

water from the hard geopressed zone has occurred have three identifying characteristics: low fluid pressures, high formation-water salinity values, and residual high pressure areas. These areas are considered to be highly prospective places to search for hydrocarbon accumulations. In the study locality there are five areas below which a vertical flush has occurred from the hard geopressed zone and each area contains commercial accumulations of hydrocarbons.

Pressure, temperature, and salinity studies, when coupled with lithology and structure, add a new dimension to hydrocarbon exploration and should definitely be used in the search for new reserves of oil and gas.

HAZEL, JOSEPH E., U.S. Geol. Survey, Reston, Va., MARTIN D. MUMMA, Eastern Washington Univ., Cheney, Wash., and WILLIAM J. HUFF, Univ. South Alabama, Mobile, Ala.

Ostracode Biostratigraphy of Lower Oligocene (Vicksburgian), Mississippi and Alabama

Ostracodes are abundant and diverse in most samples collected from clastic and carbonate facies of the Vicksburg Group (Mint Spring, Marianna, Glendon, Byram, and Bucatunna Formations) and the underlying Red Bluff and Bumpnose Formations. About 92 species have been identified from 125 samples collected from measured sections and cores from Mississippi and western Alabama. Graphic correlation, no-space graph, and principal coordinate analyses of the data have resulted in a zonation that allows more precise correlation of the lithostratigraphic units than heretofore existed in the literature.

The sequence is divided into three successive first-appearance interval zones, defined, oldest to youngest, on *Actinocythereis dacyi*, *Aurila kniffeni*, and *Actinocythereis rosefieldensis*. The top of the *A. rosefieldensis* Zone is defined by the first appearance of *Leguminocythereis quadricostata*. In Mississippi, the Red Bluff is placed in the *Actinocythereis dacyi* Zone; the base of the *Aurila kniffeni* Zone is approximately coincident with the base of the Mint Spring; and *Actinocythereis rosefieldensis* first appears in the upper part of the Glendon. The Byram and the Bucatunna, where it is fossiliferous, are included in the *Actinocythereis rosefieldensis* Zone. In western Alabama, the basal carbonate rocks of the Oligocene, commonly referred to the Red Bluff by other workers, are here considered to represent the westernmost extent of the Bumpnose; the overlying dark clays, usually referred to the nonmarine to brackish or near-shore marine Forest Hill, are here placed in the Red Bluff. Both the Bumpnose and Red Bluff represent the *Actinocythereis dacyi* Zone. The ostracode data suggest that the Mint Spring and the lower part of the overlying Marianna of western Alabama are older than the Mint Spring of Mississippi and therefore correlate with the Forest Hill. This correlation is confirmed by analysis of occurrence data for the *Pecten perplanus* lineage. The upper part of the Marianna in western Mississippi is included in the *Aurila kniffeni* Zone. No ostracodes were recovered from the Glendon in western Alabama; *Actinocythereis rosefieldensis* is first found in the Byram.

Published and unpublished planktonic foraminifer data indicate that the *Actinocythereis dacyi* and *Aurila*

kniffeni Zones are approximately correlative with the *Cassigerinella chipolensis*-*Pseudohastigerina micra* Zone (= P18 and P19). The *Actinocythereis rosefieldensis* Zone approximates the *Globigerina ampliapertura* Zone (= P20). Published calcareous nannofossil data indicate that the *Actinocythereis dacyi* Zone closely approximates the *Ericsonia subdisticha* Zone (NP21). The *Aurila kniffeni* and lower *Actinocythereis rosefieldensis* Zone correlate with the *Sphenolithus predistentus* and *Helicopontosphaera reticulata* Zones (NP22 and NP23, undifferentiated). Ostracode and calcareous nannofossil data from South Carolina indicate that the base of the upper Oligocene *Leguminocythereis quadricostata* Zone, and, therefore, the top of the *Actinocythereis rosefieldensis* Zone, is within the calcareous nannofossil *Sphenolithus distentus* Zone (NP24). The upper part of the *Actinocythereis rosefieldensis* Zone and the lower part of the *Leguminocythereis quadricostata* Zone are apparently represented in Mississippi and western Alabama by the unconformity between the Bucatunna and the overlying Chickasawhay Formation. The latter formation is of late NP24 and late *Leguminocythereis quadricostata* Zone age.

A study of the distribution of ostracode genera thought to be cogent environmental indicators and a species of *Trachyleberidea* that has trefoil surface ornamentation indicates that the entire sequence below the Byram in western Alabama was deposited in relatively deep waters, that is, probably at outer sublittoral depths. This sequence includes the Red Bluff clays previously thought to represent an eastward tongue of the deltaic Forest Hill Formation. In western Mississippi, deeper water indicators are present in the upper part of the Mint Spring through Glendon interval, but they are not dominant. The lower part of the Mint Spring and Byram are dominated by inner sublittoral forms. In eastern Mississippi, the Red Bluff, Mint Spring, Marianna, and Glendon represent open-marine, probably middle sublittoral, sedimentation. No ostracodes were obtained from rocks that could unequivocally be said to represent the Forest Hill Formation. The Byram in eastern Mississippi and western Alabama was deposited at inner sublittoral depths, as was the marine part of the Bucatunna. The presence of *Jugosocythereis* in all the shallow-water facies strongly suggests that tropical to perhaps subtropical conditions prevailed during deposition of these Vicksburgian sediments.

Seven new species are proposed: *Ghardagliaia obovata* Mumma, *Hermanites moorei* Hazel, *Leguminocythereis quadricostata* Mumma and Hazel, *L. alata* Hazel, *L. edwardsae* Hazel, *Patellacythere comptonae* Hazel, and *Loxocncha pseudoinflata* Huff and Hazel.

HOBDAV, DAVID K., Bur. Econ. Geology, Univ. Texas at Austin, Austin, Tex., and BOB F. PERKINS, Univ. Texas at Arlington, Arlington, Tex.

Paleoenvironments and Trace Fossils of Large Aggrading Delta Margin Embayment—Upper Woodbine Formation of Northeast Texas

The broad Lewisville embayment of northeast Texas covers an area of 30,000 sq km and developed during the latter half of Cretaceous (Cenomanian) Woodbine deposition as a result of reduced clastic influx and bypassing of sediment toward the south, where deltaic sys-