from all but the western part of the state during late Pliocene-Pleistocene erosion. The volcanic-ash beds that had existed in the eroded Ogallala are a potential source for some of the uranium occurrences.

Analyses of the Pearlette ash did not disclose any alteration trends or a downward decrease in the uranium concentration. The uranium content of the Pearlette is significantly higher than that of the altered Ogallala ash. The minimum ash of the Pearlette is 0.6 m.y. which suggests that efficient release of uranium from volcanic glass, at least in some examples, is not a geologically contemporaneous process.

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Triassic Paleocaliche in Red Beds of Dolores Formation, Southwestern Colorado

Early diagenesis of Upper Triassic lacustrine mudrocks and sandstones in southwestern Colorado includes pedogenic accumulation of calcium carbonate. Petrocalcic horizons, 0.4 to 1.5 m thick, are dominated by unlaminated micritic caliche concretions which range from pellets 1 mm in diameter to nodules 30 mm in diameter. Evidence for in-situ origin of these limestone concretions includes: irregular shape, floating texture, inverse grading, and truncation of back-filled burrows.

Mature paleocaliche profiles are capped by calcium carbonate plugged horizons which contain rootlets 1 to 2 mm in diameter. These plugged horizons also contain paleofracture systems filled with reddish brown mudrock. Locally paleofracture morphology suggests plant-root control in its development. In very fine sandstones, micritic caliche nodules coalesce in upward coarsening, sinuous vertical stacks that suggest a rhizoconcretion origin.

A maximum of nine petroclastic profiles were observed over a vertical interval of 56 m in one outcrop north of Durango, Colorado. The most mature profile observed exhibited the Stage III development of Gile and others. Caliche nodules and pellets occur throughout the Dolores Formation in southwestern Colorado either in pedogenic profiles or as transported clasts in fluvial, lacustrine deltaic distributary, or fan delta deposits.

Literature descriptions suggest that caliche nodules are also present in the correlative Chinle Formation of New Mexico, Arizona, Utah, and Colorado. Based on the areal distribution of modern caliche, a semiarid climate is suggested for the Late Triassic in the Four Corners region of the western United States.

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Miocene Spumellarian Radiolaria from South Pacific

The taxonomy of Radiolaria, a subclass within the phylum Protozoa, was developed by Ernest Haeckel in the late 1800s. That classification was based primarily on gross geometric patterns which have been subsequently shown to be unsatisfactory. Reclassification research has been concentrated on the Nassellarian (conical) radiolaria because of more pronounced characters. Spumellarian (spherical) radiolaria, however, have not been regrouped mainly because their morphology is more subtle and difficult. However, they are the most robust and most persistent in the fossil record (Ordovician to present), and therefore the likliest to be preserved in strata.

Two core sites, 77B and 289 from the Deep Sea Drilling Project, provide a continuous time sequence during the Miocene and both probably represent a stable equatorial current system. Slides were made at 1-m intervals from the cores and spumellaria individuals were studied from successive time sequences. Nineteen characters were recorded for each and then subjected to a rigorous analytical technique provided by a numerical taxonomy program (NTPAC-11). Pearson's correlation coefficients detected 23 species throughout the Miocene. An unweighted pair group clustering method using arithmetic averages grouped these species into 14 genera.

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Calcium Budget in Frio Sandstones, Southwest Texas

Studies of active burial diagenesis in Frio (Oligocene) sandstones in the temperature range 90 to 160°C (burial depth, 2,500 to 4,450 m), combined with other studies at lower temperatures, show important sources and sinks for calcium. The main calcium sources are conversion of smectite to illite (40 to >150°C), pressure solution of detrital micrite (<90°C), albitization of calcic plagioclase (100 to 120°C), and to a lesser extent devitrification of acidic volcanic glass (<90°C).

The main calcium sink is cement-forming calcite. The composition of the calcite appears to reflect the various sources, thus calcite cement from the breakdown of smectite shows a late-stage iron-magnesium enrichment, whereas calcite replacing albitized plagioclase is nearly pure calcite. Another sink for calcium, previously undescribed for the Gulf Coast Tertiary, is authigenic sphene which is found at temperatures greater than 150°C.

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Signature Processing of North Sea Air-Gun Data

Results of development drilling on a North Sea oil field suggested that the actual structure was much more complex than the original interpretation. We present the results of a reprocessing project on selected seismic lines over the structure. The original data were recorded using a variable cable depth and a deep tow hydrophone for the gun signatures. The data were reprocessed using only signature correction to a zero-phase wavelet. However, results obtained at the horizon of interest were still affected by cable ghosts, frequency attenuation within the overlying sediments, and practical constraints on the recording of the source ghost.

Because the purpose of the project was to improve delineation of very small faults, we decided to try to improve resolution by applying corrections for these effects. The initial tests were done by designing and ap-

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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