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Calcification, skeletal structure and composition of the cold-water coral *Desmophyllum dianthus*

Background and aim…

To study the relation between calcification rates of the cold-water coral *D. dianthus* and its ability to up-regulate the internal calcifying fluid pH_{cf}, we compared seasonal growth between corals from sites of different natural aragonite saturation ($\Omega_{ar} < 1$ versus $\Omega_{ar} > 1$) in Comau Fjord (Patagonia, Chile; Fig. 2) with high spatial resolution skeletal structure and composition analyses.

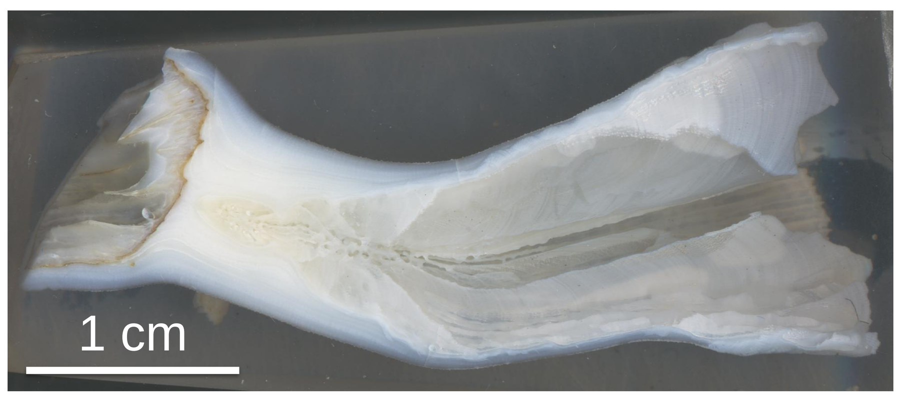


Figure 1: Longitudinal section of skeleton of the cold-water coral *Desmophyllum dianthus*.

Calcification rates of *D. dianthus*…

…were measured by the buoyant weighing technique and compared with Ω_{ar} in austral summer 2016/17 and winter 2017. Growth rates were highest at 300 m and in winter, despite $\Omega_{ar} < 1$ (Fig. 3) and low food supply. In 20 m, higher summer growth rates match a higher plankton availability. Nevertheless, growth of *D. dianthus* seems to be less influenced by Ω_{ar} than by environmental stability (high in 300 m), sufficient food supply and an effective energy allocation within the coral.

