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Antarctic Bottom Water from the Adélie and George V Land coast, East Antarctica (140–149°E)

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Abstract

We report on observations of dense shelf water overflows and Antarctic Bottom Water (AABW) formation along the continental margin of the Adélie and George V Land coast between 140–149°E. Vertical sections and bottom layer water mass properties sampled during two RVIB *Nathaniel B Palmer* hydrographic surveys (NBP00–08, Dec. 2000/Jan. 2001 and NBP04–08, Oct. 2004) describe the spreading of cold, dense shelf water on the continental slope and rise from two independent source regions. The primary source region is the Adélie Depression, exporting high salinity shelf water through the Adélie Sill at 143°E. An additional eastern source region of lower salinity dense shelf water from the Mertz Depression is identified for the first time from bottom layer properties north-west of the Mertz Sill and Mertz Bank (146–148°E) that extend as far as the Buffon Channel (144.75°E) in summer. In spring the modified shelf water on the slope is colder ($<$ -0.9°C) and there is eddy-like features that interrupt the Antarctic Slope Front over the continental slope west of 145°E that are possibly the result of cascade-induced upwelling close to the peak export season. Regional analysis of satellite derived ice production estimates over the entire region from 1992–2005 suggests that the Mertz Depression contributes up to 40% of the total ice production and is therefore likely to make a significant contribution to the total dense shelf water export from this region. Concurrent time-series from bottom mounted Microcats and ADCP instruments from the Mertz Polynya Experiment (April 1998–May 1999) near the Adélie Sill, and on the upper continental slope (1150m) and lower continental rise (3250m) to the north describe the seasonal variability in downslope events and their interaction with the ambient water masses. At the upper slope, cold dense events correlate strongly with increased speed as the warm, saline Antarctic Slope Front oscillates north-south with predominantly diurnal tides. On the continental rise, in the vicinity of the Jussieu Channel and Channel 'G' north of the Adélie Sill, weekly cold ($<$-0.8°C) and fresh ($<$ 34.63) incursions of new AABW are observed, with the peak period between July through November. The critical density for shelf water to produce AABW is examined and found to be 27.85 kg m^{-3} from the Adélie Depression and as low as 27.80 kg m^{-3} from the Mertz Depression. This study suggests previous dense shelf water export estimates based on the flow through the Adélie Sill alone are conservative, and that other regions around East Antarctica with similar ice production are likely to be contributing to the total AABW in the Australian–Antarctic Basin, in particular during the peak shelf water formation from May through October.