shore conditions of reduced salinity and belongs to the *Cavusgnathus*-biofacies.

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WIDE-LINE PROFILING

A technique developed and perfected in France by Compagnie Generale de Geophysique makes it possible to record, process, and interpet reflected events originating from every direction.

The field layout is the same as that for conventional, multiple-coverage, seismic-reflection profiling. The only difference is that shot points are placed along oblique lines, so as to obtain several parallel, regularly spaced, depth-point lines. After processing, these lines yield comparable, although not identical, seismic sections, and a computer is able to analyze, by the cross correlation process, the slight shift of reflection events caused by lateral gradients.

A complete software was developed and the longitudinal dips, lateral dips, total dips, migration offsets, and time corrections are produced by a Calcomp plotter. The basic document is a section obtained by stacking the individual parallel sections after removing events which do not correlate laterally. The Calcomp displays provide the necessary parameters for migrating all events in three dimensions.

Considerable improvement over old methods was provided in tectonically complex areas. In other cases, an apparent unconformity resulted from 2 lateral events of opposite dips, a reflection on a fault plane beyond the seismic line was identified, and good results were obtained using lateral dip criteria in an area where high multiplication had been unsuccessful.

The advantage of wide-line profiling is that it expands the multiplication in lateral directions at a small cost increase. The software developed by CGG sorts out the seismic arrivals and provides tools for migration in a true three dimensional space.

The wide-line profiling technique has now reached the industrial stage and was used successfully in areas with complex structural geology, such as Spain, France, Italy, Libya, Angola, and Canada.

MILLER, E. B.

OIL INDUSTRY VIEWPOINT

No abstract available.

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SILURIAN CONODONTS FROM DEATH VALLEY, CALIFORNIA

The northern part of the Panamint Range, Inyo County, California, contains many early and middle Paleozoic marine formations, but precise stratigraphic relations are poorly known for lack of abundant megafossils and because of postdepositional dolomitization and silicification of the rocks.

The type section of the Hidden Valley Dolomite consists of 1,365 ft of light- to dark-gray, chert-bearing dolomite. On the basis of megafossil evidence, previous workers considered that the major part was Silurian and the upper 65 ft was Early Devonian.

Approximately 1,000 conodonts were identified from samples collected in a measured section about 1.5 mi north of the type section. Specimens from the uppermost 50 ft of the underlying Ely Springs Dolomite indicate a Late Ordovician or Early Silurian age. Conodonts from the Hidden Valley Dolomite indicate the presence of the European and eastern North American *Neospathogathodus celloni* zone and the younger *Pterospathodus amorphognathoides* zone within the lower 325 ft of the formation. Both zones are of Llandovery age (C_2- C_6) and represent the first report of Early Silurian conodont zones from the Death Valley area. The middle part of the formation yielded no conodonts, but a sparse fauna about 150 ft below the upper boundary contains specimens *Polygnathus linguliformis* and *Icriodus latericrescens*, suggesting an Early Devonian age. No diagnostic Devonian conodonts were recovered from the lower 100 ft of the overlying Lost Burro Formation.

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TECTONIC AND STRATIGRAPHIC EVIDENCE FOR MIOCENE GULF OF CALIFORNIA

The correlation of clasts in Eocene river gravels in Baja California with the sources for the clasts in Sonora has indicated the necessity for the dilation of the northern Gulf of California depression prior to, or concurrent with, the 23-18 m.y. opening of the Basin Range province in Sonora. The appearance of an extensive, basin-filling seaway in Baja California and Sonora during the Miocene is consistent with a regional subsidence resulting from crustal extension. The presence of shelf-type lower Miocene marine sediments on both coasts of Baja California Sur, between Loreto and La Paz, suggests that the marine waters entered the early Gulf across a shallow, nontectonic seaway which opened to the Pacific Ocean.

The recognition of the early Miocene seaway extending into the northern Gulf, coupled with a later (4-10 m.y.) opening of the modern Gulf, supports the idea of a Gulf formed in at least 2 tectonic stages.

