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OXFORDIAN SEDIMENTATION IN WESTERN INTERIOR, USA

Upper Jurassic Oxfordian sediments of Wyoming, Montana, and eastern Idaho were deposited in part of an elongate inland seaway extending southward from the present Arctic. This seaway contained a complex of tectonic elements which influenced significantly the geographic distribution of depositional environments. On the western edge of the Oxfordian seaway (in eastern Idaho), a clastic wedge sequence is developed. Farther east, toward the center of the seaway, complex sequences of marine bars and channels are represented around the edges of the Wind River, Big Horn, and Powder River basins. On the north in Montana, and east in the Black Hills, more typical prodeltaic sequences are developed.

Sediment dispersal directions in this seaway were complex due to the interaction of tides, regional currents, depositional environment, and storms. Of these 4 controlling factors, storms may have had the most profound influence, particularly in marine-bar and channel environments. Evidence for storms may be found in coquinoid sandstones. These sandstones are of 2 distinct geometries: (1) sheetlike lags interbedded with silty shales, representing the deposition of reworked shallow benthos in deeper water areas; and (2) channel-fill lags incised into marine bar sediments, representing scours in a shallow marine environment.

Vertical successions of Oxfordian sediments display an initial transgressive sequence followed by a well-marked regressive sequence.

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BEDDED BARITE DEPOSITS IN SEDIMENTARY ENVIRONMENT

Bedded deposits of barite are supplying an increasingly large part of the world's barite production, which is now nearly 4 million tons annually. A fourfold increase in the past 25 years is due chiefly to its use in drilling mud. Bedded deposits will continue to increase in commercial importance because many contain millions of tons of high-grade barite that commonly is fine grained, dark, and fetid. A review of recent studies of the geologic and chemical features of bedded deposits in Arkansas, Nevada, and California suggested that the barite is related more closely to sedimentation and diagnesis in a eugeosynclinal environment than to later (epigenetic) replacement of favorable beds (commonly presumed to be limestone) by hydrothermal solutions. Regardless of origin, economically significant deposits of dark-bedded barite probably have gone unrecognized or unsought in many sequences of sedimentary rocks throughout the world.

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POSSIBLE LIVING ALGAL-FORAMINIFERAL CONSORTIA IN NODULES FROM MODERN CARBONATE SEDIMENTS OF GREAT BAHAMA BANK

Nodules of filamentous algae have been discovered in a tidal channel crossing an oolite shoal west of Frazers Hog Cay, Bahamas. The nodules range in size from about 1.5 to 3 cm. They have a subspherical form, and are typically concave outward on one side and depressed on the other. At the sampled locality, the nodules completely cover the sea floor, except where marine grasses or stalked algae break the cover. The water depth at the sampled locality is about 7 ft. Average surface current velocities as high as 0.6 knots have been measured in the vicinity.

Mucilaginous algal filaments in the nodules entrap skeletal and nonskeletal sedimentary particles. However, examination of the sediment remaining after digestion of several nodules in sodium hypochlorite revealed that the nodule sediment was enriched in Foraminiferida by an order of magnitude relative to nearby sediments. The foraminiferal fauna is dominated by one or more species of highly irregular milioline forams with very thin porcelaneous walls. These forams are beautifully preserved in the nodules whereas, in other Bahamian sediment samples, similar forms tend to be broken and eroded. In all probability, therefore, the algal nodules are a preferred microhabitat for the milioline forams. Similar presumed algal-foraminiferal consortia (*e.g.*, *Osagia*) are well known in late Paleozoic carbonate rocks.

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EXPLORATION AND DEVELOPMENT OF URANIUM RESERVES

Nuclear fuel consumption in the United States is dependent on the demand for electrical energy. Domestic electric-power-generating capacity is growing at an annual rate of 7–8%. The nuclear power growth rate will be substantially higher if nuclear energy is to become the major fuel source for electric power generation by the end of this century.

Proved and potential domestic uranium reserves are sufficient to fill the anticipated demand for nuclear fuel through 1980. Beyond that point new reserves must be brought into production at an increasing rate, with new reserves of 175,000 tons required for the period from 1981–1985. New production facilities for these reserves must be committed beginning in 1976. The first discoveries of new uranium reserves in the United States must be made in 1972, and the entire 175,000 tons should be proved before the end of the decade.

The cost of exploration to assure the new reserves required in the 1981–1985 period is estimated to be $315 million or about $79 million annually. This is in addition to the expenditures required to bring over 100,000 tons, now carried as potential reserves, into the proved category. The problem now facing the domestic uranium industry is how to meet the demands of the late 1970s and 1980s through investments which must be made today. The large expenditures required for exploration and expanded production capacity cannot be made from current below-replacement-cost uranium sales. The reserves required to support the needed expansion of the nuclear power industry will be assured when there is sufficient incentive established through long-term purchase agreements at realistic prices.

The annual discovery requirement needed for a 10-year forward reserve quickly reaches 100,000 tons/year beyond 1980. This means that a district equivalent in size to Ambrosia Lake, New Mexico, the largest in the United States, must be discovered every other year. Far more exploration than presently is contemplated must be performed in the vicinity of established districts and increased emphasis must be placed on the discovery of uranium in environments not presently recognized.

Large sums of money for exploration must be committed in the near future to meet the demands of the nuclear power industry.

