HOW DOWNHOLE TEMPERATURES AND PRESSURES AFFECT DRILLING

No abstract available.

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INFLUENCE OF NATURE AND DIAGENESIS OF ORGANIC MATTER IN FORMATION OF PETROLEUM

Marine or lacustrine sediments may be considered as subaquatic soils, in which organic matter is destroyed, transformed, or preserved to a certain extent, according to the conditions of sedimentation. Small amounts of hydrocarbons can be found, inherited from living organisms, either directly (like certain n-alkanes of high molecular weight) or through an early transformation (like steroid and triterpenoid types). When humic material is present in muds, it may represent a large amount of total organic matter and constitute the support of various functional types of compounds. The whole is able to evolve by loss of functional groups towards several types of kerogen, according to depositional environment.

Elevation of temperature and pressure during burial of sediments results in a physicochemical transformation of the various kerogen types, along different evolutionary paths. The products formed include oil, gas, and other compounds like water and carbon dioxide. Nature and abundance of these products depend on particular evolutionary path and grade of diagenesis. The bulk of oil is formed at that stage of diagenesis in petroleum source rocks: the greatest rate of oil generation can be identified on the evolutionary paths, and is followed by gas generation as burial increases. Other types of organic matter produce little petroleum, but produce methane at great depth.

Identification of the nature of kerogens resulting from depositional environment and of the grade of diagenesis resulting from the burial history allows the evaluation of the petroleum potential of a given formation.

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STATUS OF GAS-STIMULATION TECHNOLOGY EMPLOYING NUCLEAR EXPLOSIONS

Recent studies conclude that the tight gas sands in the Rocky Mountain region contain a resource potential of nearly 600 Tcf of natural gas. Of this amount, approximately 300 Tcf may be recovered through the use of nuclear explosives, assuming that nuclearly stimulated wells will produce for 50 years. This volume is equivalent to the present proved national gas reserves of 290 Tcf. Significant results have been obtained from full-scale tests conducted to date, namely Gasbuggy and Rulison. Additional progress has been made in further developing this technology, including (1) the successful testing of a small-diameter (less than 8-in.), low-tritium producing explosive designed specifically for gas-stimulation applications; (2) the completion of technical plans for the Rio Blanco test which will stimulate a 1,200-ft gas-bearing section; (3) progress on computer-modeling studies comparing simultaneous versus sequential detonations in the same hole; (4) the formulation of the first experiment needed to develop a sequential explosion system.

Extensive studies also have been made on the safety of this technique. Detailed investigations show that users of the gas will be exposed to an increment of radioactivity equal to about 1% of the natural radioactivity in our background. Ground motion due to the nuclear detonation is unavoidable. However, by proper choice of yield, and location, and by sequential detonation, it can be controlled to limit inconvenience and damage such as plaster cracking. Public acceptance will depend largely on a clear understanding of the value of the benefits of the program as compared to the inconveniences involved. The benefits include additional local revenues to those near to stimulated fields, royalties to landowners, and, to the nation, an additional supply of natural gas, which is very much in demand.

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IMPACT OF NASA ERTS SATELLITES ON WORLDWIDE ENERGY RESOURCES

NASA's Earth Resources Technology Satellite, ERTS-A, has returned large volumes of imagery from space since its launch in July 1972. Coverage has been obtained over much of the globe, including many little known, rarely (if ever) photographed regions. Virtually all of the United States has been covered, some areas many times over. The quality of the imagery returned is much better than anticipated, although it is less than desirable for other than regional interpretation. ERTS-B and Skylab are follow-on programs, scheduled for 1973, that promise important improvements in quality of photography.

ERTS photographs are being evaluated by many scientists covering many disciplines, including mineral and land resources, agriculture and forestry, environment, water resources, marine resources, land use, *etc.* Results indicate important findings relative to petroleum and mineral exploration.

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STRUCTURAL EVOLUTION OF WILMINGTON ANTICLINE, CALIFORNIA

Isopach maps of the major zones of the East Wilmington field shed significant light on the structural evolution of the Wilmington anticline.

