plain rocks; a barrier island-lagoonal progradation, reflecting a high rate of submergence, comprises a series of discrete sandstone lenses arranged *en échelon,* each lens intercalating landward with lagoonal deposits and seaward with off-beach marine shale. During transgression, because of the step-like topography of a barrier island-lagoonal terrain, shoreline sandstone bodies are developed only discontinuously, giving rise to asymmetrical cycles.

Because of the general paucity of organic remains in the Mesaverde, the determination of depositional environments commonly must be accomplished by the evaluation of stratification. Though there are no single stratification features peculiar to particular environments, sequences of stratification may be diagnostic. *Stratification in rocks occurs in response to physical-depositional processes;* the vertical sequence of stratification in a regressive suite of rocks reflects the lateral distribution of processes operative at the time of deposition. Beach stratification, from bottom to top, includes laminae deposited in the transition zone between off-beach shale and offshore beach sandstone, the submarine bar zone, the fore-shore beach, and the back-shore beach. A vertical sequence of lagoon stratification may reflect deposition in a tidal delta, lagoon pond, tidal channel, wave flat, and salt marsh. The character of the stratification in the different subenvironments may be determined by study of modern environments and processes; the great variety of processes present within these modern environments yields perspective on the variety of stratification to be expected in the geologic record.

27. M. DANE PICARD, University of Nebraska, Lincoln, Nebraska

PALEOCURRENTS AND SHORELINE ORIENTATIONS IN GREEN RIVER FORMATION (EOCENE), RAVEN RIDGE AND RED WASH AREAS, NORTHEASTERN UINTA BASIN, UTAH

Paleocurrent data from ripple marks and cross-stratification are related to orientations of shorelines and sandstone-body trends in the lacustrine and fluvial setting of the Green River Formation (Eocene) in the Red Wash field and the adjacent outcrops along Raven Ridge in Utah and Colorado. At 11 localities along Raven Ridge, the northeastern margin of the Uinta basin, 125 paleocurrent directions were measured from cross-stratification and asymmetrical ripple marks in the Douglas Creek and Garden Gulch Members and the lower part of the Parachute Creek Member.

Vertical stratigraphic variation of paleocurrent directions at each locality is small, indicating that the overall current system was stable. A plot of measurements of 68 asymmetric and 84 symmetric ripple marks shows that their distribution is very similar, which is interpreted to be the result of their formation by the same current system. Based on few data, there is an average difference of 5° between paleocurrent directions from cross-stratification and from ripple marks, ripple marks showing less variation than cross-stratification. The dominant paleocurrent directions are toward the north, south, and southeast. Of all observations, 25% range from 331° to 30°, and 51% range from 121° to 210°.

The shorelines in the northeastern Uinta basin area are interpreted to have been generally perpendicular to the dominant paleocurrent directions. Therefore, essentially all of the shorelines had bearings of 31°-120°. An arc of 61°-90° would contain about 40% of the bearings of the shorelines, based on the paleocurrent data. Trends of single sandstone bodies, the total footage of sandstone, sandstone plus siltstone, and net sandstone, and the major facies support the generalizations about the orientations of shorelines and sandstone-body trends.

28. PERRY O. ROEHL, Shell Development Company, Houston, Texas

ANALOGS OF RECENT LOW-ENERGY CARBONATE DEPOSITS IN STONY MOUNTAIN (ORDOVICIAN) AND INTERLAKE (SILURIAN) FORMATIONS, MONTANA

Reservoir rocks were studied from the Stony Mountain (Ordovician) and Interlake (Silurian) producing formations in several oil fields on the Cedar Creek anticline, southwestern Williston basin. In early Paleozoic time the basin was covered predominantly by epeiric seas in which were deposited shallow-water, intertidal, and supra-tidal carbonates of distinctive facies and fabric. These deposits now are dolomite in which intercrystalline porosity predominates. However, their delineation and extent are controlled strictly by original facies and subsequent diagenetic structures. Such facies and structures compare favorably with those of modern tidal-flat and supra-tidal deposits of Florida and the Bahama Islands, including the alteration forms which occur shoreward of the mean high-tide line.

A generalized working model of facies relations was derived. This model shows the proposed environment of deposition and some of the kinds of depositional structures in which original porosity distribution was preserved. Most of the important porous structures result from a combination of organic and inorganic processes in zones of low hydrokinetic potential. These are: pelleted, laminated, and burrowed mud and silt; algal mats and stromatolites; flat-pebble conglomerate; endogenic and solution breccia; and a few cut-and-fill structures. Leaching of fossils and anhydrite in certain places has accentuated and improved pore structure.

29. DONALD W. LANE, Tenneco Oil Company, Casper, Wyoming

PRIMARY STRUCTURES AND SEDIMENTARY ENVIRONMENTS IN DAKOTA SANDSTONE, NORTHWESTERN COLORADO

Depositional environments in the Dakota Sandstone in northwestern Colorado have been identified by comparisons of primary structures present in both the Dakota and in Recent sediments. Identification also is aided by study of lithologic character, organic content, and geometry of sedimentary units. The Dakota ideally consists of a transgressive sequence which, from base to top, shows the following environments: (1) channel and floodplain, (2) swamp-tidal flat-lagoon, (3) beach, and (4) surf-zone and other shallow sub-littoral deposits. In places the beach and shallow-marine sandstone bodies are absent, and shallow-marine black shale of the overlying Mancos Shale lies directly on tidal-flat sandstone in the Dakota.

The sediments of most depositional environments contain one or more significant primary structures. Channel deposits contain high-angle cross-beds in irregular, discontinuous units usually 1 ft. thick or more. These cross-beds are formed on point bars by megaripple migration during flood stages. Floodplain