and are commonly preserved in fossil shells. The microborings studied have the following morphological elements in common: sac-like enlargements (sporangia) with narrow necks (for spore release) opening to the substrate surface, and fine filaments (hyphae) interconnecting the sporangia.

The following characteristics of these three elements are compared: sporangia—shape, size, direction of the main axis, and degree of complexity; necks—length, cross section, and profile; hyphae—average width, constancy of diameter, branching, and mode of sporangial connection. The separation of three ichnotaxa within this cluster of forms is based on reconstruction of probable life cycles, morphometric analysis on the population level, and identification of the influence of different substrates on the morphology of the borings.

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Channel-Fill Deposits Formed by Aggradation in Deeply Scoured, Superimposed Distributaries of Lower Kootenai Formation

Three well-exposed channels of the lower Kootenai formation have several unusual features in common. The channels are contained within crevasse and bay-fill sequences, but the contacts between channel-fill deposits and laterally adjacent strata are erosional. The channels have a broad U-shape, range up to 300 m (985 ft) wide and 35 m (115 ft) deep, and exhibit a distinctive style of fill. Channel filling occurred in increments by accretion from the bottom up and sides in, to form a concave layering which is more or less symmetrical about the axis of each channel. Lithology of the fill of each channel is quite different, however, and ranges from mudstone, to interbedded sandstone and mudstone, to sandstone.

The channels are interpreted as superimposed distributaries formed by avulsion when the locus of sedimentation moved from one lobe to another. The lithology of the channel-fill deposits appears to be a function of the abandonment mechanism. A mud-filled channel forms where abandonment is rapid, as is the case with upstream diversion of a trunk river system. Sand and mixed sand-mudfills predominate where a distributary is progressively abandoned, for example where the discharge is diverted into an alternate favored distributary.

Superimposed channels are difficult to map in the subsurface by geologic means alone. They cut across the trend of adjacent facies so their presence cannot be predicted from analysis of the containing strata.

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Carbonate Sediment Produced by Rock-Boring Urchin, *Echinometra lucunter*, and Infauna, Black Rock, Little Bahama Bank

Bioerosion studies on Black Rock Island, Little Bahama Bank, were conducted during 4 cruises in 1982-83 on the 405-m (1,300-ft) long island of carbonate eolianite. The urchin population (mean 37 adults m^{-2}, 92 × 10^3 total) bores in a 6-m (20-ft) wide zone at depths of 0.5-3 m (2-10 ft). Scuba divers using rock chisels collected rocks, some with urchins in their boreholes and similar size rocks without urchins. The samples were placed separately in 20L, 62.5 μm screen-walled buckets for 2 days (18 useable measurements). Urchins produced spherical to elliptical pellets 1-2 mm in diameter. Disaggregated pellets contained no particles greater than 1.00 mm, 46% unimodal sand (mode = 177 μm), and 54% mud. Urchins produced a mean of 242 ± 146 mg sediment $urchin^{-1}$ day^{-1} (dry weight), equivalent to a mean of 8.9 g m^{-2} day^{-1} or 9 tons $year^{-1}$ for the entire population. Urchin boreholes were 17-126 cm^3 (mean = 72 cm^3). Calculating from boring-rate measurements, the boreholes were excavated in 0.7-10.3 years (mean = 2.9 years).

Rocks without urchins (controls) produced a mean of 0.50 ± 0.07 mg organic-free sediment cm^{-2} day^{-1} (dry weight). These particles were produced by bioerosion of an infauna (4.5-13.8 g dry weight) of eunicid and sipunculid worms, sponges, *Lithotrya* barnacles, pelecypods, and microborers. Inorganic sediment weight was correlated (r = 0.97) with surface area of the control rocks. Controls produced 5.0 g m^{-2} day^{-1} (36% of total), equivalent to 6.5 tons $year^{-1}$.

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Estimation of Oil and Gas Resources in Frontier Basins from Field-Size Distributions in Analogous Explored Basins

Oil and gas resource estimates for frontier outer continental shelf basins were expressed as field-size distributions. A list of AAPG basins was prepared to include field-level information on "original reserves" (reserves plus cumulative production) for oil and gas based on data from files maintained by the U.S. Energy Information Administration and the University of Oklahoma Petroleum Data System. Various distributions, including the 2-parameter lognormal distribution, were fit to each of the basins. In addition, basin-wide geologic characteristics were assigned to each basin. The research analyzed the statistical linkage between the fitted distributions and the geologic characteristics so that inferences could be made about the appropriate parameters for the field-size distributions in the basins to be evaluated.

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Intergranular Pressure Solution and Porosity Evolution in Quartzose Sandstones

Compared to cementation by quartz, carbonates, and clay minerals, intergranular pressure solution has long been viewed as a minor control of porosity evolution in quartzose sandstones. However, quantitative cathodoluminescence petrography and scanning electron microscopy of Paleozoic and Mesozoic sandstones from various geologic settings suggest that intergranular pressure solution is the diagenetic process that most fundamentally influences porosity and permeability evolution in a majority of cases.

Intergranular pressure solution dictates tightness of grain packing, size and geometry of primary pores, and diameter and morphology of contacts between framework grains; it also commonly predates pervasive cementation. Consequently, intergranular pressure solution is the fundamental control of minus-cement porosity. Although there is a close relationship between intergranular pressure solution and cementation in some sandstones, they are independent in others. For this reason, the percentage of minus-cement porosity actually occluded by cement is not systematic and is therefore difficult to predict.

Numerous geologic variables have been documented that influence the amount of intergranular pressure solution that occurs in quartzose sandstones. On a local scale, relatively fine-grained sandstones and sandstones containing between 3 and 9% early authigenic clay have experienced more intergranular pressure solution than other sandstones. Regionally, among sandstones of equal age, grain size, and clay percentage, those that have been exposed to greater rates of burial, greater total depth of burial, and higher temperatures have experienced more intergranular pressure solution.

These results suggest that an enhanced understanding of intergranular pressure solution may lead to a capability of predicting quartzose sandstone reservoir quality.

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Textures Formed During Shallow Water Halite Deposition—An Example from Permian of Palo Duro Basin, Texas

The Palo Duro basin, part of the broad northern shelf of the Midland basin during the Late Permian, accumulated cyclic, regressive, carbonate-anhydrite-halite sequences. Detailed interpretation of more than 2,000 m (6,500 ft) of halite core from 9 wells drilled by the United States Department of Energy in the northern Palo Duro basin permitted recognition of textures formed during halite deposition.

Textures formed on the bottom of a halite-saturated water body include color banding due to variation in composition and amount of impurities in halite beds, and vertically elongated anhedral halite mosaic, formed due to competition for space on the pool floor. Abundant fluid inclusions trapped along halite growth faces reflect rapid precipitation of halite in shallow water. Darker halite with sparse inclusions may have formed less rapidly in slightly deeper water.

Anhydrite partings, truncating the bottom-deposited fabrics, represent