field of investigation. A review of recent contributions in identification of hydrocarbon structures in petroleum supports and reaffirms earlier evidence that some of the hydrocarbons in petroleum have been derived from the residues of biological materials.

The hydrocarbons distributed in sediments are observed to be more petroleum-like after burial and compaction. There is no systematic change with depth or age. Large variations may occur between different formations and different facies of the same formation. Mild metamorphism can change the kind, and reduce the amount, of liquid and solid hydrocarbons in rock.

A number of mechanisms have been suggested for the primary migration and collection of the finely disseminated oil from the presumed source rocks. These modes of migration, however, should explain observed differences between reservoir and sediment hydrocarbons, including the larger percentages of alkanes in the heavy saturated hydrocarbons of crude oils.

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GEOLOGY OF MOUNT GRAN AREA, ANTARCTICA

The Mount Gran area, encompassing Mount Gran and the ice-free Gran Valley (unofficial name) adjoining on the north, is located 77°S and 161°E in the rugged, glaciated mountains of South Victoria Land, Antarctica.

Most of the area is underlain by sedimentary rocks, intruded by, and sandwiched between, thick diabase sills. However, a basement complex of metamorphic and igneous rocks crops out in a small, isolated exposure at the northwest corner of Gran Valley. This complex consists of granitic rocks and gneisses which are cut by acid and basic dikes. The gneisses show foliation striking northwest with a nearly vertical dip. The age of the gneisses may be Precambrian or possibly Early Paleozoic.

The sedimentary rocks, all referred to the Beacon Sandstone Group, which ranges from Silurian to Jurassic in age, crop out on the southeast face of Mount Gran and in a thick belt rimming most of the 8-mile long, northeasterly trending Gran Valley. Dips are 3°–8° northwestward. In Gran Valley, the dominant lithologic type consists of light gray to white, well sorted, fine- to medium-grained, cross-bedded, quartzose sandstone between 1,000 and 1,300 feet in thickness. The lower half of this section includes ferruginous concretions as much as one foot in diameter. A few thin beds of green silicified siltstone occur in the upper half of the section.

At Mount Gran 130 feet of the quartzose sandstone is overlain by 470 feet of a nearly cyclic sequence of carbonaceous shale, coal, conglomerate, arkosic sandstone with interbedded shaly siltstone, and sandstone. Correlation between the quartzose sandstone at Mount Gran and Gran Valley is not clear because of lack of diagnostic fossils and discontinuity of exposures, but it is believed that the coal-bearing section stratigraphically overlies the Gran Valley section.

The youngest formation, the Ferrar Dolerite, probably of Jurassic or Cretaceous age, occupies the largest part of the Mount Gran area. Two large sills are present in Gran Valley. One, which probably overlies the basement complex and generally underlies the Beacon Group, forms the floor of the valley. The second overlies the Beacon Group in Gran Valley, forming the escarpment and skyline of the Mount Gran area. To the south, at Mount Gran, the two sills join, leaving only a remnant of Beacon sandstone which is dissected by diabase sills and dikes.

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DETRITAL HEAVY MINERALS OF UPPER TRIASSIC SANDSTONES OF WEST TEXAS

Heavy-mineral analysis of 53 outcrop samples from the Upper Triassic Dockum Group in West Texas and northeastern New Mexico showed a stable heavy-mineral association of zircon, tourmaline, garnet, leucoxene, magnetite-ilmenite, and rutile. An adjacent sedimentary source terrane was suggested by these results.

Previous studies of cross-bedded Dockum sandstones indicated a source for the Upper Triassic at the southeast. Fifteen outcrop samples were therefore examined from sandstones of Pennsylvanian and Permian age in central Texas, the assumed source area. Both heavy minerals and quartz varieties in these rocks were virtually the same in most details as those of the Dockum Group. Comparisons of mineral varieties and their roundness characteristics also indicated close similarities.

It is concluded that: (1) mineralogical comparisons corroborate cross-bedding results of a major source of detritus for the Upper Triassic at the southeast, (2) this source area was the sedimentary terrane consisting of clastics of Pennsylvanian and Permian age in central Texas, (3) more than one sedimentary cycle was involved, and (4) the probable ultimate source was a granitic terrane with minor basic igneous and metamorphic contributions.

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ROLE OF BRYOZOA IN CENOZOIC PALEOECOLOGY

Distribution and abundance of fossil organisms still furnish the major basis for ecological interpretation of sedimentary rocks because organisms respond to, and therefore record, the whole complex of their surroundings, animate and inanimate. The task of the paleoecologist, resolution of this response into meaningful components, depends on knowledge of the requirements and tolerances of the organisms involved.

Bryozoa are a numerically important element of faunas enclosed in Cenozoic limestones, marls, and calcareous clays. They comprise more than 500 marine, mostly stenohaline genera that collectively are widely distributed in all of the main faunal provinces. Individually these genera tend to be stenothermal and therefore reliable paleoclimatological guides to the position and shifts of the provinces during Cenozoic time.

As part of the sedentary epifauna, bryozoans are especially sensitive to movement of water and consistency of substrate, physical determinants which are themselves consonant with water depth. This sensitivity provided the basis for investigation of two paleobathymetric problems in the Gulf Cenozoic.

1. The depth of accumulation of Quaternary mudlumps at the mouth of South Pass of the Mississippi River was determined by a taxonomic method. The mudlump faunules include 34 species whose present depth ranges are known from published accounts. Analysis of these ranges and comparison with individual Recent faunules yielded a depth of accumulation of 20–50 fathoms, 40 fathoms being the single most probable value.

