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From grazing marks to collapsed cliffs - intertidal bioerosion on all scales

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Rocky shores – particularly in limestone areas of tropical, subtropical, and some temperate regions – are subject to intense bioerosion. Detailed field studies along the Gulf of Siam and the Andaman coast of Thailand, Langkawi Islands of Malaysia, southern Java and Bali in Indonesia, Palau Islands, and Okinawa revealed the presence of rich populations of bioeroding organisms in the intertidal zone.

Molluscs capable of damaging rock (the chiton Acanthopleura, limpets, and whelks) leave grazing traces as they feed on bacterial and algal biofilms and chasmolithic and endolithic microorganisms. Boring sponges (Entobia), bivalves (Gastrochaenolites and others), boring sipunculid worms (Caulostrepsis), and sea urchins (Echinometra) drill deeper to hide from predators beneath the rock surface. Individually, members of these taxa leave marks ranging from sub-millimetre to the metre scale, but collectively, their erosion creates marine notches, several-metres-deep features extending between low and high tide marks. When cliffs overhanging these notches collapse, landscape-scale scars are left behind.

The various bioeroders display a clear vertical zonation between low and high tide. These are dictated by environmental stress, food availability, competition, and predation. Typical inhabitants of present-day zones include – from top to bottom – littorinid snails, patellid limpets, chitons, boring bivalves, and boring sea urchins. Each organism leaves a characteristic mark in the bedrock. Trace fossils found in the 'wrong place' – either too high or too low compared to the present-day occurrence of the animals – suggest changes in relative sea level. Similarly, sea level changes are suggested by the presence of compound markings produced through overprinting by organisms that live in different ecological zones. Preservation and obliteration of traces depends on the rates of sea level change and coastal denudation.

Morphology of bioerosional markings and their vertical zonation, as well as the morphology of marine notches, represent faithful records of relative changes in sea level, resolvable down to decimetric scale. Evidence of coastal uplift and subsidence, including rapid shifts caused by seismic activity, can be documented in this way, even in unexpected places. For example, the presence of uplifted marine notches the Thai-Malay Peninsula, away from active plate margins, indicates significant Holocene tectonics in intra-plate settings.

Bioeroding organisms leave permanent marks of their activity in the intertidal zones of rocky coasts. Grazing organisms (limpets and chitons) produce superficial marks, while boring organisms (sponges, bivalves, and echinoids) leave deeper cavities. Their fossilization potential increases with trace depth. Where preserved, these various traces are readily identifiable in rock surfaces and can be considered reliable evidence of former sea levels, coastal ecological zones, as well as tools to estimate the amount of erosion subsequent to the making of the initial bioerosional scars. (OTKA K67.583)

References:

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