PHYS.ORG

Geochemists challenge key theory regarding Earth's formation

May 1 2008

Working with colleagues from NASA, a Florida State University researcher has published a paper that calls into question three decades of conventional wisdom regarding some of the physical processes that helped shape the Earth as we know it today.

Munir Humayun, an associate professor in FSU's Department of Geological Sciences and a researcher at the National High Magnetic Field Laboratory, co-authored a paper, "Partitioning of Palladium at High Pressures and Temperatures During Core Formation," that was recently published in the peer-reviewed science journal Nature

Geoscience. The paper provides a direct challenge to the popular "late veneer hypothesis," a theory which suggests that all of our water, as well as several so-called "iron-loving" elements, were added to the Earth late in its formation by impacts with icy comets, meteorites and other passing objects.

"For 30 years, the late-veneer hypothesis has been the dominant paradigm for understanding Earth's early history, and our ultimate origins," Humayun said. "Now, with our latest research, we're suggesting that the late-veneer hypothesis may not be the only way of explaining the presence of certain elements in the Earth's crust and mantle."

To illustrate his point, Humayun points to what is known about the Earth's composition.

"We know that the Earth has an iron-rich core that accounts for about one-third of its total mass," he said. "Surrounding this core is a rocky mantle that accounts for most of the remaining two-thirds," with the thin crust of the Earth's surface making up the rest.

"According to the late-veneer hypothesis, most of the original iron-loving, or siderophile, elements" -- those elements such as gold, platinum, palladium and iridium that bond most readily with iron -- "would have been drawn down to the core over tens of millions of years and thereby removed from the Earth's crust and mantle. The amounts of siderophile elements that we see today, then, would have been supplied after the core was formed by later meteorite bombardment. This bombardment also would have brought in water, carbon and other materials essential for life, the oceans and the atmosphere."

To test the hypothesis, Humayun and his NASA colleagues -- Kevin Righter and Lisa Danielson -- conducted experiments at Johnson Space Center in Houston and the National High Magnetic Field Laboratory in

Tallahassee. At the Johnson Space Center, Righter and Danielson used a massive 880-ton press to expose samples of rock containing palladium -- a metal commonly used in catalytic converters -- to extremes of heat and temperature equal to those found more than 300 miles inside the Earth. The samples were then brought to the magnet lab, where Humayun used a highly sensitive analytical tool known as an inductively coupled plasma mass spectrometer, or ICP-MS, to measure the distribution of palladium within the sample.

“At the highest pressures and temperatures, our experiments found palladium in the same relative proportions between rock and metal as is observed in the natural world,” Humayun said. “Put another way, the distribution of palladium and other siderophile elements in the Earth’s mantle can be explained by means other than millions of years of meteorite bombardment.”

The potential ramifications of his team’s research are significant, Humayun said.

“This work will have important consequences for geologists’ thinking about core formation, the core’s present relation to the mantle, and the bombardment history of the early Earth,” he said. “It also could lead us to rethink the origins of life on our planet.”

Source: Florida State University

Citation: Geochemists challenge key theory regarding Earth's formation (2008, May 1) retrieved 20 April 2024 from https://phys.org/news/2008-05-geochemists-key-theory-earth-formation.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is

provided for information purposes only.