plying filters to the signature prior to the design of the wave shaping operators. We used an average cable ghost operator in this run and designed a single operator for each shot to enhance the wavelet in the zone of interest. The results were encouraging, so we decided to try removing residual effects in a separate pass on a trace-by-trace basis after the normal signature correction. The output obtained was disappointing; therefore, we decided to use prefiltering of the signature before operator design on a trace-by-trace basis.

This proved to be much less sensitive to noise on the input data and results show the small faults in the oil reservoir.

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Indian Creek Field, Fall River County, South Dakota

The original well drilled at Indian Creek in the southwestern corner of South Dakota was abandoned at a total depth of 3,874 ft (1,181 m) in the Desmoinesian part of the Minnelusa Formation in 1969. No shows of oil were encountered in this well, Ackman-Schulein & Associates 9-13 Federal-Martin, SW¼ SW¼ Sec. 9, T12S, R1E, and it was abandoned without any drill-stem tests. Log calculations of the Missourian age 2nd Leo sand (3,644 to 3,659 ft; 1,111 to 1,115 m) indicated low-water saturations and the well was reentered in 1978. A drill-stem test of the 2nd Leo in this well gauged 4 MMcf of gas per day. In June 1979, gas and oil were recovered from the 2nd Leo sand at the P & M Petroleum Management 1-9 Statecoach Government well, SE¼ SW¼ Sec. 9, T12S, R1E. Two oil wells with low gas-oil ratios have been completed in the NW¼ NW¼ and NE¼ NW¼ Sec. 16, T12S, R1E, flowing 200 and 170 bbl of oil per day, respectively. These two wells are currently producing 300 bbl of oil per day and additional development drilling is planned.

The field is located on the southeast flank of the Cottonwood Creek anticline. Subsurface control shows 2° of dip to the southeast. The 2nd Leo is a clean, fine-grained, well-sorted marine or marginal marine sandstone with a maximum known thickness of 18 ft (5.5 m) in the field area. This sand has excellent reservoir quality with a porosity range from 12 to 28% and maximum permeability exceeds 2 darcys.

The gas at Indian Creek field is a rare occurrence of gas associated with 2nd Leo or Minnelusa oil. The gas has a Btu value of 615 and contains 56% nitrogen. The oil is typical undersaturated 2nd Leo or Minnelusa oil.

The Indian Creek field is 15 mi (24 km) east of the nearest oil production which is on the Hartville uplift in Wyoming.

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Exploration in Great Salt Lake

The first offshore oil discovery in the Great Salt Lake was made by Amoco Production Co. in late November 1978. The discovery well, No. 1 West Rozel Unit, flowed heavy asphaltic oil using a gas-lift system at a rate of 2 to 5 bbl of oil per hour from perforations at 2,280 to 2,410 ft (695 to 735 m) in a Pliocene basalt. In June 1979, the No. 2 West Rozel Unit, using a water-powered hydraulic pump, had recovery rates from the basalt reservoir of 480 to 1,512 bbl of oil per day from a slotted liner from 2,345 to 2,367 ft (715 to 712 m). Additional production testing is planned to determine if the oil reserves are large enough for commercial development of this discovery.

At present, a total of seven wells have been drilled in the Salt Lake including the two wells drilled at West Rozel. No pre-Miocene Tertiary rocks have been encountered in these wells. Paleozoic and Precambrian rocks have been penetrated below the Miocene sediments.

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Paleoenvironmental Analysis of Disconformity and Condensed Bed at Contact of Austin and Taylor Groups (Upper Cretaceous), East-Central and Northeastern Texas

A disconformity and overlying condensed bed at the Austin-Taylor contact were examined in eight outcrops over a distance (Austin-Dallas-Roxton) of 450 km. Results of the analysis incorporate information from petrologic, foraminiferal, and trace-fossil studies. Both disconformity and condensed bed formed in a continental shelf environment; shallowest water depths were at Austin. Proceeding northward from Austin, water depth (1) gradually increased to Temple; (2) increased greatly from Temple to Waco; and (3) decreased from Waco to Roxton, to depths similar to those at Temple. Assemblages of omission suite trace fossils that reflect these depth changes include: (1) large *Thalassinoides*, shallowest depths; (2) small *Thalassinoides* and *Rhizocorallium*, intermediate depths; and (3) small *Thalassinoides*, greatest depths. The condensed bed, in which thickness is as great as 18 cm, is characterized by abundant nodular phosphates that are synsedimentarily phosphatized steinkerns.

Halt of Austin sedimentation and formation of the disconformity was probably due to early Campanian regression, which caused: (1) shallowing; and (2) constriction of the southern aperture of the Western Interior seaway, which was directly northwest of the outcrop area. This constriction may have caused an increase in the velocity of currents through the aperture which, combined with shallowing, increased the energy level of bottom waters in the outcrop area and led to periods of erosion and minimal net sedimentation. Subsequent transgression caused an increase in water depth and a widening of the adjacent aperture. This may have resulted in a reduced energy level for bottom waters, which raised sedimentation rates and led to deposition of the condensed bed and overlying rocks of the Taylor group.

