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Revealing the tectonic evolution and distribution of crustal heating in West Antarctica from aeromagnetics

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West Antarctica hosts the large West Antarctic Rift System (WARS), a region of continental extension characterized by active volcanism and elevated geothermal flux which has formed during several stages of rift reactivation from the Cretaceous through the Cenozoic.

The Marie Byrd Land ice dome (MBL) hosts a number of subaerial Miocene volcanic centers and propagating volcanic chains. Subglacial volcanic activity has been documented along the Executive Committee Range volcanic chain in MBL where a swarm of deep long-period earthquakes was registered in 2010 and 2011 by the POLENET seismic network. Moreover, anomalously high geothermal flux has been reported within WARS at the WAIS Divide ice core drilling site and Subglacial Lake Whillans, which is consistent with estimates in the Thwaites Glacier catchment from airborne radar based techniques.

In this presentation we 1) evaluate the distribution of potential hotspots in central WARS from analysis of magnetic anomalies in the context of other aerogeophysical data such as structures in the bed topography detected from ice penetrating radar; 2) identify different stages of tectonic and magmatic activity in WARS, each characterized by distinct magnetic and topographic character; 3) evaluate potential ramifications for heat flux distribution and contemporary ice sheet evolution in West Antarctica.

Our interpretation supports both the hypothesis that MBL was tectonically and magmaticaly reactivated multiple times during the Cretaceous and that a hotspot was emplaced there later in the Cenozoic, therefore pointing to a hotter MBL compared to Thwaites and Pine Island Glaciers.