SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

Press Release

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Streaky Upper Mantle Shows its Stretch Marks

Honolulu, HI – Scientists from Oregon, Hawaii, and France have found ancient material distributed in 40 km thick streaks in the mantle beneath the Indian Ocean. The study, published in the March 9, 2006 issue of the journal Nature, used isotopes of the elements halfnium (Hf) and Neodymium (Nd) in sea floor volcanic rocks collected from over 3000 km along the mid-ocean ridge to determine the size and number of streaks in the Indian Ocean upper mantle.

“The presence of streaks with the size distribution observed in this study has important implications for investigators trying to model the convective process that stir the Earth’s upper mantle,” says lead author David Graham of Oregon State University. “It is only one part of the puzzle of trying to understand the chemical evolution of the Indian Ocean mantle, and it was a surprising result that was only evident by the collection of closely located samples along the mid-ocean ridge.”

The mantle is the rocky outer portion of the Earth extending from the base of the crust down to the top of its core some 2700 km below. It behaves like a fluid on geological time scales, slowly stirring Earth’s interior as rock slabs of Earth’s surface sink downward at subduction zones, such as beneath the Cascadia margin of Oregon. Rising plumes beneath hotspots (for instance, the island of Hawaii) add to the motion, which helps to stir the remnants of subducting plates into the mantle, where they are stretched and thinned by the motions; some of this material is then brought back to near the mantle’s upper surface.

“Mid-ocean ridge volcanism draws magmas from the upper mantle, and such lavas carry information about the mantle below;” says co-author Ken Rubin of the University of Hawaii at Manoa. “The heavy, naturally occurring isotopes used in this study trace different compositional zones in the mantle in high resolution in part because the isotopic compositions are not changed during mantle melting to form ocean ridge magmas.”

Other studies have also suggested such streaks exist beneath rare, isolated localities on the continents, but the new research suggests that such streaks may be widespread in the upper mantle. “New data sets comparable to this one in terms of their spatial resolution and analytical precision have recently been obtained or are currently the focus of ongoing studies at several other ridge spreading centers in the Indian and Atlantic oceans,” adds Graham. “We also are obviously still interested in further evaluating the streak idea from more detailed analytical work and sampling along the Southeast Indian Ridge itself, because the size of the bands we think we have detected is very close to our sampling resolution.”

The study was funded by the National Science Foundation (United States) and INSU (France), and involved analyses of volcanic rock samples collected from more than 2 miles below the sea surface. The team of researchers included David Graham and Christopher Russo from Oregon State University, Prof. Kenneth Rubin from the University of Hawaii, and Drs. Janne Blichert-Toft and Francis Albarede from the Ecole Normale Superiere in Lyon, France.

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