WARREN, JOHN K., Univ. Texas, Austin, TX

Time Lines in Evaporitic Environments—Salina Versus Sabkha

Over the past 20 years, there has been an explosion in our knowledge of Holocene evaporitic environments, mainly due to the excellent studies completed on the sabkha (supratidal) sequences of the Persian Gulf. Our detailed knowledge of these sabkhas has given us an excellent tool for interpreting ancient evaporite sequences. The "sabkha model" implies that an ancient evaporitic sequence was deposited as a prograding sequence of three laterally extensive, continguous environments: the shallow subtidal, intertidal, and supratidal. However, some of us have called the sabkha model the dogma of the decade; few would dispute that in some ancient evaporitic sequences the sabkha analogy has been overextended.

There is another area of Holocene evaporite deposition, namely the carbonate-gypsum salinas of southern Australia, when subaqueous (?subtidal) millimeter-laminated evaporites have been forming for the past 6,000 years. The salina stratigraphy is a bull's eye pattern with nearly vertical carbonate to gypsum facies boundaries, and yet within each facies one finds horizontal bedding. This type of deposition, with major nearly vertical boundaries, and minor nearly horizontal bedding surfaces, is due to the rapid infilling of a density-stratified brine pond. A depositional model (the salina model) based on the southern Australia salinas is a model characterized by predominantly vertical rather than horizontal accretion.

Both the "salina" and the "sabkha" models have characteristics which can be used to refine a salina versus sabkha interpretation in ancient sequences.

WATERS, LAURA A., Amoco Production Co., New Orleans, LA, and ERNEST A. MANCINI, Alabama Geol. Survey, University, AL

Upper Eocene–Lower Oligocene Foraminiferal Biostratigraphy and Paleoecology in Eastern Gulf Coast Region

Definition of the Eocene-Oligocene boundary in the eastern Gulf Coast region is complicated because the upper Eocene and lower Oligocene strata in Mississippi consist of clastic-dominated deposits whereas time-equivalent strata in south-central Alabama are comprised primarily of carbonates. These strata intertongue across southwestern Alabama. Based on vertical planktonic foraminiferal distribution in these strata, the Eocene-Oligocene boundary occurs at the top of the Shubuta Member of the Yazoo Clay in Mississippi and southwestern Alabama and at the top of the Crystal River Formation in south-central Alabama. The Pachuta and Shubuta Members of the Yazoo and Crystal River are assigned to the upper Priabonian *Globorotalia cerroazulensis* (s.l.) Interval zone. The Red Bluff Clay and Bumpnose Limestone are placed in the lower Rupelian *Pseudohastigerina micra* Interval zone. Vertical compositional and diversity changes are apparent in the foraminiferal populations and indicate a rise in sea level through the Priabonian with a decrease in water depth in the lower Rupelian. The decrease in water depth might be attributed to a drop in sea level and/or to progradation of the Forest Hill delta across Mississippi into Alabama. Lower Yazoo sediments accumulated in an inner to middle neritic shelf paleoenvironment, and the upper Yazoo and Crystal River marls are middle to outer shelf deposits. The Red Bluff and Bumpnose sediments were deposited under middle to inner shelf conditions. West to east foraminiferal compositional and diversity trends are apparent. During the Priabonian and lower Rupelian, water depths in Mississippi exceeded those of south-central Alabama.

WATNEY, W. LYNN, Kansas Geol. Survey, Lawrence, KS

Carbonate-Dominated Shelf Cycles in Late Pennsylvanian of Mid-Continent: Intrabasinal and Extrabasinal Controls on Sedimentation and Early Diagenesis

The Upper Pennsylvanian (Missourian) Lansing-Kansas City Groups in the subsurface of western Kansas consist of a dozen cyclothems of carbonate and terrigenous clastics deposited on a platform that was gently tilted southward toward the more rapidly subsiding Anadarko basin. Maps of the study area covering western Kansas, derived from several thousand well logs and over 30 cores, describe four cyclothems in the Kansas City Group. Regressive carbonates developed in each of these cyclothems are major petroleum reservoirs in this region and are the focus of this examination.

The regressive carbonates thicken southward (basinward) at rates controlled by the tilt of the platform. Local and subregional variations in thickness and facies distribution are affected by local differential subsidence on the shelf, particularly along broad positive areas that closely correspond with previously active uplifts. Relatively thin carbonates having restricted shallow-marine facies are abundant over these positive areas. Subtle flexures along the shelf, especially where the slope increased basinward, were loci for ooid shoal development caused by wave and current action during shallow-water deposition.

Facies patterns interpreted from core and log-derived mapping demonstrate that neither the flexures nor the broader positive areas of the shelf were consistently active throughout the deposition of all four cycles studied. Hence, despite remarkable similarities, there are distinct variations between the cycles. Furthermore, not all cycles cover the study area to the same extent because (1) in some cycles, regressive carbonates pinch out along the northern (landward) shelf; (2) shallow restricted marine facies can be displaced southward; (3) the marine black shale, the deepest water phase of the cycle, can be missing or only poorly developed; and (4) intense local variations can occur in the early meteoric freshwater diagenesis that affects all cycles over much of the shelf.

Terrigenous clastics in the cycles are composed of thin layers of silty shale and claystone that prograded southward over much of the northern half of Kansas during the regressive phase of each cycle. Clastics from the Ouachitas, important components in cycles in eastern Oklahoma and southeast Kansas, never reached western Kansas until the Virgilian because these sediments were trapped by a relatively deep basin in western and central Oklahoma.

Extensive and prolonged subaerial weathering and associated freshwater diagenesis, marked and sharp vertical changes in the lithofacies, and broad repetitive facies patterns in relatively thin carbonates and shales can be explained by glacial eustatic changes in sea level. The Gondwana glacially influenced eustatic sea level changes had a periodicity and magnitude comparable to those of the Pleistocene. Variations in thickness, carbonate facies patterns, and diagenesis were also strongly influenced by second-order intrabasinal processes, including differential subsidence over positive areas and along breaks in slope.

WEIMER, R. J., Colorado School Mines, Golden CO, and S. A. SONNENBERG, Bass Enterprises, Denver, CO

Codell Sandstone, Denver Basin—Frontier Exploration in a Mature Basin