units can occur and more fracturing should enhance reservoir performance. (4) Younger sandstones in the Upper Cretaceous Lance and Paleocene Fort Union Formations are also overpressured in the deepest basin areas because of gas generation from associated coals. These formations should contain significant gas accumulations.

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Examples of Abnormal Fluid Pressure Produced by Hydrocarbon Generation

Abnormally high pore fluid pressures may be produced as a result of hydrocarbon generation from organic matter (kerogen) contained in "source rocks." Contributing processes include: (1) collapse of rock matrix as overburden-supporting solid kerogen is converted to non-expelled fluid hydrocarbons and (2) volume increases produced by the conversion of solid kerogen to hydrocarbons.

Hydrocarbon generation overpressures exist in the following basins: Williston, Powder River, Anadarko, Delaware, Uinta, and San Joaquin. The phenomenon probably also exists elsewhere. These regions of overpressure represent vertically and laterally restricted "cells" or "pods" in which hydrocarbons are the overpressuring fluid and the only initially producible fluid species present. The pressure cells center around actively generating source-rock units.

Actively generating source rocks within the pressure cells may be characterized by abnormally high electrical resistivities and abnormally low sound velocities. Resistivity increases may be caused by the replacement of conductive pore water with non-conductive hydrocarbons. Low sound velocities may be caused by: (1) the replacement of higher velocity pore water with lower velocity hydrocarbons and (2) the effects of abnormal pressure on porosity enhancement or preservation through dilation or under-compaction.

Hydrocarbon generation overpressures lead to the spontaneous hydraulic fracturing of the source rock and may create associated fracture-type reservoirs. They may also create fractures which propagate upward or downward from the source rocks and control vertical migration through large thicknesses of seemingly impermeable confining strata.

When a source rock ceases to generate, abnormal pressures may decay, resulting in normal or subnormal pressure conditions.

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Stable Isotope Evidence for Modern Freshwater Diagenesis of Cretaceous Edwards Limestone, San Antonio Area, Texas

The Cretaceous Edwards Limestone in south-central Texas was deposited in alternating shallow-marine, intertidal, and supratidal environments and underwent normal early diagenesis. First-stage calcites include calcitic shell material, unaltered marine micrite, submarine cement, and meteoric phreatic or shallow subsurface cements. The first-stage calcites yield isotopic values of $\delta^{13}C$ from -1.0 to $+3.5$ and $\delta^{18}O$ from -6.0 to $+3.0$.

Dolomite in the Edwards occurs in a variety of forms. These forms range from "dirty" rhombs (1 to 5 μm), petrographically very similar to but isotopically slightly lighter than modern tidal flat dolomites ($\delta^{18}O$ of 0.5 and $\delta^{13}C$ of 3.0 for the most hypersaline dolomites), to perfectly formed rhombs (30 to 40 μm) interpreted as freshwater dolomite ($\delta^{18}O$ of -5.7 and $\delta^{13}C$ of 1.7).

The Edwards was divided into two diagenetic zones by Miocene faulting along the Balcones fault zone. On the upthrown side of the fault, an oxidized freshwater aquifer developed. This water is now saturated with calcite, but undersaturated with dolomite and gypsum. Relatively stagnant brackish and reduced water on the downthrown side of the fault is saturated with calcite, dolomite, and gypsum. Differences in the chemistry of the interstitial fluids in these zones are related to different types of diagenesis.

Second-stage calcites, which can be separated regionally and petrographically from first-stage calcites, formed after faulting and result from reactions between first-stage calcites and dolomites and fresh water introduced after faulting. These reactions can be written generally as: Fresh Water + Dolomite + Gypsum $\rightarrow$ Brackish Water + Calcite. Second-stage calcites are as light as -7.5 ppm $\delta^{13}C$ and -10.0 ppm $\delta^{18}O$, and these values vary inversely while the ratios of first-stage calcite cements are heavier and vary together. The second-stage calcites are considerably lighter because they have grown in equilibrium with meteoric water containing some organically derived carbon, and sometimes at considerable depth.

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Organophosphorites in Carboniferous Rocks of Central United States

Although generally called "black shales," "sheety shales," or "paper shales," thinly bedded black rocks in upper Carboniferous successions in the Illinois basin and Mid-Continent are actually fissile coals. Thin section examination demonstrates that these rocks are as much as 90% carbon by volume. In addition to carbon, all these rocks contain large amounts of non-skeletal and much skeletal phosphate as fecal masses, gastric residues, teeth, bones, cartilage, brachiopod shells, and conodonts. We have elected the term "organophosphorite" for these rocks rather than "shale," because many of them contain less than 10% terrigenous clay.

Sources of the organic carbon, including kerogens, were varied and distributed among several plant and animal groups. Driftwood is common and testifies to input from terrestrial plants. Algal components probably dominated the plant fraction, but have left only vague traces. Animal phyla from Protozoa through Chordata are represented, but with heavy bias toward