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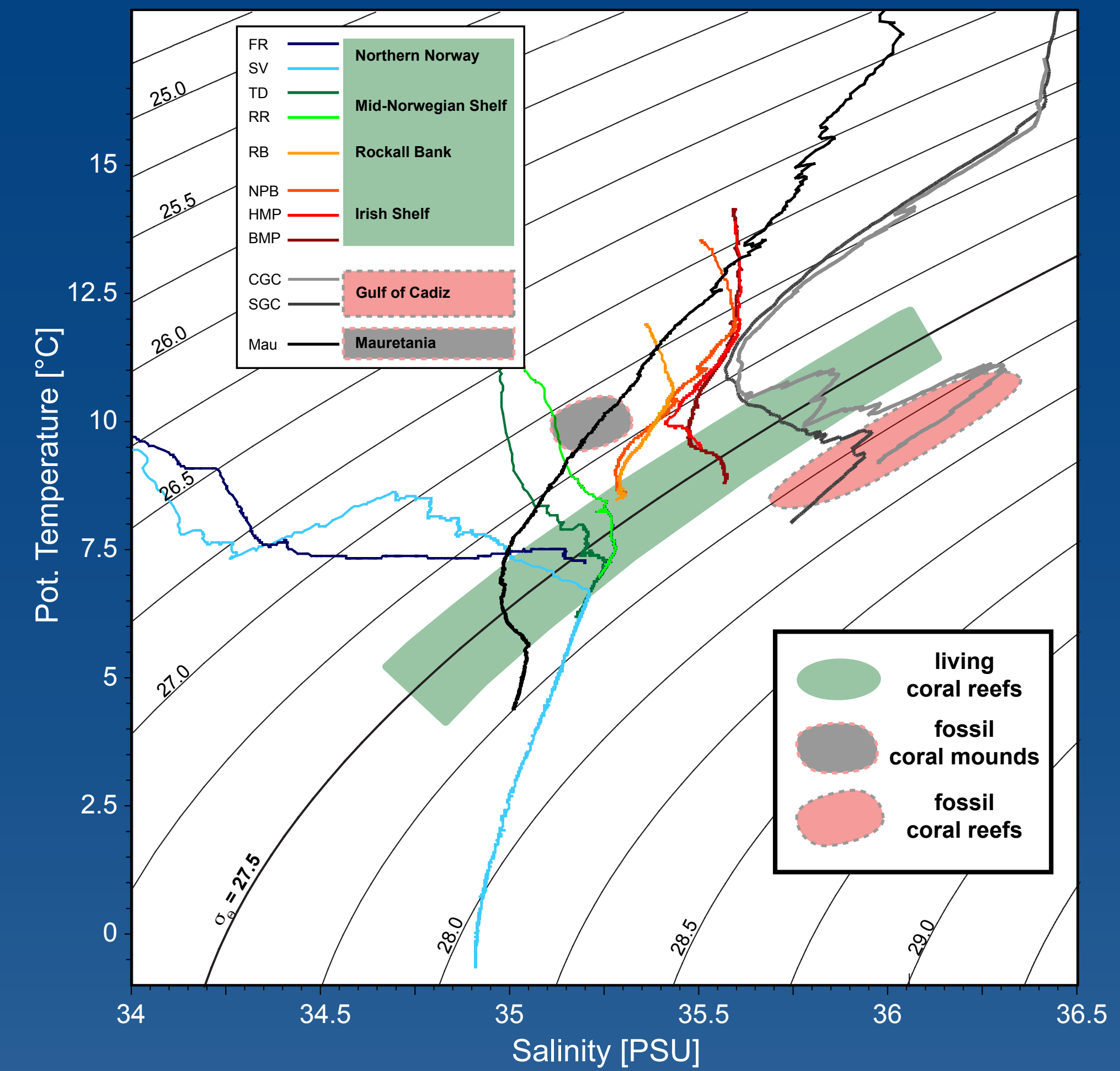
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## Introduction

