The deep ocean represents a vast reservoir of carbon. It contains much more carbon than the atmosphere or the terrestrial biosphere and it is only surpassed in size by the carbon stored in rocks. It hence has long been suggested that the deep ocean, and in particular the Southern Ocean, plays a vital role in glacial-interglacial climate change and associated changes in atmospheric carbon dioxide levels. The Southern Ocean’s carbon reservoir is sensitive to changes in sea ice cover, surface productivity, stratification, surface buoyancy fluxes, and ocean circulation, which in turn is influenced by the position of the westerly winds.
To address the role of ocean circulation during the last transition from an ice age to the Holocene, the last deglaciation, we can study the neodymium isotope composition of deep sea scleractinian corals. Such corals allow exact radiometric dating and have been shown to be reliable recorders for seawater-derived Nd isotopes, which can trace the provenance of water masses.
Results from Drake Passage corals, collected in the Southern Ocean gateway between the Pacific and Atlantic Oceans, provide the first direct constraint on glacial and deglacial water mass mixing in this critical location. They support an emerging hypothesis that increased sea ice extent/production can shoal the boundary between upper and lower overturning cells, stratify the deep ocean, and sequester carbon. They also suggest that Southern Ocean structure, rather than Atlantic overturning strength, controls water mass sourcing in the deep Southern Ocean during the last deglaciation.