A minor ancestral basement high marked the location of the Wilmington anticline at the close of the early Mohnian, but the structure was essentially a syncline on the north flank of the Catalina uplift. Uninterrupted sedimentation occurred throughout the late Mohnian and early Delmontian. No evidence of the present Wilmington anticline is seen prior to the deposition of the lower part of the Ranger. The source of sediment supply was on the northeast and the direction of transport was southwest.

Growth of the Wilmington anticline was initiated in late Miocene time, early in Ranger deposition. Most Ranger subzone isopachs reflect Ranger structure, and demonstrate continuous anticlinal growth during lower Repetto deposition. Movement on the Long Beach Unit fault began during Ranger X-sand deposition and culminated at the close of F-sand deposition. The F sand was eroded and channeled by current action along and across the anticlinal axis prior to F_o-sand deposition.

The F_o sand was deposited as a lens-shaped body on the eroded F, and is present over a minimum 48-sq-mi area. No evidence of structural growth is seen during the deposition of this sand, in contrast to the other Ranger sands. The F_o is thought to be primarily a tractionite.

Renewed uplift and additional movement on earlier faults occurred during the Pasadenan orogeny and completed Wilmington structural development.

U.S.G.S. SPOKESMAN

NORTH ATLANTIC OUTER CONTINENTAL SHELF

No abstract available.

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FACIES RELATIONS AND PALEONTOLOGY IN EO-

CENE-OLIGOCENE, SANTA YNEZ MOUNTAINS, CALIFORNIA

Facies relations between deep and shallow-marine to continental deposits in the Eocene-Oligocene sequence of the Santa Ynez Mountains, California, have been studied in detail. The rocks studied include the Anita, Sierra Blanca, Juncal (with Camino Cielo Member), Matilija, Cozy Dell, and "Coldwater" formations. The topmost unit of the Eocene-Oligocene sequence, the nonmarine Sespe Formation, was not included in this study.

In landward sequence, the facies recognized include turbidites and marine lutites, proximal turbidites, shallow-marine, coastal, and continental facies. These are present in 2 major regressive sequences. In the first, the Juncal-Matilija sequence, thin-bedded turbidites and marine lutites are overlain by, and are laterally equivalent to, very thick proximal turbidites which pass upward into shallow-marine and coastal sands. The major sand accumulations are in the basin-margin shallow-marine, coastal, and proximal-turbidite facies. The second regression, the Cozy Dell-Sespe sequence, lacks significant proximal-turbidite deposits, but has extensive shallow-marine and coastal deposits. Facies distribution and stratigraphic sequence are explained as responses to the interplay of depositional and structural processes.

Detailed stratigraphic mapping has clarified correlation in the Eocene sequence of the Santa Ynez Mountains. Micropaleontology is used in support of correlations and bathymetric interpretations. Stratigraphic and paleontologic data resolve a biofacies problem in the lower to upper Narizian interval and clarify definition of the Eocene-Cretaceous boundary. Bathymetric interpretations based on comparison of fossil assemblages with modern Gulf of Mexico fauna are in better agreement with depths of deposition interpreted from lithologic data than interpretations based on comparison with modern assemblages in the Pacific Ocean off California.

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SEISMIC EXPLORATION IN CANADIAN ARCTIC

No abstract available.

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SEDIMENT DISTRIBUTION IN SOUTHWESTERN INDIAN OCEAN

Sediment distribution patterns in the southern Mozambique Channel and adjacent southwest Indian Ocean were investigated from short gravity cores and surface bottom samples. These shelves are covered by terrigenous sediments of varying grain sizes, chiefly silty, and upper slopes by hemipelagic calcareous mud. Areas of nondeposition on parts of the African shelf and upper slope reflect the winnowing action of the Mozambique-Agulhas Current. Relict foraminiferal faunas and exposed beachrock on the African shelf indicate a former lowered sea level. Lower continental slopes (below 1,500 m), continental rises, and plateaus are covered by foraminiferal marl and chalk oozes whose distribution correlates in part with the grain-size distribution. A size analysis of planktonic Foraminifera indicates that concentrations of small and large tests in some oozes are due to sorting. Manganese nodules are abundant on the Mozambique Plateau, which is swept by an eddy of Antarctic Intermediate Water. Natal basin sediments include turbidites, derived from neritic and bathyal depths, which are dispersed from northwest to southeast. Surficial turbidite layers did not reach the southern part of the basin floor, which is covered by pelagic clay and manganese nodules.