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Uranium Exploration Systems Case Study—Copper Mountain, Wyoming

Regional surveys, including studies of rock chips and aerial radiometrics and magnetics, focused within an area of 400 sq km on the Canning stock, found enrichment in U, Th, and K. Stream-sediment data indicated an anomalous block adjacent to and including the North Canning and Fuller deposits. A subregional soil survey noted overlapping anomalies of eU, xU, Pb, Cu, and Ba in the vicinity of the North Canning deposit. This was confirmed by overlapping anomalies of eU, xU, Pb, Cu, and Ba in the rock-chip survey. Integrated radon and soil helium data were ineffective in delineating drilling targets at the subregional scale. The subregional magnetic, VLF-EM, and resistivity data confirmed the presence of a fractured and crushed zone within the host granite of the North Canning deposit. This interpretation is based on the presence of an overlapping low resistivity zone and a magnetic depression of about 40 gammas. Core holes were sited within an area of 25 sq km that included the North Canning deposit, the leachable-uranium-in-rock-chip anomaly, the aerial radiometric anomaly, and overlapping geochemical (xU, eU, Ba, He, Rn, As, Ni, and Pb) anomalies in the detailed soil survey. These holes, logged with a multispectral (K-U-Th) probe, show zonation of K, eU, and eTh in the monzonite and granitic host rock and indicate both directional and genetic information related to the origin of the uranium deposit.

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Biogenic Structures as Indicators of Depositional Rate

Distinctive blue-gray shales characterized by a homogeneous texture, blocky weathering, and an abundant trilobite fauna (*Flexicalymene, Isotelus*) are found at various stratigraphic positions in the Upper Ordovician near Cincinnati, Ohio. Whole and fragmentary trilobite body fossils are randomly oriented within the shale, bivalves are common, and biogenic structures (*Chondrites*) are locally abundant. Limestones and siltstones above and below the shales are more extensively burrowed and contain at least two ichnogenera, *Chondrites* and *Diplocraterion*.

The absence or relatively low density of biogenic structures in shale traditionally has been interpreted as (a) an inhospitable environment for burrowing organisms during shale deposition or (b) rapid deposition of the shale, which prevented disruption of the original fabric by burrowers. The abundance of trace fossils in lithologies below and above the "trilobite shales" implies favorable conditions for burrowers before and after shale deposition. The abundant pelecypod fauna and low organic content of these shales suggest the muds were well-oxygenated. The relatively low density and localized occurrence of biogenic structures in these shales, then, reflect rapid deposition of the shales. Paleontologic criteria, including the excellent preservation and random orientation of trilobites, support the interpretation of rapid deposition for the shales.

The "trilobite shales" represent events in which a turbid layer of silt and clay swept over the shelf, killing and rapidly burying the trilobites. Burrowers, also disturbed during the event, reestablished themselves and exploited the new substrate after it had stablized. Rapid, recurrent influxes prevented extensive disturbance by burrowers.

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Permeability of Clay and Shale

Permeability is a critical factor in the maintenance of abnormal fluid pressures. The permeability of "tight" geologic materials is difficult to measure, particularly in situ. Both the laboratory and in-situ methods require special techniques when the permeabilities are less than 10^{-10} cm/sec (10^{-7} darcys).

Permeability can be measured: (1) on rock samples in the laboratory; (2) in situ, using well-test procedures; and (3) on a regional scale, using a hydrodynamic analysis of the entire system.

Special techniques have been used to measure permeabilities in the Cretaceous Pierre Shale in South Dakota. Comparison indicates that the regional permeability exceeds the local permeability by two to three orders of magnitude. This suggests that secondary features, probably fractures, control the regional permeability.

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Lower Cretaceous Lacustrine Source Beds from Early Rifting Phases of South Atlantic

Significant amounts of oil are produced from Lower Cretaceous pre-evaporite, nonmarine sequences of these west African marginal basins: Gabon, Cabinda, Congo Brazzaville, and Angola. Organic-rich lacustrine source beds attain thicknesses up to 900 m. Their geometry and sediment similarities among several basins indicate a small number of large Early Cretaceous lakes extending along the South Atlantic rift with dimensions and conditions similar to Lake Tanganyika. The organic-rich facies is underlain by a sandy facies deposited during initial rifting. The lacustrine phases deposited green clays and fluviolacustrine-deltaic sands, which were abruptly terminated by marine incursions in the Aptian.

Our study of conventional whole cores from the Melania Formation of Gabon provides further evidence that these source beds were deposited in brackish to freshwater environments in a deep lake. Logs show characteristic low bulk densities and high resistivity which allow correlations over 80 km. Large-scale cyclic preservation of organic matter in a stable, low energy environment with anoxic bottom conditions is interpreted. There is little clay in the organic-rich "shales" which typically comprise finely laminated, carbonaceous and dolomite-rich rhythmic couplets. Bulk organic carbon concentrations up to 20% are not uncommon. Palynomorphs, ostracods, and algae also indicate temperate conditions around a low salinity environment. The slope sequences are richest in uniform laminates with