Surface Seismic Methods Applied to Coal-Mining Problems

Several tests have been conducted to determine the feasibility of using surface seismic methods to solve coal-mining problems. In particular, we have attempted to detect coal-seam discontinuities caused by erosional sand channels and to locate abandoned workings. An inexpensive test program to evaluate the probability of success at a given mine site was developed and has proven effective. Seismic data were acquired at four locations and features associated with coal-seam discontinuities were identified on the seismic sections. The data were used to predict the location, and in some cases, the nature of the coal-seam discontinuity. Core and geophysical log data were used to provide subsurface control and to test the validity of the seismic interpretation.

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Thick Sediment Accumulations Beneath Continental Margin of Outer Bering Sea

Multichannel and single-channel seismic reflection profiles across the outer edge of the Bering Sea Shelf between Cape Navarin and the Aleutian Islands reveal thick sedimentary sections underlying the continental slope and rise. This segment of the Bering Sea margin, about 700 km long, is covered by 200 to 3,400 m of water and is incised by several large submarine canyons. The sedimentary section overlying acoustic basement ranges from 0 to 10 km in thickness, and the thickest parts (7 to 10 km) are located at the base of the slope along the northern and southern areas of the margin. A maximum thickness of 10 km (5.9 sec, two-way) occurs in uplifted rise deposits that lie in 800 m of water near the mouth of Zemchug Canyon.

Recent dredging along the continental slope indicates that upper Eocene or lower Oligocene sediment lies unconformably on an Upper Jurassic acoustic basement. The reflection profiles across the sediment-draped areas of the margin suggest that only the upper half of the thick sedimentary section at the base of the slope is younger than early Oligocene. The age of the deeper sediment may be as old as Mesozoic.

Several aspects of the sediment wedges along the Bering Sea margin make these wedges favorable targets for future hydrocarbon exploration: (1) the large total thickness of Cenozoic sediment; (2) the presence of internal structural and stratigraphic features such as diapirs, faults, crustal warps, onlaps, and pinchouts; and (3) the likelihood of Cenozoic source areas rich in organic and coarse-gained detrital debris.

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Crude Oil-Like Hydrocarbons in Recent Sediments of Santa Barbara Basin

Significant amounts of indigenous hydrocarbons have been found in recent sediment cores from the Santa Barbara basin offshore of southern California. The molecular composition of these hydrocarbons is like that of crude oil and appears to be uniform across the basin and not altered by depth of burial. The molecular composition of this incipient crude oil differs from local crude oils and oil seeps and from hydrocarbons contained in underlying, geologically older rocks. Phytoplankton, which are so abundant in the nutrient-rich waters of the Santa Barbara Channel, appear to be the major source of the hydrocarbons. Study of these cores seems to be leading to the general conclusion that the process of oil generation starts very early in the depositional cycle.

One piston core from the basin contained a 2-m thick sand and shell layer buried 2 m below the mud line. In contrast to the surrounding clay muds, a large fraction of the extractable organic matter from the sand-shell layer was hydrocarbons, and the hydrocarbons exhibited a more crude oil-like composition than the hydrocarbons in the clay. Thus, it appears that hydrocarbons have migrated from organic-rich, clay muds into a reservoir bed within a few thousand years.

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Antarctica and Gondwanaland

From field studies during the last 80 years, the geology of Antarctica is sufficiently known to allow definition of two main provinces—East Antarctica (mainly east longitudes) and West Antarctica. East Antarctica is a continental landmass with an ancient basement complex overlain by a subhorizontal sedimentary and volcanic sequence. The basement rocks (Archean to early Paleozoic) include a variety of igneous and metamorphic types; granulitic rocks such as enderbite and charnockite are widespread. The overlying stratified sequence (Devonian to Jurassic) of mainly clastic sedimentary rocks contains coal, the *Glossopteris* flora, and mafic sills and flows. West Antarctica is a diverse and complicated terrane of Phanerozoic rocks. Fossiliferous Cambrian beds are present in one range, but no definitely Precambrian rocks are known, although some could be that old. Five tectonic zones have been identified in Antarctica—the ancient shield and four Phanerozoic orogenes.

To understand the history and resource potential of Antarctica, it must be considered as a central piece of Gondwanaland with ties to all the other major fragments. The supercontinent had obtained most of its area by late Precambrian time, and the Pacific border was an active continental margin from then until early Mesozoic time. Major orogenes are traceable into the other Gondwanaland fragments and provide important ties for reconstruction. Breakup began during the Jurassic with separation of South America and Antarctica from Africa, and continued into the Cretaceous with the separation of New Zealand, and probably India, from Antarctica. The parting of Australia and Antarctica occurred during Eocene time. Breaking of the last linkage with South America during middle Tertiary time led to formation of the Antarctic Circumpolar Current and the modern isolation of Antarctica.