Preliminary results of IODP Expedition 379 (Amundsen Sea West Antarctic Ice Sheet History)

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The Amundsen Sea sector of Antarctica is the most vulnerable part of the West Antarctic Ice Sheet (WAIS) because of the great water depth at the grounding line, the absence of substantial ice shelves, and potential intrusion of relatively warmer Circumpolar Deep Water (CDW) onto the Amundsen Sea continental shelf (e.g., Hillenbrand et al., 2017, Holland et al., 2019). The WAIS has been losing ice throughout the satellite record, currently at a rate equivalent to global sea-level rise of ~4.5 cm/100 yr (2012–2017 average) (Shepherd et al., 2018). Recent models suggest that much of the Antarctic Ice Sheet could be lost even under relatively moderate greenhouse gas emission scenarios (RCP4.5) (DeConto and Pollard, 2016). Given these situations, the IODP Expedition 379 aimed to reconstruct the WAIS history during the Neogene and Quaternary to unravel driving forces of the retreat and advances of the WAIS.

During the IODP Expedition 379 in January–March 2019, persistent sea ice prevented access to all proposed continental shelf sites and abundant mobile icebergs forced loss of ~50% drilling time, however the expedition accomplished two successful drill sites (U1532 and U1533) on the continental rise of the Amundsen Sea (Gohl et al., 2019). Site U1532 drilled to a depth of 794 m below seafloor (90% recovery) and obtained a nearly continuous record from the upper Miocene to the Pleistocene (< 6.033 Ma), while site U1533 reached 383 m below seafloor with 70% recovery. These sites are located on a large sediment drift, and high sedimentation rates (10–61 cm/kyr) in the Pliocene–Miocene sequence allow us to analyze high-resolution paleoceanographic changes in this region. Both cores are characterized by cyclic lithofacies of massive muddy sediments, including higher microfossil abundance and ice-rafted debris (IRD), and laminated terrigenous muddy sediments, suggesting a possibility of repetitive cycles corresponding to interglacial and glacial cycles (Gohl et al., 2019).
Pb is mainly supplied to the ocean by continental weathering, and its particle reactive nature results in shorter residence time (20–400 yrs) in the ocean. These geochemical characteristics make it useful for investigating region-specific continental weathering, and paleo-seawater records of Pb isotope compositions can be obtained from Fe-Mn oxide leaching of marine sediments. Preliminary data on Fe-Mn oxide Pb isotopes ($^{206,207,208}Pb/^{204}Pb$) of massive muddy sediments from U1532 showed systematically lower values compared to those of laminated terrigenous muddy sediments, suggesting that weathering intensity in western Antarctica with relatively unradiogenic Pb were increased during the intervals with higher abundance of microfossil and IRD. Post-expedition studies on mineralogical and geochemical analyses of IRD, microfossil analyses, organic geochemical analyses done by exp. 379 scientists will further improve our understanding of the WAIS history over the glacial–interglacial and longer timescales in the Pliocene.

Keywords: IODP, Amundsen Sea, West Antarctic Ice Sheet, Pliocene

