missing data, conflicting data, and fuzzy or nonstandard data definitions.

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Analytic and Interpretive Procedures for Geologic Applications

The extraction of geologic information from remotely sensed data, which consist of encoded radiometric signals detected above the terrain, is procedurally governed by the same logical sequence and argument employed by a geologist when the data are typical ground-based observations and measurements. Each respective data set relates physical and compositional conditions of the geologic environment. In either situation, the sequence of problem definition, data collection, data reduction, interpretation, and testing is followed and, commonly, dictates the geologist's success or failure in arriving at an adequate geologic interpretation.

The most useful data format for geologic analysis and interpretation is an image display in which both radiometric and geometric relations in the data can be correlated with conditions on the earth's surface. The objectives of applying a systematic approach in obtaining geologic information from images are: (1) to provide a framework in which geologic interpretations are logically derived from the imaged data; (2) to separate the more objective aspects of image analysis from the subjective considerations imposed on a geologic interpretation; and (3) to facilitate the efficient reduction of imaged data by separating tasks, concentrating attention, and thereby minimizing omissions.

In geologic investigations, imaged data are analyzed and their geologic significance is interpreted; consequently, both spectral and spatial aspects of the data are considered in deriving geologic information. Preceding the interpretation of geologic relations, the data must be grouped according to their spectral characteristics. Subsequently they are reduced into landscape elements based on their spatial distribution and association. These two actions, the spectral classification and spatial reduction, constitute the two phases of image anlysis. The interpretation of geologic information from the analyzed data must be made by a person trained in geology. Beyond this, the individual must be able to correlate and interpret the geologic significance of the landform, drainage, and cover patterns that are products of image analysis.

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Geologic Significance of Sedimentary Reflectors in Deep Western North Atlantic

Several major seismic reflectors in the deep western North Atlantic have been calibrated according to age and physical and lithologic nature by JOIDES drilling. These reflectors result from geologically abrupt changes in depositional conditions and lithofacies. Within the limits of biostratigraphic resolution, the reflectors are approximately but not strictly synchronous, and sediment accumulation, although commonly changing in rate, was continuous across the seismic boundaries. Major reflectors include horizon B, which ranges between Hauterivian and Barremian in age and correlates with an upward change from limestone to black clays coincident with a rise in the calcite compensation depth (CCD). In middle to late Maestrichtian time, a brief, sharp depression of the CCD caused widespread deposition of chalks that correlate with horizon A. This reflector commonly conforms to preexisting topography, a fact which suggests its pelagic origin. Widespread deposition of sediments enriched in biogenic silica occurred during the Eocene, and diagenesis formed chert beds in the upper lower to lower middle Eocene section. The top of these cherts matches horizon A^C, which is one of the most laterally extensive reflectors in the western North Atlantic. Across the western Bermuda Rise, an overlying reflector, horizon A^T, correlates with the top of a sequence of turbidites deposited prior to and during uplift of the rise in the latter half of the Eocene. Limited biostratigraphic data at JOIDES boreholes suggest that the reflector is diachronous; this probably results from gradual westward offlap of the turbidites as the Bermuda Rise was uplifted. One major reflector, horizon A^U, is not within a continuously deposited sedimentary section, but corresponds to a major unconformity eroded between late Eocene and early Miocene time by abyssal currents along the lower continental rise. Sedimentation patterns mapped from the distribution and spacing of these reflectors are used to interpret the paleo-oceanographic conditions in the basin.

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Models for Evolution of Interior Basins

The structure of many interior basins is dominated by lithospheric flexure. A wide range of observations has confirmed that the outer shell of the earth, which has a temperature of less than about 600°C, behaves elastically on geologic time scales. This behavior is consistent with theoretical and laboratory studies of rock rheology. The linear structure of the Appalachian basin and the near circular structure of the Michigan basin can be attributed to lithospheric flexure under loading. In general, the structure of sedimentary basins with horizontal scales of a few hundred kilometers can be attributed to lithospheric flexure. The time evolution of many sedimentary basins appears to be governed by the thermal time constant of the lithosphere (i.e., about 100 m.y.). A simple model for the subsidence of sedimentary basins assumes that the lithosphere is initially hot; as the lithosphere cools its density increases and it subsides. This simple model explains the subsidence record of parts of the Los Angeles basin. This mechanism does not appear to be sufficient, in itself, to explain the subsidence of interior basins such as the Michigan basin. An additional mechanism such as a thermally activated phase change is required.

