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GEOLOGIC HISTORY OF PACIFIC OCEAN

Extrapolations from Deep Sea Drilling Project data suggest that the Pacific plate may be about 200 m.y. old at its west edge, but Cretaceous volcanism has largely buried the older record.

Post-Jurassic sedimentary facies patterns reflect the northwestward motion of the plate relative to the equatorial zone of high biological productivity, as well as progressively increasing sea-floor depths as newly formed crust moves away from the East Pacific Rise. The Early Cretaceous volcanism which inundated much of the older western part of the plate was succeeded during the rest of Cretaceous and Cenozoic time by the building and subsidence of long chains of seamounts as the plate moved northwestward, possibly over hot spots beneath the lithosphere.

A dearth of calcareous sediments of earliest Tertiary age in the central Pacific and a prominent unconformity beneath widespread middle Eocene cherts suggest a time of erosion and dissolution by especially vigorous deep currents, perhaps associated with the creation of a high-latitude circum-Antarctic Ocean.

The Pacific is about a third narrower now than during the Jurassic, owing to the opening of the Atlantic. Crustal consumption has been faster along the east side of the Pacific than on the west, resulting in a progressive eastward shift of the rise crest from its earlier more central position. Additional extra losses of old lithosphere are chargeable to Cenozoic spreading behind the western island arc systems.

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EARLY PHASE DIAGENESIS AND LITHIFICATION OF DEEP-SEA CHALKS AND CHERT

Deep-sea drilling has recovered rare, but areally persistent, consolidated and semiconsolidated calcareous nannofossil oozes from Tertiary strata of present ocean basins. They are ideal for studies of early phase diagenesis and lithification of carbonate and siliceous rock. Scanning electron microscope observations of hard laminae within unconsolidated Oligocene ooze sequences in the South Atlantic have revealed evidence of submarine lithification effected at bathyal depths through the chemical precipitation of calcite cement as overgrowths on organic skeletal particles and as free-growing euhedral crystals. Calcite cementation may be followed by the deposition of authigenic zeolite (clinoptilolite) and the mobilization of silica initially deposited as volcanic glass and tests of siliceous organisms. In some chalks from the Caribbean Sea and the South Atlantic, silica has been redeposited in the form of spherical aggregates about 2½–3 μ in diameter which partly fill pore spaces and may form an accessory cement. Chert stringers and lenses are also present in these chalks and the spherical aggregates may represent an early stage in the formation of deep-sea chert.

Environmental and geologic factors responsible for the lithification of Tertiary deep-sea calcareous oozes are probably not everywhere the same. Studies of Pacific chalks and oozes (Deep Sea Drilling Project Leg 18) indicate that movement of interstitial fluids in response to compaction may be important in determining the solution and lithification histories of some calcareous sediments.

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HYDRODYNAMICS OF FLUID INJECTION

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CHERT IN LISBURNE LIMESTONE OF ALASKA

Cherts from the Mississippian/Pennsylvanian Lisburne Limestone of northern Alaska can be divided into 2 distinct fabric types. These are (1) intragranular cherts in which the silica has started nucleation within the skeletons of crinoids and pelecypods, and (2) matrix chert which occupies the intergranular spaces and shows replacement of contained bioclastic debris only from the exterior. The matrix chert is considered to be of direct biogenic origin, but preservation of the original skeletons is very rare because of their progressive recrystallization since deposition. The intragranular chert began nucleation early in the diagenetic process, probably as a result of the reaction of the organic tissue in the crinoid pore-spaces with the silica of the interstitial waters. The organo-silicic acid produced by this mechanism then could react with the calcium carbonate of the crinoid plates and deposit silica on a piecemeal basis.

Dolomite is a common accessory of chert even when dolomite is absent from the adjacent limestone host-rock. The dolomite usually is distributed homogeneously through the chert either as euhedral or corroded rhombs. In places iron-rich dolomite forms a reaction-rim at the chert-calcite interface. A process of progressive solution of dolomite in the interior of the chert and reprecipitation at its edge is necessary to explain this distribution. Dolomite probably is only locally soluble in organo-silicic acids and the source of its magnesium is almost certainly the high-Mg calcite skeleton of the crinoid.

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CONTINENTAL INTERSECTIONS WITH OCEANIC RISES AND PETROLEUM PROVINCES OF PACIFIC SLOPE OF AMERICAS

All petroleum provinces on the American rim of the Pacific lie on or near present or past intersections of continents and spreading centers. Pacific coast production in the conterminous United States is restricted to the region between the East Pacific Rise in the Gulf of California and the Gorda Rise off northern California; the coastal basins may have started generating petroleum when North America drifted westward over the East Pacific Rise. The petroleum provinces of coastal and offshore Ecuador and Peru are near an east-west spreading center near the Galápagos Islands. Cook Inlet, Alaska, is not now on an oceanic rise, but magnetic anomalies in the Gulf of Alaska suggest that a rise intersected southern Alaska in Tertiary time. In contrast, no commercial oil has been found on the Pacific slope of any American island arc, including the Aleutian, Cascade, Mexican-Central American, and Andean arcs and volcanic chains.

Intersections of rises and continents are favorable regions for petroleum accumulation. Block faulting characteristic of rises tends to produce stagnant basins