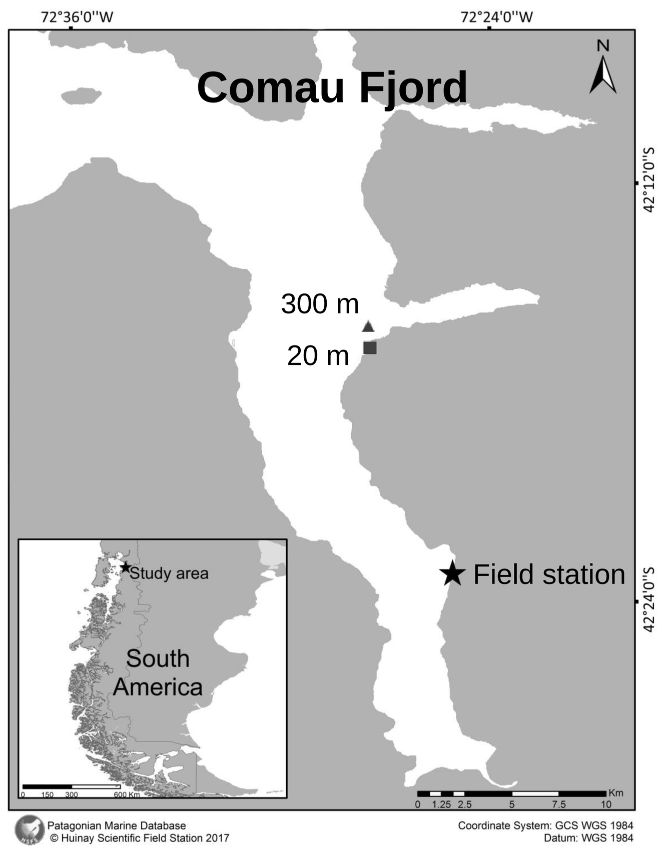
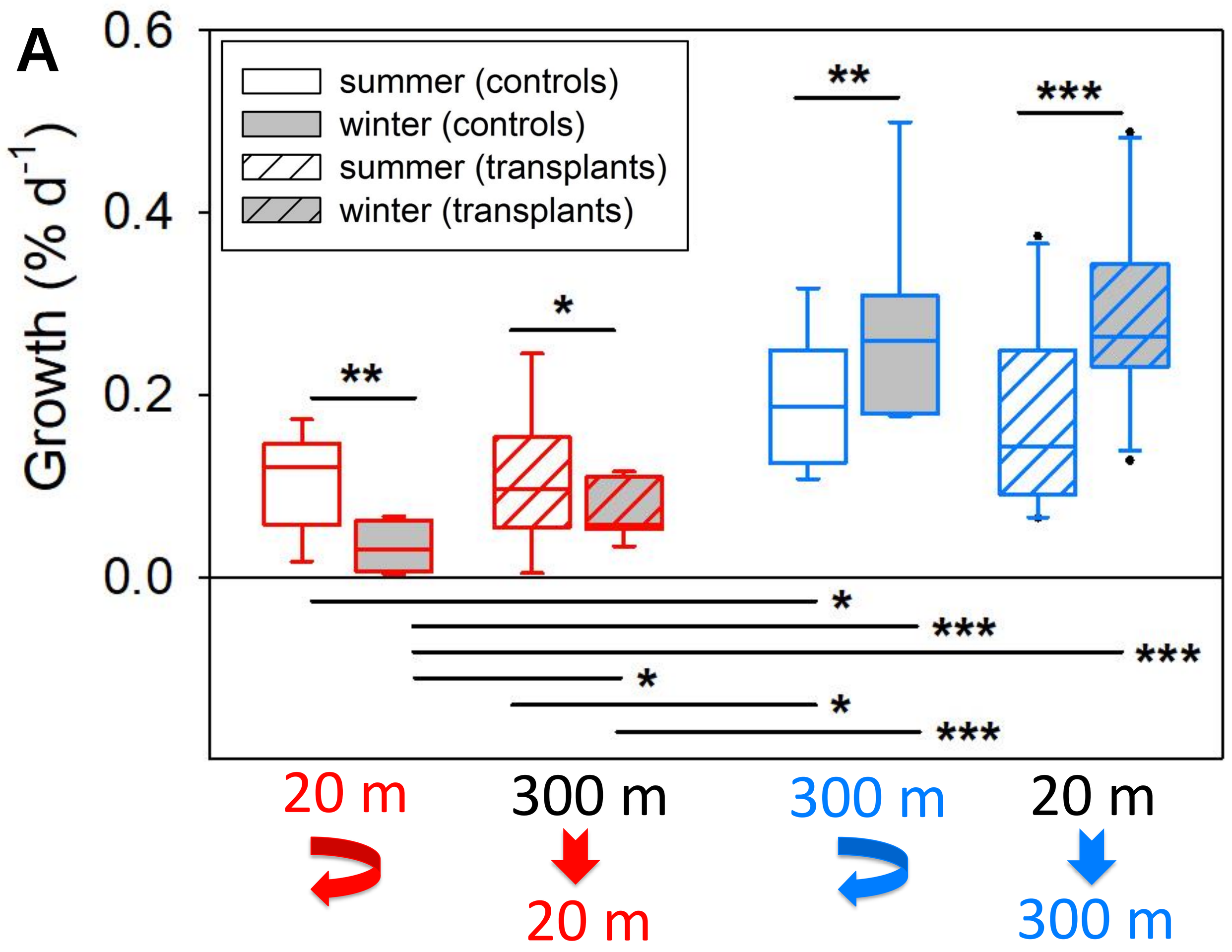


Figure 2: Study sites of coral samples in Comau Fjord (Chile).



