the oil presents an impenetrable physical barrier that can persist after the oil itself is degraded by bacteria.

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Environmental Significance of Fossil Root Casts from Koobi Fora Formation (Pliocene-Pleistocene), East Turkana, Kenya

Roots and fossil root casts at East Turkana, Kenya, are valuable as paleo-environmental indicators. Roots are preserved within the Koobi Fora Formation as calcified concentric and nodular casts in lithologies independently interpreted as fluviodeltaic or lacustrine-coastal plain. Five common root cast "types" are recognized: (1) horizontal, planar root mats; (2) vertical or vertically branching root structures; (3) horizontal or horizontally branching root structures; (4) diagonally branching root structures; and (5) root clusters or balls. Root mats are usually in blocky or laminated muds. Typically, the mats extend laterally over tens of square meters, although an individual mat will be only about 5 cm thick. They appear to have grown in quiet-water lagoons. Vertical root structures are best developed in coarse-grained sands interpreted as fluvial channel, and secondarily in fine-grained silts believed to be interdistributary overbank deposits. They are uncommon in blocky or laminated lagoonal muds. Comparison of root morphologies among living East Turkana plants supports interpretation of the fossil associations. In arid environments water availability is a dominant factor in root morphology. Plants growing along intermittent streams or flood plains must frequently rely on perched water bodies or underground seepage, and therefore send out long vertical tap roots to take advantage of this limiting resource. Plants living within shallow reed swamps have no such requirement, as their roots are nearly continually immersed in ground water; during floods the plant stalk itself is subaqueous. The roots of these plants tend to extend laterally in thin mats over much of the lagoon.

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Nearshore Glacial-Marine Sedimentation; Preliminary Modeling Based on Pliocene-Pleistocene Deposits of Puget Lowlands

Environmental interpretations based on combined sedimentologic and micropaleontologic analyses together with field relations have enabled preliminary modeling of processes of nearshore glacial-marine sedimentation in the Puget Sound region (Washington and British Columbia). Although these processes are active today in the Arctic and Antarctic, ice cover makes direct observations of them difficult. Therefore, uplifted Pliocene-Pleistocene deposits were examined, using various criteria for the recognition of similar deposits in the ancient record.

Forty-six whole or partial sections from the Puget Lowlands have been measured, described, and sampled, and over 200 samples have been analyzed for foraminiferal content. These data, in conjuction with detailed textural (settling tube) analyses and available radiocarbon dates from the area, have enabled the delineation of sedimentary environments and their associated facies.

Modeling is based on the interaction of such parameters as thermal regime of the ice sheet, eustatic sea-level fluctuations, circulation patterns as delineated by the microfaunas, and changes in bathymetry resulting from isostatic loading and rebound and from regional tectonics. Thermal regime of the ice appears to be the major controlling factor, determining both the kinds of sediments deposited and the extent to which marine processes are able to act on them. Microfaunas show strong evidence of the mixing of a restricted shallow-water ice-shelf fauna with mid-shelf and outer-shelf forms which must be explained by any subsequent models. Glaciotectonic structures appear to be an important consideration for interpreting these sequences and may possibly be used to explain some of the present problems with regional stratigraphic correlations.

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Isotope Geochemistry of Natural Gas in Illinois Basin

Natural gas samples collected throughout the western half of the Illinois basin were analyzed chemically and isotopically to determine the origin and history of the gases. The samples were obtained from a variety of sources including groundwaters (fresh water and brines), cores, oil wells, and gas wells. Samples from shallow (50 to 500 ft; 15 to 150 m) groundwaters contain methane of bacterial origin; the δC^{13} values for methane from these waters are generally in the range of -65 to -90 parts per thousand. Samples from relatively deep (1,500 to 3,000 ft; 450 to 900 m) gas and oil accumulations contain thermogenic methane having δC^{13} values in the range of -46 to -56 parts per thousand. Gas accumulations that have isotopic compositions intermediate between those of the deep thermogenic gases and the shallow bacterial gases may be the result of mixing of gases from these two sources. There is also a general trend of increasing δC^{13} values southward, however, presumably reflecting increasing maturity of the source rocks in that direction as indicated by increasing coal rank. Therefore, some of the gases with δC^{13} values in the range of -56 to -65 parts per thousand may be "low grade" thermogenic gases. Additional C^{13}/C^{12} analyses and some D/H analyses are in progress to help resolve this question.

Most of the gas wells are on the margins of the basin. Gases from these wells are isotopically similar to solution gases from oil wells in the center of the basin, but often are depleted in the heavier hydrocarbons, some consisting almost entirely of methane. This chemical difference is believed to be at least partly a result of fractionation during migration of the gas toward the basin margins. Other available data are being assimilated to test this hypothesis.

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