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NATURE OF THRUST FAULTING IN SOUTHERN INYO MOUNTAINS, SOUTHEASTERN CALIFORNIA

East of Lone Pine, California, on the west flank of the Inyo Mountains, a series of imbricate thrust faults appears in a narrow belt that trends roughly N30°W for a distance of approximately 17 m. The faults cut rocks ranging in age from Late Cambrian to Middle Triassic(?) and are cut by plutonic rocks possibly as old as Early Jurassic. The pattern exhibited by these faults is similar to that of folded overthrust faults generated by Link in model experiments. The faults decrease from approximately 50° dip to flat-lying, with increasingly higher structural position. They do not cut and offset one another, but converge upward with attendant decrease in dip.

Thrust faults of the southern Inyo Mountains are thought to be closely related to other extensive, essentially flat-lying thrust faults on the north and east, because of the similarity in time of emplacement and sense of movement of the allochthons involved. A general alignment of trend, considering some left-lateral offset north of Darwin, and other similarities suggest that thrust faults in the Darwin district are a southeastward continuation of thrust faults exposed in the southern Inyo Mountains. Thrust faults exposed farther north and east may represent higher structural positions.

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CORAL-REEF AND BIOHERM MORPHOLOGY—CRITERIA FOR INTERPRETATION OF EVOLUTION OF JURASSIC BASIN OF CENTRAL HIGH ATLAS MOUNTAINS, MOROCCO

The Jurassic sedimentary basin of the High Atlas Mountains is an elongate northeast-southwest trough 100 km wide and 800 km long in which sedimentation was initiated across continental Triassic sediments and terminated with Upper Jurassic continental sediments. More than 75% of the rocks of this sequence are exposed and provide a unique opportunity for the study of the evolution of a sedimentary basin; some of the best tools for this analysis are the coral reefs and related bioherms common to the basin.

Biohermal structures include the following. (1) Micrite and sponge bioherms range from a few meters to more than 1 km in diameter and are approximately 100 m thick. Their lack of sorting and geographic position in the center of the basin suggest formation below wave base. (2) Barrier coral reefs are several hundred meters in diameter and thickness. The position on the shelf margin, sorting of the interbedded sediments, and the presence of flanking and capping beach sediments suggest formation just below and within the intertidal zone. (3) Coral-reef pinnacles are 100 m in diameter and thickness. The bases of the pinnacles lack evidence of wave sorting, but their tops are sorted and are covered by lag deposits, suggesting, together with their central position in the basin, that the pinnacles formed just below and up to wave base. (4) Patch reefs consist of (a) microatolls of mud and brachiopod hash up to 100 m in diameter and a few meters thick (sorting of the related sediments suggests that they formed above wave base, but lack of beach features or supratidal evidence indicates a lagoonal environment) and (b) coral-lined channels several tens of meters across and a few meters deep. Their occurrence within crossbedded and sorted sands without sorting of the coral suggests formation within the subtidal zone. By using the coral reefs and other sedimentary features, it can be shown that the margins of the basin remained shallow platforms throughout the basin history, and that the center of the basin deepened progressively.

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PHYSICAL AND BIOGENIC CHARACTERISTICS OF NEARSHORE SHELF, PENSACOLA, FLORIDA

Two sampling profiles were made from the high-tide line to 15 n. mi. seaward of Santa Rosa Island, Florida, to determine the beach-to-offshore sequence of a medium-high energy environment. Preliminary results are based on examination of sediment texture, zoologic collections, scuba observations, epoxy relief casts, X-ray radiographs, and submarine morphology.

A steep profile exists from the backshore to 400 m offshore in a water depth of 8 m. The substrate is composed of clean, well-sorted, white, medium- to fine-grained, crossbedded sand; bioturbation is negligible, and few species or individuals are found. Between 8 and 12 m water depths (horizontal distance of 1 n. mi.), the clean white sand is highly bioturbated, mud layers are present, and the number of benthic species and individuals is high. The seaward limit of this zone is the "relict-recent" boundary.

