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

4 mi north of the Arkansas-Louisiana border in Columbia and Lafayette Counties, Arkansas. The trap is provided by the northern limit of a Smackover oolite facies which changes to equivalent Buckner shales and fine-grained limestones. The geologic model proposes that additional bar units, of slightly older geologic age, could be developed farther updip.

A new 7-mi (11 km) seismic line was recorded north-south across the field. Two displays of conventionally processed seismic data define a subtle amplitude feature at the apparent Walker Creek field limits. One seismic display contains data with a 10-55-Hz filter, and a broader band section, containing 0-110-Hz data, certainly adds to the trap definition.

Seislog (trademark of Teknika) inversion of these seismic data and detailed correlation of sonic logs to the Seislog line provide further definition of the facies geometry creating the amplitude feature. Definition of the updip limit of the 100 ft (30 m) of producing Smackover oolite is offered on the inverted seismic traces from 10, 800 ft (3,292 m; 2.1 sec).

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Land Development and Faulting Near Houston, Texas

Once a developer acknowledges the possible presence of faults on his land, he needs to consider such questions as their reality, location and extent, and likely rate and amount of movement. The final answers to these questions commonly must come from the subsurface, where they may be obtained by drilling a series of boreholes, 150 to 500 ft (45 to 150 m) deep. These are logged for electric spontaneous potential, and for resistivity using a single-point electrode to obtain maximum bed resolution and character. The borehole method has the advantages of economy, speed, and reliability; it can be done almost everywhere; and the electric logs provide a permanent, objective record of the strata penetrated. Airphotos, 1-ft (0.3 m) contour-interval topographic maps, and field inspection are useful guides in determining locations for boreholes for maximum efficiency. The subsurface information enhances the accuracy of the surficial methods.

The client's reaction generally depends on whether he is siting an industrial building or developing residential lots. Industrial builders usually are very concerned about exact choice of location, and plan carefully taking the faulting into consideration. However, land developers have a very wide range of reactions, and even the most responsible lack flexibility for much replanning because of prior commitments to major thoroughfares, etc. Although the presence of faults frequently delays full development of a tract, it does not seem to prevent it. Where one operator drops his option because of faulting another (ignorantly?) will come along and build. Also, a few large (but low) buildings have been designed and constructed knowingly over fairly active faults, and certainly many more have been built unknowingly.

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Quaternary Fault Activity in Texas Gulf Coast

Normal faults that offset Quaternary sediments fringing the Gulf of Mexico are best known in the vicinity of Houston, but have been recognized from east of Baton Rouge, Louisiana, to the Mexican border—a distance of nearly 1,100 km. Throughout this large area, scattered faults 1 to 20 km long are active—a term that is here limited to faults whose movements have damaged man-made structures. High-resolution shallow seismic lines across selected faults demonstrate that scarps mapped at the surface represent only the most recent displacements along faults that persist to depths in excess of several hundred meters and show evidence of continued Quaternary movement. Additional data support the general conclusion that observed scarps are the surface expressions of both Tertiary growth faults and faults associated with the intrusion of salt domes.

Current fault activity is probably related to both natural and man-induced factors. Topographic maps based on 1915-16 surveys provide direct proof that some faults had already displaced the land surface before large-scale fluid extraction had significantly altered the stress state within shallow subsurface sediments. This and additional evidence suggest that natural faulting of the land surface was characteristic of the Quaternary history of much of the Gulf Coast, and locally may be continuing. In general, however, natural rates of fault motion are probably so low as to be of little consequence to man. Damage resulting from current fault motion is more likely attributable to widespread extraction of subsurface fluids. Several observations suggest that most offset of the land surface in the heavily pumped Houston area has taken place only within the last few decades: (1) few scarps are evident on early topographic maps; (2) faults are more visible on recent (1970s) aerial photographs than on photographs of comparable scale and quality taken in 1930; and (3) present rates of fault creep are far in excess of average prehistoric rates of land-surface offset.

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Handil Field, East Kalimantan, Indonesia

Handil field is located in the swamp area of the present delta of the Mahakam River in East Kalimantan, Indonesia, in the central part of the Tertiary Kutei basin. The anticlinal feature was found by seismic work in 1973, the discovery well being drilled in April 1974.

An east-west fault perpendicular to the axis of the anticline (10.5 km long, 4.5 km wide) divides the field into two blocks of equivalent area. Areal closure is 35 sq km. Vertical closure increases with depth through the hydrocarbon-bearing section. Most of the 120 reservoir sands between 500 and 2,900 m are tidal to fluvial delta-plain sediments (middle to late Miocene). Most of them are oil bearing with a gas cap. Their types of deposition can be identified as channel fills, offshore bars, etc.

A high pressure zone is encountered below 2,900 m, where deeper prospects remain for investigation. More than 50 significant markers (lignite, carbonate streaks) are used to correlate the sand bodies. Vertically, the field has been divided into six zones corresponding to