sequences (graded bedding characterizes both facies), and single versus multiple clast types.

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Extractable Geothermal Energy in Benue Area, Nigeria

An episodic mobile belt underlies the zone of geothermal springs in the Benue area of Nigeria. The close resemblance between the transverse gravity profiles for the Benue depression and profiles of the central Red Sea depression may indicate a similar origin for the depression. The Benue depression is an expression of a spreading ridge generated from a RRR triple junction which was active in the Early Cretaceous. Separation in the Benue trough ceased in the Late Cretaceous, and the spreading ridge is now defunct and at least partly obscured. In Neogene time, there was predominance of igneous activity in the Cameroon-Adamawa volcanic zone which has many attributes of an embryonic spreading ridge. Many of the Neogene alkaline volcanics in the Benue depression and on the Jos plateau trend northwest-southeast, roughly perpendicular to both the Benue depression and the Cameroon-Adamawa volcanic zone, and may mark the sites of future transform faults.

It is postulated that the geothermal springs in the Benue area are surface expressions of a convective hydrothermal system associated with an embryonic spreading ridge or hot spot. It is also suggested that extraction of energy from this convective hydrothermal system, either for direct heat application or for conversion to electricity in the Benue area, is feasible.

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Late Cenozoic Paleo-oceanography of Norwegian Greenland Sea and Northeast Atlantic: Benthic Foraminiferal Evidence

Analysis of late Cenozoic deep-sea benthic foraminifera from DSDP Legs 12 and 38 was conducted to determine faunal patterns and relate them to the evolution of bottom-water circulation. In the Norwegian Greenland Sea, middle to late Miocene sites from 1,200 to 1,800 m present water depth have an agglutinated benthic foraminiferal assemblage dominated by *Martinottiella communis* and *Spirosigmoilinella* sp.; shallower and deeper sites are barren. A regional unconformity appears to span an interval from within the late Miocene to the early Pliocene. A sparse early Pliocene calcareous assemblage is dominated by *Cassidulina teretis.* Intervals interpreted to represent colder episodes within the late Pliocene-Pleistocene are either barren or contain an assemblage dominated by *Oridorsalis tener.* These alternate with a more diverse assemblage dominated by *Cibicides wuellerstorfi* (> 1,500 m) or *C. teretis, Islandiella norcrossi,* and *Melonis barleeanum* (<1,500 m) that represent interstadial or interglacial intervals.

North Atlantic sites show higher benthic foraminiferal diversity and better preservation throughout most of the late Cenozoic than the Norwegian Greenland Sea sites. The Norwegian Greenland Sea does not appear to have been a source of North Atlantic deep water during the Miocene to early Pliocene interval because conditions were not conducive to the preservation of calcareous foraminifera. Late Pliocene-Pleistocene assemblage changes in the Norwegian Greenland Sea are interpreted to represent changes in bottom- and surface-water circulation. Episodes of ice cover inhibited bottom-water formation and affected the food supply to the benthos. These intervals alternated with times of more productive ice-free conditions, some of which may have been conducive to bottom-water formation.

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Drilling-Mud Emanometry, a New Technique for Uranium Exploration

Bendix Field Engineering Corp., as a part of the Department of Energy's National Uranium Resource Evaluation (NURE) program, has investigated the feasibility of measuring radon in recirculating drilling mud, and whether the radon variations might be useful for uranium exploration. To implement this program, a prototype instrument was developed and tested. The system works by degassing the drilling mud as it recirculates and by continuously measuring the radon activity of the evolved gas. A record of the relative radon activity, as related to borehole depth, is obtained.

Radon data were obtained at two sites: Sand Wash basin in northwestern Colorado, and the Great Divide basin in south-central Wyoming. At both sites it was found that radon could be measured in the recirculating mud, and the downhole radon profiles paralleled gamma logs obtained from the same drill holes. At the Sand Wash site, the radon content in the mud varied with the lithology encountered. The conglomeratic member of the Browns Park Formation had the highest radon content, twice that of the sand member. The shale of the Mancos Formation had much lower radon levels than either of the other two lithologies. At the Great Divide basin site, the lithology was not as well delineated by the radon profiles.

From this study it was found that radon can be detected in drilling mud and that anomalous radon zones can correspond to uranium concentrations and to variations in lithology. It may also be possible by this method to detect the presence of nearby uranium concentrations.

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Dip-Profile Method of Constructing Structural and Stratigraphic Cross Sections

Dip profiles are graphs that show apparent dip as a function of distance along selected horizontal, vertical, or inclined lines on cross sections. Such profiles not only serve to integrate structural control of all kinds (surface dips, dipmeter dips, and dips derived from contour maps and migrated seismic sections) into a single numerical package, but they also provide a foundation for sophisticated geometric constructions based on the concepts of curvature trajectories and dip isogons. A curvature trajectory is a smooth line that connects points on a cross section where the bedding curvature has a distinctive property not shared by points on either side. (The trace of an axial plane is a familiar example.) Eight kinds of curvature trajectories (of which two relate to dip-slip faults) occur in nature. Each kind is distinguished on dip profiles by a specific, mathematically-defined special point. A dip isogon is a smooth line that connects points of equal apparent dip on those parts of a cross section where the bedding is curved. (The trace of a crestal plane is a familiar example.) Reliable procedures for extrapolating and interpolating curvature trajectories and dip isogons (based on the known or deduced tectonic style) can be used to establish a network of primary and secondary dip profiles—thereby insuring structural and stratigraphic interpretations that are statistically and