Lower Jurassic Radiolaria, San Hipolito, Formation, Vizcaino Peninsula, Baja California Sur

Lower Jurassic radiolarian faunas recovered from the sandstone member of the San Hipolito Formation, Baja California Sur, indicate a younger age for much of this member than previously assumed. The San Hipolito Formation, exposed at Punta San Hipolito on the Vizcaino Peninsula, consists of 2,400 m (7,875 ft) of marine sedimentary rocks. The oldest member, a *Halobia*-bearing green chert, lies on pillow basalts and is successively overlain by limestone, breccia, and sandstone members. Upper Triassic (upper Karnian? and/or lower Norian to lower upper Norian) radiolarians have been described from the chert member. The hemipelagic pelecypod *Monotis* cf. *M. subcircularis* (Gabb) of Late Triassic (late Norian) age is found in the upper part of the limestone member.

The uppermost member of the San Hipolito Formation, a volcaniclastic sandstone 1,840 m (6,035 ft) thick, previously yielded only poorly preserved radiolarians, and was inferred to be of Late Triassic age. In this study, well-preserved radiolarians were not recovered from the sandstone and tuff beds. Thin limestone beds at the very base of the sandstone member contain a unique radiolarian fauna with some forms similar to Triassic radiolarians described from Austria and Italy. Discoidal limestone concretions and thin limestone beds from the top of the lower part of the sandstone member yielded abundant, well-preserved Lower Jurassic radiolarians.

No ammonites are found in association with the San Hipolito Lower Jurassic radiolarians, but the radiolarians are similar to Lower Jurassic radiolarian faunas from British Columbia and Oregon, for which excellent ammonite biostratigraphy is available. Based on the occurrence of the radiolarian genera *Canoptum, Droltus, Bagotum, Canutus, Hsuum, Lupherium* and *Pseudoheliodiscus*, a Pliensbachian and/or Toarcian age is assigned to the top of the lower part of the sandstone member of the San Hipolito Formation. The continuation of radiolarian studies in British Columbia, Oregon, and Baja California will provide a basis for further elaboration and refinement of a Lower Jurassic radiolarian zonation.

WHITE, THOMAS C., Baylor Univ., Waco, TX

Diagenesis of Permian Sabkha Carbonates and Evaporites, San Andres Formation, West Howard County, Texas

The San Andres Formation, on the basis of cores from west Howard County, Texas, consists of a westward-prograding sequence in the Midland basin. It is composed of five principal facies: (1) intrabasinal to basinal limestones; (2) open-marine bivalve or crinoid wackestones and/or packstones; (3) open-marine fusulinid wackestones and/or packstones; (4) subtidal to intertidal lagoonal mudstones and/or wackestones; and (5) intertidal to supratidal carbonate-evaporite sabkha. Contacts between facies are uniformly gradational.

The formation shows a complex diagenetic history. Carbonate sediments have undergone pervasive dolomitization, marked principally by complete dolomitization of the mud matrix, leaching and destruction of allochems, and partial void fill by subhedral to euhedral dolomite rhombs. Matrix-crystal enlargement occurs at the upper end of the sequence, where the sabkha reaches its greatest development. Anhydrite is ubiquitous in the formation, and is well developed throughout the sequence. Primary crystal habits are chaotic, blocky rectangular, radial, and poikilotopic. Anhydrite has been subjected to substantial diagenesis, including replacement by length-slow chalcedony, lutecine, hematite, pyrite, sphalerite, and free sulfur. Two major zones of leaching are marked by nearly complete solution of anhydrite and precipitation of coarse blocky and fibrous calcite, with levels of porosity exceeding 20%. Rehydration of anhydrite to satin spar and pseudomorphic gypsum is common, particularly concurrent with zones of leaching. Although paragenetic indicators are sparse, poikilotopic and rectangular void-filling anhydrite apparently postdates precipitation of nodular anhydrite, and solution of evaporites postdates replacement of anhydrite by length-slow chalcedony, as indicated by loose spherulites in the bases of leached voids.

WILKINSON, BRUCE H., AMANDA L. SMITH, and SUSANNE U. JANECKE, Univ. Michigan, Ann Arbor, MI

Low-Magnesium Sparry Calcite Marine Cements in Phanerozoic Hardground Grainstones

Many zones within Phanerozoic cratonic carbonates exhibit numerous features demonstrating synsedimentary submarine lithification at or near the sediment-water interface in normal-marine settings. Two such units, one from the Middle Ordovician Verulam Formation in Ontario, the other from the Upper Jurassic Sundance Formation in Wyoming, occur in sequences with multiple hardground zones, consist of coarse grainstones, and contain numerous borings of endolithic invertebrates which crosscut both allochems and early cement. The presence of borings in these grainstone units provides an unequivocal criterion for the discrimination and evaluation of hardground cement habits in that they constrain the timing of early cementation. Marine cement in both units consists of equant crystals of clear, inclusion-free, luminescent, low-magnesium calcite.

These cements are identical in habit to meteoric phreatic cement in calcitized Pleistocene sequences and are strikingly unlike Holocene marine cements which consist almost exclusively of acicular crystals of aragonite and/or high-magnesium calcite. Their presence in these two Phanerozoic normal marine carbonate sequences demonstrates that generalizations which relate cement morphologies to cement compositions, and which relate cement compositions to the chemistry of water in various cementation environments in modern systems, may not be valid when applied to ancient limestones.

WILSON, DOUGLAS, ARCO Exploration Co., Lafayette, LA

Petrography and Paleoenvironment of Upper Cretaceous Anacacho Formation in Southwest Texas

The Anacacho Formation is an Upper Cretaceous carbonate-bank sequence that formed in a narrow zone between the waning Cretaceous seaway and the young Gulf of Mexico. The Anacacho crops out along the Cretaceous Gulf coastal trend from Kinney to Bexar Counties, Texas. The most complete and extensive exposures occur in the Anacacho Mountains in Kinney County and the Whites Mine area of Uvalde County where asphalt is actively mined.

In this study area, the Anacacho Formation was deposited in the northern Rio Grande embayment on the fringe of a structural transition zone between compressional features on the west and extensional faulting on the east. The compressional features resulted from Carboniferous continental collision on the southern margin of North America, and Late Cretaceous subduction on the western margin. These events resulted in deep crustal weaknesses and the penetration of mafic intrusions which produced bathymetric highs where Anacacho organisms began to flourish.