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NEWS FROM THE UNIVERSITY OF TASMANIA, AUSTRALIA

Media Release

Chiefs of Staff, News Directors

Tuesday 26 May 2015

Geoscience research makes the mystery of Earth's formation a little clearer

Research led by a University of Tasmania marine geoscientist at the Institute for Marine and Antarctic Studies (IMAS) has produced new information about how the world has formed.

Dr Jo Whittaker, IMAS senior lecturer in marine geophysics, led the international team undertaking the research, which was published today in the journal *Nature Geoscience*.

The paper, *Long-term interaction between mid-ocean ridges and mantle plumes*, was co-authored by scientists from Macquarie, Leeds, Sydney and Hawaii universities.

Underwater spreading ridges in the world's ocean basins are where tectonic plates separate and new ocean floor is formed from molten and other viscous rock. Much larger amounts of such rock can also reach Earth's surface via channels, or plumes, from up to ~2900 kilometres deep within the Earth.

Mantle plumes and the massive magmatism they cause have been thought to occur independently from plate tectonic motions on Earth's surface.

"In this paper we show that these massive eruptions almost always occur where a mantle plume interacts with a mid-ocean ridge, where new oceanic crust is created as the tectonic plates separate," Dr Whittaker said.

Dr Whittaker's work was a global synthesis study, using a plate tectonic model for the past 200 million years using reconstructed plate tectonic boundaries (mid-ocean ridge locations, subduction zones), plume locations and Large Igneous Provinces.

Iceland is the prime example of where a plume interacts with a mid-ocean ridge. Other examples of massive eruptions include much of the Kerguelen Plateau, formed approximately 100 million years ago as a massive volcanic eruption.

"The cause of the Kerguelen eruption was the arrival of a plume or channel bringing hot, buoyant material from deep within the Earth to the crust that we inhabit," Dr Whittaker said.

She said the research team showed that the locations where plumes and spreading ridges interact have been remarkably stable over at least the past 180 million years, with repeated massive eruptions interspersed by tens of millions of years.

Dr Whittaker said the importance for geoscience is the idea that mantle upwellings in the form of mantle plumes are coupled with surface plate tectonic motions, contrary to what has been previously thought.

"Our research shows that mantle plumes may form the link between the very deep mantle (core-mantle boundary) and where new seafloor is created on the surface of the Earth, and that these connections are stable over very long periods of time.

"We could show the relationship extending back 180 million years, but it may have existed for much longer than this (other studies are suggesting 540 million to 3 billion years).

“Our results suggest for the first time that surface plate tectonic boundaries and processes are linked by plumes to these locations in a pattern than can remain stable for tens or possibly 100s of millions of years,” she says.

In the future, the link between the deep Earth and surface by mantle plumes will likely be incorporated into 4D (3D space and time) simulations of the evolution of the Earth, which are used for many purposes including predicting where hydrocarbon and mineral deposits are most likely to be and how ancient climate and oceanographic systems operated.

View the paper at: http://dx.doi.org/10.1038/ngeo2437

Information released by:
Communications and Media Office, University of Tasmania
Phone: 61 3 6324 5019
Email: Lana.Best@utas.edu.au