In mature exploration areas the ability to rapidly evaluate acreage for further exploration and development has previously been restricted by the vast amounts of data that must be analyzed. To efficiently evaluate selected areas it becomes necessary to subdivide such areas into workable tracts based on the amount of data and time available. Regional attempts at exploration in many places become too manpower-intensive for many energy companies.

Through utilization of computer data bases it is possible for a small group of individuals to effectively evaluate significant amounts of acreage. In mature provinces, this capability lets individuals rapidly develop exploration recommendations which previously could be made only by geologists who were already knowledgeable about that part of the province.

Two approaches which have been successfully applied to recent exploration efforts are (1) mapping of exploration potential/development potential values and (2) statistical mapping of structural trends. The exploration potential/development potential concept assigns arbitrary values to pertinent tests of specific geologic horizons. By using automatic contour mapping programs it becomes possible to define areas of exploration potential as well as areas of development potential.

The second application involves residual and trend surface analysis mapping of selected geologic horizons to define regional paleostructures. In the example to be presented, both seismic and well control indicated that sedimentary onlapping occurred during Lower Cretaceous time on the flanks of basins; these onlaps were located by computer-drawn contours. Significant potential hydrocarbon plays lie within these onlap zones.

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Deltaic Influence on Shelf-Edge Instability Processes

Large river systems deliver significant quantities of fine-grained sediment to continental shelf regions. In specific areas off deltas, deposition rates are rapid and the sediment may be involved in a variety of mass movement processes on the subaqueous slopes (slumps and slides, debris flows, and mudflows) causing rapid sediment accumulation at shelf-edge depths and resulting in active progradation of the shelf edge. Seismically, the deposits appear as large-scale foresets and are commonly composed of in-situ deep-water deposits alternating with shallow-water sediments transported by mass movement. On electric logs, sands within these units are sporadic and display sharp basal planes and blocky shapes. Progradation of the shelf-edge deposits is generally accompanied by oversteepening and large-scale instability of the upper shelf-edge slopes. Deep-seated and shallow rotational slides move large volumes of sediments and deposit them on the adjacent slopes and upper rise. Extensive contemporaneous faults commonly form at the shelf-edge. Continuous addition of sediment to the fault scarps, particularly by mass movement from nearby delta-front instability, causes large volumes of shallow-water sediment to accumulate on the downthrown sides of the faults, mostly forming large-scale rollover structures. Continued movement along the concave-upward shear planes commonly results in compressional folds and diapiric structures. Contemporaneous accmulation of shallow-water mass movement deposits may occur in association with these structures.

Massive retrogressive, arcuate-shaped landslide scars and canyons or trenches can also form at the shelf edge owing to slumping and other mass-movement processes. Such canyons and trenches can attain widths of 10 to 20 km, depths of 800 m, and lengths of 80 to 100 km. The creation of such features by shelf-edge instability results in exceptionally large volumes of shallow-water sediment yielded to the deep basins in the form of massive submarine fans. The infilling of depressions by deltaic progradation is rapid, forming large foresets near the canyon heads. The low strength of the rapidly infilled, underconsolidated sediments causes downslope creep or reactivation of failure mechanisms, resulting in multiple episodes of filling and evacuation.

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Petrologic Factors Controlling Internal Migration and Expulsion of Petroleum from Source Rocks: Woodford-Chattanooga of Oklahoma and Arkansas

Upper Devonian-Lower Mississippian Woodford-Chattanooga black shales are oil source beds throughout Oklahoma and much of western Arkansas. Diagenesis in the Woodford-Chattanooga source section proceeded through the following relative time sequence: (a) silicification, chiefly by recrystallization of radiolarians, which probably followed the reaction conversion of amorphous opal-A to opal-CT to chert; (b) dolomitization of deep-basin opal or chert and shallow-platform carbonate laminae; (c) tectonic faulting, folding, and associated fracturing and stylolitization predominantly associated with the late Paleozoic Arbuckle and Ouachita orogenesis; (d) late silicification and mineralization along fractures contemporaneous with (e) generation and expulsion of petroleum.

The principal expulsion mechanism for these Upper Devonian-Lower Mississippian oil source rocks is whole-oil migration through coarser grained matrix pores, stylolites, and fractures, rather than diffusion on a molecular scale. Diffusion migration does occur but appears only to affect internal migration over a few millimeters within the source rock, and thus cannot account for expulsion of large volumes of oil. Preliminary calculations based on source rock extract data indicate that approximately 147 billion bbl of oil have been generated within Woodford shales in the 23,000 sq mi (60,000 sq km) geographic area of southern and western Oklahoma underlain by the Woodford Formation. Minimum relative oil-expulsion efficiency appears to have been approximately 18 to 19% of the oil generated. Thus, at least 27 billion bbl of oil have been expelled from the Woodford into adjacent formations in southern and western Oklahoma while 120 billion bbl of oil remain unexpelled in the source rock.

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Now You See It, Now You Don't—Seismic Expressions of the Subtle Trap

Exploration geologists and geophysicists have much in common in terms of tools and vocabulary when it comes to searching for hydrocarbons, but there are clear differences in approach. Certain occurrences of hydrocarbons are subtle in terms of their geologic setting. Others may be obvious in terms of geology, but subtle in their seismic expression. Little has been written about such traps other than what has appeared in works on stratigraphic applications for seismic data. It is also important to distinguish between subtle seismic expressions of traps and complicated seismic expressions. The complicated seismic expression, while difficult to interpret, is not often overlooked. Noting subtle seismic signature in the first in-