lode sources that together contain inferred reserves of approximately 300,000 lb of Nb.

Splits of samples collected by the Bureau of Mines in the early 1950s from tailings piles of now-inactive drift mines were reanalyzed. Most of these samples contain between 0.2 and 4.5% Nb. The presence of relatively higher concentrations of Nb in the Deep Creek–Miller Gulch–Idaho Gulch area suggests proximity to an Nb lode source in that area.

In an effort to locate the lode source of the placer Nb, trenches excavated by the Bureau of Mines in 1956 on upper Idaho Gulch were reexamined. Between 0.02 and 0.10% Nb is present in two lenses of radioactive ferruginous regolith exposed in these trenches. In the regolith, the Nb mineral, aeschynite [$(Ce,Ca,Fe,Th)(Ti,Nb)_2(O,OH)_6$], occurs with up to several percent apatite and zircon and trace amounts of monazite. The lenses persist 1,200 ft along strike, and drilling shows them to continue 150 ft downdip. Apparently, they are derived from the selective weathering of dolomite marble containing magnetite, pyrite, and pyrrhotite and traces of zircon and apatite. The inferred reserve of the regolith lenses is approximately 200,000 lb of Nb, which is twice that of the inferred placer reserves.

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West Sak and Ugnu Sands: Low-Gravity Oil Zones of the Kuparuk River Area, North Slope, Alaska

Low-gravity oil in Upper Cretaceous and Tertiary shallow marine and deltaic sands of the North Slope have been known since 1969. The majority of the oil occurs in two intervals informally named the West Sak sands (Maestrichtian) and the overlying Ugnu sands (Maestrichtian-Paleocene). These zones are oil-bearing primarily in the Kuparuk River and Milne Point units where they occur at depths ranging from 2,000 to 4,500 ft (610 to 1,370 m) subsea.

The West Sak consists of very fine-grained, unconsolidated sands with interbedded siltstone and mudstone that were deposited in an inner-shelf to delta-front environment. The oil in the West Sak is a less heavy to intermediate crude with gravities ranging 16°-22° API. The Ugnu consists of fine to medium-grained, unconsolidated sands with interbedded siltstone, mudstone, and coal that were deposited in fluvial and delta-plain environments. The oil in the Ugnu sands is bitumen and extra heavy crude with gravities between 8° and 12° API.

The total oil in place in the West Sak and Ugnu sands is estimated to be as large as 40 billion bbl. Geochemical work on these oils indicates that they have the same source as the oils in the deeper Kuparuk and Sadlerochit reservoirs but have been biodegraded.

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Paleomagnetism of Early Tertiary Alaska Peninsula Rocks and Implications for Docking of Peninsular Terrane

In order to refine the tectonic history of the peninsular terrane, Alaska, 22 sites (averaging 10 samples/site) in Paleogene Tertiary volcanic and sedimentary formations were sampled in the vicinity of Chignik, on the Pacific side of the Alaska Peninsula. Ten of the sites were drilled in the early Oligocene Meshik volcanics, ranging from andesite to basalt, and the other twelve sites were drilled in the late Eocene Tolstoi Formation sediments. Nine of the volcanic sites yielded stable R and/or N characteristic magnetization. Virtually no fine-grained, interbedded sediments occur with the Meshik volcanics at the sample sites, thus making reliable paleohorizontal determinations difficult. Although flow attitudes were tentatively used, it became rapidly apparent that problems of initial dip were insurmountable. As a result, all volcanic sites were considered unreliable for determining a meaningful paleomagnetic inclination.

Upon thermal demagnetization, five of the sedimentary sites were judged stable. The mode of the paleomagnetic direction was calculated, D/I = 349.8/75.3 (β95 = 8.5), indicating no significant rotation. Uncertainties in structural corrections, however, may render only the inclination meaningful, which, from McFadden statistics, yields I = 75.9, α95 = 7.9, corresponding to a paleolatitude of 63.3°. This paleolatitude agrees with the expected value for the North American craton at 40 m.y. B.P., implying that the peninsular terrane had docked by at least that time.

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Method and Application of Faciolog Technique to Geological Problems

The Multiwell Faciolog (mark of Schlumberger) computer process is a data-reduction technique that uses multivariate analysis to integrate data from wireline logs, core data, and geologic knowledge into a geologically significant display of electrofacies. Electrofacies are defined by Serra and Abbott as the "set of log responses that characterizes a sediment and permits the sediment to be distinguished from others."

The computing chain begins with log normalization and correction for environmental effects. The corrected logs from a selected key well are then used to construct an n dimensional crossplot incorporating data from n number of input logs. The program selects n principal component axes through the resulting cloud of data points and automatically clusters the data into local modes, which are then displayed in two-dimensional principal component space. Each group of local modes represents intervals that have similar log response. Local modes are then clustered into a smaller number of terminal modes, which are identified by rock type, using core lithology data and geologic knowledge, and are manually clustered into a significant number of electrofacies. Once the electrofacies are defined in the key well, a data base is established, containing information on the average log values for each electrofacies, geologic descriptions, and display patterns. Each subsequent well with a similar logging suite is then compared to the data base. Those zones corresponding to electrofacies previously defined in the data base will be identified as the same electrofacies. Those zones with different average log values will be identified as different electrofacies and will be added to the data base.