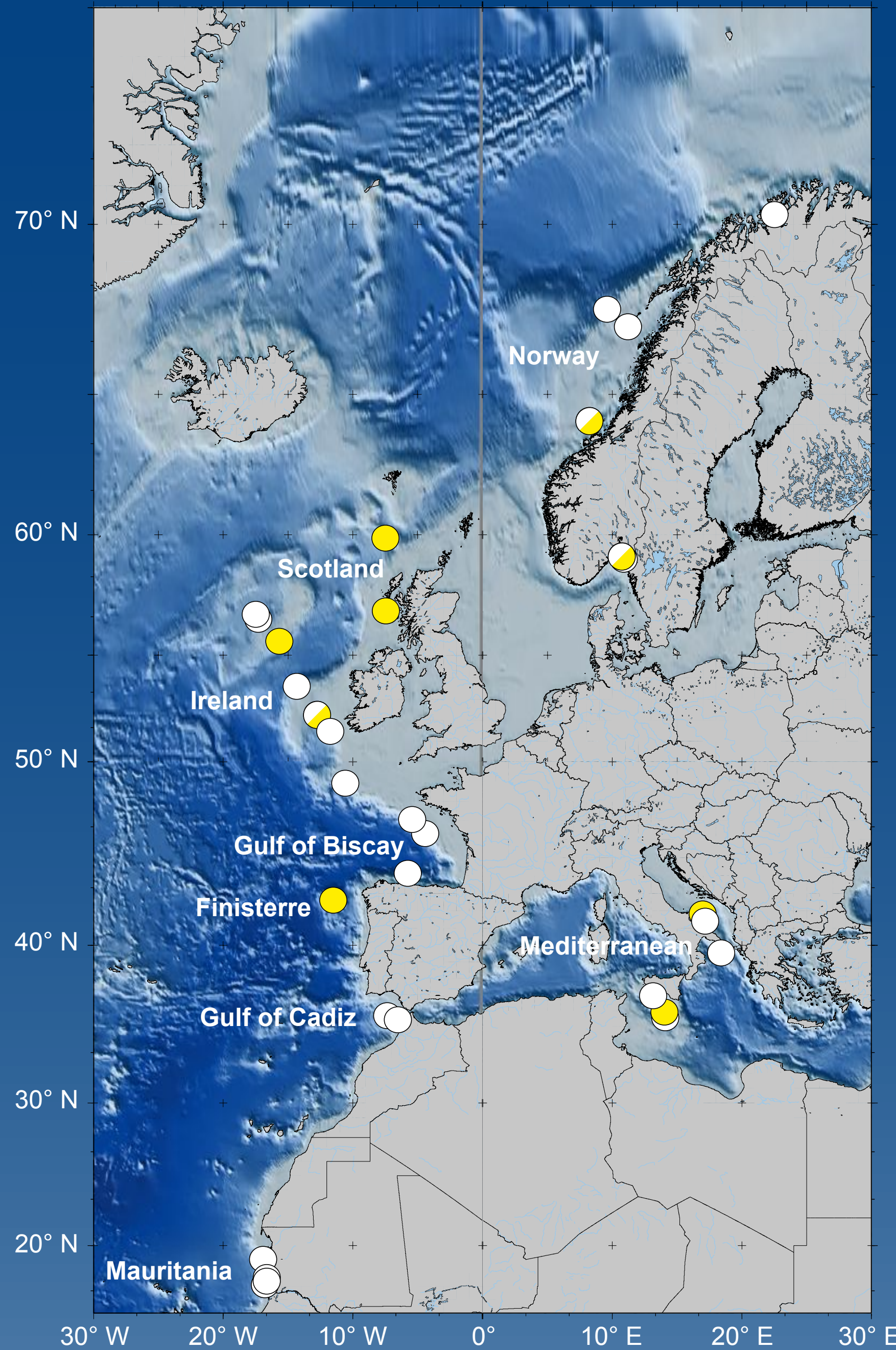
Cold-water corals are abundant along the European continental margin, where they build large reef ecosystems especially off Norway and Ireland (Figs. 1 and 2). Their living occurrence is not well-balanced:

- (1) Most impressive reefs and mounds forming huge bioconstructions with a real framework (green areas in Figs. 2–6) have been found off northern Norway and off Ireland (Fig. 6a).
- (2) Patchy growth with colonies of some square metres are found at the Scottish sites and in the Bay of Biscay, but also in the Oslo Fjord (Fig. 6b).
- (3) Small and frequently isolated colonies or even single living polyps on dead coral rubble (red areas in Figs. 2–6) and fossile carbonate mounds (grey areas in Figs. 2–6) have been observed off Mauritania, the Mediterranean and the Gulf of Cadiz (Fig. 6c).