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Antarctic Logistics for Earth Sciences

The United States and about 12 other nations support continuous earth sciences programs in Antarctica. These range from station geophysics at a single coastal location to the complex mixes of many aspects of geology, geophysics, and cartography that are mounted by the United States and the USSR every year ranging over much of the continent. Year-round stations are maintained at 29 locations on the coast and three interior places from which seismic, magnetic, and gravity measurements can be made on a continuous basis. Marine geophysics (including gravity, magnetics, and reflection and refraction seismic) and marine geology (including dredging and coring) are supported from a variety of research ships and icebreakers. Some of these same types of surveys are also supported by tracked vehicles and aircraft from locations on fast sea ice. Geologic and geophysical research on the continent are supported on oversnow traverses by tracked vehicles or, more frequently, from temporary camps by fixed-wing, ski-equipped aircraft and by helicopters. In the United States program, approved projects are given grant funds to cover salaries and direct expenses, plus transportation from California to Antarctica, all food, field clothing, camp equipment and supplies, transportation to field locations, and movement in the field area by tracked vehicle, motor toboggan, or man-hauled sled. During fiscal year 1978 (1977-78) U.S. funds available for support of Antarctic science were $6,475,000 and to cover the costs of logistic support for this science were $41,758,000. Much of the logistics funds were used to contract for logistic support from the U.S. Navy, the U.S. Coast Guard, and a private corporation, Holmes and Narver.

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Hydrocarbon Occurrence as Function of Thermal Alteration of Organic Material

Fourteen wells from the Lenora gas field, Dewey County, Oklahoma, have been studied by vitrinite reflectance microscopy to determine maximum paleotemperature and temperature gradients.

Various types of petroleum hydrocarbons (oil, distillate, and gas) are formed at varying temperatures which have been empirically related to the degree of vitrinite reflectance (R_o). R_o values at the depth of petroleum accumulation are consistent with the types of hydrocarbons encountered. Geochemical data obtained from well cuttings indicate that the petroleum originated in surrounding shales. Therefore, the R_o values obtained reflect accurately the maximum temperature to which the petroleum and its precursors were subjected.

Reflectance gradients calculated for each well by taking R_o measurements at several depths in each borehole reveal a gradient anomaly directly over the reservoir when compared to the gradients existing beside the reservoir. The reservoir itself is a small sand lens, possibly of barrier-island or bar origin. It is possible, then, that determination of paleotemperature gradients by vitrinite microscopy and the identification of gradient anomalies in a basin may be useful in the search for new reservoirs.

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Ekofisk—First of Western European Giant Oil Fields

No abstract available.

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Mid-Cenozoic Fortuna Formation, East-Central Tunisia; Record of Late Alpine Activity on Cratonic Margin of North Africa

The Oligocene–early Miocene paralic to nonmarine Fortuna Formation in east-central Tunisia accumulated in a cratonic basin on adjacent parts of the Tunisian Atlas province and the Pelagian block. This coarsening-upward detrital sequence was derived from west and northwest uplands and reached a maximum thickness of 1,100 to 1,200 m near the northeastern end of its northeast-trending depocenter (graben?) along the boundary between the two crustal blocks.

After early Cenozoic culmination of the Alpine orogeny the Fortuna basin and source area were created during a new phase of extensional deformation that affected the western Mediterranean region. Continued differential uplift and subsidence produced an increasingly sandy Oligocene lower member composed of shallow-marine to deltaic mudstone and fine-grained sandstone, a maximum of 400 to 600 m thick along the central part of the axial trough. Detritus from the uplift was dispersed east and southeast, and the sandstone grades into a marine carbonate facies on the Pelagian shelf on the east.

Accentuated vertical displacement of basin and source area produced the increasingly coarser grained fluvial upper member (lower Miocene) that was dispersed mainly east and northeastward. This member has a maximum thickness of 850 m near the northeastern end of the trough. Stringers and lenses of conglomerate in the upper part contain well-rounded pebbles of quartz, chert, and quartzite, as long as 4 cm near the northwestern border and 2 cm along the axial depocenter. Accumulation of the Fortuna Formation terminated abruptly, followed by a widespread late early Miocene marine transgression.

Fortuna basin and its northwestern upland on the unstable cratonic margin of North Africa responded to remote effects of late Alpine activity. Early Oligocene to Pliocene sediments in the Fortuna basin area reflect each episode of deformation, regression, and transgression that dominated the western Mediterranean.

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Walker Creek Field, Arkansas—Smackover Case History

Walker Creek field is a stratigraphic trap containing 100 million bbl of oil and 100 Bcf of gas. The field lies