In-situ temperature measurements for deriving geothermal heat flux in the Amundsen Sea Embayment, West Antarctica

Ricarda Dziadek[1], Karsten Gohl[1], Norbert Kaul[2]

[1]Alfred Wegener Institute, Helmholtz-Centre for Polar and Marine Research, Bremerhaven, Germany, ricarda.dziadek@awi.de
[2]University of Bremen, Department of Geosciences, Bremen, Germany

Abstract

Elevated and/or spatially variable geothermal heat flux (GHF) is suspected to affect basal conditions of ice sheets, i.e. basal melting and subglacial hydrology. Thermomechanical models demonstrate the influential boundary condition of geothermal heat flux for (paleo) ice sheet stability. Due to a complex tectonic and magmatic history of West Antarctica, the region is suspected to exhibit strong heterogeneous geothermal heat flux variations [e.g. Schroeder et al., 2014; Fisher et al., 2015]. Although the maximum ice extent has retreated from the shelf since the last glacial maximum, the trends of offshore GHF patterns and the overall order of magnitude are hypothetically related to those areas onshore where the West Antarctic Ice Sheet (WAIS) rests on geologically related structures. High-resolution GHF will aid the understanding of the paleo-retreat of the ice sheet in this sector. The problem with testing these possibilities is that direct observations of GHF in Antarctica are so sparse that it is accounted for the greatest source of uncertainty in ice sheet studies for the continent [Larour et al., 2012].
This presentation builds on our previous studies in which we discussed geothermal heat flux based on 26 in-situ temperature measurements that were conducted in 2010 in the Amundsen Sea Embayment (ASE) in West Antarctica. We found, that the shallow (3 m) in-situ temperature measurements were likely influenced by inter-annual bottom-water temperature variability, leading to GHF estimates biased towards lower values (mean = 33 mWm^{-2}). In contrast, our numerical models of geothermal heat fluxes, based on Depth-to-the-Bottom-of-the-Magnetic-Source estimates, suggest that GHF spatially varies from 68 to 110 mWm^{-2}. During RV *Polarstern* expedition PS104 in early 2017 we collected additional 28 in-situ temperature measurements in marine sediments (up to 11 m probe depth) for deriving geothermal heat flux in the ASE, which will overall improve the spatial coverage of this region. We present GHF results of this novel data set and discuss challenges of measuring in-situ temperatures for GHF in the Amundsen Sea Embayment.

Keywords: Geothermal heat flux, West Antarctica, in-situ temperature measurements

References

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