Heat source under Antarctica melting its ice sheet: NASA

The Thwaites Glacier in West Antarctica. | Photo Credit: AP

A geothermal heat source called mantle plume lies deep below Antarctica's Marie Byrd Land, explaining some of the melting that creates lakes and rivers under the ice sheet, a NASA study has found.

Although the heat source is not a new or increasing threat to the West Antarctic ice sheet, it may help explain why the ice sheet collapsed rapidly in an earlier era of abrupt climate change, and why it is so unstable today.

The stability of an ice sheet is closely related to how much water lubricates it from below, allowing glaciers to slide more easily, NASA said.

Understanding the sources and future of the meltwater under West Antarctica is important for estimating the rate at which ice may be lost to the ocean in the future.

Antarctica's bedrock is laced with rivers and lakes, the largest of which is the size of Lake Erie.

Many lakes fill and drain rapidly, forcing the ice surface thousands of feet above them to rise and fall by as much as six metres. The motion allows scientists to estimate where and how much water must exist at the base.

About 30 years ago, a scientist at the University of Colorado Denver in the US suggested that heat from a mantle plume under Marie Byrd Land might explain regional volcanic activity and a topographic dome feature. Very recent seismic imaging has supported this concept.

"I thought it was crazy. I didn't see how we could have that amount of heat and still have ice on top of it," said Helene Seroussi of NASA's Jet Propulsion Laboratory (JPL) in California.

With few direct measurements existing from under the ice, Seroussi and Erik Ivins of JPL concluded the best way to study the mantle plume idea was by numerical modelling.

They used the Ice Sheet System Model (ISSM), a numerical depiction of the physics of ice sheets.

Seroussi enhanced the ISSM to capture natural sources of heating and heat transport from freezing, melting and liquid water; friction; and other processes.

To assure the model was realistic, the scientists drew on observations of changes in the altitude of the ice sheet surface made by NASA's IceSat satellite and airborne Operation IceBridge campaign.

"These place a powerful constraint on allowable melt rates — the very thing we wanted to predict," Ivins said.

Since the location and size of the possible mantle plume were unknown, they tested a full range of what was physically possible for multiple parameters, producing dozens of different simulations.

They found that the flux of energy from the mantle plume must be no more than 150 milliwatts per square metre.

Seroussi and Ivins' simulations using a heat flow higher than 150 milliwatts per square meter showed too much melting to be compatible with the space-based data, except in one location: an area inland of the Ross Sea known for intense flows of water.

This region required a heat flow of at least 150-180 milliwatts per square meter to agree with the observations.

However, seismic imaging has shown that mantle heat in this region may reach the ice sheet through a rift, that is, a fracture in Earth's crust such as appears in Africa's Great Rift Valley.

Sundarbans proved a challenge for camera traps and GPS collars

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