From approximately 1 to 7 n. mi. offshore (12-36 m water depth), the submarine topography is irregular. The substrate in this zone is composed of "relict," coarse, moderately well-sorted, brown to gray sand, which is crossbedded and bioturbated by heart urchins. Seaward of this zone to 12 n. mi. offshore (maximum depth of 25 m), sediment texture remains unchanged, but crossbedding and the distinct heart-urchin traces are replaced by complete bioturbation, and a second maximum in the number of species and individuals is found. The most seaward samples were taken at 14 to 15 n. mi. offshore in water depths of 32 and 34 m, where the bioturbation is low, and the coarse, clean sand is crossbedded.

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PRIMARY SUBTIDAL DOLOMICRITE FROM BAFFIN BAY, TEXAS

Unlithified to lithified beds of dolomicrite, 1-3 cm thick, have been cored from the muds of Baffin Bay from depths greater than 350 cm below the water-sediment interface. From a consideration of the 7 m and greater depth of these dolomicrites below present sea level, the relative stability of this part of the Texas coast, and comparison with accepted sea-level curves, it has been demonstrated that these dolomicrites must be of subtidal origin. C^{14} dates on the dolomicrites indicate that they formed 2,000-4,000 years B.P.

The δ O^{18} values of Baffin Bay surface waters reflect the salinity conditions of the waters. With salinity ranges of 5°/oo to 60°/oo, the corresponding δ O^{18} values are −3.4°/oo to +3.3°/oo. Intermediate salinities have intermediate δ O^{18} values.

The δ O^{18} ranges for the dolomicrite sediments are +4.8°/oo to +5.4°/oo relative to PDB. These values indicate that the dolomicrites precipitated from hypersaline waters. δ C^{13} ranges for the dolomicrite sediments range from −1.6°/oo to −7.5°/oo relative to PDB. These values indicate a considerable influence of metabolic carbon during the precipitation of the dolomicrites.

Lack of textural or isotopic evidence of a carbonate precursor to the dolomicrite, as well as the observed isotopic ranges of the dolomicrites and their position in the sedimentary column, lead to the belief that the dolomicrites from Baffin Bay, Texas, are of a primary, subtidal origin.

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DOLOMITIZATION PROCESS IN SABKHA ENVIRONMENT

Along the southern shores of the Persian Gulf, Holocene carbonate sediment infilling of coastal lagoons has generated extensive salt-encrusted, supratidal surfaces or coastal sabkhas, which are the site of penecontemporaneous dolomitization. Recent diagenetic dolomite is present mainly in the unlithified, upper-intertidal facies sediments, although minor quantities are at greater depths in other sediment facies. The aragonite fraction of the sediment is replaced, and the process may be complete (100% dolomitization) within 1,500 years after primary sediment deposition. Dolomitization is local in effect, depending on a combination of fluids high with $^mMg^{++}/^mCa^{++}$ ratios, a rapid interstitial flow rate (2-3 cm/yr), and a high surface-flooding frequency; the flanks of flood channels and peninsulas best achieve these requirements, and their primary sediments may be completely dolomitized. The local distribution of intensively dolomitized sediments is related to rapid sedimentation and associated shoreline progradation (approximately 2 m/yr); at slower progradation rates, more extensive dolomitization would ensue. The diagenetic dolomite occurs as 1-4 micron rhombs, is nonstoichiometric (Ca_{51-54}), is partly ordered, has δO^{18} = +2.5 to +3.7 ‰, and δC^{13} = +4.0 to +4.4 ‰. Radiocarbon ages increase progressively inland from the present shoreline (1,500-3,500 years ago); these dates, however, reflect more the age of the original sediment than the age of the dolomitization event, most of the carbon in the reaction being derived from the original aragonite. The dolomitizing fluids are of marine origin and have the following characteristics: 3.25-3.75 $^mCl^-/Kg$: $^mMg^{++}/^mCa^{++}$ ratios between 7 and 22, pH between 6.3 and 6.9, a minimum $^PCO_2$ of 10^{-3} to 10^{-2} atmospheres, temperatures between 25° and 40°C and at saturation with respect to gypsum and celestite. Associated early diagenetic minerals within the coastal sabkha sediments include huntite, magnesite, gypsum, bassanite, anhydrite (nodular), celestite, and halite. Many ancient dolomites of probably analogous, penecontemporaneous, sabkha origin can be shown to have undergone later diagenetic recrystallization with a concomitant coarsening of grain size, approach to a stoichiometric composition, an increase in ordering, and a loss of trace cations.