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GEOLOGIC EVOLUTION OF NORTH-NORTHEAST CONTINENTAL MARGIN OF BRAZIL

The Brazilian north-northeast continental shelf, between 35° and 47° west, is composed of the offshore Barreirinhas, Piaui, Ceará and Potiguar basins. The total area within the 200-m bathymetric contour, excluding the shallow basement area, encompasses approximately 51,000 sq km. The sedimentary sections of these basins can be subdivided in several genetic sequences of strata, which by comparison, from older to younger, show the tectosedimentary and paleogeographic evolution of the area.

The Equatorial Atlantic rift (which probably started in Eo-Cretaceous time) had its great development in Aptian time. From the beginning of the rift opening to the end of Albian time, all the coastal basins were of the semigraben type tilted to the south. From Cenomanian to Santonian time, these basins gradually evolved into northward-opening marginal-type basins. At the end of this period, the final separation of South America and Africa took place, developing a north-south compressional stress in the fracture zones. As a result, folding, reverse faulting, transcurrent faulting, and grabens developed. From Campanian to Holocene, these coastal basins maintained their northward-open, marginal-basin characteristics.

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SEDIMENTARY AND TECTONIC HISTORY OF CRETACEOUS FLYSCH IN SOUTHWESTERN ALASKA

Cretaceous deep-water sedimentary rocks are discontinuously exposed or have been dredged, along 1,700 km of the outer continental margin of the Alaska Peninsula-Bering Sea shelf. In the Shumagin and Sanak Islands, on the continental shelf near the southwestern end of the Alaska Peninsula, the deep-sea sediments are comprised of monotonous sections of thin (4 cm) to thick (10 m) bedded sandstone and mudstone, showing grading, convolute lamination, groove and flute casts. The sandstone beds are lithic arenite with more than 40% volcanic-derived framework grains. Over 500 measurements of sole marking in the Shumagin and Sanak Islands show maxima toward the southwest and west-northwest respectively, with minor lateral feed from the north.

This flysch sequence was deposited primarily by turbidity currents in an elongate trough supplied from a northerly volcanic source area. In the absence of a confining basement seaward of the flysch deposits, the original depositional basin is interpreted as an oceanic trench. These trench deposits were deformed initially in a semilithified state with the development of axial-plane slaty cleavage. Fold axes parallel the existing continental shelf edge, trending northeast and west-northwest in the outer Shumagin and Sanak Islands, respectively. Folds are overturned seaward predominantly, axial surfaces dipping landward. Locally units may be described as broken formations, though no mélanges are observed. The style of this early folding is consistent with, but not diagnostic of, gravity gliding. Alternatively, the rocks may have been deformed by underthrusting at the trench inner wall. At strain rates of 10^{-13} to 10^{-14}/sec (calculated assuming underthrusting), the trench sediments may have undergone "strain hardening" from increasing internal grain friction and cementation during dewatering.

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SEDIMENTS AND STRUCTURE OF CONTINENTAL MARGIN, CENTRAL VENEZUELA

The continental margin of central Venezuela is a borderland similar to the area off California. Major east-west faults separate tilted crustal blocks which form horsts and grabens. Gravity gliding on these blocks has developed folds and secondary faults. The shelf east of Margarita Island is a shallow terrace topographically, but seismic profiles show an underlying system of sediment-filled horsts and grabens. The Antilles arc can be traced from Grenada to Testigos Island and on through Margarita and Tortuga Islands.

Sediment-size distribution is related to bathymetry. Sands are restricted to the Tortuga-Margarita rise and the broad terrace east of Margarita. These sands are high in carbonate content and have abundant glauconite. They are mainly relict sediments that were reworked during lower sea level of the last glacial episode. Silts and clays cover the continental slope, Cariaco basin, and the inner shelf between Cumaná and Cape Codero, marking deeper areas of the sea floor and areas where only fine sediments are available.

Sand composition also is related to bathymetry west of Margarita. The Tortuga-Margarita Rise sediments are reef-related material. The rest of the shelf is dominated by a benthonic Foraminifera-Mollusca shell-fragment facies. The continental slope and Cariaco basin sands consist of planktonic Foraminifera. The eastern terrace sands are more complex. Reworked detrital sands surround Margarita. Around Testigos and in the south, there is a reef debris facies. Except for a pellet facies north of Araya Peninsula and Carupano, the rest of the area has a benthonic Foraminifera-shell-fragment facies.

