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CALCIFICATION AT FANNING ATOLL

Alkalinity, pH, and salinity measurements were made during the summer of 1972, in the lagoon of Fanning Atoll, Line Islands. These measurements were used to estimate water residence time and the rate of various CO_2 flux processes, particularly calcification.

Residence time of water in the lagoon is about 1 month, and the calcification rate is about 1,000 g $CaCO_3$ m^{-2} yr^{-1}. This rate is less than a third of what might have been anticipated on the basis of coral standing crop there. The lagoon water is supersaturated with respect to $CaCO_3$, but is significantly less so than is the adjacent open-ocean water. Possibly the metabolic process of calcification is limited by this lowered saturation state.

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CITY AND STATE REGULATIONS AFFECTING OIL INDUSTRY

No abstract available.

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METAMORPHISM OF SEDIMENTARY ORGANIC MATTER

Organic constituents both in fine-grained rocks and reservoirs undergo chemical and physical changes in both the diagenetic and metamorphic realms. Four factors affect the final products—the original kind of organic material and its diagenetic state, heat due to geothermal gradient and metamorphism, time, and subsequent alteration in the reservoir.

In the diagenetic realm, algal debris is readily convertible to potentially hydrocarbon-rich, amorphous debris (floccules) through the action of organisms and suitable water chemistry. Phytoclasts, such as cuticle and spores, are more resistant, but also can be converted. High-carbon-structured fusinite is relatively inert to diagenesis or low-grade metamorphism.

Three facies of organic metamorphism with increasing temperature/time are recognized. The immature facies has abundant methane, trace quantities of C_2-C_{14} hydrocarbons, and a C_{15+} fraction containing abundant NSO compounds. The mature facies exhibits a complete spectrum of hydrocarbons; its start marks the onset of oil generation. The metamorphic facies, characterized by abundant methane, only traces of heavier hydrocarbons, and practically no NSO material in the C_{15+} fraction, signifies the thermal destruction of preexisting oil pools. These facies, which can be mapped very early in the exploration of new-venture areas, can be recognized by combined cuttings-gas and organic-matter study. Chemical changes are paralleled by measurable physical changes in the solid-organic components. A correlation of coal rank, vitrinite reflectance, and thermal alteration numbers, based on color of organic debris, is presented.

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PLIOCENE TO HOLOCENE SEDIMENTS IN MEDITERRANEAN AREA AND THEIR TECTONIC SETTING

Today's plate-tectonic boundaries in the Mediterranean area are delineated on the basis of earthquake hypocenters, faults, ophiolites, intermediate volcanic rocks, paleomagnetic data, linear gravity anomalies, and magnetic anomalies. These plate boundaries are subdivided into subduction zones, zones of oceanic crust formation, and transform or strike-slip faults.

The thickness and facies of Pliocene to Holocene sediments, both onshore and offshore, have been compiled from many sources, which include measured surface sections, well data, offshore sparker and other seismic surveys, and cores from JOIDES Leg XIII drilling sites. A prominent, subbottom, acoustic reflector is present on almost all marine-seismic sections. This reflector was proved to be the top of an upper Miocene evaporite sequence in cores from JOIDES site 134, where late Miocene Foraminifera are present in marine shales intercalated with halite. Evaporites from the same reflecting horizon were cored at 5 other JOIDES sites. On this evidence the prominent acoustic reflector has been identified as marking the Miocene-Pliocene boundary. The subsea Pliocene to Holocene sediments correlate with post-Messinian onshore sediments.

A comparison of the postulated Mediterranean geometry with the Pliocene to Holocene sediment distribution shows the following correlations.

1. Thick, linear accumulations may occur along subduction zones, as in Italy, the eastern Carpathians, and the southern Caspian Sea-Caucasus area, but may also be thin or virtually absent, as offshore south of Crete and north of Algeria.
2. Sediment fans occur at the mouths of larger rivers as the Nile, Rhone, and Ebro; and where sea currents emerge from a constriction as south of the Strait of Messina. Some fans are related to plate-rift margins.
3. Thin sediment sheets or patches characterize the interior areas of both continental and oceanic plates.

