ing and meet the crest and trough at sharp angles; stoss slopes are wholly erosional. At higher velocities, ripples become progressively lower and more rounded, and the resulting laminae are complex and sigmoidal; stoss-slope laminae become more common, resulting in temporary development of ripple-drift configurations, even in the absence of net bed aggradation. Low ripples are succeeded by a flat bed with relatively crude lamination and textural lineation parallel with flow.

At the lowest velocities capable of maintaining ripple migration, sediment is transported entirely as bed load. Suspended-sediment concentration is high at velocities near and above the transition from ripples to flat bed, but the sediment-water mix behaves as a turbulent fluid rather than as a slurry.

The 2 silts, derived from Illinois Pleistocene loess, have median diameters of 30 and 40 μ, are well sorted, and consist mainly of angular quartz chips. The flume used is a recirculating open channel 36 ft long and 3 ft wide.

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SAND SURFACE TEXTURES: EXPLORATION APPLICATIONS

Interpreting depositional environments by scanning electron microscope analysis of sand surface textures is a useful new technique for petroleum exploration. The method enhances the geologic interpretation of well cuttings, and is particularly attractive where no other direct geologic information may be available.

Diagnostic surface textures appear on quartz sand grains from dune, high- and low-energy littoral, glacial, glaciofluvial, and diagenetic environments. With the scanning electron microscope, dune and littoral grain textures were observed on sand in cuttings from 4 offshore Gulf Coast wells. These primary depositional textures may be preserved to depths of 14,000 ft, and consistent preservation of depositional textures is common to 10,000 ft. Grains of Pleistocene and late Pliocene sediments commonly display primary depositional textures, fairly independently of depth. Diagenetic textures normally obliterate the primary depositional textures at depths below 10,000 ft and in sediments older than late Pliocene, but a few breaks in the general pattern of increasing diagenesis with depth allow reasonably accurate environmental interpretations of scattered deep sandstones. The depositional environments as determined from grain textures closely parallel the environmental interpretations derived from paleontologic and lithologic analyses.

The recognition of distinctive types of diagenetic surfaces holds additional promise for enhancing the geologic interpretation of well cuttings. Some diagenetic textures appear independent of one another in their occurrence and stratigraphic distribution, though the causes of these variations are not presently known. The relations of diagenetic sand surface textures to cementation, chemistry of formation waters, and fluid migration currently are being studied.

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RECOGNITION AND DELINEATION OF FLUVIAL SEDIMENTARY BODIES IN SUBSURFACE

A new method of recognition and delineation of ancient stream channels is based on the interpretation of subsurface sedimentary structures. A study of the Columbia Formation (Pleistocene) was conducted in a small area in northern Delaware. Forty holes were drilled through the formation and 486 samples were collected. In the absence of definite correlation between sedimentary units in various holes, and in the absence of any dependable horizon markers, the Columbia sediments have been thought of as divided into horizontal layers spaced 5 ft apart, and referred to their height above sea level.

Primary sedimentary structures (crossbedding in sands and gravels, horizontal bedding in coarse sands, and horizontal lamination in clayey silts) determined from the drilling samples were mapped for each layer separately. This mapping made possible the recognition and delineation of Pleistocene stream channels. The behavior of these ancient streams, interpreted from the maps, is suggestive of low, flat topography, easily eroded banks, shallow and wide channels, frequent change in water and sediment discharges, and flooding. All these are the characteristics of a braided stream system. In spite of frequent lateral shifts of stream courses, the channel bodies of the Columbia Formation are vertically continuous.

The method of subsurface investigation of fluvial sedimentary bodies described here could be applied to the exploration for oil and gas in areas where sufficient well control and sampling are available.

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DISTRIBUTION OF FORMS OF *Millepora* (HYDROZOA) ON RECENT CORAL REEF, BARBADOS

The genus *Millepora* Linné 1758 is a common, although generally subordinate, component of Caribbean and western Atlantic hermatypic coral communities. It is one of the few extant heavily calcified hydrozoans and has been compared with the extinct stromatoporoids. It shows a wide range of morphologic forms which have been interpreted as either ecophenes or biospecies.

The distribution of morphologic variants of *Millepora* was studied on a fringing reef and submerged barrier reef off the western coast of Barbados, West Indies. At depths between 0 and 15 m 4 morphologic forms of *Millepora* can be distinguished: (1) encrusting (taking the form of the substrate), (2) boxwork (erect, short-curved coalescing plates with irregular nodose surfaces), (3) bladed (smooth discrete plates), (4) branching (erect, smooth, digitate, irregularly dendroid to fan shaped). These forms are moderately distinct. Some specimens are hard to categorize but they do not represent a continuum of variation. Forms 2, 3, and 4 appear to correspond with the species *M. squarrosa, M. complanata,* and *M. alcicornis,* respectively. At depths exceeding 10 m all the forms are present in the small area studied. With decreasing depth as the shore is approached the branching, bladed, boxwork, and encrusting forms disappear in that order.

This distribution appears to reflect the relative strengths of skeletons of the different forms: those which are more compact and stronger extend farther into shallow water. This suggests that local water turbulence is the main factor governing the distribution of forms. Distinct forms in the same environment support the view that major variation in the form of *Millepora* is controlled genetically rather than environmentally.

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SPANISH MEDITERRANEAN AMPOSTA MARINO OIL FIELD

The Spanish Mediterranean new-field discovery