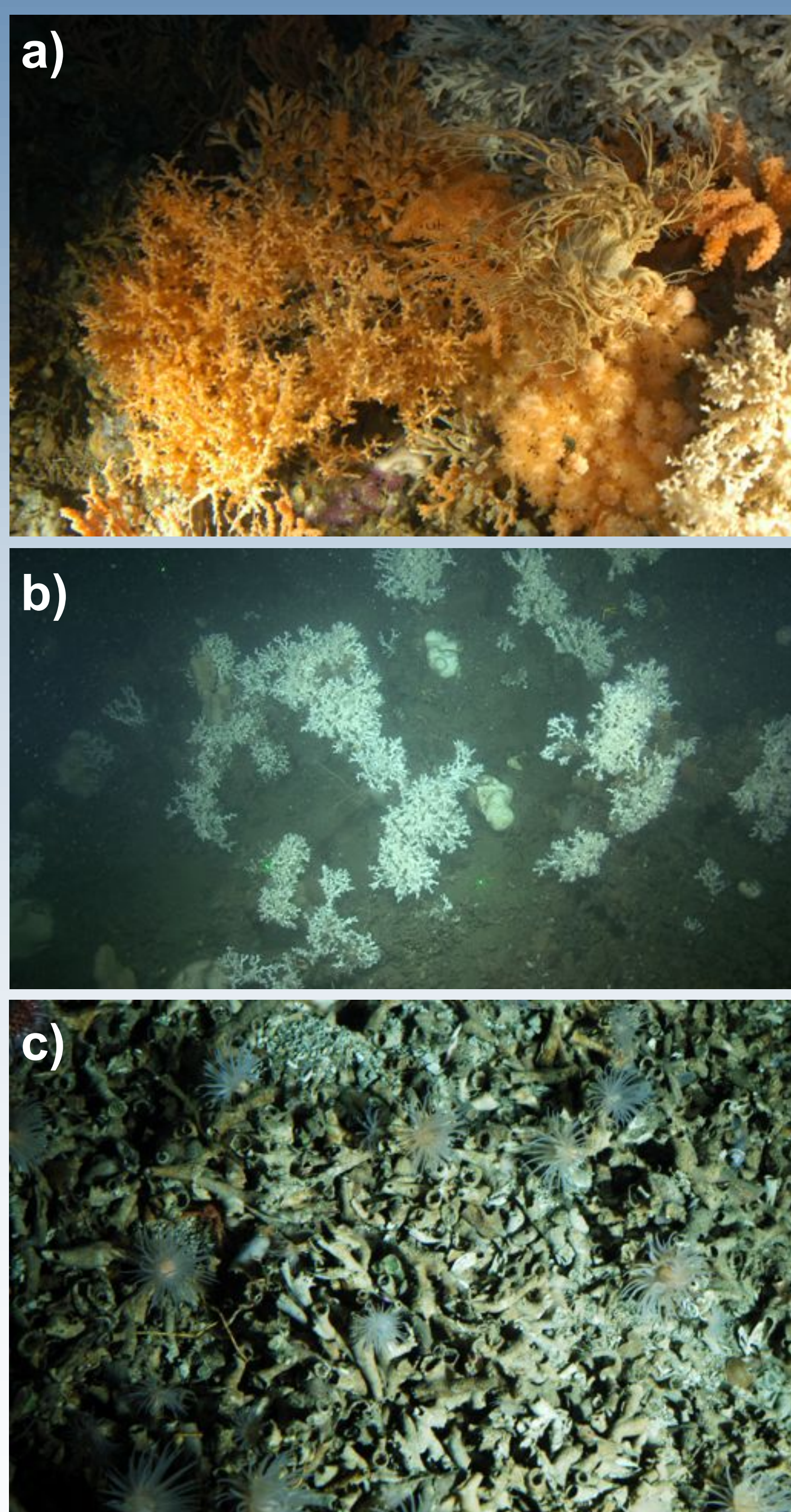
There is a clear dependence of CWC reefs on environmental parameters of the seawater like temperature, salinity, density, DIC, pH<sub>T</sub>, and total alkalinity (Figs. 2–6).



