A moderate increase of oceanic acidification leads to a dramatic shift in benthic habitats

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Dominant habitats, coralligenous outcrops and maërl beds out of the vent systems.

Rising levels of CO_2 released by anthropogenic activities are driving unprecedented changes in the chemistry of the oceans. The mean ocean surface acidity has increased by a near 30% as the advent of the Industrial Revolution. In agreement, ocean acidification is receiving increasing attention because of its potential to affect marine ecosystems.

A research, headed by researchers at the University of Barcelona, shows that a decrease from pH 8.1 to 7.9 observed in a CO_2 vent system at 40 m depth leads to a dramatic shift in highly diverse and structurally complex habitats. Forests of the kelp Laminaria rodriguezii, usually found at larger depths (greater than 65 m), replace the otherwise dominant habitats, coralligenous outcrops and maërl beds, which are mainly characterized by calcifying organisms. Only the aragonite-calcifying algae are able to survive in acidified waters, while high-magnesium calcite organisms lack almost completely.

The study, published today in the journal *Proceedings of the Royal Society B*, was carried out at the Columbretes Islands in the Mediterranean Sea. These islands emerge 30 nautical miles off the coast of Castelló (Spain), about 56 kilometres, and form a tiny volcanic archipelago that consists of one main island, several islets and rocks and a number of shoals. The presence of CO_2 vents was examined with a remotely operated vehicle (ROV) in September 2011 inside and outside the Columbretes Marine Reserve. In June 2012, scuba diving surveys were performed to characterize the carbonate system parameters and the community composition.

Rare CO_2 vents offer a unique opportunity to investigate the response of

benthic ecosystems to acidification. However, the benthic habitats investigated so far are mainly found at very shallow water (less than or equal to 5 m depth) and, therefore, are not representative of the broad range of continental shelf habitats. "The present study shows that moderate acidification observed in a CO2 vent system leads to a dramatic shift in highly diverse and structurally complex benthic habitats thriving at depths rarely explored in terms of ocean acidification effects", explains Cristina Linares, Ramon y Cajal researcher at the University of Barcelona, first author of the paper and coordinator of the project LIFE+INDEMARES.

In a CO2 vent system forests of the kelp Laminaria rodriguezii, replace the otherwise dominant habitats which are mainly characterized by calcifying

organisms.

Kelps replace dominant habitats

Habitats widely extended across the Mediterranean Sea, such as coralligenous outcrops and maërl beds, mainly characterized by a large dominance of calcifying organisms, are replaced by forests of the deep-water kelp Laminaria rodriguezii. "This species becomes dominant at depths much shallower than under normal seawater conditions, which indicates the potential vertical range shifts of some benthic species analogue to the changes observed in terrestrial ecosystems due to global warming", highlights Enric Ballesteros researcher at the Centre d'Estudis Avançats de Blanes (CEAB-CSIC).

A long-term survey of the venting area would be necessary to fully understand the effects of the variability of pH and other carbonate parameters over the structure and functioning of the investigated mesophotic habitats. However, "results point that, in addition of significant changes at species level, moderate ocean acidification may entail major shifts in the distribution and dominance of key benthic ecosystems at regional scale, which could have broad ecological and socio-economic implications", says Miquel Canals, professor in the Department of Stratigraphy, Paleontology and Marine Geosciences and head of the Research Group on Marine Geosciences at the University of Barcelona. Canals was one of the general coordinators of the oceanographic campaign in 2011.

More information: C. Linares et al. Persistent natural acidification drives major distribution shifts in marine benthic ecosystems, *Proceedings of the Royal Society B: Biological Sciences* (2015). DOI: 10.1098/rspb.2015.0587

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