Geophysical Research Abstracts, Vol. 9, 05244, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05244

Ice-Shelf - Ocean Interactions at the Fimbul Ice Shelf, Antarctica from Oxygen Isotope Ratio Measurements

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Melt water from the floating ice shelves at the margins of the southeastern Weddell Sea make a significant contribution to the fresh water budget of the region. In February 2005 a multi-institution team conducted a campaign of oceanographic measurements at the Fimbul Ice shelf on the Greenwich Meridian as part of the UK Natural Environment Research Council's Autosub Under Ice Programme. This included a mission of the autonomous submarine Autosub 25 km into the cavity beneath the Fimbul Ice Shelf, and a number of ship-based hydrographic sections on the continental shelf and adjacent to the ice front. In addition to temperature, salinity and current measurements, we collected water samples for oxygen isotope ratio analysis.

Our measurements reveal two significant sources of glacial melt water at the Fimbul Ice Shelf: the main cavity under the ice shelf and an ice tongue that protrudes from the main ice front and out over the continental slope into deep water. The source glacial water is found to have a delta-O18 value of around -30.23 per mille. Glacial melt water is concentrated in a 200 m thick Ice Shelf Water (ISW) layer below the base of the ice shelf at 150-200 m, with a maximum glacial melt concentration of up to 1.6%. Some glacial melt is found throughout the water column, and much of this is from sources other than the Fimbul Ice Shelf, however up to 0.5% of the water in the ISW layer cannot be accounted for by other processes and must have been contributed by the Ice Shelf. Just downstream of the Fimbul Ice Shelf we observe locally created ISW mixing out across the continental slope.

The ISW formed here is much lighter than that formed in the southwest Weddell Sea, and will ultimately contribute a freshening (and reduction in O18) to the upper 100-150m of the water column in the southeast Weddell Sea.