ly dominated deltaic and shallow-marine sands and muds of the Graneros Shale. These deposits completed the filling of pre-Cretaceous valleys and buried the predepositional topography. By early Turonian time, the eastern edge of the seaway had transgressed far to the east, leaving western Iowa far from siliciclastic source areas. The result was the deposition of the carbonate muds of the Greenhorn Limestone. Renewed introduction of siliciclastic muds, probably from the northeast, resulted in deposition of the Carlile Shale.

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Relations Between Stromatolites and Burrowing Organisms

The activity of burrowing organisms seems to be of great importance in limiting the occurrence of stromatolites. Profiles of Callovian and lowermost Oxfordian of the Cracow-Wielun Upland, central and south Poland, are very useful for studies of relations between stromatolites and burrowing organisms. Many burrows, with up to 20 burrow apertures/sq m, of the *Thallasinoides* type occur in sandy crinoid limestones of early Callovian age. They are sublittoral deposits without stromatolites. However, stromatolites occur in stratigraphically condensed limestone sequences of middle and late Callovian age, and indicate deeper-water deposition. The associated fossils are pelagic forms: ammonites, belemnites, and coccoliths. Also present are iron-manganese nodules with a red or brown color. Probably these deposits accumulated on a submarine swell at a depth of several tens of meters. They pass laterally into deeper water marls which do not show any features of stratigraphic condensation. The latter deposits are without stromatolites, but contain numerous *Zoophycos* burrows.

Stromatolites of condensed sequences occur as beds of various thicknesses, up to 40 cm. Interstitia and pockets in stromatolites are filled by highly bioturbated red limestones. The limestones and marls above the stromatolites contain numerous burrow structures of the *Chondrites* type. Such relations suggest competition for space between blue-green algae and burrowing organisms. Probably the instability of the sediments caused by the activity of the burrowing organisms was an important factor limiting the spread of algal mats.

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New and Developing Techniques in Coal Exploration

New techniques in coal exploration develop slowly. Most of the current work being done in this field relies heavily on the techniques and practices in common usage about 20 years ago. Developments in three areas are improving the geologist's ability to better quantify available information and to better predict the position and distribution of coal seams between and beyond drill holes: (1) improved geophysical techniques; (2) modeling of the deposition environments; and (3) manipulating available information with computer programs.

Several new geophysical techniques are proving useful. These include improved resolution of downhole logging probes that more accurately indicate depth and thickness of seams and give coal quality information. High-resolution seismic equipment and techniques are now defining better the discontinuities in seams. Faults can be identified readily, but sedimentary cutouts are more difficult to define. New instrumentation in gravity and magnetic technology show some promise. These new geophysical methods lean heavily on manipulation of data by computers.

Modeling of depositional environments is gradually becoming more accepted as a better means of predicting what happens to the coal seam and adjacent rocks beyond the outcrops and drill holes. Not only does it allow the geologist to extrapolate the presence and thickness of seams, but also to predict the rock type that overlies and underlies the coal. All of this information is important for mine planning.

Increased use of computers and accessories provides rapid handling of large amounts of data. Once the data are entered, the computer will construct a variety of maps, do statistical calculations, and tabulate requested information.

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Potential Petroleum Reservoirs on Deep-Sea Fans Off Central California

A variety of potential petroleum reservoirs are indicated in subbottom siesmic profiles or implied by the depositional history of the deep-sea fans off central California. The size and extent of both the stratigraphic and tectonic traps off California are large compared to terrestrial analogs as seen only through the crude filter of acoustic profiling. Stratigraphic traps such as buried deep-sea channels, sand lobes, and updip pinch-out sands are produced as a normal consequence of the formation of deep-sea fans. Such stratigraphic traps can be expected on any submarine fan if the sand budget and porosity are sufficient. Slumps of sediment from the continental slope cover large areas of the deep-sea fans, and slumped sediment may isolate and bury channel segments and associated sand bodies. Tectonic traps resulting from folding or faulting are rare in deep-water fans. Faulting and folding are more commonly observed in fans from slope basins and from the California borderland and produce both tectonic traps and stratigraphic traps by altering configuration of the basin.

Large deep-sea fans are built over irregular oceanic crustal topography that has as much as 2 km of relief. As a result, many localized basins on the middle and outer fan are substantially thicker than much of the adjacent fan. On Monterey fan, for example, these local basins include valleys between abyssal hills and a large fracture-zone trough.

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Reservoir Rock, Source Rock, and Trapping Mechanism of Permian Basinal Facies, Delaware Basin