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RESOURCE SIGNIFICANCE OF URANIUM DEPOSITS IN FLUVIOCLASTIC ROCKS IN TERTIARY VOLCANIC TERRANES

Projections of future demand for nuclear-powered electrical generating capacity indicate that a large amount of uranium will be needed by the year 2000. Uranium deposits of the type found in the Colorado Plateau region and in Tertiary basins in Wyoming have been the principal source of uranium in the United States, and potential resources in such deposits are large. Even so, they may not be fully adequate to supply all the uranium needed. For this reason, attention is focused here on a variant type of deposit that so far has not yielded much uranium, but that may have a significant potential because the deposits are widely distributed in a geologic setting that is extensive in western United States.

The deposits, like the better known Colorado Plateau and Wyoming deposits, consist of uranium minerals interstitial in continental sandstone and conglomerate that also contain carbonized plant remains. The deposits are in lenticular beds within sequences of Tertiary volcanic rocks, mostly at or near the base of a sequence. The sedimentary lenses containing mineralized rock are irregular, probably because their form and distribution were controlled in part by underlying pre-volcanic topography and in part by drainage changes on an unstable volcanic terrane.

If geologic ingenuity can discern the irregular pattern of the host lenses under a cover of volcanic rocks and establish the relation of deposits to the pattern, new uranium resources might be the reward.

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ISOTOPE GEOCHEMISTRY OF MODERN ARID SUPRATIDAL (SABKHA) EVAPORITE ENVIRONMENT, ABU DHABI, TRUCIAL COAST

Considerable data exist on the isotopic composition of ancient sedimentary sulfates. Interpretation of these data has been hampered by the absence of a base line for comparison from a modern evaporite environment.

Isotopic analyses (258 total determinations) of pore brines [$\delta O^{18}(H_2O)$, $\delta S^{34}(SO_4^=)$] and coexisting diagenetic gypsum and anhydrite [$\delta S^{34}(SO_4^=)$] in the Abu Dhabi sabkha indicate: (1) that the regional distribution of δO^{18} and δS^{34} in brines reflect the climatic regime and possible favorable fractionation of 0^{18} into H_2O of precipitated gypsum (δO^{18}); (2) that the source (marine versus continental) of fluid input into the sabkha is reflected in the brine δO^{18} and δS^{34} values; (3) that δS^{34} in diagenetic sulfate minerals reflects the favorable fractionation of S^{34} into the precipitating sulfates from pore fluids and (4) δS^{34} values of anhydrites permit the identification of anhydrites formed under a marine versus continental-derived fluid regime.

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PLASTIC DEFORMATION THEORY OF OIL ACCUMULATION

Scientifically accepted geologic ideas have never explained certain types of oil accumulations, some of which are functions of subsurface plastic deformity that can vary with overburden. Plastic deformity is a reservoir property which when acknowledged and understood, helps explain the positions of known oil pools and conversely facilitates the bracketing of new deposits. A knowledge of plastic reservoir deformity resolves some annoying mysteries concerning well fracing, drill-stem test results, and very deep reservoir producing behavior.

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NEWBURG OF WEST VIRGINIA

The Newburg (subsurface equivalent to the Williamsport Sandstone of Late Silurian age) has been the most important pre-Middle Devonian drilling target in West Virginia for several years. Seven gas fields have been discovered, covering an area of about 110 sq mi. Two wells have produced commercial quantities of Pennsylvania grade crude oil. As of November 1, 1970, the fields had produced an estimated 150 billion cu ft of gas. The median producing depth is approximately 5,500 ft.

Trapping is both structural and stratigraphic, but predominantly controlled by porosity. Reported thicknesses of Newburg range from 0 to more than 25 ft but few wells have effective sandstone thicknesses in excess of 15 ft. Porosity values of 20% or more have been reported, but few sandstone beds with porosity of 8% or more are thicker than 10 ft. Permeability values in the more productive areas range up to more than 200 md.

Fields are located in the western third of the state, and the best possibilities for future production lie in the undrilled parts of this division. Second best prospects lie within the middle third of the state which has been sparsely drilled to sufficient depth, and where two Newburg gas shows have been reported. Possibilities for the eastern highly folded belt are problematical.

Some of the early wells were acidized, but now it is almost standard practice to fracture them; usually with very beneficial results. A few wells have been completed without stimulation.

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SURFICIAL SEDIMENTS OF BARKLEY SOUND AND ADJACENT CONTINENTAL SHELF, VANCOUVER ISLAND, BRITISH COLUMBIA

The bathymetry of Barkley Sound and the adjacent continental shelf off Vancouver Island, has been affected by glacial erosion. Several fiords widen and coalesce to form the sound, which is continuous with glacially eroded basins on the inner continental shelf. Basins are flanked by flat-topped banks, the larger of which merge with the gently sloping outer shelf which terminates at the 200-m isobath, some 58 km from shore.

Studies of surficial sediments for size, color, mineralogy, organic carbon, $CaCO_3$, and fauna, led to recognition of 5 sediment types: (1) modern sediments, at present accumulating in Barkley Sound, are littoral sands and gravels, and deeper water organic-rich muds; (2) relict sands and well-rounded gravels mantle banks and parts of the outer continental shelf; (3) authigenic sands composed of mixed-mineral "glauconite" pellets are present near the shelf break, where they are closely associated with (4) residual sediments derived from submarine exposures of Tertiary mudstone; (5) organic sediments, composed of calcareous invertebrate