Fingerprinting the provenance of marine sediments off West Antarctica

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The West Antarctic Ice Sheet is currently loosing mass at an accelerating rate. A powerful way to constrain its stability under warmer than present conditions is to study the geochemical provenance of marine sediments in the past. A good knowledge of modern shelf sediment composition and its relationship to continental geology is, however, paramount. Here we present new geochemical data on the detrital fraction of 45 marine core top sediments in proximal to distal locations to West Antarctica. All samples were analysed for major and trace elements, strontium (Sr) and neodymium (Nd) isotopic compositions of the fine-grained (<63μm) fraction, and hornblende and biotite $^{40}Ar/^{39}Ar$ ages of the iceberg-rafted sediment fraction (>150μm).

The geochemical fingerprint of marine sediments in proximity to exposed continental geology, such as in Marie Byrd Land or the southern Antarctic Peninsula, reveals excellent agreement between onshore and offshore compositions. In areas where hinterland outcrops are scarce, such as the Amundsen Sea Embayment (ASE), shelf sediment geochemistry can reveal information about the geology hidden under the ice. The western ASE is characterised by uniform Sr and Nd isotopic compositions from near shore to the shelf break ($^{87}Sr/^{86}Sr$: 0.709-0.710 and ε_{Nd}: -2.2 to -2.8). This observation either points to a very homogeneous source rock in the direct hinterland, or a very constrained area of modern erosion. In contrast, proximal to distal sediments from the eastern ASE show a significantly larger range in Sr and Nd isotopic compositions ($^{87}Sr/^{86}Sr$: 0.708-0.724 and ε_{Nd}: -1.9 to -7.2), indicating that the geological provenance of the Pine Island Glacier drainage basin has a distinct isotopic composition compared to surrounding areas that shed sediment onto the shelf. Similar mixing trends across the shelf can be observed in the Bellingshausen Sea.

Overall, geochemical analysis of detrital marine sediments off West Antarctica offers insights into continental geology, sedimentary mixing and transport pathways on the continental shelf. As such our results look very promising for reconstructing past changes and their relation to ice sheet dynamics in future down-core studies.