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4D Antarctica: recent aeromagnetic, aerogravity and satellite data compilations provide a new tool to estimate subglacial geothermal heat flux

Fausto Ferraccioli[1,2], Ben Mather[3], Egidio Armadillo[4], Rene Forsberg[5], Jörg Ebbing[6], Jonathan Ford[1], Karsten Gohl[7], Graeme Eagles[7], Chris Green[8], Javier Fullea[9], Massimo Verdoya[4], and Juan Luis Carillo de la Cruz[10]
[1]Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Sezione di Geofisica, Trieste, Italy e-mail: fferraccioli@inogs.it
[2]NERC/British Antarctic Survey, Cambridge- UK
[3]University of Sydney, EarthByte Group, Sydney, Australia (e-mail: ben.mather@sydney.edu.au)
[4]Universita' degli studi di Genova, Dipartimento di Scienze della Terra dell'Ambiente e della Vita, Genova, Italy (egidio.armadillo@unige.it)
[5]National Space Institute, Technical Institute of Denmark, Lyngby, Denmark (rf@space.dtu.dk)
[6]Christian-Albrechts-Universität Kiel, Kiel Marine Science, Kiel, Germany (joerg.ebbing@ifg.uni-kiel.de)
[7]Alfred Wegener Institute, Geosciences, Bremerhaven, Germany (graeme.eagles@awi.de)
[8]University of Leeds, School Earth and Environment, Leeds, UK (C.M.Green@leeds.ac.uk)
[9]Universidad Complutense de Madrid, Madrid, Spain (jfullea@ucm.es)
[10]Comisión Nacional del Agua. Mexico

Geothermal heat flux (GHF), coupled with subglacial topography and hydrology, influences the flow of the overlying Antarctic ice sheet. GHF is related to crustal and lithospheric structure and composition and tectonothermal evolution, and is also modulated by subglacial sedimentary basins and bedrock morphology. Despite its importance for both solid earth and cryosphere studies, our knowledge of Antarctic GHF heterogeneity remains limited compared to other continents- especially at regional scale. This is due to the paucity of direct measurements and the spatial gap wrt much larger scale geophysical proxies for GHF, based on continental-scale magnetic and seismological predictions that also differ considerably from each other in several regions. To reduce this major knowledge gap, the international community is increasingly active in analysing geophysical, geological and glaciological datasets to help constrain GHF (e.g. Burton-Johnson et al., *SCAR-SERCE White Paper*, 2020). Here we focus on 4D Antarctica- an ESA project that aims to help link bedrock, crust, lithosphere and GHF studies, by analysing recent airborne and satellite-derived potential field datasets.

We present our recent aeromagnetic, aerogravity and satellite data compilations for 5 study regions, including the Amundsen Sea Embayment sector of the West Antarctic Ice Sheet (e.g. Dziadek et al., 2021- *Communications Earth & Environment*) and the Wilkes Subglacial Basin (WSB), the Recovery glacier catchment, the South Pole and Gamburtsev Subglacial Mountains and

East Antarctic Rift region. We apply Curie Depth Point (CDP) estimation on existing aeromagnetic datasets and compilations in our study regions conformed with SWARM satellite magnetic data (Ebbing et al., 2021- *Scientific Reports*). We tested the application of different methods, including the centroid (e.g. Martos et al., 2017, *GRL*) and Bayesian inversion approaches of Curie depth and uncertainty (e.g. Mather and Fullea, 2019- *Solid Earth*) and defractal and geostatistical methods (e.g. Carrillo-de la Cruz et al., 2021- *Geothermics*). We then compare our CDP results with crust and lithosphere thickness and interpretations of crustal and lithospheric setting.

Using our new aeromagnetic interpretations we define Precambrian and early Paleozoic subglacial basement in East Antarctica that is mostly concealed beneath Phanerozoic sedimentary basins and ice sheet cover. This enables us to discuss whether different basement provinces differ in terms of CDP estimates (as expected), or if these are either not or only partially resolved. A particularly informative case is the WSB. Here our magnetic assessments of GHF heterogeneity for the Terre Adelie Craton, Wilkes Terrane and Ross Orogen can be indirectly tested by exploiting independent geological and geophysical information derived from their Australians correlatives, namely the Gawler and Curnamona cratons and the Delamerian Orogen.

Our Curie depth estimates yield geologically reasonable thermal boundary conditions required to initialise new thermal modelling efforts in several study areas. However, developing 3D models of crust and lithosphere thickness and intracrustal composition (as a proxy for the ranges of radiogenic heat production and thermal conductivity) with reasonably detailed crustal architecture, derived from both potential field and seismological datasets is a key next step to constrain Antarctic geothermal heat flux heterogeneity at higher-resolution ice stream scale.