EGU21-9151, updated on 04 Mar 2021
https://doi.org/10.5194/egusphere-egu21-9151
EGU General Assembly 2021

U-Pb zircon geochronology of dropstones and IRD in the Amundsen Sea, applied to the question of bedrock provenance and Miocene-Pliocene ice sheet extent in West Antarctica

Christine Siddoway et al.

IODP Expedition 379 to the Amundsen Sea continental rise recovered latest Miocene-Holocene sediments from two sites on a drift in water depths >3900m. Sediments are dominated by clay and silty clay with coarser-grained intervals and ice-rafted detritus (IRD) (Gohl et al. 2021, doi:10.14379/iodp.proc.379.2021). Cobble-sized dropstones appear as fall-in, in cores recovered from sediments >5.3 Ma. We consider that abundant IRD and the sparse dropstones melted out of icebergs formed due to Antarctic ice-sheet calving events. We are using petrological and age characteristics of the clasts from the Exp379 sites to fingerprint their bedrock provenance. The results may aid in reconstruction of past changes in icesheet extent and extend knowledge of subglacial bedrock.

Mapped onshore geology shows pronounced distinctions in bedrock age between tectonic provinces of West or East Antarctica (e.g. Cox et al. 2020, doi:10.21420/7SH7-6K05; Jordan et al. 2020, doi.org/10.1038/s43017-019-0013-6). This allows us to use geochronology and thermochronology of rock clasts and minerals for tracing their provenance, and ascertain whether IRD deposited at IODP379 drillsites originated from proximal or distal Antarctic sources. We here report zircon and apatite U-Pb dates from four sand samples and five dropstones taken from latest Miocene, early Pliocene, and Plio-Pleistocene-boundary sediments. Additional Hf isotope data, and apatite fission track and $^{40}Ar/^{39}Ar$ Kfeldspar ages for some of the same samples help to strengthen provenance interpretations.

The study revealed three distinct zircon age populations at ca. 100, 175, and 250 Ma. Using Kolmogorov-Smirnov (K-S) statistical tests to compare our new igneous and detrital zircon (DZ) U-Pb results with previously published data, we found strong similarities to West Antarctic bedrock, but low correspondence to prospective sources in East Antarctica, implying a role for icebergs calved from the West Antarctic Ice Sheet (WAIS). The ~100 Ma age resembles plutonic ages from Marie Byrd Land and islands in Pine Island Bay. The ~250 and 175 Ma populations match published mineral dates from shelf sediments in the eastern Amundsen Sea Embayment as well as granite ages from the Antarctic Peninsula and the Ellsworth-Whitmore Mountains (EWM). The different derivation of coarse sediment sources requires changes in iceberg origin through the latest Miocene, early Pliocene, and Plio/Pleistocene, likely the result of changes in WAIS extent.

One unique dropstone recovered from Exp379 Site U1533B is green quartz arenite, which yielded mostly 500-625 Ma detrital zircons. In visual appearance and dominant U-Pb age population, it resembles a sandstone dropstone recovered from Exp382 Site U1536 in the Scotia Sea (Hemming et al. 2020, https://gsa.confex.com/gsa/2020AM/meetingapp.cgi/Paper/357276). K-S tests yield high values ($P \geq 0.6$), suggesting a common provenance for both dropstones recovered from late Miocene to Pliocene sediments, despite the 3270 km distance separating the sites. Comparisons to published data, in progress, narrow the group of potential on-land sources to exposures in the EWM or isolated ranges at far south latitudes in the Antarctic interior. If both dropstones originated from the same source area, they could signify dramatic shifts in the WAIS grounding line position, and the possibility of the periodic opening of a seaway connecting the Amundsen and Weddell Seas.

How to cite: Siddoway, C., Thomson, S., Hemming, S., Buchband, H., Quigley, C., Furlong, H., Hilderman, R., Robinson, D., Watkins, C., Cox, S., and Licht, K. and the IODP Expedition 379 Scientists and Expedition 382 Scientists: U-Pb zircon geochronology of dropstones and IRD in the Amundsen Sea, applied to the question of bedrock provenance and Miocene-Pliocene ice sheet extent in West Antarctica, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-9151, https://doi.org/10.5194/egusphere-egu21-9151, 2021.

Display materials

Display file

Comments on the display material

Login to access the discussion