Hatter's Pond field: anhydritic mudstone, skeletal-peloidal packstone or grainstone, oolitic grainstone, microcrystalline dolomite, finely crystalline dolomite, and coarsely crystalline dolomite. The microcrystalline dolomite is commonly associated with bedded and nodular anhydrites and is interpreted to represent early replacement in a sabkha environment. Both the finely and coarsely crystalline dolomites are secondary in nature and represent replacement of low-energy skeletal-peloidal packstones and high-energy oolitic grainstones, respectively.

The majority of the reservoir porosity in the Smackover is late stage vuggy and/or moldic and is facies-selective and preferential to the coarsely crystalline dolomite. This porosity, which commonly ranges from 4 to 22% with permeabilities of 2 to over 100 md, is a product of mesogenetic leaching related to migration of carbon dioxide-charged fluids during the early stages of hydrocarbon maturation. The porosity is facies-selective to the coarsely crystalline dolomite, as this lithology possessed the greatest porosity and permeability at the time of migration of the carbon dioxide-charged solutions.

Evidence suggests the oolitic grainstones, which were the precursors of the coarsely crystalline dolomites, were deposited as a series of linear bars along the flanks of the Wiggins uplift. If this is the case, and more study is needed to document this definitively, the coarsely crystalline dolomite should occur in elongate mappable trends. Hydrocarbon exploration in this area and all along the flanks of the Wiggins uplift should involve location and mapping of these trends, with the greatest success occurring in areas where the trends are superimposed over structural highs produced by faulting and/or salt diapirism.

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Abnormal Pressures in Lower Vicksburg, McAllen Ranch Field, South Texas

The Vicksburg Formation consists of an upper shale member about 2,000 ft (610 m) thick and a lower member of interbedded sandstones and shales about 4,000 ft (1,220 m) thick. The entire section is abnormally pressured, and gradients reach 0.94 psi/ft (21.2 kPa/m). Pressures within the section were established by extrapolation of shut-in buildup pressures and by estimation of pressures from conductivity logs. Hydrostatic heads were then calculated and displayed in a vertical potentiometric profile. Head distributions suggest that hydrodynamic flow is taking place from areas of high pressure to an underlying major, listric normal fault and then updip along the fault plane. There is also upward flow from Jackson Shale below the fault. The top of abnormal pressures occurs at a depth of 7,500 ft (2,286 m) and at a temperature of about 210°F (99°C) where there is an abrupt decrease in smectite within the mixed-layer illite-smectite clays. Pressure increase with temperature does not follow isodensity lines for water as in the case of aquathermal pressuring. Therefore, it is concluded that abnormal pressures are largely the result of clay transformation, perhaps accompanied by pressuring caused by hydrocarbon generation.

A second zone of abnormal pressures with gradients to 0.74 psi/ft (16.7 kPa/m) occurs at about 6,000 ft (1,829 m) in the lower Frio Formation. In this zone, pressure increase with temperature follows isodensity lines for water, and it is concluded that aquathermal pressuring is the major cause of abnormal pressures. Shale densities suggest that nonequilibrium compaction may have played a minor role in creating abnormal pressures in the Frio.

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Geometry and Mechanisms of Folding Related to Growth Faulting in Nordheim Field Area (Wilcox), De Witt County, Texas

The Nordheim area in western De Witt County, Texas, has produced over 121 bcf of gas, of which over 53 bcf has come from the deep lower Wilcox. Consequently, a better understanding of folding in the Nordheim area should aid future exploration efforts, especially in the deeper (greater than 10,000 ft, 3,000 m) Wilcox. The folding mechanisms recognized are: mechanical folding, or folding due to faulting; drape compaction; and differential compaction. As a consequence of separating the various folding mechanisms, important geometric aspects of folding were recognized at Nordheim. They include: (a) the upward movement of folds relative to regional dip, (b) the shift of fold crests along dip and strike at various depths, and (c) the role of compaction in the final fold geometry. Upfolding is the term used to define the upward movement of folds relative to regional dip. Upfolding is recognized where intervals thicken off a fold crest in all directions, not just in the direction of the growth fault. For example, the deepest interval in the lower Wilcox, the Migura, has over 200 ft (60 m) of isopach relief and about 250 ft (76 m) of closure. Shallower intervals and zones show similar relationships between structure and isopach, but with less relief. Upfolding is the dominant mechanism of folding in the Nordheim area. Most of the folding not explained by upfolding is explained by either drape or differential compaction.

Previously proposed mechanisms of folding related to growth faulting have only incorporated two dimensions. Upfolding is a three-dimensional concept, and it is believed to be caused by material moving down a concave listric normal fault. The concave shape may cause a volume problem, which is overcome by the upward movement of material.

Three specific exploration concepts have been developed as a result of this study.

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Relation of Smectite-Illite Transformation and Development of Abnormal Fluid Pressure and Structure in Northern Gulf of Mexico Basin

Water expelled from smectite into the pore system of the host shale during the process of diagenesis may migrate out of the shale early, or may be totally or partially trapped and released slowly through time. In areas such as the northern Gulf of Mexico basin, where much of the water is partially trapped, clay diagenesis data indicate a close relation between high fluid pressure build-up and the smectite-illite transformation process.

Abnormal pressures affect, in part, the type and quantity of hydrocarbons accumulated, as pressure controls the direction of fluid flow and partially controls the geometry of structures formed in basins where shale tectonism is the primary mechanism for structural development. In basins of these types, contemporaneous faults and related anticlines are the most common types of productive structures found. The depth to which faults can penetrate and the angle of dip that faults assume at depth is dependent largely on fluid pressure in the sedimentary section at the time of faulting. Some faults, formed in the overpressured Tertiary section of Texas, have been observed to flatten and become bedding plane types at