Exploration for Tertiary accumulations is carried out by: (1) mapping source rocks in basins with proper depth for maturity, (2) establishing presence of reservoir rocks, and (3) delineation of traps by photogeologic-geomorphic techniques, gravity surveys, and seismic shooting.

Numerous shows of oil and gas have been recorded in wells drilled in various basins, both in Paleozoic and Tertiary rocks. Other oil and gas indications include the Bruffey oil and gas seeps (Pine Valley, Nevada), the Wells oil seep (west of Wells, Nevada), an asphaltite dike in Mississippian sediments (Piñon Range, east of Pine Valley), the West Brigham City and Farmington gas areas (east of Great Salt Lake, Utah), and the Fallon gas area (Carson Sink, Nevada). Oil source units include Cretaceous to Tertiary lake deposits (Sheep Pass Formation, Elko Shale, Kinsey Canyon Formation, Newark Canyon Formation, and King Lear Formation), Mississippian Chainman Shale, Devonian Pilot Shale, and Ordovician Vinnini Shale.

Several Paleozoic plays exist in Nevada, including the Mississippian Diamond Peak (Illipah, Scotty Wash) sandstone pinch-outs. Reef buildups may be present in the Silurian and Devonian section.

Exploration in the Basin and Range province should result in significant discoveries of oil and gas in the future.

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Smectite-Illite Transformation—Role in Generating and Maintaining Geopressure

Mixed layer smectite-illite clays comprise a significant fraction of fine-grained clastic sediments in many basins around the world. Abnormally high fluid pressure (geopressure) is associated with parts of these basins. The presence of smectite-illite is a necessary but not sufficient criterion for the existence of geopressure.

Smectite reacts with potassium feldspar producing illite, silica, sodium-calcium feldspar, and releasing loosely bound water. Observations in the northern Gulf of Mexico support an equilibrium model for the reaction, the shift in the logarithm of the equilibrium coefficient with depth being proportional to the product of the reaction enthalpy and the geothermal gradient. Reaction enthalpies range from 2,000 to 26,000 cal/mole, highest reaction enthalpies occurring along the south Texas coast, lowest in the Mississippi delta. Abrupt diagenesis-depth profiles are associated with geopressure, gradual reaction with depth associated with near hydrostatic fluid pressure gradients.

Sediments compact over intervals where the effective pressure increases. Geopressure is associated with porosity increase and effective pressure decrease with depth. The top of the zone of sediment under-compaction coincides with change in sign of the effective pressure gradient from positive to negative. In this interval, fluid pressure increases with depth faster than does the overburden pressure. Very high fluid-pressure gradients are associated with the combination of low shale permeability, high shale porosity, and rapid basement subsidence. Because of the close connection between high fluid-pressure gradient and abrupt conversion of smectite to illite, we conclude that this reaction is responsible for abnormal loss of permeability, probably a result of the finely divided silica that is produced.

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Application of Inversion Processing to Exploration for Point-Bar Sandstones

West Moorcroft field, Crook County, Wyoming, produces from a point-bar sandstone of the Fall River formation of Cretaceous age. New Bielau field, Colorado County, Texas, is productive from an Eocene age, Wilcox formation point-bar sandstone. Although both reservoir sandstones were deposited in a similar "meander belt" facies, the expressed geometry of the trap as defined from the Seislog® traces is unique to each field.

In West Moorcroft field, at 4,800 ft (1,463 m) hydrocarbons are trapped by the arcuate shape of channel-filling shale that forms a seal for approximately 40 ft (12 m) of sandstone. Analysis of bandpass filtered sonic logs suggests that the frequency content of conventional seismic data is likely inadequate to uniquely separate porous sandstone from shale. Inversion of the seismic data facilitated identification of a higher velocity event, which although not discretely sandstone could be related to the productive unit. Updip, the channel-filling shale, the real trap, does form a mappable stratigraphic unit.

The producing point-bar sandstone at New Bielau is both deeper (8,700 ft; 2,652 m) and thicker (65 ft; 20 m) than at West Moorcroft. As predicted by bandpass filtered sonic logs, the sandstone is not uniquely resolved on inverted seismic data.

In this example, a high velocity marker beneath the productive interval clearly illustrates the concave morphology of the channel and serves to define the trap. Although poorly defined, the shale in the channel fill is recognizable.

In a comparative sense, the two fields illustrate the ability of inversion processing to identify very subtle stratigraphic units that can then be related to a reasonable geologic model. The expression of this stratigraphy on the conventional seismic section reminds us just how subtle those indicators really are.

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Controls of Zeolite Cementation in Upper Jurassic Sandstones, Lower Cook Inlet, Alaska

Field and petrographic studies indicate that the major factors controlling zeolite cementation in Upper Jurassic sandstones of Lower Cook Inlet were provenance, depositional environment, and igneous activity. The Jurassic strata record the unroofing of a Mesozoic volcanic-plutonic arc complex related to subduction and plate accretion beginning at least by Triassic time. Petrologic-stratigraphic trends show a striking increase in the ratio of quartz to volcanic rock fragments from Lower Jurassic to Upper Jurassic sedimentary rocks, re-