Wildcat exploration for the elusive 1st Cat Creek pay zone will require detailed stratigraphic studies accompanied by careful well-site sample analysis, well-chosen suites of electric logs, and modern gas-detection equipment.

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Paleoecologic Determination of Bathymetric Position of Organic Buildups—Example from Lower Paleozoic of Appalachians

Bathymetry of organic buildups may determine their reservoir potential. Whether a buildup was formed on a shelf, at a shelf edge, or downslope toward a potential source basin may determine distance of hydrocarbon migration, porosity and permeability history, and reservoir "sealing" events. Although there are physical paleobathymetric indicators, the most sensitive criteria are paleobiologic in nature. Our case study example involves several buildups in the Appalachian Ordovician. Depth was initially established on sedimentologic and stratigraphic bases; paleoecologic analysis of upslope versus downslope buildups led to generalizations which may apply to other Paleozoic buildups. Shelf, upslope, and downslope buildups have features in common such as abundant and diverse echinoderms, gray to red mudmounds, and abundant cross-bedded grainstones (although cross-beds are of different origin in shallow and deeper locales). Significant paleoecologic differences exist. Upslope and shelf buildup communities were dominated by echinoderms and arborescent bryozoa, with red and green algae. Some encrusting red algae were binders of mud-mounds. Endolithic borers were abundant. Downslope buildups were constructed by echinoderms, and encrusting bryozoa acted as binders of mudmounds; algae are absent, and evidence of boring is rare.

Ecologic distinction between the settings may have resulted from differences in light intensity, abundance of suspended organic detritus in bottom waters (a resource derived from shelf areas), and the height above the sediment of suspended food. In shallow water, resuspended detritus allowed suspension feeding at many levels while deeper water conditions allowed suspension feeders, chiefly bryozoa, only very near the bottom.

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Evaluation of Uranium Potential of Frontier Areas by Functional Source-Rock Analysis

Rapid, inexpensive evaluation of the potential of frontier areas for epigenetic uranium deposits can be conducted using functional source-rock analysis analogous to that employed in the petroleum industry. Association of uranium-rich volcanic glass with nearly all such deposits suggests that their uranium came from glass. Concentration of uranium in ores is about 10^3 times that in glass-rich sources, so great volumes of depleted rock should mark favorable areas.

Fresh rhyolite glass contains uranium adsorbed on shard surfaces, soon washed off, and 5 to 10 ppm internal uranium, which is released when the glass converts to a crystalline assemblage. Only under certain circumstances does released uranium migrate. Studies conducted in south and west Texas and in Nevada on volcanic rocks and sediments that originally contained abundant volcanic glass lead to the following conclusions: conversion in soil or by very early diagenesis, and low temperature conversion of glassy ash flows to clay release uranium for migration; high temperature conversion by divitrification or vapor phase crystallization and diagenesis in open hydrologic systems trap uranium near its site of release. Structures and textures produced during each of these processes are distinctive and can be recognized in the field or in thin section. Furthermore, the processes probably produce distinctive chemical effects other than depletion of uranium. Functional source rock exploration for uranium consists of field, petrographic, and geochemical detection of depleted rock that altered in a favorable fashion. Evaluation of likely migration routes; geologic, geochemical, and radiometric exploration for traps; and drilling programs can then be concentrated in the most favorable areas.

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Seismic Stratigraphy in Low-Energy Carbonate Depositional Environment

Seismic stratigraphic mapping in carbonate rocks has been historically concentrated on the shelf margin environment where unit geometry and abrupt facies-velocity changes are often easily discernible with the seismic tool. In contrast, low-energy, more subtle shelf interior statigraphic features have attracted less geophysical attention. This report describes the study of seismic data from five United States oil fields which produce from reservoirs formed from shelf interior deposits. Three Smackover fields, a Permian basin producer, and a Williston basin example are compared.

Review of the depositional model indicates the difficulty of seismic mapping in non-reef carbonates. If sedimentary accretion is nearly vertical, porosity traps are predicted to exhibit only lateral change in unit velocity. In regressive or transgressive sequences, the geologic model indicates that angular discordance due to sediment buildup in combination with a velocity contrast generates an angular feature that has a different velocity pattern. These five fields provide examples of both trap types.

Jay field (Florida) and Walker Creek field (Arkansas) both produce from the Smackover Formation and are (seismic-defined) stratigraphic traps which illustrate angular discordance and velocity contrast owing to regressive buildup. The trapping mechanism at Big Escambia Creek (Alabama), also productive from the Smackover, is from a transgressive pulse devoid of vertical buildup. Hence, the porosity trap is indicated only by a lateral velocity change without angular discordance.

