Tracking ice-sheet dynamics by detrital feldspar Pb-isotope and $^{87}$Rb/$^{87}$Sr dating during the Middle Miocene Climatic Transition, Weddell Sea, Antarctica

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1 - Introduction and Motivation

- The Mid-Miocene Climate Transition is marked by an eccentricity-dominated, high CO2 climate (c. 350-400 ppm), making this a potentially useful analogue for modern anthropogenic warming.
- We aim to use sedimentary provenance, by linking ice-rafted debris to bedrock data, to understand ice-sheet instability during the Mid-Miocene Climatic Transition.
- We use in-situ Rb-Sr dating (LA-ICP-MS) for source terrane fingerprinting (Flowerdew et al. 2012).

2 - Preliminary Results

- Mesozoic Rb-Sr age peak corresponds to bedrock data by Flowerdew et al. (2012). Red - Dronning Maud Land (DML). Blue - West Antarctica (WA), Pink - Shackleton Range (SR), Yellow - Ellsworth (EW), Orange - Pensacola (P).
- This indicates active iceberg calving in the region during the MMCT.
- Precambrian Rb-Sr age peaks correspond to southern Dronning Maud Land derived IRD, as bedrock ages were determined from the Antarctic Peninsula (Fig. 1).
- Plagioclase Pb-isotope data indicates source terranes corresponding to West Antarctica, Dronning Maud Land and Shackleton Ranges, as bedrock values by Flowerdew et al. (2012). Red - Dronning Maud Land (DML). Blue - West Antarctica (WA), Pink - Shackleton Range (SR), Yellow - Ellsworth (EW), Orange - Pensacola (P).

3 - Preliminary Interpretations

- Mid-Miocene Climate Optimum for sea surface temperature. The Mid-Miocene Climate Transition is depicted. While this transition marks an expansion of the Antarctic Ice Sheet, IRD samples deposited 14.12, 14.15, and 14.26 Ma indicate an unstable period.
- This indicates active iceberg calving in the region during the MMCT.

Fig. 1 - Ice sheet thickness in response to a warm climate interval simulation (500 ppm CO2 and astronomically favourable conditions for deglaciation). Approximate Mid-Miocene bedrock topography used. From Gasson et al. (2016). Red circles indicate source area of IRD for the observed age peaks (Fig. 3). See Fig. 4 caption for source terrane abbreviations. Inset from Budge and Long (2018), showing iceberg tracks around Antarctica.

Fig. 2 - Global deep-sea oxygen records modified after Zachos et al. (2001). $^{18}$O curve is a proxy for sea surface temperature. The Mid-Miocene Climate Optimum and the Climate Transition are depicted. Star symbols showing sample origins.

Fig. 3 - Model $^{87}$Rb/$^{87}$Sr age density plots of K-feldspar from three samples from ODP113-694. a) Data for coarser (red) and finer (black) size fractions depicted. Ages of deposition shown on each figure. Age peaks present at Mesozoic, Neoproterozoic, and Late Mesoproterozoic.

Fig. 4 - Plagioclase Pb-isotope data from three samples. Coloured regions indicate bedrock data by Flowerdew et al. (2012). Red - Dronning Maud Land (DML). Blue - West Antarctica (WA), Pink - Shackleton Range (SR), Yellow - Ellsworth (EW), Orange - Pensacola (P).

Fig. 5 - Global deep-sea oxygen records modified after Zachos et al. (2001). $^{18}$O curve is a proxy for sea surface temperature. The Mid-Miocene Climate Transition is depicted. While this transition marks an expansion of the Antarctic Ice Sheet, IRD samples deposited 14.12, 14.15, and 14.26 Ma indicate an unstable period.

Fig. 6 - 3D plot of $^{206}$Pb/$^{204}$Pb, $^{207}$Pb/$^{204}$Pb, and $^{187}$Sr/$^{166}$Sr of plagioclase samples acquired from ODP113-694.