2. The paleogeography of the eastern Gulf Coast during Jacksonian (Late Eocene) times was reconstructed by a combination taxonomic-morphologic method. For Tertiary faunules some of the precision lost by using taxonomic data alone, by the change from specific to generic level, is restored by adding morphologic data. This treatment of Jacksonian faunules is an elaboration of one introduced by L. W. Stach in 1936 and consists of determining relative frequencies of zoarial growth forms. Coupled with taxonomic data, these frequencies suggest water depths of 20–50 fathoms in Alabama and western Florida and 5–20 fathoms in peninsular Florida.

The morphologic approach seems especially versatile and capable of extension, but for proper evaluation the adaptive significance of many features, e.g., avicularia and vibracula, must be ascertained.

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EFFECT OF CLIMATE AND SOURCE AREA LOCATION ON BROWNS PARK FORMATION PETROLOGY

The Browns Park Formation of Miocene age consists dominantly of cross-bedded feldspathic sandstones and was deposited by a series of northward flowing rivers that headed in the vicinity of the San Juan Mountains. The sandstones were transported 150 to 250 miles to northwestern Colorado and south-central Wyoming.

Abundant plutonic and volcanic rock material show that the sandstones are largely first cycle sediments. The quartz, feldspar, volcanic rock fragments, and heavy minerals all are considerably rounded; some are very well rounded. The freshness of much of the feldspar demonstrates that corrosion at the source is not responsible for the rounding, but the distance of fluviatile transport is too short to explain the degree of rounding. The quartz grains are commonly frosted and pitted, considered to be due to eolian action. The rounding of the sand grains apparently took place during intermittent periods of eolian activity. Fluviatile transport associated with eolian activity suggests a semi-arid climate.

Volcanic centers in northern Utah and southern Idaho have been suggested as a source of the volcanic material which occurs abundantly in the Browns Park Formation. Grain size determinations of quartz, feldspar and volcanic rock fragments showed an increase in size of all components toward the south and not toward the suggested western area. The mean grain size, sorting coefficient, and other grain-size parameters are similar in the quartz, feldspar and volcanic material. This relationship suggests that volcanic material was carried an appreciable distance with the other components in the sandstone. The grain-size characteristics of the volcanic-rich Browns Park sandstones indicate that most of this material was derived from volcanic centers in the San Juan region.

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MINOR SEDIMENTARY STRUCTURES IN A PROGRADING DISTRIBUTARY

Minor sedimentary structures were studied in cores taken at the mouth of a small prograding distributary within the Mississippi River delta. The mouth of Johnson's Pass in Garden Island Bay was mapped and the following environments were recognized: subaerial and subaqueous natural levee, channel, distributary mouth bar, interdistributary bay, and marsh. Oriented, undisturbed cores were taken from each environment. These cores were split, dried, and photographed and the types of minor sedimentary structures within each environment were tabulated. Natural levee deposits contained abundant current ripple bedding, unidirectional cross-laminations, parallel and wavy laminations, distorted layers and burrowed oxidized silty sands, whereas channel fill deposits consisted of alternating beds of clay and silt containing trough cross-laminations, scour and fill structures, and distorted layers. The distributary mouth bar, composed predominantly of silt and sand, is characterized by a variety of small-scale multi-directional cross-laminations and air-heave structures. Three types of interdistributary bay deposits were recognized; highly burrowed interbedded silt and clay, homogeneous clay with scattered brackish-water fauna, and a predominantly clay section with thin parallel and lenticular laminations and ripple marks. The structures within these three types are a reflection of availability of coarse detritus. Marsh deposits are characterized by the abundance of peat, carbonaceous clays, calcareous nodules, and root disturbances.

Each environment is characterized by a distinct assemblage of structures. These assemblages can be used to interpret paleoenvironments in ancient sedimentary rocks.

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DEEP LOWER CRETACEOUS EXPLORATION ON THE WESTERN GULF COASTAL PLAIN

Hydrocarbon exploration in Lower Cretaceous rocks of the western Gulf Coastal Plain dates from the 1920's when such shallow fields as Luling, Darst Creek, and Salt Flat were discovered. Deeper exploration for objectives in the Lower Cretaceous increased sharply following the 1954 discovery of Stuart City field, LaSalle County, Texas.

The rock column under consideration, dates from Neocomian to upper Albian including, in ascending order, the following stratal units: Trinity, Fredericksburg, and Washita. While the deep Lower Cretaceous activity is often referred to as "the Edward reef play," objective horizons actually fall within the Edwards, Glen Rose, and Sligo limestones.

The middle Trinity Pearsall shale and middle to late Washita Del Rio shale are widely distributed, easily mapped units. Limestones between these key beds are composed of three generalized lithofacies grading from north-northwest to south-southeast as follows: (1) Carbonate rocks of shallow-water origin characterized by mudstones, wackestones, and packstones in which miliolid and larger foraminifers, oölites, and algal structures are common. Evaporites are locally abundant and dolomite is widely developed; (2) Wackestones, boundstones, and grainstones of shallow-water origin in which the dominant faunal elements are rudistids, corals, algae, and stromatoporids; (3) Carbonate mudstone of somewhat deeper-water and more open-sea origin bearing pelagic foraminifers and calcispheres.

Lithofacies 1 and 3 have widespread distribution whereas the rudistid-bearing rocks are limited to a rather narrow band along platform margins, and have thus become known as "the Edwards reef."

These Lower Cretaceous rocks produce from fault closures in the Edwards and Glen Rose where dolomitization and dissolution have greatly improved the reser-