Geophysical Research Abstracts
Vol. 19, EGU2017-9277, 2017
EGU General Assembly 2017

Melting at the base of the Greenland Ice Sheet explained by the Iceland mantle plume history

Irina Rogozhina (1,2), Alexey G. Petrunin (3,2,4), Alan P. M. Vaughan (5,6), Bernhard Steinberger (2,7), Jesse V. Johnson (8), Mikhail K. Kaban (2,4), Reinhard Calov (9), Florian Rickers (10), Maik Thomas (2,11), Ivan Koulakov (12,13)

(1) University of Bremen, Center for Marine Environmental Sciences, Faculty of Geosciences, Bremen, Germany (valmont@gfz-potsdam.de), (2) Helmholtz Centre Potsdam GFZ German Research Centre For Geosciences, Potsdam, Germany, (3) Faculty of Earth Sciences, Goethe University, Frankfurt am Main, Germany, (4) Schmidt Institute of Physics of the Earth, Moscow, Russia, (5) Midland Valley Exploration Ltd, Glasgow, UK, (6) Department of Geology, Trinity College, Dublin, Ireland., (7) Centre for Earth Evolution and Dynamics (CEED), University of Oslo, Oslo, Norway, (8) Department of Computer Science, The University of Montana, Missoula, Montana, USA, (9) Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany, (10) Department of Earth Sciences, Utrecht University, Utrecht, The Netherlands, (11) Berlin Free University, Institute of Meteorology, Faculty of Geosciences, Berlin, Germany, (12) Institute of Petroleum Geology and Geophysics, Novosibirsk, Russia, (13) Geological Department, Novosibirsk State University, Novosibirsk, Russia

Ice-penetrating radar measurements and ice core drilling have shown that large parts of the north-central Greenland Ice Sheet are melting from below. Locally these observational data indicate that an anomalously high geothermal flux is needed to explain the observed basal ice melting. In this study we reconstruct the distribution of geothermal flux in Greenland and identify a large-scale geothermal anomaly beneath the thick ice cover. The anomaly represents a continuous 400-km-wide band of elevated heat flux, crossing Greenland from west to east. Our combined analysis of seismic, gravity and tectonic data links the origin of this anomaly to Greenland's passage over the Iceland mantle plume between roughly 80 and 35 million years ago. Most of the observed subglacial melting as well as previously suggested hydrological networks operating under the ice sheet occur within the anomalous zone. Also the position of the enigmatic 750-km-long northeastern Greenland ice stream is controlled by the enhanced ice deformation and basal sliding induced by the elevated heat flux. This rapid ice flow initiates at the very heart of the reconstructed anomaly, where our study and observations indicate some of the highest rates of basal ice melting in interior Greenland. Our findings suggest that the present-day subglacial hydrology and rapid ice flow of the north-central Greenland Ice Sheet have their origin in tectonic events that predate the onset of Greenland glaciations by many tens of millions of years.