

A comparison of the present data and previous work shows that the greatest occurrence of extinctions is found at the Paleocene/Eocene boundary with a lower number of extinctions at the middle/late Eocene and Eocene/Oligocene boundaries. The lack of a major catastrophic change at the Eocene/Oligocene boundary may be a result of previous faunal events at the Paleocene/Eocene and middle/late Eocene boundary eliminating stenothermal species, leaving environmentally tolerant species in the late Eocene that were largely unaffected by the 3°C (37°F) temperature decrease at the Eocene/Oligocene boundary.

CORNELL, WILLIAM C., Univ. Texas, El Paso, TX

Some Permian (Leonardian) Radiolarians from Bone Spring Limestone, Delaware Basin, West Texas

A sample of the deep basinal Bone Spring Limestone (Leonardian) has yielded a diverse and superbly preserved assemblage of spumellarian radiolarians, associated with siliceous sponge spicules, and conodonts. Radiolarians include typically Paleozoic paleoactinommids, entactinids, and rotasphaerids; Permian albailellids and parafollicucullids; and triradiate spongodiscs or hagiastriids. Triradiate forms, which include approximately 60% of the shells in the sample, have not previously been reported to be abundant in pre-Mesozoic rocks. Albailellids and parafollicucullids are similar to forms reported from the Permian strata of Japan, but the Bone Spring forms do not fit in the biostratigraphic zonation proposed by Japanese workers. This may be due to gaps in the Japanese stratigraphic sections or to provincialism in radiolarian faunas.

Diversity in the Bone Spring assemblage is higher than in other Permian assemblages. Most reported Permian radiolarians have been recovered by HF extraction of cherts, while the Bone Spring specimens were extracted from limestone with acetic acid. Thus, diversity differences can be partly attributed to fortuitous preservation.

CRAWFORD, F. D., C. E. SZELEWSKI, and G. C. ALVEY, Home Oil Co. Ltd., Calgary, Alberta

Geology and Exploration in Takutu Basin, Guyana

The Takutu basin is an intracratonic graben 280 km (174 mi) long and 40 km (25 mi) wide in northern Brazil and adjoining Guyana, lying entirely within the center of the early Precambrian Guyana shield. Acidic metavolcanic rocks and thick Proterozoic quartzite lie to the north of the basin. Granulite, gneiss, and granite border the graben to the south and east. High mountains arise along the south-bounding fault whereas more subdued topography flanks the north side of the basin. Triassic basalt forms a wide band of outcrop along the southern and eastern margins of the rift. There are very poor and sparse outcrops of the basin fill. The graben is filled with up to 4,000 m (13,123 ft) of Cretaceous and Jurassic sedimentary rock underlain by 1,500 m (4,921 ft) of mafic volcanics of Triassic age and possibly older (i.e., Proterozoic).

The geologic history of the Takutu graben is interpreted to extend back into Precambrian time because it occupies an ancient suture zone in the Guyana shield. Renewed rifting and major subsidence occurred in Mesozoic time resulting in the deposition of thick nonmarine clastics, evaporites, and carbonates. A basal(?) Jurassic clastic-carbonate sequence overlies the eroded basalt. It is overlain by thick Cretaceous Aptian salt and interbedded shales that were deposited over most of the basin and contain good oil source rocks. The only indication of a marine

environment is found within the subsurface post-salt clastics in Brazil. Lacustrine and deltaic depositional processes were dominant as indicated from well and seismic data.

Two main structural styles, namely pre-salt and post-salt, occur in the basin. The former is characterized by block faulting and horst and graben development. Non-piercement halokinetic forms swells and ridges in the post-evaporite Takutu Formation. Wrenching and salt solution are interpreted on seismic records. A large, cross-basin arch is present in Guyana where at least six undrilled prospects have been mapped.

Three widely spaced exploratory wells have been drilled down to the mafic volcanics. The wells are located on structures near the rift margin or in areas of thinner basin fill. Two of the tests were dry and abandoned while Home Karanambo #1 was classed as a noncommercial oil discovery in fractured basalt. Several clastic depocenters have been interpreted and delineated from the seismic and drilling results. They lie near the southern and eastern unexplored basin margins, distant from the wells drilled to date.

CREAMER, ELIZABETH A., Univ. Maryland, College Park, MD

Surface Expression of a Deep Mafic Pluton in Kentucky and Tennessee

The density and orientation of lineaments have been mapped from Landsat imagery in a 30,000 km² (11,583 mi²) area in central Kentucky and central Tennessee to determine whether known lower crustal intrusion is expressed on the surface through anomalous lineament patterns. A seismic refraction line through northern Tennessee and southern Kentucky indicates an anomalous region approximately 200 km (125 mi) long and 70 km (43 mi) wide where the upper crust is less than 10 km (32,808 ft) thick. The anomaly is coincident with a magnetic high seen on aeromagnetic surveys and with a Bouguer gravity high. Satellite magnetic surveys indicate a high in the general region of the anomaly. A basement core in the southern part of the anomaly is composed of peralkaline riebeckite syenite, a rock characteristic of a rift tectonic environment.

Lineaments were mapped as alignments of morphologic features such as streams, escarpments, mountain ranges, and tonal features on 1:500,000 scale multispectral scanner images of Bank 6. Winter scenes were chosen for a lower sun angle for better lineament mapping. The location of the anomaly was not revealed until lineament mapping was completed. Density and orientation of the mapped lineaments were then analyzed.

The following conclusions were reached from these data. (1) The lower crustal structure has no apparent expression through anomalous direction of lineaments over the structure. (2) The lower crustal structure is expressed on the surface through an increase in density of lineaments over the structure. (3) Aeromagnetic and satellite magnetic highs coincident with lineament density highs suggest correlation with deep crustal intrusive structures.

CROSS, AUREAL T., Michigan State Univ., East Lansing, MI

Plants of Devonian-Mississippian Black Shales, Eastern Interior, U.S.A.

Macrofossils of the New Albany shale and equivalents of Late Devonian of Early Mississippian age in the east-central United States are known from three main "floras" or assemblages. One "flora" is almost entirely composed of *Callixylon* logs, slabs,