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MECHANISM FOR LARGE-SCALE DEFORMATION IN EOLIAN DUNES

Large-scale deformation of laminae in ancient sandstone of supposed eolian origin has perplexed geologists for many years. Other workers have described several types of deformation related to lee-side avalanching, but none at the scale observed in some ancient eolian sandstone. Our observations on the surface and in trenches of a transverse dune in the Killpecker dune field in southwestern Wyoming suggest that incorporation of snow into dunes may provide such a mechanism.

During periods of snowfall, large snow cornices form on the crests of dunes. In the spring the cornices are covered by blown dry sand which is remobilized after most other snow has melted. Subsequent warming causes the sand-covered cornices to melt, become unstable, and slide at least part way down the slipface. Both folding and brecciation take place in the sand covering the snow during melting and sliding. Folding of laminae in sand under the snow also occurs. Further burial of this deformed mass of snow and sand results in its incorporation into the internal structure of the dune. Collapse breccia is formed where climatic conditions and depth of burial permit the continued melting of incorporated snow. In some cases, however, the covering sand provides sufficient insulation to prevent further melting and the snow becomes a permanent or semipermanent part of the dune.

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PALEOGEOGRAPHY, PALEOBATHYMETRY, AND PALEOTECTONISM OF MID-TERTIARY JAMAICA

Two biologically and lithologically distinct realms of carbonate deposition characterized mid-Tertiary Jamaica. After a latest Cretaceous to Paleocene orogenic episode, complete submergence of insular paleo-Jamaica accompanied the strike-slip or extensional faulting associated with the formation of the Cayman Trench on the north. Differential subsidence along a series of peripheral subsea escarpments (Duanvale-Wagwater escarpment) produced relief of more than 2,000 m by the middle Eocene. The slowly subsiding Cornwall-Middlesex platform was covered by shoal-water limestones which ended the supply of clastics to sea-bottoms north and east of the escarpment, where contemporaneous planktonic-foraminiferal pelagites accumulated. Middle Eocene to middle Miocene carbonate rocks deposited in the deep-sea realm represent a distinctive lithogenetic unit herein united as the Montpelier Group.

The preponderance of globigerinid and radiolarian tests typifies lower Montpelier (late Eocene to early Miocene) microfossil assemblages. Dominant benthic forms include *Melonis pompilioides, Fontbontia wuellorstorfi*, and species of *Stilostomella* and *Pleurostomella*. Available faunal criteria including assemblage parameters, depth preferences for extant species, and convergent-ecologic morphologies suggest that abyssal (below 2,000 m) paleodepths prevailed at the depositional site on a sediment apron at the base of the Duanvale-Wagwater escarpment. Middle Eocene to early Miocene subsidence computed from inferred paleodepth and estimated sedimentary thickness totals 2,800 m. Biostratigraphic and paleoecologic evidence does not support the concept of a regional unconformity within the Montpelier, as has been proposed.

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NEOGENE STRATIGRAPHY OF PARATETHYS OF CENTRAL EUROPE AND ITS CORRELATION WITH OTHER AREAS

During the last 10 years, a group of Neogene specialists has restudied the Neogene sections in the Alpine and Carpathian foredeep (molasse zone) and the inner Alpine and Carpathian basins. These studies have given rise to a new Neogene stratigraphic concept for this area—the so-called "Paratethys."

The lower boundaries of these Miocene and Pliocene stages (Egerian, Eggenburgian, Ottnangian, Carpathian, Badenian, Sarmatian, Pannonian, Pontian, Dacian, and Romanian, in ascending order) are defined by planktonic and larger foraminifers, calcareous nannoplankton, ostracods, mollusks, microvertebrates, and macrovertebrates. From radiometric age determinations of biostratigraphically dated glauconite and rhyolitic or andesitic tuff zones, correlations are possible with the Neogene planktonic zonation of Blow on one side, and with vertebrate Neogene scales on the other. Correlations can be made between the boreal, Atlantic, and Mediterranean bioprovinces of Europe and, therefore, with most of the stratotypes of the international Neogene time scale. On the basis of Paratethys faunas, the bioprovinces of western Europe can be correlated with the eastern Neogene deposits as far as the Crimean and Caspian Sea areas. Planktonic and larger foraminifers, as well as microvertebrates and macrovertebrate correlation levels, can be related to the Neogene of the United States. There are major conflicts between the early and middle Miocene radiometric dates obtained in the Paratethys and those from deep-sea cores.

