Permian Marine Sand Wave Complex in Central Arizona

The Lower Permian Rancho Rojo Member of the Schnebly Hill Formation exhibits unusual large-scale compound or intraset cross-stratification near Sedona, Arizona. The very fine-grained, moderately sorted subfeldspathic to quartzarenite, is divided into four facies. The lowermost tabular-planar foreset facies comprises giant foresets that dip westward at 13-19°, with foreset bundles of planar, wavy, and minor intraset cross-strata separated by surfaces of erosion.

The intraset cross-stratified facies consists of giant foresets arranged in bundles that contain compound cross-stratification including tabular-planar herringbone pattern and complex trough sets separated by planar and trough erosion surfaces. The westerly dipping master sets have superimposed intrasets that display widely varying current vectors.

Both facies were deposited in a marine sand wave complex following rapid transgression across underlying fluvial-estuary deposits. The erosion surfaces that bound the master sets were likely formed during storms. The intraset planar and trough sets were formed by migrating tidally driven megaripples on the westerly dipping surfaces of the sand wave. Documentation is provided by close similarities with other reported ancient sand waves and the newly proposed Allen sand wave model.

These two facies are overlain by the ripple-laminated and homogeneous sand facies that developed during the waning stages of sand wave deposition. The former was probably produced by shoaling waves and the latter by bioturbation. The well-exposed Rancho Rojo will help advance the study of these controversial sand bodies and aid in the paleogeographical interpretation of the Permian in central Arizona.

BLAND, ALAN E., THOMAS L. ROBL, and DAVID W. KOPPENAAL, Univ. Kentucky, Lexington, KY

Geochemistry of Mississippian and Devonian Oil Shales of Northeastern Kentucky

Detailed chemical analyses were conducted on 10 cores drilled in Lewis and Fleming Counties of Kentucky in an oil-shale resource assessment funded by the U.S. Department of Energy. The stratigraphic units studied include the Sunbury Shale and the Ohio Shale, which is divided (from top to bottom) into the Cleveland Member, the Three Lick Bed, and the Huron Member. The chemical analyses include C, H, N, S, major element oxide, and trace-element determinations from 760 samples.

Carbon concentration was found to increase from top to bottom in the Sunbury Shale and Huron Member, and decrease in the Cleveland Member of the Ohio Shale. Average carbon concentrations were 11%, 6%, and 9% by weight in these intervals, respectively. Oil yield was determined by Fischer-assay and a good correlation with carbon was found. The Cleveland produced approximately 10% more oil per unit of carbon than the Sunbury. Although C, H, N, and S showed significant stratigraphic variability, the distribution patterns for these elements were found to be highly correlatable. The only systematic geographic variation of note was a 15% increase in hydrogen concentration in the Sunbury and Huron from north to south in the study area.

The Sunbury Shale was the least siliceous of the stratigraphic intervals and had the highest concentration of trace elements. Trace elements could be placed into four groups based on major element affinities: (1) those elements that showed strong association with carbon (Cu, Cr); (2) those with a weaker association with carbon (Ni, V, U); (3) those with an affinity for sulfur (Co, Mo, Pb, Zn); and (4) those with an inorganic affinity (Ba, Rb, Sr, Zn).

BLIEFNICK, DEBORAH M., Gulf Science and Technology Co., Houston, TX

Freshwater Diagenesis of Holocene Carbonate Sediments

Holocene carbonate sediments that compose small buildups in the Joulters Cays area of the Bahamas have been extensively altered by freshwater. Sediments, which include skeletal packtones and grainstones, and oolitic grainstones, were deposited in open shelf and ooid shoal environments. Evidence of the subsequent freshwater diagenesis includes mineralogic, petrographic, isotopic, and geochemical data. Mineralogically, the sediments are calcite with no high magnesium-calcite and only minor amounts of aragonite. Aragonitic grains such as mollusks and ooids have been dissolved resulting in skelmoldic and oomoldic textures. Such dissolution results in relatively high porosity despite extensive pore-filling cement. Values of δC^{13} are negative indicating exchange with isotopically light meteoric water. Analyses by atomic absorption spectroscopy and electron microprobe reveal low Mg^{++} and Sr^{++} values which reflect the flushing of freshwater through the system.

There are two possible sources for the freshwater: (1) the Pleistocene high just seaward of South Joulters Cay which could serve as a barrier to open-water exchange with the ocean. Ponding and freshening (by rainfall) of seawater would result in freshwater phreatic alteration of underlying sediments; and (2) the freshwater lens associated with a previous, older Joulters Cays. A modern analog is the Florida coastal acquifer which extends seaward several tens of km and phreatically alters carbonate rocks which remain well below sea level. It is likely that an earlier Joulters Cays existed and that the sediments were altered by the freshwater lens associated with those islands.

BLOCH, SALMAN, Oklahoma Geol. Survey, Norman, OK, JOSEPH A. CURIALE and JANINA R. BLOCH, Univ. Oklahoma, Norman, OK, et al

Uraniferous Pyrobitumens from Southwestern Oklahoma

Pyrobitumen nodules from the northern flank of the Wichita Mountains, Kiowa County, Oklahoma, contain unusually high concentrations of uranium (2,235 to 10,112 ppm), while the thorium content is low (0.1 to 2.0 ppm). The nodules are surrounded by a halo of gray dolomitic siltstone in a Permian (Hennessey Group) red dolomitic siltstone matrix. Microscopic examination indicates that the nodules consist of at least two phases of distinctly different reflectivity. Surprisingly, the uranium is associated with the low reflectance phase, in which it ranges up to 10% by weight.

Stable carbon isotope ratios of the uraniferous nodules show a consistent decrease from −31.2 ppt in the center of the nodule to −31.6 ppt at the outer edge (all values relative to PDB). This isotopic lightening at the edge of the nodule is also reflected in the surrounding siltstones. The carbon of the carbonate within the gray siltstone immediately surrounding the nodule is always lighter than that in the adjacent red siltstone by 0.3 to 0.8 ppt. Atomic H/C ratios of whole nodules average 0.83, while atomic O/C ratios of the nodules average 0.15, indicating that the nodules are extremely oxidized.

The presence of petroliferous rocks in the subsurface of the study area and zones of reduction along cracks and faults in the red siltstone suggest that the pyrobitumens are secondary,