Subsurface geologic sections of San Andres production at Cato San Andres field (New Mexico) and Mission Canyon pay at Haas field (North Dakota) reveal no diachronous buildup. As expected these fields demonstrate only a lateral change in velocity within the formation.

Application of stratigraphic-seismic techniques to low-energy carbonate facies can fall into two depositionally controlled divisions. When sediment accretes vertically, traps are mapped solely by lateral changes in velocity. Sedimentary buildup in transgressive or regressive sequences provides angularity, which combined with velocity contrast facilitates seismic detection of the trap.

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Strategy of Exploration for High Temperature Hydrothermal Systems in Basin and Range Province

A 15-phase strategy of exploration for high temperature convective hydrothermal resources in the Basin and Range province features a balanced mix of geologic, geochemical, geophysical, hydrologic, and drilling activities. The strategy is based on a study of data submitted under the Department of Energy's Industry Coupled Case Study Program. Justification for inclusion in or exclusion from the strategy of all pertinent geoscientific methods is given. With continuing research on methods of exploration for and modeling of convective hydrothermal systems, this strategy is expected to change and become more cost-effective with time. Variations on the basic strategy are to be expected where the geology or hydrology requires it. Personal preferences, budgetary constraints, time and land position constraints, and varied experience may cause industrial geothermal exploration managers to differ with our strategy. For those just entering geothermal exploration, the strategy is expected to be particularly useful.

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Middle-Late Permian Paleogeography of Idaho, Nevada, Montana, Utah, and Wyoming

Conodont and brachiopod biostratigraphic zones are used to divide the Phosphoria Formation and related rocks into 7 discrete time intervals of the middle and Late Permian to examine the general sedimentation patterns of the Phosphoria basin. Three depocenters existed in the middle Permian: one in southwestern Montana, one in northeastern Nevada, and one in central-eastern Nevada and adjacent Utah. The sedimentation occurred in two transgressive phases followed by sea level stillstands. A major regression occured in late Guadalupian time. The conodont and brachiopod faunas indicate that cooler water existed in the area of maximum phosphorite deposition, generally in eastern Idaho and southwestern Montana.

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Permian Conodont Biostratigraphy and Paleoecology

Permian conodont faunas are not diverse but yield a wealth of information on biostratigraphy and paleoecology. Pennsylvanian faunas carried over into the Early Permian and became extinct in the late Wolfcampian. At this time the rapidly evolving neostreptognathodid and common neogondolellid stocks arose. Predominately, these two stocks are used to subdivide the Permian.

Through most of the Permian, three ecologic faunas can be recognized: (1) a shallow, nearshore fauna dominated by *Hindeodus*, (2) an intermediate fauna dominated by *Neostreptognathodus* or *Merrillina*, and (3) a far-from-shore fauna dominated by *Neogondolella*. Some species of *Neogondolella* varied according to nearness to shore; populations containing higher percentages of individuals with serrated or bumpy margins were nearer to shore, often occurring with *Hindeodus*.

Early Permian *Neogondolella* faunas were cosmopolitan. In the middle Permian three provinces of *Neogondolella* faunas can be recognized: a very endemic west Texas province, a partly endemic Canadian province, and a cosmopolitan Eurasian province. All three provinces consist of stocks that seem to be derived from a common widespread ancestor, *Neogondolella idahoensis*. Only the Eurasian province faunas persisted into the Triassic. It appears that the basins containing the west Texas and Canadian faunal provinces dried up and their respective faunas died out in the Late Permian.

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Multiphase Fluid Movements in Glass Micromodels of Pore Systems

The efficiency with which oil or gas can be displaced by water in the pores of a reservoir rock is affected by the properties of the fluids and the properties of the pore spaces which contain those fluids.

Pore casts provide the most effective way of viewing pore structures and are prepared by impregnating pore systems with resins and subsequently removing the host rock by solution in acid.

Unsteady state relative permeability tests, countercurrent imbibition tests, and drainage-imbibition capillary pressure tests can be used to estimate the displacement efficiency for particular fluid conditions in selected cores of reservoir rocks. The results of these tests can be compared with visual observations of pore structure made from pore casts and, in this way, it is possible to suggest which attributes of pore systems in reservoir rocks are critically important in influencing displacement efficiency. These variables include: pore to throat size ratio, the average number of throats connecting with pores, the types, abundance, and arrangement of non-random heterogeneities, and the roughness of surfaces.

However, pore systems in any rock are a complex of variables and, to further understand and define the interaction of fluid and pore variables in trapping oil or gas during displacement, it is necessary to create physical models of pore systems which incorporate the characteristics of real systems but in simplified and controlled forms. The fluid and pore geometric attributes can be varied singly and displacement tests can be viewed under the microscope in transparent micromo-