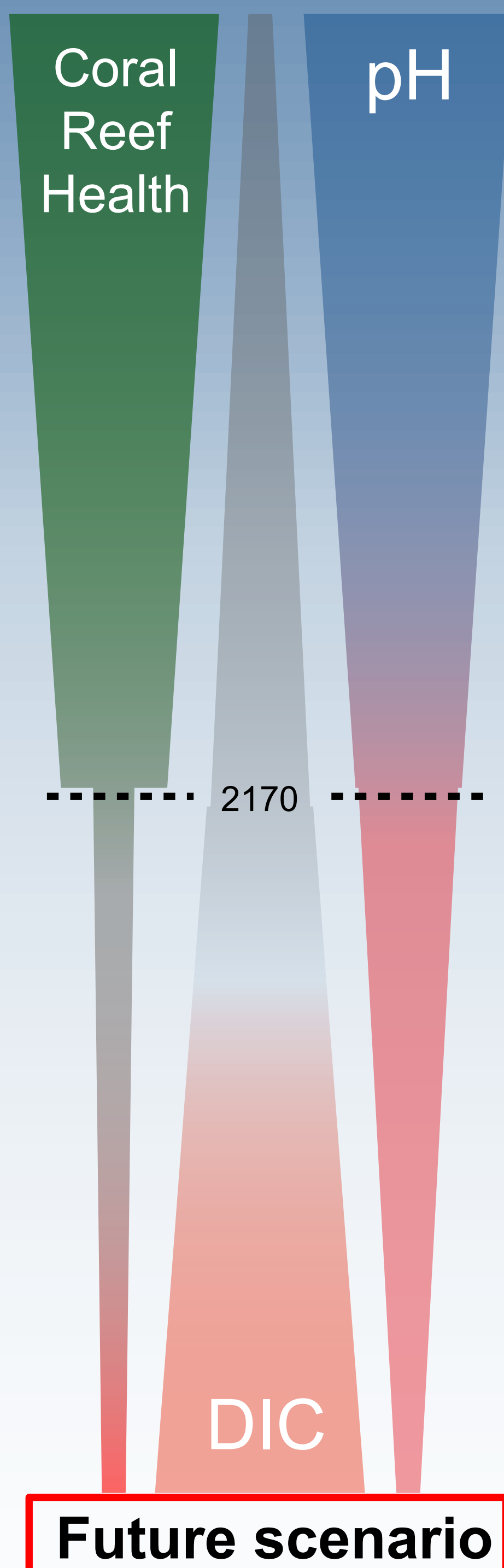
**Figure 2.** a) Distribution of living and dead CWC reefs in relation to T, S and seawater density ( $\sigma_\theta$ ). Living reefs occur at a density envelope of  $\sigma_\theta = 27.5 \pm 0.15 \text{ kg/m}^3$  (green). Fossil/dead reefs with single/patchy coral occurrences lay outside of the envelope (after Dullo et al. 2008).



**Figure 1.** Sample sites of cold-water coral *Lophelia pertusa*, seawater and environmental parameters (T, S, DIC) along the European and African continental margin (yellow dots indicate literature values, white dots own data).



**Figure 6.** a) healthy coral reef, b) coral patches, and c) dead corals (© JAGO Team GEOMAR, Kiel) as example for the different occurrences. Healthy coral reefs will be limited in a future scenario with increasing ocean acidification and increasing amount of DIC.

