

sippi, exerted significant control on the areal distribution of this facies. Porous and permeable intervals in the deeply buried Smackover are restricted to this facies. The most significant textural parameter of the dolomitic facies is crystal size. Finely crystalline dolostone is normally of low porosity and low permeability, whereas coarsely crystalline dolostone exhibits more-favorable reservoir properties.

The distribution of these diagenetic facies has important implications on future hydrocarbon exploration in the deeply buried Smackover Formation.

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#### Visual Kerogen Assessment of Thermal History

The microscopic particulate organic matter occurring in sedimentary rocks is referred to as visual kerogen when examined by use of strew slides prepared from a kerogen concentrate. Examination under a high-powered microscope in transmitted light yields information on both the organic matter type present and the level of organic metamorphism (LOM). This presentation concentrates on the LOM aspects of visual kerogen and addresses it from a utilization point of view.

The color of the kerogen, preferably plant cuticle fragments or pollen and spores, is used to determine the level of organic metamorphism. Various scales have been proposed to reflect this change in coloration. The TAI scale is most commonly used. Visual kerogen assessment is considerably less precise than vitrinite reflectance. It is a subjective call made by the analyst. Additionally, the equivalent reflectance range broadens as higher LOMs are attained. However, the ability to visually discern differences in the suite of organic material present can override its drawbacks in precision. Caved versus indigenous populations can be recognized, as can recycled versus primary vitrinite. Thermal history can also be established in sections that are barren of vitrinite. As is the case with nearly all organic geochemical techniques, reliable interpretations can be made if the limitations of the method are considered and the results are cross-correlated with other methods.

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#### Geochemical Investigation of Australian and New Zealand Crude Oils

Australian and New Zealand oils are derived predominantly from terrestrial source material. Relatively sparse information exists in the geochemical literature on the distribution of biomarkers in terrestrially derived crude oils. A detailed geochemical investigation of oils from a number of basins in this region has revealed interesting and unusual distributions of biomarkers. The compound classes that were analyzed included sesquiterpenoids, diterpenoids, triterpenoids, and steranes. From the information obtained, it has been possible to correlate the oils from several basins, in particular the Gippsland, Surat, and Carnarvon, into a number of source-related families. Evidence was also obtained that indicated a contribution from coal-like source material for many of the New Zealand oils.

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#### Emplacement Mechanism and Trapping Potential of Gravity-Driven Allochthons

Gravity-slide blocks of Paleozoic carbonate detached from the Snake River Range show evidence of episodic emplacement into the Salt Lake group (Mio-Pliocene) in the Palisades reservoir area near Alpine, Wyoming. The allochthons lie in a large graben system created by the Grand Valley listric normal fault, a reactivated thrust that soles into a ramp in the underlying Absaroka thrust. In the Alpine 7 1/2-min quadrangle, one of the detached blocks is 2 1/2 mi (4 km) by 1 mi (1.6 km) in map view and contains the Ferry Peak thrust as well as other Laramide structures. Structures and formations of the Alpine allochthon may be matched to those in the range to restore approximate predetachment position. Very low-angle westward translation at or near the surface moved the blocks across the Grand Valley fault into the graben. The current location and

attitude of these allochthons are due to subsequent movement and rotation on the Grand Valley fault. The allochthons occur at different stratigraphic levels in the Salt Lake group, each level corresponding to the time of a specific emplacement event.

Catastrophic emplacement of a fractured allochthon, a potential reservoir, into a lacustrine or other source rock depocenter creates a unique and potentially predictable type of petroleum occurrence. Paleogeographic reconstruction may explain anomalous occurrence of discrete allochthons in structurally low areas where it can be shown that a gravitational potential existed for detachment and sliding. The resulting trap would consist of allochthons encased in autochthonous source rock.

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#### Geochemistry of an Insular Phosphate Deposit, Nauru, Equatorial Pacific

The world's largest insular phosphate deposit is found on Nauru, an uplifted coral atoll in the western equatorial Pacific. This deposit, which is draped over a dolomitized karstic surface, has an earthy pelletal texture; it is oolitic at its base and structureless in its upper part. The only phosphate mineral found is a carbonate fluorapatite with the stoichiometry  $\text{Ca}_{10}(\text{PO}_4)_{5.6}(\text{CO}_3)_{0.6}\text{F}_{1.6}(\text{OH})_{1-x}$ . This mineral is slightly depleted in  $\text{F}^-$  and  $\text{CO}_3^{2-}$ , relative to  $\text{PO}_4^{3-}$ , to be considered a true francolite.

Abundant specimens of corals and micromollusks within the dolomite are representative of two contrasting atoll environments: a coral reef and a deep-water lagoon. The biostratigraphy has not been determined. Radiometric dates give a minimum age of 200,000 yr.

The source of the phosphorus is bird guano. The  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  values of the apatite and dolomite suggest that phosphatization occurred in meteoric water, possibly within and above a Ghyben-Herzberg lens; whereas dolomitization occurred in hypersaline water that refluxed from the lagoon when it became isolated from the open ocean during uplift. This interpretation is supported by the occurrence of as much as 15% gypsum in lagoonal sediments.

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#### Log-Analysis Problems Associated with Bimodal Pore System, Interlake Formation, North Dakota

The Interlake Formation is a Silurian-age sequence of dolostones, which produces hydrocarbons in the Williston basin. Log analysis of numerous Interlake wells from the Nesson anticline reveals that both water-productive and hydrocarbon-productive zones commonly have calculated water saturations in excess of 60%. These high calculated water saturations, in zones that produce water-free hydrocarbons, appear to be the result of a bimodal pore system. Non-fabric selective vugular pores are the major type of porosity seen in visual examination of Interlake cores. These vugs have been interconnected by fracturing and are responsible for most of the hydrocarbon production. The matrix that separates the vugs is composed of small equant dolomite crystals and also contains large amounts of intercrystalline microporosity, which is interconnected by pore throats less than 0.5  $\mu\text{m}$  across. These small pore throats result in low permeability and high capillary pressures; thus the microporosity is capable of holding 100% irreducible water, whereas the vugular pores produce water-free hydrocarbons. Because it composes up to 50% of the total porosity, this microporosity drastically reduces the resistivity of the formation.

Recognition that a formation contains a significant amount of microporosity is important not only in preventing bypassed production, but also in determining reserves and exploration economics. Determination of the percentage of effective porosity cannot be made using electric log or conventional core analysis. A combination of special core analysis and petrographic techniques is needed to better define the amount of effective porosity.

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#### Cenozoic and Upper Cretaceous Sedimentary Facies of New Jersey Continental Slope and Rise