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Seismic Stratigraphic and Sedimentologic Studies of Paleogene Sediments, Eastern Coastal Region, China

The study area includes the Bohai basin of north China and Dongtai basin of east China. Regional cycles of sea level change during the Tertiary in the Bohai basin correlate fairly well with global cycles, but differ from those in the Dongtai basin where the lowest sea level occurred at the end of the Eocene. The paleogene sediments, which were previously considered to be of continental origin, are now shown to be marine deposits because of the presence of abundant nannoplankton. This reinterpretation of the Paleogene indicates that transgression had taken place in these areas at that time, and that the closure of the paleosea between the North China and South China plates was delayed for a long time. Fan-delta and turbidite facies occur in anticlines of different dimensions, some of which form traps for oil and gas accumulations. Abnormal formation pressures occur in Eocene shale sections and contributed to the formation of shale diapirs, growth faults, and some large-scale gravitational slide blocks. The slide blocks are the most important structural features of the region.

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Abnormal Formation Pressure of Qaidam Basin and Its Cause

Qaidam basin is a Mesozoic and Cenozoic inland oil basin where the abnormal formation pressure is as developed as in many offshore regions.

The abnormal formation pressures are found at depths below 3,200 m in relatively depressed regions. Their pressure gradients are from 0.14 to 0.22 atm/m.

The causes of abnormal formation pressure in this region are as follows.

1. Compaction unequilibrium is the principal cause of high pressure. Abnormal pressure occurs not only in the zone of fine-grained rocks, but also in the interbedded strata of sandstone and shales as long as the rate of deposition is rapid enough at the time when abnormal pressure is produced.

2. In this region, an aquathermal pressure effect is also apparent; the geotemperature gradient is 35°C/km, and the actual average rate of pore pressure increase since isolation is 0.31 atm/m, significantly higher than 0.23 atm/m of the average overburden pressure gradient.

3. Because there is not any montmorillonite content in some sequences developing abnormal pressure, montmorillonite-illite conversion and dehydration are not prerequisites for the abnormal pressure.

In addition, growth faulting of some regions and the volume expansion produced by thermal degradation of organic matter may also enhance the formation pressure.

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Relationship of Structural Development and Cenozoic Sedimentation, Northern Gulf of Mexico

Development of structure in the northern Gulf of Mexico, mainly listric faulting and salt features, is directly related to Cenozoic sedimentation. Essentially all oil and gas production in this region occurs in structural features resulting from faulting and/or salt movement.

A thick section of continental shallow-water sediments rimming the entire Gulf of Mexico was deposited during overall Gulf subsidence in Mesozoic time. Very little sedimentation took place in the central Gulf, so that, at the close of the Mesozoic the central Gulf probably was of abyssal depths. Cenozoic sedimentation surpassed the rate of subsidence causing sediments to prograde across the Mesozoic shelf margin, with greatest deposition occurring gulfward of this margin. These depocenters or areas of thickest sedimentation prograded gulfward throughout time (in response to sediment supply) and migrated northeastward from south Texas to south Louisiana.

Listric or growth faults that formed contemporaneously with deposition are a common structural feature developed during Cenozoic sedimentation. These features are apparently caused by differential loading

of higher density sandstones on prodelta shales near the shelf margin. In those areas underlain by thicker salt, such as the Miocene and younger depocenters, there is greater involvement of salt in growth-fault development.

Salt features, the other major type of producing structure, are developed by salt movement as a direct response to Cenozoic sediment loading. Initiation of salt movement is believed to be due to differential loading of prograding sediments. Further salt movement and structural development are completely dependent on continued sedimentation.

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Origin of Laminae in Holocene-Pleistocene Evaporitic Sequence of Salt-Flat Playas, West Texas and New Mexico

Salt-flat playas of West Texas-New Mexico are represented by a series of north-south aligned Holocene-Pleistocene dried salt lakes. Shallow (up to 100 cm) cores on the alkali flats of these lakes reveal a well-defined sequence of alternating dark and light laminae in the evaporitic sediments. These laminates bear a close resemblance to the laminated calcite-, dolomite-, and anhydrite-bearing sequences of the Middle Devonian Winnipegosis Formation of western Canada, Permian Castile Formation of west Texas and New Mexico, and recent sediments from hypersaline pools of the Gulf of Aqaba and other locations. XRD studies, augmented by petrographic evidence, show that laminates from the salt-flat playas are comprised of layers of differing mineral composition. The darker layers are dominated by gypsum (average 36.89%), halite (average 27.71%), calcite (average 17.74%), and dolomite (average 15.81%), whereas lighter layers are impoverished in calcite and dolomite and consist mainly of gypsum (average 72.86%) and halite (average 27.14%). Beside the mineralogical variations, the laminae also differ significantly in the abundance of total organic matter (TOM) content, with darker laminae being invariably richer (average 51% TOM in contrast to average 21% in lighter laminae). Micritic sediments that are relatively less altered by later recrystallization have retained a higher concentration of organic matter. In the gypsiferous sediments, which seem to owe their origin to a micritic mass, the organic matter is widely dispersed. In addition to the interspersed organic matter in evaporitic laminae, laminae comprised exclusively of algal mats also are common in these sequences. Liquid chromatographic studies reveal that these algal mats are remarkably similar in their hydrocarbon content to that of the algal mats that are now growing sporadically on the moist playa surfaces. These observations suggest that the laminitic sequence of the salt-flat playa sediments have originated in a restricted shallow basin characterized by alternating periods of desiccation (precipitation of gypsum and halite) and freshening (algal growth and deposition of micritic sediments).

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Triassic/Jurassic Faulting Patterns of Conecuh Ridge, Southwest Alabama

Two major fault systems influenced Jurassic structure and deposition on the Conecuh Ridge, southwest Alabama. Identification and dating of these fault systems are based on seismic-stratigraphic interpretation of a 7-township grid in Monroe and Conecuh Counties. Relative time of faulting is determined by fault geometry and by formation isopachs and isochrons. Smackover and Norphlet Formations, both Late Jurassic in age, are mappable seismic reflectors and are thus reliable for seismic-stratigraphic dating.

The earlier of the 2 fault systems is a series of horsts and grabens that trends northeast-southwest and is Late Triassic to Early Jurassic in age. The system formed in response to tensional stress associated with the opening of the Atlantic Ocean. The resulting topography was a series of northeast-southwest-trending ridges. Upper Triassic Eagle Mills and Jurassic Werner Formations were deposited in the grabens.

The later fault system is also a series of horsts and grabens trending perpendicular to the first. This system was caused by tensional stress related to a pulse in the opening of the Gulf of Mexico. Faulting began in Early Jurassic and continued into Late Jurassic, becoming progressively younger basinward. At the basin margin, faulting produced a very irregular shoreline. Submerged horst blocks became centers for shoaling or car-