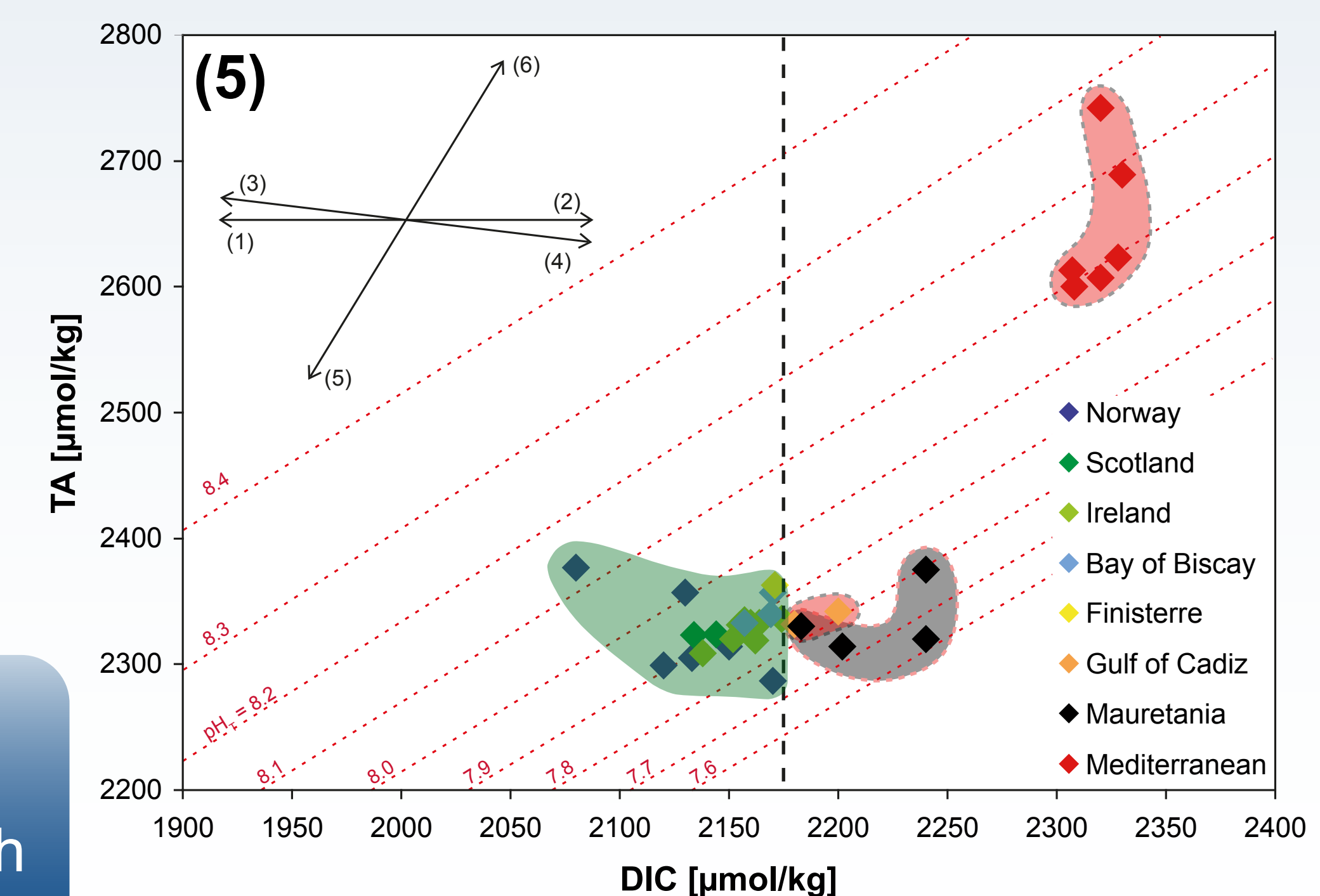
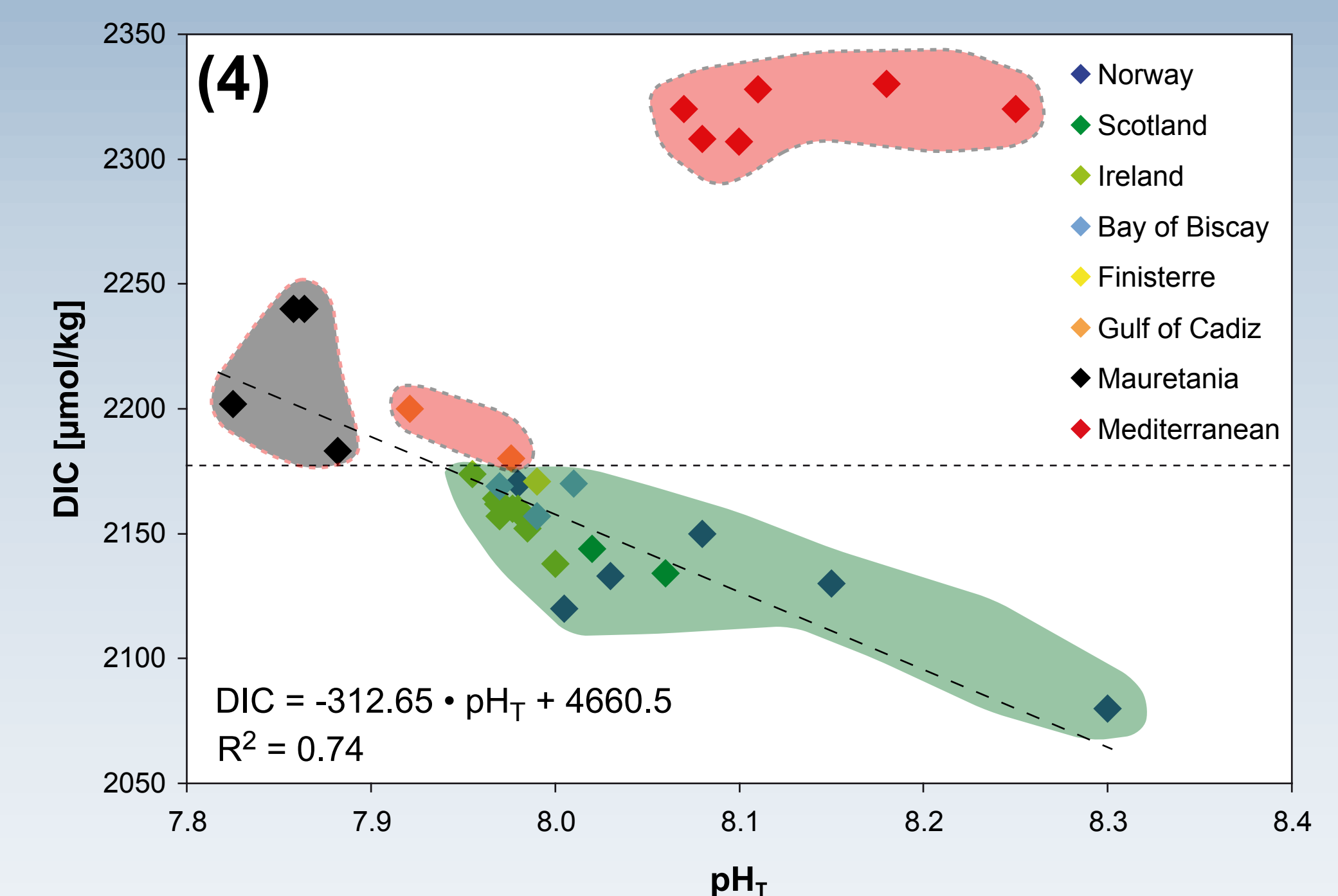
