GEOTRACES GP17 proposed research: Thomas Williams, University of Florida.
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The primary focus of both my PhD (British Antarctic Survey/Cambridge University, UK) and postdoctoral research (University of Florida) has been the reconstruction of past ocean circulation within the Southern Ocean, in the main utilizing $\delta^{13}C$ and ε_{Nd}. This work has included cruises to both the SE Indian Ocean (TT1811) and Southern Ocean, including the Bellingshausen Sea region (JR298), and published work on the Amundsen Sea (Williams et al., 2019, Paleoceanography and Paleoclimatology). Both cruises included collection of CTD casts, including for ε_{Nd}, $\delta^{13}C$ and $\delta^{18}O$. As the main focus of my work to date has been employing the ε_{Nd} proxy, I am primarily interested in involvement with the collection and analysis of seawater ε_{Nd}, along lines GP17-OCE and/or GP17-ANT. Collection of seawater ε_{Nd} data along these lines would aid with characterization of key water mass ε_{Nd} signatures, as well as provide insights into boundary exchange most likely occurring along the Antarctic continental margin.

In addition, I am interested in the collection of seawater samples for the analyses of dissolved inorganic carbon concentration ([DIC]), $\delta^{13}C$ and $\delta^{18}O$ along both the GP17-OCE and GP17-ANT sections. [DIC] and $\delta^{13}C$ measurements will allow us to trace the invasion of anthropogenic carbon and the Suess Effect on $\delta^{13}C$ within waters from the SE Pacific and Southern Ocean, specifically within Subantarctic Mode Water, Antarctic Intermediate Water, and their precursor surface/subsurface waters. Estimates of rates of [DIC] and $\delta^{13}C$ change can be achieved by comparison with previously published values from the region (e.g. WOCE lines P17E/P19S/P19C/P18/S04P, and CLIVAR lines P16/P18), following the methods of Quay et. al., Science, 1992; Quay et. al., Global Biogeochemical Cycles, 2017. Additionally, $\delta^{13}C$ measurements from the Antarctic shelf will allow better constraints of the on-shelf advection of modified Circumpolar Deep Water (mCDW), believed to be the primary driver of sub-ice shelf melting within the region, and help better contextualize reconstructions of past upwelling using foraminiferal $\delta^{13}C$ in the region (e.g. Hillenbrand et al., Nature 2017).

$\delta^{18}O$ measurements will allow us to trace meltwater outflow from sub-ice shelf cavities within the westward flowing Antarctic coastal current, and better contextualize recent $\delta^{18}O$ and model-based studies of meltwater within the Amundsen and Bellingshausen seas (e.g. Biddle et al., JGR Oceans, 2019; Regan et al., Deep Sea Res. Part I, 2018; Holloway et al., Nat. Comms. 2016). $\delta^{18}O$ measurements may also aid in reconstructing the seawater-meltwater ratio of sub-ice shelf cavities, depending on how close to ice shelf fronts it is possible to reach.

The various research areas proposed here would directly contribute to the US GEOTRACES mission statement to **establish sensitivity** – e.g. of [DIC], $\delta^{13}C$ and $\delta^{18}O$ – to **changing environmental conditions** – i.e. to increasing anthropogenic contributions to atmospheric CO_2 and increased sub-ice shelf melting. It would additionally contribute directly to the GP17-OCE stated aims of **characterizing near- and far-field TEI inputs** and help investigate their impacts on seawater ε_{Nd} (e.g. boundary exchange). Finally, it would also contribute to the GP17-ANT stated aims of **quantifying gradients in the TEI distribution; characterizing sea ice, glacial and subglacial meltwater inputs** in the Amundsen Sea; determining $\delta^{13}C$ and $\delta^{18}O$ composition of mCDW **as it flows southward across the shelf break;** and **estimating advective fluxes meltwaters through the region.**