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MAJOR PERMIAN TECTONIC FEATURES AND POST-PERMIAN DISPLACEMENTS IN WESTERN UTAH, NEVADA, AND SOUTHEASTERN CALIFORNIA, AS REFLECTED BY DISTRIBUTION OF PERMIAN RIEPE SPRING CORALLINE FACIES

Several facies of the Riepe Spring Limestone and its equivalents in Utah, Nevada, and California have been recognized. The most distinctive is limestone with massive, rugose corals. This facies is interpreted as representing low-energy, shallow-shelf deposition, on the basis of sedimentary characteristics and abundance of algae. Generally eastward, the coralline facies is replaced by dolomite and sandstone representing nearshore, restricted environments of deposition. Westward, higher energy and/or deeper water deposits accumulated. The coralline facies forms a band 15-50 mi wide that extends from southern Idaho to southeastern California. In northeastern Nevada and western Utah, this facies forms an enormous westward-directed loop, where it accumulated around an approximately westward-trending axis of restricted environments. In southern Nevada and southeastern California, the coralline facies clearly is offset tens of miles in a right-lateral sense on the Las Vegas shear zone and on the Furnace Creek-Death Valley fault zones. Southeast of the Garlock fault, either facies trends shift directions abruptly, or there has been tens of miles of movement in a left-lateral sense.

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UPPER PRECAMBRIAN AND LOWER PALEOZOIC MIOGEOCLINE IN GREAT BASIN, WESTERN UNITED STATES

Shallow-marine, intertidal, and supratidal detrital and carbonate strata of late Precambrian (less than 850 m.y.) and early Paleozoic (more than 345 m.y.) age thicken from a few thousand feet in cratonic areas east of the Great Basin to 40,000 ft in the central Great Basin 200-300 mi west. Coeval rocks in the western Great Basin are deep-water strata characterized by chert and argillite associated with mafic pillow lavas. Strata deposited at moderate depths are present between the shallow- and deep-water facies, but have a limited distribution, suggesting a relatively abrupt transition from shelf to deep-ocean basin. The thick accumulation of shallow-water deposits in the Great Basin is similar to deposits along present-day stable continental margins. Such accumulations have been termed miogeoclines, rather that miogeosynclines, because they are open to the sea on one side and are not synclinal in form.

The continental margin along which the late Precambrian and early Paleozoic miogeocline was constructed apparently developed as the result of a late Precambrian (less than 850 m.y.) continental separation. Extensional faulting and flowage related to this separation extended well into the continent and may have produced major crustal thinning as far east as the "Wasatch line," across which the rate of westward thickening of upper Precambrian and Paleozoic strata increases markedly. A persistent positive belt, perhaps analogous to the buried ridge beneath the outer edge of the present-day Atlantic continental shelf, may account for regional thinning and local erosional truncation of lower Paleozoic strata along the western margin of the Cordilleran miogeocline.

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MODELS FROM EUROPEAN SEAS TO AID DETECTION OF, AND SEARCH FOR, ANCIENT SAND BODIES

Many large porous sand bodies formed in open reaches of ancient continental shelves and slopes should be recognizable in the stratigraphic record; they have considerable economic and academic significance. The present paper is concerned with modern analogues in the shallow seas around western Europe. The new deposits and their depositional environment allow the depositional environment of the ancient ones to be interpreted more realistically. In addition to the extensive but thin sand sheets, there are many modern sand bodies that are isolated from one another. They can be tens of miles in length, a few miles wide, and more than 200 ft thick. They may occur singly or in extensive groups and are parallel with or transverse to the currents that formed them. Some of the largest ones were made by the Mediterranean undercurrent on the continental slope of the Gulf of Cadiz. Others, of similar size on the continental shelf, are attributed to a tidal-current origin. Modern tidal flow around the British Isles also is responsible for such sand bodies, as well as a variety of other forms. Only semiunidirectional currents seem to be depositing sand in the western approaches to the Baltic.

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