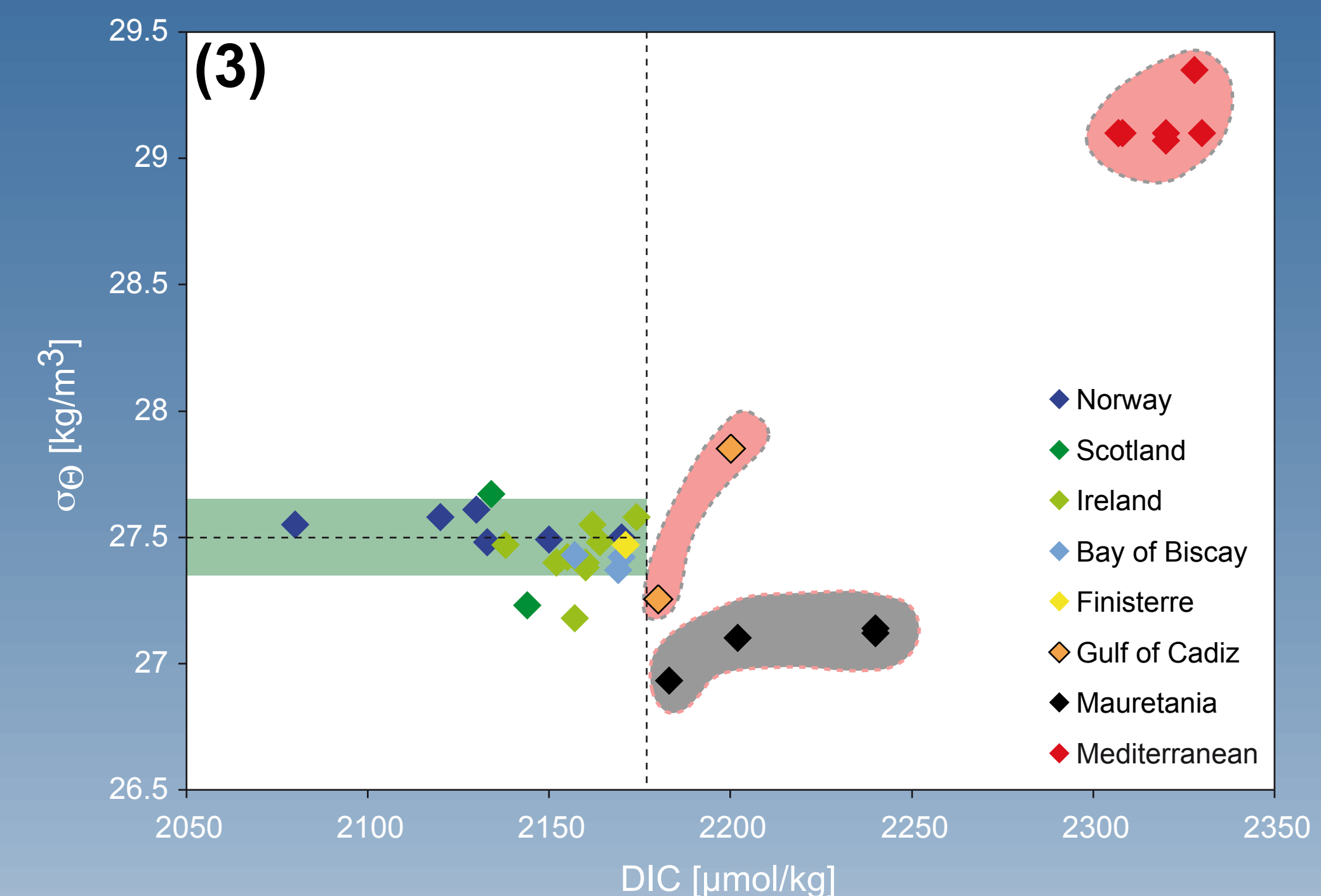


