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Petrography of a Reef Complex in Lower Cretaceous James Limestone, Fairway Field, Texas

The James Limestone at Fairway field and vicinity is an elongate, northwest-trending, atoll-like reef complex about 9 miles wide, 36 miles long, and 200 feet in maximum thickness. Along the northeast, southeast, and southwest margins of the reef complex, reef calcarenite interfingers with and grades laterally into clayey calcisiltite and calcareous shale of open-marine origin. Toward the northwest, reef calcarenite passes rather abruptly into oölitic calcarenite.

The development of the complex is characterized by a main reef phase followed by a lagoonal phase. During the main reef phase, two parallel-trending contemporaneous reef cores were constructed on a muddy, calcareous foundation unit. Both cores are marked by a distinct vertical zonation of bio-constructed limestones which from top to bottom include: (a) rudistid limestone, (b) *Chondrodonta* (pelecypod) limestone, and (c) algal-spongiomorph limestone. As the reef cores grew, considerable reef-derived calcarenite accumulated peripherally to the reef cores and far exceeded the reef cores in areal extent.

Near the end of the main reef phase, a shallow depression created between the reef cores became the site of a lagoon in which was deposited an interbedded sequence of foraminiferal-pelletal calcarenite, algal nodule-bearing calcilutite and biostromes of rudistid and *Chondrodonta* limestone. With the exception of additional minor growth of reef cores, lagoonal limestone deposition prevailed through a limited area and climaxed the development of the reef complex.

The sequence of diagenetic processes operative on the reef complex is summarized as follows:

1. Skeletal breakdown and grain diminution caused by boring organisms at the time of reef growth.
2. Post-depositional leaching of the reef complex, resulting in the development of skeletal modic porosity and sparry calcite cementation of reef calcarenite.
3. Impregnation of certain parts of the reef complex by a hard, brittle, bituminous (?) substance causing local reduction of porosity and permeability.

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Late Pleistocene and Recent Sedimentation in Strait of Juan de Fuca

During part of the late Pleistocene (at least 14,000 years B.P.), the Strait of Juan de Fuca was occupied by a lobe of the continental ice sheet that extended from the Cascade Mountains of Washington and British Columbia on the east, to the nearshore waters of the Pacific Ocean on the west.

As the front retreated, marine waters were able to re-invade the lower region, changing the type and character of sedimentation, and permitting benthic Foraminifera to migrate into the strait. The sediments of this time appear to be glacio-marine, and indicate that the fauna was able to adapt to a sedimentary environment of cold brackish waters containing vast amounts of sediment, with a few coarser sediments and cobbles supplied by berg or shelf ice. As the ice front retreated farther toward the east and north, the Strait of Juan de Fuca waters became progressively less brackish and supported a more marine fauna.

Later, almost catastrophically, the environment changed from one of primary deposition to one of non-deposition or erosion. The upper part of the section and the surface sediments today are primarily coarse sand and gravel. This upper sand layer appears to lie disconformably on the underlying glacio-marine section. Measurements of the currents in the strait suggest that it is presently an area of non-deposition for fine sediments. Whether the upper sand layer in the strait represents a lag deposit after the removal of the finer fraction, or sediments added from coastal erosion, has not been determined. There is some seismic evidence, however, that Recent sediments are being shed into the strait from both sides.

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Origin of Diapiric Shale Structures of South Louisiana

The intrusive diapiric shale structures of south Louisiana are related to the undercompacted shales that occur in normal stratigraphic sequence. These undercompacted shales, characterized by low density, low velocity, low resistivity, high porosity, and high formation pressure, are derived from the outer-neritic shale facies deposited on the continental shelf. The critical prerequisite of their occurrence is the absence of porous and permeable interbedded sandstone members that are pressure-connected with the atmosphere. Where present in the section, these undercompacted shales provide the mother or source bed for the diapiric shale structures, which may or may not be associated with diapiric salt derived from the much more deeply buried mother bed, the Louann Salt.

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Designing an Exploration Program for Maximum Profit

The concept of an exploration system designed to yield maximum profit recently has been successfully applied to exploration for metallic ore deposits. Similar methods using estimation of the probability of different exploration outcomes may be useful in the search for petroleum. The design of such a mineral exploration system involves the analysis of ownership, production, geological, geochemical, and geophysical data to produce maps showing regional and local probability values of mineral occurrence. These probability maps can be used in a general sequence to evaluate large land areas for minimum cost while limiting the use of more costly methods to smaller areas of progressively higher discovery potential.

Maps showing the distribution of mineral value in production and reserves covering areas as large as 100,000 square miles are of particular use. These maps guide the selection of smaller areas of 25,000 square miles where patterns of basic mining activity and ownership can be related to regional geologic features. In turn, they may be used to outline smaller areas of