

## **CO<sub>2</sub> storage and release in the deep Southern Ocean on millennial to centennial timescales**

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The carbon content of the deep Southern Ocean is widely thought to control atmospheric CO<sub>2</sub> on glacial-interglacial timescales, but few direct tests of this hypothesis exist. Here we present new deep sea coral boron isotope data that reflect the pH – and thus CO<sub>2</sub> chemistry – of the deep Southern Ocean over the last 40,000 years. At sites most influenced by deep Southern waters we find a close relationship between ocean pH and atmospheric CO<sub>2</sub>: during intervals of low CO<sub>2</sub> ocean pH is low, reflecting enhanced ocean carbon storage; during intervals of rising CO<sub>2</sub> ocean pH rises, reflecting loss of carbon from the ocean to the atmosphere. In contrast at shallower sites we find extremely rapid (centennial-scale) pH decrease during abrupt CO<sub>2</sub> rise, reflecting the transfer of carbon from the deep to the upper ocean and atmosphere. These data thus confirm the importance of the deep Southern Ocean in ice age CO<sub>2</sub> change, and demonstrate that deep ocean CO<sub>2</sub> release can occur as a dynamic feedback to abrupt climate change on centennial timescales.