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Physical controls on cold-water coral growth

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Along the Atlantic European continental margin, living cold-water coral reefs occur over a wide bathymetric and hydrographical range. Focussing on two regions, the Celtic and the Norwegian shelves we found that they are bound to different intermediate water masses. Measurements of the physical and geological properties indicate that parameters such as temperature, salinity, dissolved oxygen content, current intensities, and different substrates do vary in a wide range without impacting the distribution of living cold-water coral reefs to a first degree.

Our study shows that cold-water corals in the North Atlantic tolerate a wide range of environmental conditions. The habitat of living reefs comprises a temperature-salinity field with its lower boundary being equivalent to the Intermediate Salinity Maximum (ISM). The ISM on the Celtic margin is represented by Mediterranean Outflow Water, while it is replaced by Atlantic Water on the Norwegian margin. The upper limit corresponds to water mass boundaries of Eastern North Atlantic Water / Mediterranean Outflow Water on the Celtic margin and Norwegian Coastal Water / Atlantic Water on the Norwegian margin.

The density of seawater is a frequently used parameter by oceanographers to describe and understand ocean-mixing processes, as it is easier to mix water along a surface of constant density (an ísopycnaĺ) rather than across it. The potential density anomaly sigma-theta is a function of salinity, potential temperature, and pressure at the sea surface. This parameter indicates values of sigma-theta = 27.35 - 27.65 kg m-3 for all living cold-water coral reefs of the Porcupine Seabight, the Rockall Bank, and the Norwegian margin highlighting the importance of physical boundary conditions on cold-water coral growth and distribution. Additional information from literature shows that this value is also valid for reef sites along the Western Atlantic (Nova Scotia, Florida Strait, Brazilian margin) suggesting that this observation is an Atlantic-wide phenomenon. In areas where coral growth is restricted to some small patches and reefs, or recent mound growth is limited, like in the Gulf of Cadiz or off Mauritania, recent sigma theta values lay outside the envelope of 27.5 $\pm$ 0.15 kg m-3. However, it has to be mentioned that corals do not occur everywhere along the European continental margins where sigma theta values are around 27.5 kg m-3. In this case, second order parameters like sedimentation rates, currents, the lack or presence of good settlement substrates, nutrient concentrations, etc. are controlling the coral growth and settlement.

Literature

Dullo, W.-Chr., Flögel, S., Rüggeberg, A. (in press) Cold-water coral growth in relation to the hydrography of the Celtic and Nordic European Continental Margin. Marine Ecology Progress Series.