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COASTAL ZONE—SEARCH FOR OPTIONS

Man's involvement with the water environment is most intense in the shallow-water zone bordering landmasses. This area provides food, pleasure, mineral commodities, a means of transportation, an avenue for military exploitation, and a convenient place to dump waste. Historically, rewards for utilization were accrued by the aggressive, imaginative, respectful, and the lucky; losses were sustained by those who tempted or disregarded nature. This relation was direct and accountability was short-term.

Studies have been presented in which evidence was cited for environmental degradation or an apparent increase in the level of contaminants in the water realm as a result of man's activities. Journalists have publicized these studies, but often have neglected or ignored the less sensational reports which are not amenable to instant analysis. Consequently, the public reacts in alarm by advocating stricter governmental control or abolition of activities which may be detrimental to the environment. Conflicts among users arise and a recipe for a confrontation battleground evolves.

This enigmatic situation poses an interesting question: is anyone interested in comprehensive evaluations which require great effort and understanding; or has our capacity for reasoning been limited by impatience, cynicism, and emotionalism?

The present dilemma to choose between two alternatives can be illustrated by several incidents involving environmental concern in coastal waters. These case histories lead to the question: are we really limited to only 2 options?

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STUDIES OF QUARTZ SAND GRAINS BY CATHODOLUMINESCENCE

Surfaces and cross sections of individual quartz sand grains have been examined and compared in the cathodoluminescence (CL) mode with the scanning electron microscope. Six kinds of nontopographic CL have been found; the presence of non-CL areas commonly is due to the occurrence of a disrupted lattice layer wherever grinding has taken place. This layer is shown to be irregularly distributed, both in cross sections and on grain surfaces; its distribution, depth, and intensity can be examined in detail for the first time. Reversal of CL contrast has been accomplished experimentally by raising the temperature of grains above the alpha-beta transition in quartz (573°C); a similar reversal, found in certain natural sedimentary grains, suggests that they likewise have been heated above the transition temperature. Fractures present on natural grain surfaces in the CL mode can be observed in omissive-mode photographs and probably could be used for environmenta. interpretation. Detail of the same kind, observed in the CL mode but not in the emissive mode on other grains, could further extend the use of sand-grain surface textures for environmental interpretation.

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DIAGENESIS OF AMINO ACIDS AND THEIR ENANTIOMERS

Diagenesis of amino acids in sediments and shells involves many processes including (1) conversion of one amino acid to another, (2) interconversion of amino acid enantiomers from dominantly L- to D, L- configurations, and (3) ultimate destruction. Amino acids, generally in the form of biopolymers such as proteins, enter the lithosphere from the biosphere. Hydrolytic processes begin immediately to release monomeric amino acids, and in some shells amino acid polymers no longer exist after about 12 m.y. As with any other organic compounds, destruction of amino acids occurs with time, but for many amino acids, such as glycine, alanine, valine, leucine, and isoleucine, the rate is very slow. Evidence for conversion of one amino acid into another is provided by observations wherein certain amino acids tend to disappear with time, while new amino acids are created. For example, pipecolic acid recently found in Pleistocene and Miocene *Mercenaria* is thought to have been derived from lysine through deamination and internal cyclization. The mechanism for the conversion is not yet known.

Interconversion of amino acid enantiomers also takes place with time, L-amino acids racemize to D, L-amino acids at different rates. In deep-sea sediments from the Atlantic Ocean and Caribbean Sea, valine, glutamic acid, and leucine racemize at slower rates than do phenylalanine, aspartic acid, alanine, and proline. Rates of racemization are temperature dependent; in the lithosphere, racemization of amino acids should be complete in about 15 m.y. at the maximum. Measurement of the extent of racemization of amino acids provides a potentially useful geochronologic tool for the very late Cenozoic Era.

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MICROSEISMICITY AND RECENT TECTONIC ACTIVITY, WHITTIER FAULT AREA, CALIFORNIA

The Whittier fault is a principal strand of the San Andreas fault system near the southwest edge of the Puente Hills in the northeastern Los Angeles basin. Physiographic evidence indicates recent movement along the Whittier fault and its southeast extension, the Elsinore fault. Exposures in test trenches