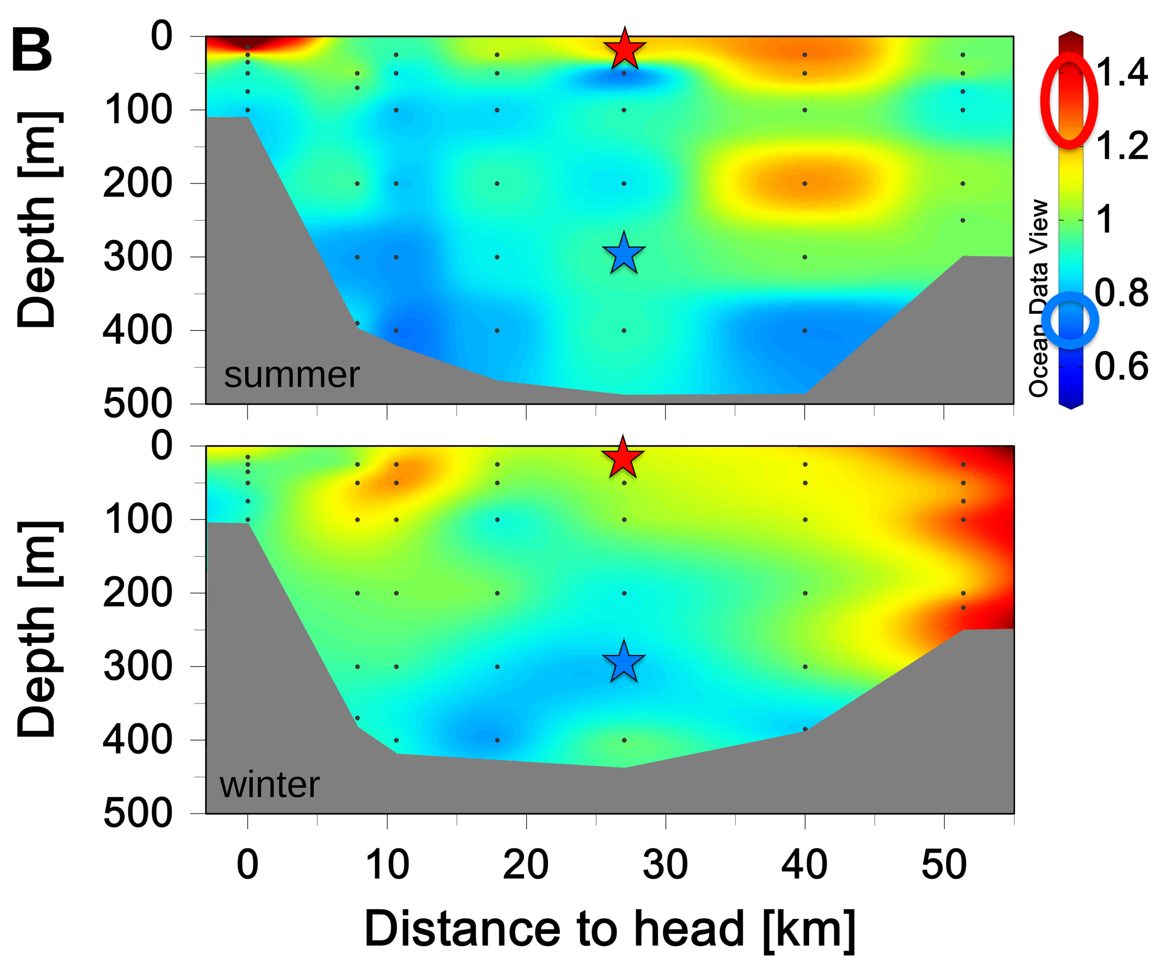


Figure 3: Growth rates of *D. dianthus* in Comau Fjord (Chile). Growth rates at 20 m ($\Omega_{ar} > 1$) and 300 m ($\Omega_{ar} < 1$) water depth. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$ B) Aragonite saturation (Ω_{ar}) in Comau Fjord in austral summer and winter.

Skeletal structure…

…investigated using confocal Raman microscopy mapping to visualise:

- organic matrix distribution (fluorescence intensity, Fig. 4B)
- microstructural arrangement of aragonite crystals (e.g. location of early mineralisation zone, Fig. 4C)

…to detect periodicities in growth increments and relate them to subsequent geochemical analyses of the skeleton.

