SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY
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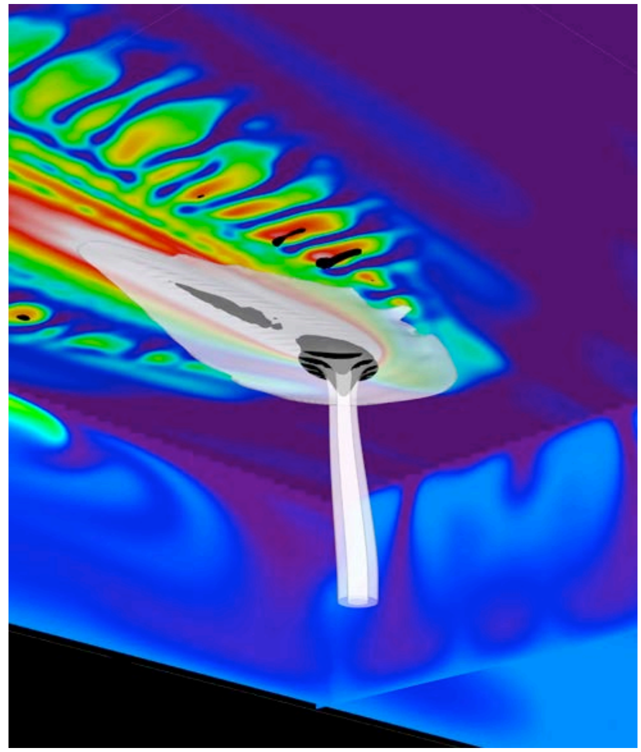
Hawaiian hotspot variability attributed to small-scale convection



Three-dimensional image showing predicted mantle temperatures (blue = warm, red=hot, white = hottest) and a plume of hot mantle rising beneath the Hawaiian hotspot.
Image courtesy Maxim Ballmer, SOEST/UHM

Honolulu, HI – Small scale convection at the base of the Pacific plate has been simulated in a model of mantle plume dynamics, enabling reasearchers to explain the complex set of observations at the Hawaiian hotspot, according to a new study posted online in the June 26th edition of Nature Geoscience. "A range of observations cannot be explained by the classical version of the mantle plume concept," says Maxim Ballmer, Post Doctoral Researcher in the Department of Geology and Geophysics in the School of Ocean and Earth Science and Technology (SOEST) at UHM. These observations include the occurrence of secondary volcanism away from the hotspot (e.g., Diamond Head, Punchbowl, Hanauma Bay), as well as the chemical asymmetry (Mauna Loa compared to Mauna Kea) and temporal variability (over timescales greater than 10,000,000 years) of hotspot volcanism itself.

Ballmer and colleagues, including advisor Garrett Ito, Associate Professor, in the Department of Geology and Geophysics in the SOEST at UHM, designed a geodynamic model of the mantle that successfully predicts a large range of observations thus providing insight into the composition and dynamics of the mantle. Ballmer says the findings of their model, "make an important contribution toward understanding the origin of volcanism away from plate boundaries. This is a long-standing question in our community that potentially provides general insight into the dynamics of our planet, and particularly into the make-up of the deepest mantle, from where mantle plumes originate. For many reasons, understanding the deepest mantle is relevant for questions about the early days of Earth, and the origin of water and life."

These findings came as a bit of a surprise. Although small-scale convection was one hypothesis for explaining late-stage rejuvenated volcanism on the islands, Ito reports, "this study is the first to qualitatively explore this mechanism and to show that it can explain both rejuvenated as well as arch volcanism, well away from the islands."

As a next step in understanding mantle dynamics, Ballmer hopes to explain some of the characteristics of the Hawaiian plume that have been revealed by SOEST – UHM colleague Cecily Wolfe using seismic earthquake tomography. To do this, he will simulate a thermochemical mantle plume, which in some ways behaves similarly to the upwellings in lava lamps. A thermochemical plume is a plume that is hot (i.e. thermally buoyant), but compositionally dense. Such a plume typically behaves more complicatedly than a classical plume.

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