ROLE OF BIOLOGICAL PROCESSES IN THE FORMATION OF MANGANESE CRUSTS ON SEAMOUNTS IN HAWAII

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ABSTRACT

Rates of manganese crust deposition on seamounts vary between 1-3 mm/My. These rates are very slow compared with those of organic filming and settlement and growth of benthic organisms. It remains unexplained why manganese crusts, whose thickness averages about 2.5 cm, are not overwhelmed by biological processes.

To test whether sessile macro-invertebrates prefer to settle on manganese crusts, arrays of natural manganese and oceanic basalt samples were placed by submersible at 460 and 975 m depth on Cross Seamount, 250 kms south of Oahu, for fifteen and eighteen months, respectively. The seamount experiments also permitted the observation of two other potentially relevant factors for crust accretion, namely, mediation of crust formation by certain taxa and low larval supply. To compare the response of a variety of large shallow-water sessile organisms in the field to these two substrata and with the seamount results, arrays of crust and basalt samples were also deployed at five-week periods during one year at 2.0 m depth on Coconut Island reef, Kaneohe Bay, Oahu, Hawaii.

Settlement experiments were conducted using these two substrata in a seawater aquarium with larvae of the hermatypic corals Pocillopora damicornis, Montipora verrucosa and Porites compressa spawned in the aquarium from adult heads collected from Kaneohe Bay.

Metazoan settlement in the seamount experiments was too sparse for rigorous statistical testing. Nevertheless, rather than avoidance, bryozoans and hydroids showed a preference for manganese crust. Overall, 47 of the 57 metazoans found had settled on manganese crust samples. Benthic foraminifera also exhibited a highly significant preference ($P < .01$) for manganese crusts. Results of the reef experiments suggest that serpulid and spirorbid polychaete worms prefer basalt ($P < .001$ and .05, respectively). While the hermatypic corals exhibited no statistically significant

preference for either substratum, a trend favoring basalt was evident for M. verrucosa and P. compressa.

These data suggest that biological processes do not overwhelm manganese crusts because of the operation of a number of interactive factors: 1) low larval supply in the deep sea; 2) benthic foraminifera may mediate crust accretion; and 3) some sessile metazoans may avoid or be debilitated by crusts because of boundary layer chemistry. The frequent physical process of spallation of manganese crust observed on the seamount may further contribute to the elimination of larger metazoans, which could interfere with crust formation. In the oxygen minimum zone, low oxygen values may also inhibit the growth of large metazoans.