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Upwelling of low pH waters and its potential impact on coastal biocalcification

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In the context of ocean acidification, efforts have been recently devoted to examining the coastal $CaCO_3$ saturation state and its potential impact on the ecosystem calcification. In one case, the aragonite undersaturation state (Ω_{arag} <1.0) was reported in nearshore surface waters off the Oregon-California border, due to the upwelling of corrosive "acidified" water onto the shelf area (*Feely et al*., 2008). They propose that the upwelling processes will expose coastal aragonitic calcifiers living in the less saturated waters, which might result in the decreasing calcification rate and further exacerbate the biological impacts of ocean acidification on the coastal ecosystem. In another case, we found that all Ω_{arag} values were higher than 1.0 in nearshore upwelled waters on the northern South China Sea (NSCS) shelf, suggesting that ocean acidification currently plays a minor role in lowering the $CaCO_3$ saturation state [*Cao et al.*, 2011]. The contrasting scenarios might be related to the different "acidity" of source waters of upwelling. In the former case, offshore subsurface waters from ~150 m with Ω_{arag} <1.0 and pH_{SW} <7.75 upwell to surface nearshore. In the NSCS system, the upwelled subsurface water has a significantly higher Ω_{arag} value of ~1.9 and pH_{SW} value of ~7.95 despite also being sourced from the depth of ~150 m. Moreover, the enhanced biological consumption of dissolved inorganic carbon (DIC)gradually elevated Ω_{arag} during the transport of upwelled waters in nearshore areas of the NSCS shelf. And correlations between salinity normalized total alkalinity (TAlk) and DIC indicated that organic carbon production rather than biocalcification exclusively induced the DIC removal. However, we contend that with more anthropogenic CO_2 accumulation, undersaturated waters with Ω_{arag} <1.0 may be possible in this local marine ecosystem in the future. In this presentation, we are attempting to examine different scenarios with upwelling of low pH waters and its potential impact on coastal biocalcification. Future changes in the $CaCO_3$ saturation state and corresponding ecosystem calcification rate in coastal seas may well be complex under the anthropogenic stress of ocean acidification driven by the rise of anthropogenic CO_2 and coastal upwelling.

References:

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