Wave Control on Fringing Reef Morphology and Coral Distribution: Southern Moloka'i, Hawai'i.

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We are currently studying the fringing reef off the south coast of Moloka'i, Hawai'i, as part of a multi-disciplinary project headed by the U.S. Geological Survey that focuses on the health and geologic variability of coral reef systems. As part of this study, we utilized wave modeling and field observations to help understand the physical controls on reef morphology and the distribution of coral species. The morphology of the reef crest, which extends roughly 50 km from east to west and up to 1500 m offshore, appears to be primarily controlled by the amount of wave energy impinging on the coastline. Extratropical cyclones and interanticyclonic systems crossing the North Pacific during the winter months generate the wave energy regime that appears to dominate the reef. This North Pacific swell typically ranges in height from 3-8 m and has periods >15 sec, developing near-bed orbital velocities >3.0 m/sec and shear stresses >2.5 N/m^2 that inhibit substantial coral development in shallow water. The reef is shadowed from these waves by the island of Moloka'i; however, refraction around the east and west ends of the island cause the reef crest to pinch out roughly 5 km from each end of the island. The southeastern portion off the reef is sheltered from the >12 sec period swell typically generated in the Southern Ocean. The western half of the reef, however, is exposed to these long-period swell that can generate near-bed orbital velocities >1.5 m/sec and shear stresses >1.0 N/m^2 that suspend large quantities of sediment on the reef flat and transport it across the reef crest and reef front. Where the reef crest welds onto the shoreline, the fore reef is typified by more robust high-energy corals and low percentages of live coral cover. In contrast, the central portion of the reef, which is sheltered from the large North Pacific swell, is characterized by more delicate branching corals and up to 95% live coral cover. Further wave modeling and instrument deployments will better clarify both the alongshore and cross-shore variations in wave energy and other physical processes influencing coral reef development.

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