CALCIUM CARBONATE BUDGET OF THE SOUTHERN CALIFORNIA CONTINENTAL BORDERLAND

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN OCEANOGRAPHY

MAY 1970

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ABSTRACT

Calcium carbonate sedimentation of the Southern California Continental Borderland can be examined by means of a budget. Carbonate transfer is the change in amount of calcium carbonate in the Borderland with time. Transfer can be divided into deposition, mechanical transfer other than deposition, biological transfer, and chemical transfer.

Most Borderland carbonate deposition occurs on basin floors and basin slopes. Carbonate deposition in the Borderland is 125×10^{10} g/yr. Aragonite and Mg-calcite percentage decrease with depth; dolomite percentage is a function of geographic coordinates (a response to source area). Total carbonate content of the sediments is independent of depth and geography.

Potentially important forms of mechanical transfer include river influx, aerial transfer, and ocean current transfer. Of these, only river influx is an important Borderland carbonate transfer process (16×10^{10} g/yr). Aerial transfer cycles material produced in the Borderland without removing or adding significant amounts. Ocean currents may be important to intra-system transportation but not to transfer. River input is low Mg-calcite, with minor amounts of dolomite.

Discussion of biological transfer includes only input. Biological input categories are shallow (<30 meters) rocky macrobenthos production, slope macrobenthos production, basin macrobenthos production, foraminifera production, and other production. Shallow rocky macrobenthos production is evaluated from estimates by divers of standing crop and from various estimates of turnover. This production amounts to 40×10^{10} g/yr. Sandy shelf, slope, and basin macrobenthos production is 34×10^{10} g/yr. Foraminifera production is 247×10^{10} g/yr, and other production is assumed to be 25×10^{10} g/yr. Production by shallow rocky macrobenthos is particularly interesting, because this second-largest of the biological production processes occurs over only 1 per cent of the Borderland area. The total production is dominated by low Mg-calcite, with minor amounts of high Mg-calcite and aragonite.

Chemical transfer involves solution on the basin floor, where waters are enriched with the solution products of 400×10^{10} g $CaCO_3$. Deep water flushing has been estimated by other workers to be biennial, so 200×10^{10} g/yr is dissolved. Dolomite is not dissolved; the other carbonate minerals are dissolved to varying extent. Aragonite solution is diminished because only minor amounts of fine-grained aragonite are moved to deep water. Dissolved calcium input rate to the

Borderland by rivers can account for 30 per cent of the annual calcium carbonate sedimentation. The remainder of the calcium must be extracted from ocean water flowing through the Borderland.

Calcium carbonate production rate in temperate-water shallow rocky bottom areas is comparable to tropical, non-reef production (about 500 $(g/m^2)/yr$). Coral reef production is about 10,000 $(g/m^2)/yr$. Pelagic production is about 50 $(g/m^2)/yr$. Pelagic production rates over the world's oceans are capable of exceeding dissolved calcium supply rate of the world's rivers by an order of magnitude. The other two environments may also be able to match river supply of calcium. Excess calcium carbonate is re-dissolved.

Tertiary limestones of the Pacific coast of North America are generally either dominated by recognizable debris from one or two phyla or are fine-grained, impure limestones. Both characteristics might be expected of limestones forming in an area similar to the present Borderland.

This investigation has demonstrated that considering the budget of carbonate input to and output from an area is an adequate method for enumerating processes controlling carbonate content of marine sediment.