge on southwesterly moving blocks on the north side of that fault. The easternmost range in the Transverse Ranges, the San Bernardino Mountains, is under similar compression on the north side of the bent portion of the SAF.

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Phosphatic Glauconitic Sandstone and Oncolite Deposition at the Upper Paleozoic Base of Etivluk Group, North-Central Brooks Range, Alaska

Carboniferous stratigraphy of the Picnic Creek allochthon in the central Brooks Range is dominated by bedded cherts and shales. In the Killik River quadrangle, bedded black cherts of the Lisburne Group are overlain by a thin diagnostic clastic unit composed of sandstone and conglomerate. The sandstone is a thin (0.35-m), laterally extensive, planar, laminated litharenite with an average Q:F:L of 40:17:43 and a Qp:Lv:Ls of 12:8:80. The provenance is interpreted to be a recycled orogen dominated by uplifted sedimentary sequences with minor plutonic, metamorphic, and volcanic sources. The presence of glauconite (7%) and authigenic phosphate (18%) indicates deposition in a shelf environment.

This phosphatic sandstone forms part of the matrix in a conglomerate at one locality. The conglomerate is lenticular (2 m × 10 m), crudely graded, and very poorly sorted, and it contains black chert ripups. Clasts are composed of oncoids (70%), chert (22%), shale (5%), and limestone (3%). Barite preferentially replaces all clasts except chert and part of the matrix. The oncolites are SS-type mode C hemispheroids, indicating formation in a continuously agitated shallow to intertidal marine environment.

Sedimentologic and petrographic observations suggest that the phosphatic glauconitic sandstone developed in a shelf environment, and the oncolitic conglomerate is a debris flow off a nearby carbonate platform that transported shallow-water material out onto the shelf. Preservation of unaltered echinoderm fragments and calcareous algal oncolites clearly indicates deposition above the CCD. Radiolarians from immediately above the clastics include spongy tetrahedral Latentifistulidea, which suggests that sandstone and conglomerate deposition probably occurred in the Morrowan (Early Pennsylvanian).

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Water Resources of the North Slope, Alaska

Lakes, streams, springs, snow, and ice are the most obvious source of fresh water on the North Slope. However, permafrost and seasonal climatic effects restrict the availability of these sources for water supply.

Shallow thaw lakes, ranging from the 315-mi^2 (815-km^2) Teshekpuk Lake to ponds less than an acre, literally blanket large parts of the coastal plain. Ice-cover formation and thickening on these lakes in winter are accompanied by an increase in dissolved-solids concentration in the remaining water, thus limiting its suitability for water supply.

Most of the precipitation occurs as snow, which is stored on the land surface until it melts in late spring and summer. Snow and ice are used to construct temporary roads and airfields, and melted snow and ice are often used as potable water. Most of the annual streamflow occurs during