Average sedimentation rates of sediments younger than approximately 4,000-6,000 years range from 1 to 9 cm/1,000 years, depending on topographic position and distance from land. The average rate of accumulation for undisturbed deep-sea ooze during the entire late Quaternary is 1.5-2.5 cm/1,000 years.

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TRANSPORT PROCESSES FOR LOWER PALEOZOIC RESEDIMENTED CONGLOMERATES OF APPALACHIANS

Three fining-upward sequences of resedimented conglomerate, totaling about 40 m in thickness, are present in the lower Paleozoic Cap Enragé Formation of Gaspé, Quebec. Boulders, dominantly of shelf-type carbonate rocks, are up to 3 m in diameter, but average about 10-50 cm. Individual beds are more commonly massive than normally graded, although inverse grading occurs at the base of many beds. Stratification, delineated by alternations of grain size, is common.

At the base of each fining-upward sequence, beds tend to be poorly sorted, and contain very large boulders. At the top of the sequences, well sorted conglomerates, with pebbles normally less than 5 cm, are interbedded with sandstones. Deep scouring is uncommon.

The best clue to the transport process which resedimented the conglomerates into the Appalachian geosyncline is the well-defined pebble fabric. Most beds show a strong preferred southwest orientation of *a*-axes in plan view. In vertical cross section, most beds show a well-developed pebble imbrication. The *a*-axes of the pebbles dip upstream (rather than lying horizontal, transverse to flow) and indicate flow toward the southwest, parallel with the present tectonic strike. This type of fabric is very rare in deposits where pebbles rolled as bed load, because such movement develops a transverse *a*-axis fabric. Bed load transport was minimal to nonexistent for these conglomerates. Alternative mechanisms include some form of mass flow for each bed, or movement of pebbles in suspension. Mass flow is unlikely because of the well-developed imbrication and stratification, and hence it is suggested that the pebbles fell onto the bed out of fluid suspension, and were not subsequently moved. The outstanding problem is how the boulders were maintained in fluid suspension.

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CAMBRIAN OF THE GRAND CANYON—A REEVALUATION

The Grand Canyon Cambrian, previously thought to represent a subtidal transgressive-regressive sequence recording deepening offshore accumulations of marine sandstone, shale, and limestone, is reinterpreted to record shallow-marine, tidal-flat, and fluvial sedimentation on the landward part of a vast cratonic platform marginal to the Cordilleran miogeosyncline

The basal Tapeats Sandstone is dominantly trough-crossbedded, contains no record of organic activity or marine-tracer grains, and displays a low-variance, unimodal paleocurrent trend down the paleoslope. This part of the Tapeats Sandstone records prevegetation, bed-load fluvial sedimentation.

Shallow-marine "lagoonal" deposits dominate the rest of the sequence: burrowed, very thinly interbedded fine sandstones and shales (Bright Angel Shale) and arenaceous or soft-pellet limestones and dolomitic siltstones (Muav Limestone).

Within the Bright Angel Shale, many 1-6 m thick units of burrowed, cross-laminated sandstone and glauconitic sandstone record shoaling sedimentation. These sandstones locally are succeeded by hematitic oolite beds which were exposure surfaces. Unburrowed, channeled, flaser-bedded sandstones form an extensive 20 m thick tidal-flat sequence in the western Grand Canyon.

Within the Muav Limestone, 1-8 m thick units of dolomitized eocrinoidal biocalcarenite and algal-ball limestone, flat-pebble intraclast beds, and a few stromatolites emphasize the shoaling nature of the carbonate platform. A 20 m thick, dolo-