

areas of numerous large anticlines with multiple unconformities and complex growth and fault histories; areas of small, gentle, low-relief anticlines and areas where the Tertiary sediments onlap older volcanic rocks with little or no folding of the strata. Both oil and gas shows have been detected, but no commercial accumulations have yet been found.

SKIPPER, KEITH, Dept. Geology, McMaster Univ., Hamilton, Ont.

#### ANTIDUNE CROSS-STRATIFICATION IN TURBIDITE SEQUENCE, CLORIDORME FORMATION, GASPÉ, QUEBEC

Large-scale, single set cross-stratification, considered to have been produced by the upstream migration of antidunes, is present in the basal division of turbidite beds 2–3 m thick in the  $\beta_1$  member of the Cloridorme Formation (Ordovician), Gaspé, Quebec. The local westward paleocurrent direction is approximately parallel with the east-west strike of the vertical beds, which crop out on the wave-cut platform.

The beds generally show 3 broad divisions. The basal division (2–15 cm) consists of very coarse-grained sand with a smooth or fluted base and sinusoid top (wave length from 45 to 100 cm and amplitude from 3 to 7 cm) and internal laminae inclined at a shallow angle (less than 15°) toward the east. Where flutes occur they give a paleocurrent direction toward the west. A second division consists of spindle or globular-shaped nodules ("pseudonodules") in an argillaceous matrix and commonly occurs above the basal division. In 1 bed, which occurs in a sequence with beds exhibiting ripple-drift cross-lamination, a ripple-drifted horizon is developed between the basal and pseudonodule divisions, the ripple-drift produced by a paleocurrent toward the west. The upper division consists of fine-grained siltstone or shale.

Because the basal very coarse sandstone is a small percentage of the total thickness of any bed, it appears that the settling velocity of the coarser grains probably was reduced by a high concentration of fine suspended material which increased the viscosity and reduced the density difference between the coarse grains and the suspension; the result was a high transport rate and the formation and preservation of antidunes, because of a delicate balance between traction and suspension in the current. Calculations suggest that the current moved at velocities of approximately 1 m/sec.

SMITH, DONALD L., Dept. Geology, Univ. Montana, Missoula, Mont., PETER GARRETT, Dept. Earth and Planetary Sciences, Johns Hopkins Univ., Baltimore, Md., DAVID PATRIQUIN, Dept. Geology, McGill Univ., Montreal, Que., and AUGUSTUS O. WILSON, Dept. Geology, Univ. North Carolina, Chapel Hill, N.C.

#### PHYSIOGRAPHY, ECOLOGY, AND SEDIMENTS OF TWO BERMUDAN LAGOON REEFS

To provide a possible Holocene analogue for some ancient reefs, we studied the physiography, ecology, and sediments of two small reefs in Bermuda's north lagoon. Both are rough-topped "mesas" rising 18 m from the relatively featureless lagoon floor to within 1–2 m of sea level. On the reef top, irregular coral- and algae-covered knobs are separated by sediment-filled valleys and hollows. The central area of 1 reef, believed to be in a more advanced stage of development, is an atoll-like sandy plain with only scattered knobs.

Scleractinian corals, principally *Montastrea annularis*

and *Diploria strigosa*, are the most important reef-framework builders, as revealed in sections artificially constructed by blasting with dynamite. Coral growth is thought to be the major factor influencing the shape of reef cavities that are common throughout the reef mass. The walls of these cavities are covered with distinctive wall growths built by the skeletons of shade-loving organisms, principally encrusting red algae, pelecypods, a foraminifer, and ectoprocts.

Sediments on the reef top are generally coarse to very coarse sand with good to moderate sorting. The particles, dominated by *Halimeda*, which is also common in lagoonal sediments, are derived entirely from the breakdown of reef-top organisms. These same reef-top sands are washed down the reef face to build a steep reef-sediment slope. Fine sediments are winnowed from the reef-top and settle from suspension to the near-reef lagoon floor, where they form a "halo" of fines around the reef.

SORAU, J. E., Dept. Geology, State Univ. New York at Binghamton, Binghamton, N.Y.

#### MICROSTRUCTURE OF RUGOSAN SKELETON (COELENTERATA)

Scanning electron and petrographic studies of *Thamnophyllum*, *Pachyphyllum*, *Tabulophyllum*, and *Charactophyllum* indicate that the Rugosa have much in common with the Scleractinia in terms of formation and structure of their exoskeleton. Possibly all rugosan septa are trabecular in construction, as lamellar structures are secondary, and fibro-normal structures are at least partly the result of modification of trabecular septa by diagenetic processes. There is no difficulty in applying the scleractinian model of biocrystallization to the rugosans. The question of original skeletal mineralogy remains unanswered, with some evidence of occurrence and microarchitecture suggesting that it was calcitic. However, recent study of aragonite inversion or recrystallization to calcite in scleractinians shows that structures produced by these processes are close to those noted in the Rugosa.

SPENCER, DEREK W., Woods Hole Oceanographic Inst., Woods Hole, Mass., and C. B. KOONS, Esso Production Research Co., Houston, Tex.

#### STUDIES ON ORIGIN OF CRUDE OIL: STATISTICAL ANALYSES OF CRUDE OIL DATA

Multivariate statistical methods, including factor analysis and generalized analysis of variance and covariance, were used for interpretation of molecular and isotopic data obtained on 92 crude oils from the Western Canada basin. The data used in this study were obtained through gas-chromatographic and mass-spectrometric analyses of the oils.

Interpretations made through statistical analysis of the data are: (1) the 92 oils fall into natural groups that correspond to major variations in stratigraphy and geography; (2) a major part of the differences that exist among these groups is not due to regional temperature and pressure variations but rather to source differences; (3) all of the crudes are derived from an original primary petroleum which consists predominantly of high-ring naphthenes, high-ring aromatics, resins, and asphaltenes; and (4) more than 70% of the present variance in the oil data can be explained by low-temperature chemical reactions in the reservoir.

STELCK, C. R., Dept. Geology, Univ. Alberta, Edmonton, Alta.