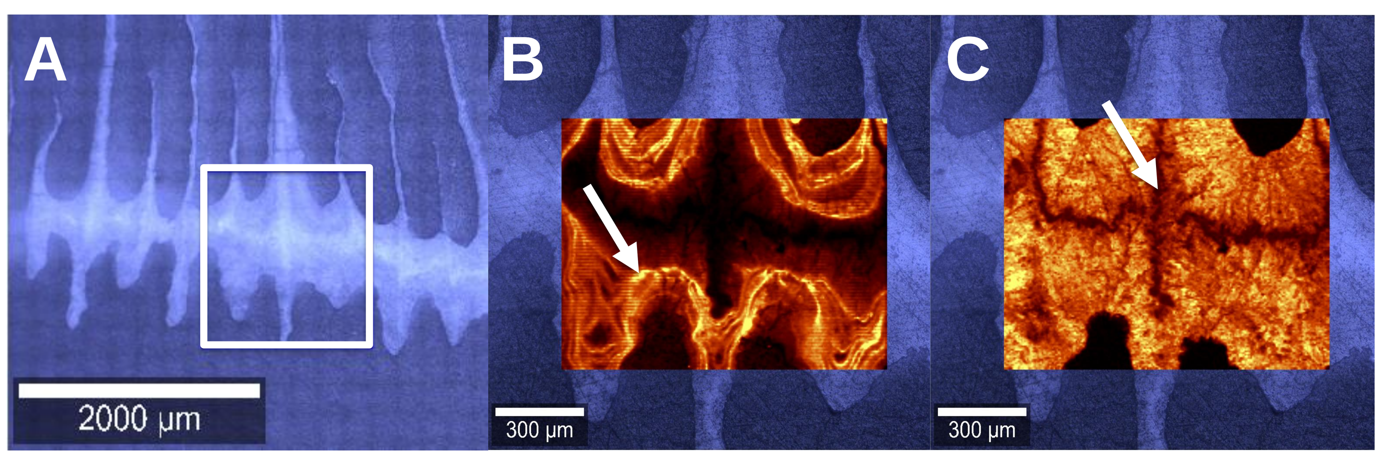
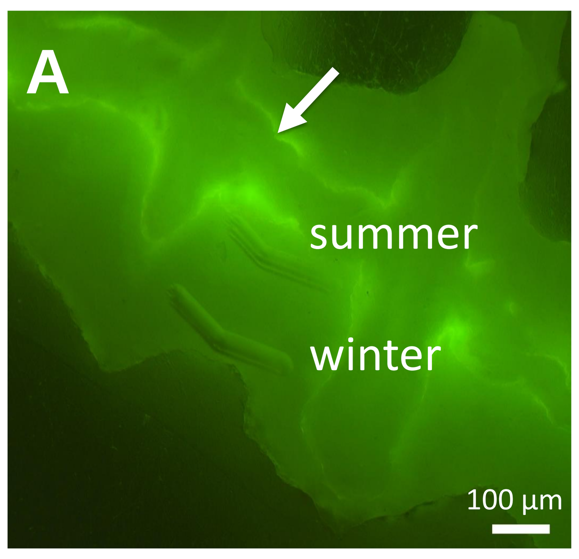


Figure 4: Raman maps of *D. dianthus*. A) Embedded skeleton showing area of measurement, B) Fluorescence intensity map showing organic bands (arrow), C) Map showing changes in the orientation of the aragonite crystals and the location of the early mineralisation zone (arrow).