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SEDIMENTARY AND TECTONIC HISTORY OF OUACHITA MOUNTAINS

The Ouachita Mountains of Oklahoma and Arkansas contain Paleozoic flysch-like geosynclinal rocks exposed by elongated east-west folds and thrust faults. Approximately 5,000 ft of Cambrian to Devonian flysch consists predominantly of dark slates and cherts, comprising a classical "starved trough" succession. Minor incursions of mature sands, apparently from the North American craton, invaded the trough at three different intervals. The succeeding Carboniferous, almost 40,000 ft thick, consists of proximal and distal turbidite sandstones, black shales, and minor interlayered wildflysch and volcanic ash. Sedimentary structures indicate southwestward, westward, and northwestward sand dispersal. Sandstone compositions suggest a cratonic, quartz-rich provenance as well as a feldspathic, lithic extracontinental source.

The tectonic setting may well have been due to oceanic crust spreading northwestward, plunging under continental crust, and creating an island-arc-trench-subduction zone whose present location is overlapped by post-Paleozoic rocks. Northwest of the trench, a complex of slope, rise, and abyssal sediments formed upon the depressed outer margin of continental crust. East of the Ouachitas, continent-continent collision caused suturing of Africa and North America, which created source materials that were subsequently emplaced as a westward-building subsea cone during the Carboniferous. In the Ouachita area, continued subduction finally created a series of uplifted tectonic lands resulting in northward sliding of the sedimentary succession as continentward-directed folds and thrust sheets. Subsequent stress-field orientation changed so that the area then became dormant.

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STRUCTURE, SEDIMENTATION, AND PALEOENVIRONMENTS OF NORTHERN CAPITAN REEF COMPLEX, NEW MEXICO AND WEST TEXAS

The Capitan Reef complex may be subdivided into western, northern, and eastern segments by major differences in structure and sedimentation. The western segment is characterized by a barrier "stratigraphic" reef and simple shelf folds paralleling the basin-shelf margin. In contrast, the northern segment has current-oriented mounds formed by shelf beds draped over biohermal cores that extend at approximately right angles to the basin-shelf margin, and shelf domes of irregular orientation superimposed on larger structures and distributed at random in the shelf. Test drilling suggests that primarily detrital and recrystallized dolomite and dolomitic limestone lie between the current-oriented mounds in what are interpreted as ancient Capitan channels. The current-oriented mounds of the Capitan shelf and tidal-current ridges of the Great Bahama Bank have some similarities: (1) both are on an innermost shelf margin facing a deep basin or oceanic tongue, and (2) the long structural axes of both appear to have been determined by prevailing marine-currents. Shelfward from the tidal-current ridges of the Bahama Banks are moundlike accumulations of sand, which are similar in shape to the Capitan shelf domes. The Bahama mounds and tidal-current ridges were formed by marine-current deposition of oolites and carbonate detritus, whereas the Capitan current-oriented mounds and shelf domes were probably formed by marine-current deposition of carbonate detritus and by organic biohermal growth. The channels between current-oriented mounds probably provided a ready passageway for Permian marine currents and allowed a large influx of quartzose clastics into the Delaware basin.

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LATERAL VARIATIONS OF CLAY MINERALS IN DELTAIC SEDIMENTS OF COLVILLE AND ADJACENT RIVERS, NORTH SLOPE, ALASKA

The less than 2-micron fraction of deltaic sediments of the central North Slope, Arctic Alaska, were analyzed by X-ray diffraction. In almost all samples illite is the predominant clay mineral; smectite, chlorite, and kaolinite are present in minor amounts. In the Colville Delta, there is a notable increase in the illite/smectite ratio and a decrease in the smectite/kaolinite ratio from the fluvial channels to the saline fluviomarine and marine regions adjacent to the estuarine mouth. These changes in clay mineral assemblages presumably are due to reconstitu-