

hydrocarbon migration, which has significant effect on formation-water chemistry. The relationship between hydrocarbon migration and diagenetic minerals may be used as a pathfinder for hydrocarbon accumulation at depth.

ALSOP, JANICE L., Univ. Texas at Austin, Austin, TX

Pennsylvanian Shelf Carbonates, Madera Formation, Taos Trough, Northern New Mexico

The sandy limestones of the Madera Formation differ significantly from shelf carbonates described in other south-western late Paleozoic basins in that: (1) they were deposited adjacent to an active uplift that provided terrigenous clastics; and (2) no large scale phylloid algal mounds were developed. Prior to deposition of the Madera limestones, early to middle Desmoinesian deltaic deposits derived from the Uncompaghe uplift prograded eastward into the basin. Carbonate deposition was locally initiated on abandoned deltaic platforms, where low relief blue-green algal mudbanks and bryozoan mounds developed.

Carbonate deposition became widespread during a middle Desmoinesian transgression. Hummocky to cross-bedded crinoid grainstone shoals formed on and seaward of the algal mudbanks. These initial crinoid shoals were small and laterally discontinuous. As the shoals prograded and evolved into wave resistant barriers, extensive lagoonal and channeled tidal-flat deposits developed behind them. These low-energy lagoonal facies are characterized by small, low relief phylloid algal bars separated by bioturbated sandy siltstones. Fusulinid packstones filled tidal channels which graded laterally into dasycladacean algal flats. Progradation of the shoals also caused steepening of the platform margin, which led to restricted circulation in the slope/basinal depression. Anoxic conditions developed, and thick black, calcareous shaly siltstones were deposited in the basin. Carbonate deposition on the shelf was then terminated by renewed fluvial activity.

ANDREJKO, MICHAEL J., Univ. South Carolina, Columbia, SC, ROBERT RAYMOND, JR., Los Alamos National Laboratory, Los Alamos, NM, and ROBERT ERLICH and ARTHUR D. COHEN, Univ. South Carolina, Columbia, SC

Evidence for Pervasive Bioerosion of Silica Substrates in a Freshwater Peat Environment

Siliceous particles (30 to 100  $\mu\text{m}$ ) collected from freshwater peat deposits in the Okefenokee swamp show extensive effects of bioerosion. When viewed with the SEM these effects include: (1) depressions (similar to those produced by diatoms); (2) perforations (holes 2  $\mu\text{m}$  in diameter); and (3) borings (holes  $>2 \mu\text{m}$  in diameter). These features are most likely to be of biological origin because of their smooth surfaces and the consistency of the geometry of the cavities. The delicate nature of the eroded grains dictates that the biological agents responsible must have lived in the peat-forming environment. For example, monaxon sponge spicules have lost as much as half their original mass through hundreds of tubular microborings, rendering them far too fragile for transport. Heretofore, microborings have been observed to commonly occur on carbonate substrates, and in only two cases has bioerosion been reported in siliceous sediments in a marine environment. Our observations show that freshwater organisms are also capable of boring/dissolving silica, and that this form of degradation may play a major role in silicon mobility within peat-forming environments.

ARARIPE, P. T., M. SAITO, S. SHIMABUKURO, and C. H. R. CUNHA, PETROBRAS, Rio de Janeiro, Brazil, and R. O. KEHLE, Turk, Kehle & Associates, Austin, TX

Barra Nova Salt Domes Province, Espirito Santo Basin, Off-shore Brazil

The Barra Nova salt domes province, in the Espirito Santo basin, offshore Brazil, bears some resemblance to the interior basins of the Gulf of Mexico. Two main hypotheses try to explain the origin of the Barra Nova salt domes. (1) Since Aptian salt was overlain by uniform Albian platform, salt movement began as a consequence of the general eastward tilting of the basin which caused gravity sliding and the formation of salt pillows. (2) Existence of an uneven sedimentary loading is represented by Upper Cretaceous volcanic flows extending over the area underlain by salt. These volcanics sank into the salt, forming exposed salt masses which were dissolved, causing salt withdrawal and gravity sliding. Continued sedimentation on the evacuated areas induces the formation of salt domes.

The initial salt pillows began forming during the Albian. Before the Maestrichtian, they reached the extrusion/collapsing phase which extended to the Holocene with the salt domes being dissolved on the present sea floor. One of the mapped domes represents an exception, as it seems to be already in the burying phase.

The gravity sliding, originated from halokinesis, was an important factor in the tectono-sedimentary evolution of the Espirito Santo basin from Late Cretaceous on.

ARCHER, ALLEN W., DePauw Univ., Greencastle, IN, and DONALD E. HATTIN, Indiana Univ., Bloomington, IN

Analysis of Upper Cretaceous Trace-Fossil Assemblages, U.S. Western Interior

Diversity and abundance of trace fossils in strata of the Greenhorn and Niobrara cyclothems of west-central Kansas, southern Colorado, and south-central Utah have been used to quantify trace-fossil assemblages. Recognition of assemblages is based on use of quantitative, semi-quantitative, and binary (presence-absence) data in conjunction with cluster and factor analysis. Although the character of the original burrowing infauna was a primary factor in assemblage composition, the nature of burrowed sediments and diagenesis exerted strong influence on the preserved trace-fossil record. Thus, the present composition of originally similar assemblages may differ among the several lithotypes (sandstone, shale, chalk, limestone) because of variations in depositional and diagenetic processes that affected preservation of biogenic structures. It is suggested that some of the observed differences in these Upper Cretaceous trace-fossil assemblages are more apparent than real.

At present, taxonomic problems relating to trace fossils hinder quantification of the Upper Cretaceous assemblages. Direct application of standard taxonomic conventions could lead to conceptual confusion because the morphology of trace fossils is controlled as much by general behavior of organisms and their specific responses to sedimentologic parameters as by body form. For example, *Ophiomorpha* is known to grade into *Thalassinoides*, some of which developed *Teichichnus*-like form. Furthermore, some *Rhizocorallium* are connected to *Thalassinoides* burrow systems. The first three genera could be synonymized with *Rhizocorallium*, which has priority. A more constructive approach involves erection of suprageneric categories, such as *Rhizocorallium*-group, that would express