corresponds to increased upwelling associated with intensified cooling in the uppermost Miocene.

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Geophysics—The Next 50 Years

This year marks the beginning of the second 50 years of the Society of Exploration Geophysicists and, effectively, it is also the start of the second half century of what may be termed the modern application of geophysical exploration techniques.

Will there even be a need for geophysics by the year 2030? The answer must be an unqualified yes.

The total worldwide demand for energy and raw materials will increase as population and industrialization grow. Nuclear, synthetic, and renewable energy supplies, such as solar, wind, hydroelectric, and biomass plus conservation efforts, will moderate the demand. Exploration plays will be smaller, deeper, more difficult to locate, and more costly to produce than in the past. As a result there will be a critical need for a strong exploration industry—one that combines the best techniques and efforts of both geology and geophysics—to discover and develop the resources of the future.

What will geophysics be like 50 years from now and what new tools and methods will be brought to bear? This is a difficult question to answer. The key to such long-range prediction is the identification of specific technologic advances. Further refinements in existing techniques will occur, but undoubtedly the application of yet undiscovered principles also will be made.

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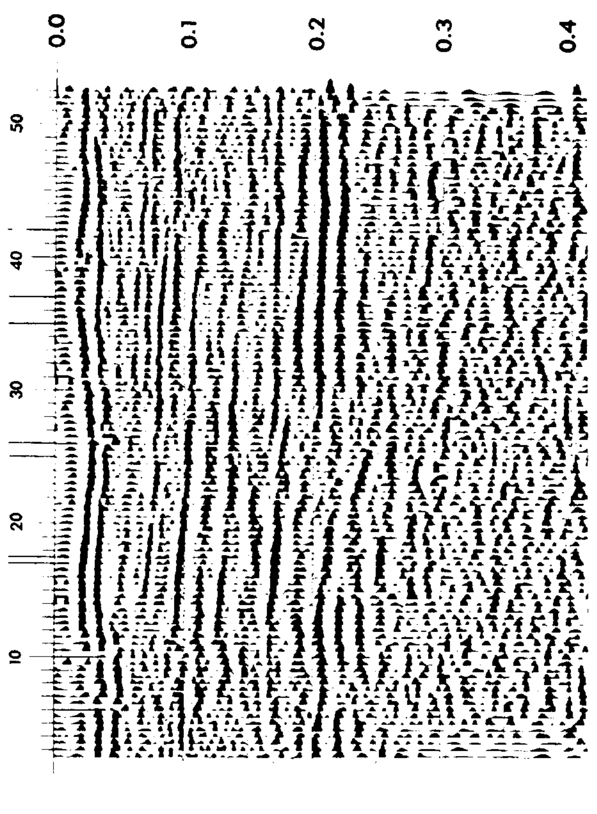
High-Resolution Reflection Seismics at Potential In-Situ Coal Gasification Test Site



Sandia National Laboratories is the technical manager for a Department of Energy project directed toward selection and characterization of a potential in-situ coal gasification site in the State of Washington. Prior geophysical investigations at this site in the Centralia-Chehalis coal district included in-line and broadside refraction surveys, VLF and Turam electromagnetic surveys, in-seam seismic wave propagation, and geophysical logging of exploratory boreholes. The results of these surveys, presented at last year's SEG meeting, indicated several anomalous features which we interpreted as faulting. Detailed description of the existing structure, however, could not be determined from the earlier surveys.

A high-resolution, seismic reflection survey, reported here, was later conducted to detail the site geologic structure and, thereby, determine areal continuity of objective coal seams. Approximately 12,000 ft (3,658 m) of survey line was obtained over this 62-acre (25 ha.) site, seeking to define the first 1,000 ft (305 m) of the subsurface. A 30-ft (9 m) receiver interval was employed; a portable "shotgun" source supplied seismic energy yielding a net stack of 1,200% at 15 ft (4.6 m) CDP spacing.

Analysis of the resulting reflection data verifies the existence of faulting across the site as interpreted from earlier geophysical and borehole data. However, the geologic structure is found to be more complex than indicated by the earlier data above. A sample reflection record section is given in the figure. Here, faulting of the "Big Dirty" seam (approximately 170 msec) is evident as are offsets in both deeper and shallower seam. Correlation of prior data and those most recent lead to total site characterization.

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Feldspar Dissolution Before Advent of Land Plants on Earth

The sedimentary record throughout geologic time shows that, in general, plagioclases alter faster than K-feldspars. Examination of detrital feldspars in Cambrian and Ordovician arenites shows that most K-feldspars are altered very little, whereas plagioclases are either absent or severely altered. This is in sharp contrast to the varying degrees of alteration suffered by all feldspars found in post-Silurian sediments. It is possible that regolithic processes of Cambrian-Ordovician times preferentially destroyed plagioclases while preserving K-feldspars.

Weak organic acids in soils, commonly due to humus, can dissolve all feldspars. In addition, continued uptake of potassium by land plants depletes the K^+ ion concentration in soil waters and favors the dissolution of potassium-bearing phases. During Cambrian-Ordovician times, in the absence of vascular land plants (green algae and lichen notwithstanding), there would be no potassium-chelating agent, and the K^+ ion concentration in soil waters would not have been depleted. Therefore, the composition of Cambrian-Ordovician soil waters could have been within the stability field of K-feldspars but beyond that of plagioclase (assuming that the silicon, aluminum and hydrogen activities did not make all feldspars unstable). Under such circumstances, K-feldspars would not be altered but the dissolution of plagioclases would continue. If so, weathering processes before landplant times must have been responsible for the unusual detrital mineral assemblage (quartz + fresh K-feldspars + no plagioclases) observed in Cambrian-Ordovician arenites.

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Reefal Margins of Pliocene-Pleistocene of Great Bahama Bank