Modified Lopatin diagrams were used for detailed maturation modeling of four of the Phosphoria sampling sites. This detailed modeling clearly demonstrates that the thermal effects of overthrusting do significantly influence the maturation history of organic material incorporated in overthrust sediments. Briefly, the result of thrusting is to cool the overriding sheet and warm the sediments being overridden. A unit in the hanging wall of a thrust will not be subjected to high temperatures for nearly as long a time as the equivalent unit in the footwall of the thrust. Comparison between observed reflectance values for the four sampling sites with vitrinite reflectance values calculated from Lopatin diagrams indicates that better agreement between observed and calculated values is obtained when thermal modifications due to thrusting are incorporated within the Lopatin diagrams.

Finally, in the absence of actual geochemical information such as R_o or T.A.I., the models here described appear to be accurate enough to give a reasonable estimate of the thermal maturity of a potential source bed. Such a predictive technique can be of great value in planning an exploration program in previously untested overthrust terrains.

EHRHART, THOMAS P., Mobil Exploration and Producing Service, Dallas, TX

Depositional Environments of Ranger Limestone (Pennsylvanian), North-Central Texas

The Ranger Limestone was deposited on the broad shallow Eastern shelf of the Midland basin during Missourian time. The sequence of alternating carbonate and terrigenous sediments comprising the Ranger Limestone is reflective of the overall cyclicity exhibited by the Canyon Group. An analysis of the interrelationships of the facies produced a framework for reconstructing the depositional history. Earliest carbonate deposition in the Ranger appears to have been initiated on local topographic highs of probable minor relief. Phylloid algae are abundant biotic constituents in the Ranger Limestone and probably played a key roll in the carbonate buildup. The Ranger Limestone is composed primarily of sediments that represent four major depositional environments. The carbonate environments recognized include an inner shelf, a transitional inner shelf, and a restricted inner shelf. These carbonate accumulations are laterally restricted by distal delta-front deposits of the Perrin delta complex.

A multivariate statistical analysis based on point-count data of lithologic and biologic constituents was utilized in the delineation of facies within the Ranger Limestone. On the basis of the detailed petrographic study four facies were defined. These facies are: (1) algal-echinoid-bryozoan wackestone, (2) algal wackestone, (3) lime mudstone, and (4) calcareous shale.

EJEDAWE, J. E., S. J. L. COKER, D. O. LAMBERT-AIKHIONBARE, K. B. ALOFE, and F. O. ADOH, Univ. Benin, Benin City, Nigeria

Evolution of Oil-Generative Window (OGW) in Niger Delta Basin

Assuming a simple model of delta development involving progradation and uniform subsidence to present depths (rate, 500 m/m.y.; 1,640 ft/m.y.), oil-genesis nomographs derived from the TTI method were constructed for various geothermal gradients of the Niger delta (2.2., 2.5., 2.9, 3.2, 3.6, 4.0, 4.4, and 4.7°C/100 m) and utilized in mapping the positions (depth, temperature) of the top of the oil-generative window (OGW) at arbitrarily selected times (40 m.y.B.P., 30 m.y.B.P., 15 m.y.B.P., and the present). About 200 data points were evaluated.

During the active subsidence phase, oil generation within any megastructure was initiated at a temperature of 140 to 146°C (284 to 294°F) and depth of 3,000 to 5,200 m (9,842 to 17,060 ft) within 7 to 11 m.y. after deposition of the potential source rocks. After cessation of subsidence, upward movement of the OGW by 800 to 1,600 m (2,624 to 5,249 ft) was accompanied by a temperature lowering of 23 to 54°C (73 to 129°F). Lower temperatures produced correspondingly heavier crudes.

In some parts of the delta oil generation and expulsion from the lower part of the Agbada Formation predates the cessation of subsidence and structural deformation, while in others it postdates those events. In most parts of the Niger delta, the upper and normally compacted part of the Akata Formation appears to constitute the major source rock.

EKDALE, A. A., Univ. Utah, Salt Lake City, UT, and RICHARD G. BROMLEY, Inst. Historical Geology and Paleontology, Copenhagen, Denmark

Biogenic Structures in Pelagic Carbonates: An Ichnofacies Comparison of Deep-Sea and Shelf-Sea Chalks

As a general rule, pelagic sediment is totally bioturbated, and primary sedimentary structures are rarely preserved. The fabric and internal structure of the sediment are modified postdepositionally by the burrowing activities of the infaunal benthos. However, various aspects of the original depositional environment, such as water depth, sediment type, and substrate stability, may be reflected in the ichnofacies. The ichnotaxa apparently differ in their environmental requirements and tolerances; thus, ichnofacies transitions exist even within the pelagic depositional regime.

Today fine-grained, calcitic nannofossil ooze is deposited beyond the reach of terrigenous sources in water depths of about 2,000 and 4,500 m (6,562 to 14,764 ft). At certain times in the past, however, such as during the Late Cretaceous in northern Europe, fine-grained calcareous ooze was deposited in much shallower depths as well, perhaps as little as a few hundred meters.

Trace fossils aid our understanding of the paleobathymetry and substrate conditions in ancient chalky sea bottoms. Deep-sea chalks differ from their shallow-water counterparts in northwest Europe in their typical lack of abundant shelled megafossils and flint horizons. The European chalks commonly contain a *Thalassinoides*-dominated ichnofacies, which very directly influenced such early diagenetic processes as hardground formation and silica reprecipitation. A deeper water ichnofacies in the European chalks, dominated by *Zoophycos*, is less commonly associated with hardgrounds and flint horizons. In truly deep-sea chalks, *Thalassinoides*, bored hardgrounds, and well-developed burrow flints are very rare; a *Zoophycos-Chondrites-Planolites* association is characteristic.

ELLER, LYNN H., Geological Information Library of Dallas, Dallas, TX

Depositional Environment of Pittsburgh No. 8 Coal Seam

The Pittsburgh No. 8 coal, the basal member of the Monongahela Formation, is considered one of the most important coal seams in Ohio. Maceral analyses and reflectance studies were conducted on four seams to determine its depositional environment. Petrographic analyses of coal from Guernsey, Belmont,