The advantage of the Multiwell Faciolog technique is that voluminous data, including wireline, core, and geologic information, can be integrated into one or two key displays. This program is flexible and allows the interpreter to adjust and modify the data base, as necessary, with the addition of each new well. The data base does not require a unique data set and can be constructed from open-hole logs, cased-hole logs, or computed logs common to the study wells. The final cross-sectional displays can be an aid in tracing geologic characteristics from well to well.

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Some Palynological Aspects of Oligocene to Early Miocene Transition in Southern Alaska

The Oligocene to early Miocene transition in southern Alaska perhaps represents one of the most dramatic floristic changes in the entire Tertiary of Alaska. The basic modification is from a dominant deciduous, broad-leaved forest biome in the late Eocene–early Oligocene (early Zemorrian) to a dominant moist, temperate, coniferous forest biome in the early Miocene (Saucesian). A similar change can be seen between the deciduous broad-leaved forests and the montane boreal coniferous forest of China today.

This change in flora—and from a palynological perspective this change in microflora—reflects the onset of global cooling in the Neogene and the concurrent change from a dominant marine transgressive to a dominant nonmarine regressive mode of sedimentation.

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Comparison of Two Suites of Okpikruak Formation: A Point-Count Analysis

The Lower Cretaceous Okpikruak Formation lies unconformably on the Etivluk group in the Foothills thrust belt of the central Brooks Range. These deep marine sediments were shed northward during the first phases of Brookian deformation. The formation, as sampled, contains two petrographically distinct populations: the upper Kurupa–Oolamnagavik River drainage samples (KOR) of the Picnic Creek allochthon, and the Cobblestone Creek samples (CC) of the Endicott Mountains allochthon.

The KOR samples have an average Q:F:L of 49:21:30 and Qp:Lv:Ls of 46:37:17. Variations in total detrital grain populations are greater for

quartz (40-50%) and rock fragments (22-39%) and less for feldspar (17-27%). The KOR population is characterized by high proportions of polycrystalline quartz and low proportions of sedimentary rock fragments. Interpretation of detrital modal analyses suggests a complex source terrane involving orogenic recycling and mixing of sediments from a magmatic arc and a subduction system.

In contrast to KOR samples, CC samples have an average Q:F:L of 16:11:73 and Qp:Lv:Ls of 11:34:55. Total grain populations vary most for rock fragments (56-85%) and quartz (6-27%) and to a lesser degree for feldspar (8-17%). The high variation in rock fragments suggests variable volcanic and sedimentary sources. Interpretation of detrital modal analyses also suggests complex sources but with a significant arc-orogen component.

Both populations are characterized by varying proportions of diagenetic products, which include albite, calcite, chlorite, sericite, and epidote.

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Meshik and Aleutian Arcs—Tertiary Volcanism on Alaska Peninsula, Alaska

The Meshik and Aleutian arcs of the Alaska Peninsula are magmatic arcs of predominantly calc-alkaline affinity. The Meshik arc, primarily of Eocene and Oligocene age, is in part stratigraphically equivalent to "early series" rocks of the Aleutian Islands. Its northeasternmost outcrops lie south of Mother Goose Lake, but rocks of the arc occur in the subsurface as far north as Becharof Lake. The Aleutian arc is of middle Miocene to Holocene age; it extends from Hayes Volcano in the southern Alaska Range to Buldir Island in the Aleutians. On the Alaska Peninsula, the dominant major volcanic-rock types in both arcs range from leuco basalt to dacite. Plutonic rocks of the Aleutian arc crop out in many places on the peninsula, including the Devils and Agripina Bay batholiths. Rock types of the plutons are commonly quartz diorite, granodiorite, and lesser tonalite. Plutonic rocks of the Meshik arc are less common, though compositionally similar to Aleutian-arc plutonic rocks.

Both the Aleutian and Meshik arcs exhibit a shift in the locus of magmatism over time. Available data document a shift in the magmatic locus of the Aleutian arc about 50 km northwestward from the Pacific Coast in the middle Miocene to its present position. Less definitive evidence suggests that the Meshik arc shifted a similar distance to the southeast during Eocene and Oligocene time. Although segmentation of the Aleutian arc is well described, less evidence exists to suggest similar segmentation of the Meshik arc.

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Lateral Variability in Coals in Western North Slope, Alaska

Results of our investigation of foot-by-foot sections from drill cores of two North Slope coals of Cretaceous age from Cape Beaufort and Kukpowruk River indicate drastic changes in environment during formation of the seams. Indicative of these changes are unusually wide variations in the petrographic composition and ash characteristics within the seam. For instance, the Kukpowruk samples showed an increase in semifusinite from 1.3% at the bottom to 32% at the top. Furthermore, the concentrations of Fe_2O_3 + CaO + MgO in the Kukpowruk seam ranged from a low of 7.2% to a high of 80.9%. Similar changes were found in the samples from Cape Beaufort.

The variability in these coals was further identified by changes in the swelling behavior of the coal and to a lesser extent by rank characterization. Changes in the coal structure and its low temperature ash were also studied by means of Fourier transform infrared spectroscopy.