suring the ratio of known forms which inhabit different sonic scattering layers in mid-water. The lowermost layer represented in each fauna is in part a function of water depth, and also commonly indicates the boundary between water masses of sedimentologic importance.

The 4 zones detailed in this study are (1) mid-shelf; (2) cold bottom and epipelagic, or shelf-edge; (3) lanternfish, or oxygen minimum; and (4) bathypelagic, or Antarctic water. All these zones may be subdivided by later investigations.

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EMPIRICAL EVIDENCE FOR PETROLEUM MIGRATION IN SOLUTION AND DETECTION OF ALTERED CRUDE OILS

The volume and composition of light-liquid fractions in unaltered petroleum deposits are influenced by the salinity of associated formation waters. The implication is that low-molecular-weight hydrocarbons (boiling less than 200°C) are in a "dynamic equilibrium" with their accompanying waters. Hence, any significant variations in salinity could affect their relative solubilities and control their accumulation and escape.

The specific gravity of the light fractions in an unaltered crude is an approximate measure of the composition and relative abundance of the hydrocarbon components. A factor λ which normalizes the volume of light liquid fractions for variations in composition (specific gravity) is devised by dividing the volume (%) total plus naphtha, 10 times the specific gravity. The volume percent of the light fraction and the specific gravity are taken directly from U.S. Bureau of Mines Routine Crude-Oil Analyses.

If the volume of light fractions is salinity dependent, as zero-salt concentration is approached, the ratio of λ (%) to salinity (%) similarly should approach some limit. A log-log plot of λ divided by salinity versus salinity for 83 petroleum deposits of wide geographic distribution and geologic age shows a marked relation.

Evaporation, inorganic oxidation, through-put of relatively fresh water (water-washing), and microbial activity are known to affect appreciably the low-molecular-weight fractions of crudes, commonly resulting in oils that are in a disequilibrium with their formation waters (altered crudes). The low-carbon-number *n*-paraffins appear to be particularly biodegradable; biodegradation of a petroleum has been interpreted to be evidenced by a greatly reduced *n*-paraffin content, increased nitrogen content, and increased optical rotation of the remaining dense fraction. Detection of these effects requires relatively complicated laboratory procedures. Altered deposits show no systematic relation between λ divided by salinity and salinity, and this permits their ready identification. Laboratory analysis of a variety of oils corroborates the interpretation.

The nature of the data for unaltered crudes and theoretical considerations suggest an equilibrium relation in the form log λ equals 1 plus A times the square root of c, minus B times c, where c is the total concentration of solids in the associated formation water and A and B are empirically determined constants. A semilog plot of λ minus one divided by the square root of c, versus the square root of c, yields a straight line, suggesting that the volume and composition of the light liquid fraction in a petroleum are indeed salinity dependent.

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LATE PRECAMBRIAN-EARLY CAMBRIAN STRATIGRAPHY OF KELSO MOUNTAINS, EASTERN MOJAVE DESERT, CALIFORNIA

A detailed study has been made of several outcrops of late Precambrian-Early Cambrian strata in the southern Kelso Mountains. These strata, which are part of the predominantly detrital basal sequence of the Cordilleran miogeocline, previously have been described only in reconnaissance.

In the Kelso Mountains, these strata have been assigned to 5 regionally recognized formations. The late Precambrian Johnnie Formation, which lies unconformably on metamorphic basement, displays rapid lateral changes in lithology and thickness, perhaps due in part to infilling of uneven basement topography. Of 4 sections of Johnnie exposed, 3 are similar, consisting of 91-141 ft of quartzite and dolomite. Conformably overlying the Johnnie Formation are the late Precambrian Stirling Quartzite (186 ft thick, only the uppermost regional member is present), the late Precambrian-Early Cambrian Wood Canyon Formation (712 ft thick), the Early Cambrian Zabriskie Quartzite (75 ft thick), and the Early Cambrian lower part of the Carrara Formation (70 ft thick).

Comparison of these strata with equivalent miogeoclinal strata in the Providence Mountains 8 mi southeast and with Early Cambrian cratonic strata in the Marble Mountains 30 mi south shows that the northeast-trending craton-miogeocline boundary was not an abrupt break (an interpretation based on comparison in Nevada and Utah of thick allochthonous miogeoclinal strata with autochthonous cratonic strata), but rather a relatively broad transition zone of gradual thickening of strata from southeast to northwest.

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SEDIMENT TRANSPORT AND SHORELINE CHANGES ALONG ALASKAN ARCTIC COAST

Sediment-transport processes have been studied within a lagoon-barrier island environment on the Alaskan Arctic Ocean coast. In this area, active transportation is confined to the period from June to October. Analysis of aerial photographic surveys during the period 1949-1971 indicates accretion on one island (Thetis) at a mean rate of 2,580 sq m/year, whereas an adjacent island (Pingok) has been breached and eroded at both the western and eastern extremities. Recent studies of seasonal shoreline erosion demonstrate that more than 10 m may be removed within a single season. Erosion rates for the eastern end of Pingok Island are calculated to be at least 3,000 sq m/year. Littoral sediment transport along the northwestern and northeastern shores, landward of the lagoon (Oliktok Point), ranges from 0 to 38 sq m/day with current velocities of 0-75 cm/second. Most of the coastal spits and shoals in this area trend west. The prevailing winds are from the east and northwest. Overflow during breakup, thermal erosion of beach cliffs, normal fluvial and nearshore sedimentary processes, summer storms, and ice-rafting are the predominant mechanisms of erosion and deposition.

The more significant sediment movements here represent a net transport from east to west, especially on the barrier islands. These movements are considered to be due to the catastrophic effects of summer storms, for rates of littoral transport are lower, and the season for this transport is relatively short, in comparison with conditions in temperate areas.

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PALEONTOLOGIC EVIDENCE FOR MID-MIOCENE REFRIGERATION, FROM SUBSURFACE MARINE SHALE, LOUISIANA GULF COAST

The Harang facies, a regional, diachronic middle Miocene shale in Louisiana, has characteristics that can be interpreted as indications of deep-water or cold-water deposition. It consists of a seaward-thickening subsurface wedge of dark-gray to brown or black marine shale and clay with interbedded sandstones, containing a distinctive foraminiferal biofacies. The biofacies is characterized by an abundant and diversified benthonic foraminiferal fauna, including huge arenaceous forms