stance is another matter. A challenge is presented when both geology and seismic expression entail subtlety. These problems are encountered frequently and often are treated with great success. Detection of fracture porosity in carbonate rocks is an example.

Bounds and nature of seismic visibility and detectability are developed for families of lithologies of exploration interest. Geometric considerations are examined in the context of subsurface definition. Tools and techniques currently available for treating seismic data for the subtle trap are described, and uses for these tools and methods are given. In reconciling geologic and geophysical views toward the subtle trap, a more complete definition of the concept and a still larger family of exploration targets are provided.

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Carbonate Submarine Fan Facies Along a Paleozoic Prograding Continental Margin, Western United States

Mass-transport deposits, though common in carbonate basins, normally occur as widespread sheets or debris wedges, as in the Devonian of Canada and elsewhere, or in modern interplatform troughs of the Bahamas.

Reexamination of a seaward-prograding Cambrian and Ordovician continental margin section in central Nevada reveals a 150-m thick interval whose facies resemble current models of submarine-fan deposition. The upper 100 m of sediment is assigned to an inner-fan setting and is characterized by submarine slides and several entrenched channels 10 m deep and 500 m wide. The channels are filled with disorganized boulder-bearing conglomerates but are not arranged in any well-defined thinning- and fining-upward sequences. Stratigraphically below this interval are thinning- and fining-upward organized, pebble to cobble-bearing channelized conglomerates, 30 to 50 m thick. These channels are 1 to 5 m deep, 20 to 100 m wide, and rapidly coalesce laterally and vertically. The conglomerates grade laterally into and are interbedded with thin and discontinuously bedded ripple-laminated and graded calcarenites, similar to detrital overbank-levee and interchannel deposits. These sedimentary units probably represent a system of braided channels in a mid-fan position. Below the braided channels are 10 to 20 m of thickening- and coarsening-upward cycles of virtually nonchanneled beds; beds in the cycles are composed of calcarenites exhibiting Bouma divisions. These carbonate sand sequences are interpreted to represent prograding outer-fan lobes.

The recognition of carbonate submarine-fan sequences raises several questions. (1) What sedimentologic and tectonic conditions are conducive to fan development in carbonate provinces? (2) Do these conditions resemble those for clastic-fan development, or do carbonate provinces have unique requirements? By recognizing carbonate submarine fans and the geologic conditions that control their sediment dispersal patterns, areas of maximum sediment accumulation may be predicted as an aid in exploring for petroleum reservoirs of deeper water carbonate environments.

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Distribution of Recent Deep-Sea Benthonic Foraminifera from Southwest Indian Ocean

Deep-sea benthonic foraminifera from the Crozet, Madagascar, and Mascarene Basins of the southwest Indian Ocean were studied (9-45°S, 45-80°E) to determine faunal-water mass relations. Principal component analysis of the faunal data reveals distinct trends related to depth and bottom-water potential temperature. Principal component 1 represents an average of all the faunal data. Negative values of principal component 2 reflect the importance of *Epistominella umbonifera* and are found generally south of 35°S latitude in the Crozet Basin and on the flanks of the Madagascar, Southwest Indian, and Southeast Indian Ridges. These negative values are associated with bottom-water potential temperatures ranging from -0.1 to 1.2°C with the high relative values (≤ -0.4) associated with potential temperatures $\leq$0.8°C. Positive values of principal component 2 reflect the importance of *Planulina wuellerstorfi,* rare species ($\leq$ 3%), *Globocassidulina subglobosa,* and *Astrononion echolsi,* and are found on the Central Indian and Madagascar Ridges where bottom-water potential temperatures are 0.4 to 1.2°C. High relative values of principal component 2 ($\geq$ 0.4) are found with potential temperatures of 1.2°C. High negative values of principal component 3 reflect the importance of *G. subglobosa* and high positive values reflect the importance of *Epistominella exigua, P. wuellerstorfi,* and *Pullenia bulloides.*

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Uranium Mineralization in Eocene Point-Bar Deposit, South Texas

An Eocene point-bar deposit was exposed by open-pit mining near Conoco's uranium mill in Karnes County, Texas. Two oxidation cells within the 1-mi-wide point bar are closely associated with the sedimentary facies. One oxidation cell with a subtle color difference was wedge shaped, confined by the steeply dipping accretion sets of the point bar. Color differences between oxidized and unoxidized sediments are very subtle. The front of oxidation was in basal point-bar sediments immediately below a sandy channel fill sequence. This sequence contains the second or upper oxidation cell, which is tube shaped and is only 50 ft (15 m) wide and about 20 ft (6 m) thick. Abundant clay galls within the sandy channel fill prevented the encroachment of oxidation along lateral boundaries of this oxidation cell and, therefore, controlled the distribution of local crenulations in the front. Trough cross-bedding and ripples indicate a south to southwesterly paleocurrent direction within the point bar. The orientation of the upper oxidation cell suggests that oxidizing fluids flowed in an easterly direction. Therefore, mineralization developed substantially later than sediment deposition, after uplift and a change in ground-water flow direction.

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Contrasting Facies in Upper Mesozoic Strata of Pacific Northwest

Upper Jurassic to Lower Cretaceous sedimentary rocks in the San Juan Islands, Washington, can be grouped into two facies that are represented elsewhere along the Pacific margin from southeastern Alaska to California. The eastern facies comprises well-stratified volcaniclastic turbidites depositionally overlying mafic to felsic volcanic rocks resting on a mafic-ultramafic igneous basement. Sedimentary breccias derived from the basement and pelagic radiolarian argillites are locally