**Figure 3.** Relation between  $\sigma_\theta$  and dissolved inorganic carbon (DIC) of the seawater from CWC reef sites (coloured areas corresponding to Fig. 2; after Flögel et al. subm.).

A sharp boundary between living and dead CWC reefs is visible at DIC value of  $2170 \mu\text{mol/kg}$ . This observation is important for future implications, as other studies predict an increase and a shallowing of seawater DIC for the NE Atlantic Ocean (Tanhua et al., 2007).

**Figure 4.** DIC vs. pH<sub>T</sub> (total scale) from the different CWC reefs indicate a linear relation of all Atlantic sites with increasing DIC and increasing acidity. The Mediterranean sites are offset to this trend (after Flögel et al. subm.).

**Figure 5.** Total alkalinity (TA) plotted against DIC and on pH<sub>T</sub> isolines. The vectors indicate the impact of important natural processes with respect to the CO<sub>2</sub> system: Release/Uptake of CO<sub>2</sub> to/from the atmosphere (1,2), primary productivity (3), respiration (4), calcification (5), and carbonate dissolution (6; after Flögel et al. subm.).



## Conclusion

Pristine CWC occurrences are limited to bottom waters with DIC values  $< 2170 \mu\text{mol/kg}$ . Strongly elevated DIC values cannot be regulated by metabolic/calcification processes. Increasing DIC and decreasing pH may therefore have future implications for the health of cold water coral reefs!

## Acknowledgements:

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