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A Song of Fire and Ice: decadal investigation of the Antarctic geothermal heat flux and its implications on the Antarctic Ice Sheet instability

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The Antarctic Ice Sheet (AIS), a ~ 2-km thick, permanent ice body and covering more than 98% of the polar continent, is an important component of the global climate system. Affected by human activities such as the warming sea water, AIS is also responding to a variety of Earth processes on a range of timescales. Geothermal heat flux (GHF), the rate of heat transfer across the ice-rock interface, is an important boundary condition of the AIS: it plays key roles in the accurate modeling of the past ice sheet states, and determination of the sub-ice environment and distribution of sub-ice hydro systems. Although evolving slowly compared with other boundary conditions, GHF of Antarctica can be affected by a variety of tectonic activities and geological features, such as continental rifting, sub-ice volcanoes, and concentration of heat generation elements in the crust, and thus provides additional information about the geological history of the frozen continent. However, the scientific importance of GHF of Antarctica, is contrasted by the extremely limited direct measurements, owing to the remoteness of Antarctica and the coverage of the thick ice sheet. Indirect tools provided by geophysical measurements (e.g., seismological constraints) thus have been developed and applied over the past decades. In this presentation, I will summarize decades of effort in constraining the GHF of Antarctica and exhibit its implications on the geological history and instability of the AIS. Field works in Antarctica to collect seismic data and its processing to map the GHF will be particularly presented.

As a trained seismologist, Weisen Shen has participated in the internationally collaborated POLNET project and deployed/serviced/decommissioned multiple seismic stations in Antarctica through his multiple trips to the frozen continent. He has visited McMurdo and the South Pole stations, and camped on ice near the Siple Dome on the Ross Ice Shelf. He obtained his Ph.D. from the Department of Physics at the University of Colorado Boulder in 2014, and started working at the Department of Geosciences at Stony Brook University after he finished a 2-year postdoc training in Washington University in St Louis.