Boron isotopic composition ($\delta^{11}B$)…

…measured by UV femtosecond (10^{-15} s) laser ablation coupled to MC-ICP-MS (Nu Plasma II)

- high spatial resolution to determine seasonal $\delta^{11}B$ and pH_{cf} (Fig. 5B)
- high variability in $\delta^{11}B$ between individuals, likely due to high calcification rates in upper part of coral calyx



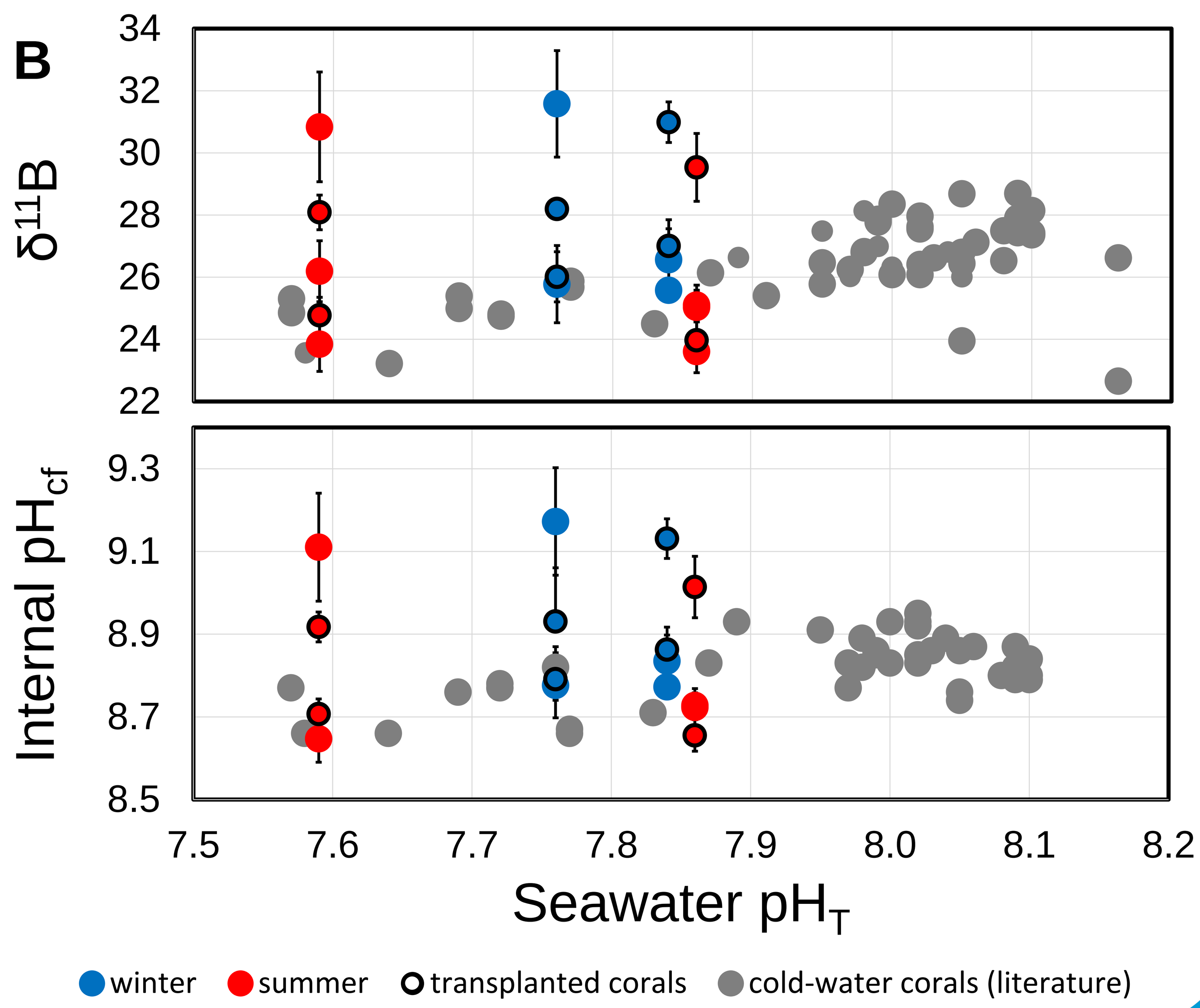


Figure 5: A) Transversal section of embedded coral skeleton with green fluorescent calcein staining line (arrow) and laser ablation tracks of summer and winter increment, B) Boron isotopic composition ($\delta^{11}B$) of *D. dianthus* from Comau Fjord (head and mouth of fjord, transplanted between head and mouth) in summer and winter and $\delta^{11}B$ data from different cold-water coral species [1-5].

References

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