five distinct lithologic facies. The composite properties of these facies imply deposition in subenvironments associated with an outer, predominantly subaqueous deltaic plain—distributary-channel, distributary-mouth-bar, crevasse, reworked and probably drifted bar-sand, and open-bay subenvironments.

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TRACE FOSSILS, BASIN MIGRATION, SEDIMENTATION, AND BATHYMETRY OF OUACHITA GEOSYNCLINE OF OKLAHOMA

Flysch-type *Nereites* trace-fossil associations, paleocurrent data, and relatively numerous, thick sandstone beds with fluted soles, graded tops, contorted and convolute lamination, and ripple-drift indicate a continuous deep-water (bathyal-abyssal) axis for the Ouachita geosyncline during the deposition of the Stanley Group, Jackfork Group, Johns Valley Shale, and Atoka Formation of Oklahoma.

Eventual migration of the basin onto the shelf is suggested by the west, northwest, and north overlap of the Atoka Formation on the Johns Valley Shale, Springer Formation, Chickachoc Chert, and Wapanucka Limestone, and by a transitional, shoal- to deep-water facies developed over the Chickachoc Chert and Wapanucka Limestone in the Atoka Formation.

The transitional facies consists of a thick shale which is thought, on the basis of modern analogues, to have been deposited on a slope. Thin sandstone beds are present in this shale and are more numerous upward in the section. The sandstone beds are characterized by a trace-fossil association similar to a trace-fossil association in the basin axis, and by tooled soles, contorted lamination, ripples, and little grading. Downslope, the transitional facies grades into the axial facies in which thick-bedded, axial-type sandstone becomes dominant.

North of the Ouachita Mountains in the Arkoma basin, the top of the Atoka Formation is preserved. Physical-sedimentary structures and molasse-type *Cruziana* trace-fossil associations indicate shoal and near-shoal conditions. Toward the base of the section, there is no evidence for intermediate or deep-water facies. The older transition and deep-water facies are concealed in the thick Atoka section of the Arkoma basin or are farther south, beneath the Choctaw thrust which borders the west, northwest, and north margins of the Ouachita Mountains.

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STRUCTURAL AND TEXTURAL DESCRIPTIONS OF MARINE SEDIMENTS

It is commonly difficult to make accurate structural and textural descriptions of marine sediments because of the plasticity of the material and the significant but subtle property differences. Several methods, however, can be applied.

X-ray radiography, both stereo and normal, allows the nondestructive examination of the sample. Structures may be mapped and anomalous features identified before other tests are carried out.

Electric-logging procedures, both in the laboratory and "at sea," are used to correlate cores and relate sample sites. Spontaneous potential, resistivity, and other logging techniques also can be used.

Cholesteric liquid crystals are applied to the investigation of fine structural and textural changes. The ability of these solutions to delineate thermal conductivity differences is used to map structural, textural, and lithological differences. By changes in color in response to minor temperature changes, thermal resolution of 20 line pairs per millimeter is achieved.

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SAN ANDRES (PERMIAN) FACIES AND DIAGENESIS IN REEVES FIELD, YOAKUM COUNTY, TEXAS

The Reeves zone is about 500 ft below the top of the Permian San Andres Formation and includes low-energy and high-energy facies in repeated cycles. Lithologic types represented are (1) carbonate mudstone, (2) wackestone, (3) packstone, and (4) oölitic grainstone. Two types of cycles recognized are (1) shelf-edge cycles which culminate in well-developed oölites, and (2) back-shelf cycles which culminate with stromatolitic mudstone.

Three major diagenetic processes that altered the Reeves field carbonate rocks are (1) leaching, (2) dolomitization, and (3) gypsum precipitation—but not necessarily in this order. The grain-supported rocks contained approximately 25% depositional porosity, most of which was infilled by anhydrite; 80% of the perforations are in mudstone-supported facies which, according to core analyses, are permeable and porous. Postdepositional processes have reversed the depositional porosity pattern.

Reeves is a typical Permian basin San Andres field. It was discovered in 1957 and has reserves estimated at 20 million bbl.

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COMPARISON OF STRATIGRAPHIC AND MICROSCOPIC EVIDENCE FOR ORIGIN OF VIRGINIA "TERRACE" SEDIMENTS

Post-Miocene stratigraphic units on the coastal plain of southeastern Virginia consist of nearshore marine, beach, backbarrier, and fluvial facies. Electron-microscope studies of surface features on quartz grains from these stratigraphic units suggest origins which correlate closely with information obtained independently from stratigraphic studies.

Superposed surface features were used to establish the depositional history of sand grains affected by more than one environment. Relative ages of stratigraphic units were determined from degree of surface etching on quartz grains. The presence of surface features characteristic of glacial action has been used to differentiate Pleistocene from pre-Pleistocene stratigraphic units. The contact between beach and dune sand, as determined by electron microscopy, has been used, together with independent stratigraphic data, to determine the maximum elevations of Pleistocene sea levels associated with the stratigraphic units and morphologic features on the Virginia coastal plain.

This study shows a close correspondence between inferences based on electron-microscope studies of quartz-grain surface textures and independent data obtained from field studies of morphology and stratigraphic relations. The correlation suggests that electron-microscope studies may be useful in interpreting