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Problems and Principles of Sandstone Body Classification

The geometry of sandstone bodies involves their shape, size, and orientation. The original geometry is subject to later modification by erosion, faulting, folding, tilting, compaction of underlying sediment, and internal "compaction."

Although orientation or "trend" has been, and will continue to be used successfully in some cases without knowledge of the origin of the sandstone bodies, greater predictability should be possible if the origin can be determined—provided the distributional patterns of sediments of various origins are known. Insofar as geometry is concerned, three major problems are (1) to reconstruct the geometry correctly, (2) to know what it implies regarding origin, and (3) to know the distributional pattern of sediment of that origin in an analogous depositional situation.

For reconstruction of sandstone body geometry, total sand thicknesses or sand-shale ratios for thick sedimentary sequences are of limited value. Isopach maps of individual sand bodies define their size and orientation, but only partially define their shape; cross-sections "hung" on a closely related underlying or overlying bed, whose original attitude relative to the sandstone body is known or can be reasonably assumed, are also required to define shape. Possible modification of original shape by compaction or other processes must be considered.

The plan dimensions of present-day deltas, barrier bars, and other sedimentary types are rather well-known, but three-dimensional data are scarce. Too often, third-dimensional data from ancient sediments are misleading because the origin has been incorrectly determined.

Such internal features as cross bedding, flow markings, grain orientation, bed or grain size sequences, and the relationship of a sandstone body to beds above, below, and laterally are important for interpreting origin particularly where control is too sparse to define the geometry.

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Oil and Gas Prospects of Maritimes Region of Eastern Canada

Portions of the Provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland, bordering the Gulf of St. Lawrence, are underlain by sediments of Ordovician and Mississippian age in which manifestations of hydrocarbons occur.

Although some oil is present in the Ordovician in Newfoundland, the prospects for finding commercial fields in rocks of this age do not appear to be promising. In New Brunswick one small oil and gas field has produced from the Mississippian since 1909. At several localities throughout the Maritimes region oil seepages occur and showings of oil and gas have been obtained in wells which penetrated the Mississippian rocks. In general the Mississippian consists of conglomerates and sandstones, a thick series of shales, a large percentage of which are bituminous, followed in ascending order by a carbonate-evaporite-red-bed sequence that was repeated a number of times. There are present in the basin a number of stratigraphic and structural features, namely diapir salt structures, salt domes, fault blocks, anticlines, porosity pinch-outs; sand lenses, and other types considered as favorable for the trapping of oil and gas.

The stratigraphic and structural conditions are complex, and although the results of exploration to date have not been encouraging, this region must still be considered as worthy of further investigation.

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Jackpile Sandstone: Structurally Localized Fluvial Deposit

The Jackpile sandstone of local usage—exposed near Laguna, New Mexico—is in the uppermost unit in the Morrison formation of Jurassic age. The petrography, sedimentary structures and shape of the unit, its relation to tectonic structures, and analogies to similar ancient and modern sandstones suggest that it was probably deposited by a northeast-flowing stream system that was largely confined by contemporaneous structural depression. Continued downwarping after deposition, followed by erosional truncation, emphasized the structural localization of the unit.

The sandstone is fine to medium grained, friable, and moderately well sorted; coarser grained beds are more abundant near the base of the unit. The composition ranges from a calcite-cemented subarkose near the base to kaolinite-indurated quartz sandstone near the top. Terrestrial plant remains are locally abundant.

The so-called Jackpile sandstone is a northeast-trending tabular body as much as 12 miles wide, at least 30 miles long, and up to 200 feet thick. It splits into distributary-like bar fingers to the northeast. Cross-beds in the Jackpile sandstone dip mostly northeast, suggesting that the sediments were transported northeastward. The unit wedges to the northwest and southeast along an angular unconformity bounded by the overlying Dakota sandstone, and broad folds in the strata below this unconformity parallel the southeastern limit of the Jackpile sandstone. Other stratigraphic units in the Morrison formation tend to thicken in the area of the Jackpile sandstone. This suggests that structural downwarping was active in the area before, as well as during and after Jackpile deposition.

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Carbon Isotopic Evidence on Mechanisms of Petroleum Maturation

The $C^{13}/C^{12}$ ratio of gas (largely methane) separated from crude petroleum is about 1 per cent lower than that of the whole crude. Analyses of liquid distillate fractions of petroleum indicate that the $C^{13}/C^{12}$ ratio is highest in the lowest boiling fraction (gasoline) and decreases gradually in consecutive higher temperature fractions; the rate of $C^{13}/C^{12}$ ratio decrease is about 0.015 per cent per 100°F. increase in boiling range.

To account for the observed $C^{13}/C^{12}$ ratio increase in the transition from complex petroleum constituents to the simpler hydrocarbons of the gasoline fraction, we postulate that the lowest molecular weight hydrocarbons are formed by decomposition of high molecular weight components. This decomposition is accompanied by carbon isotope fractionation that enriches the lowest molecular weight products (methane and ethane) in $C^{12}$. The residue left behind after methane formation, therefore, has undergone a reduction in molecular weight and an increase in $C^{13}$ content. As decomposition