Origin of the bilateral structure of Pacific plume conduits

CINZIA G. FARNETANI[1 (*)], ALBRECHT W. HOFMANN[2,3], AND CORNELIA CLASS[2]

[1] Institut de Physique du Globe de Paris, France, cinzia@ipgp.fr (* presenting author)

[2] Lamont Doherty Earth Observatory, Palisades, N.Y. 10964, USA class@ldeo.columbia.edu

[3] Max-Planck-Institut für Chemie, 55020 Mainz, Germany. albrecht.hofmann@mpic.de

Hotspots with double volcanic chains provide a unique opportunity to map the distribution of isotopic heterogeneities in the deep mantle. Recently, Weis et al., [1] proposed that the isotopic enrichment of the southern (Loa-trend) Hawaiian volcanoes is due to sampling of deep material coming from the edge of the 'large low-shear-velocity province'. By studying several Pacific hotspots with double volcanic chains (i.e., Hawaii, Samoa, Marquesas) Huang et al., [2] showed that the southern chain is always isotopically enriched with respect to the northern one. Such a large scale, systematic geochemical zonation may be caused by the progressive involvement of a more enriched (DUPAL) component toward the southern latitudes.

Here we take a geodynamics perspective and model a north-south increase in the radiogenic lead isotope ratio (^{208}Pb*/^{206}Pb*) across the thermal boundary layer (TBL) source region of plumes. Our numerical simulations show that the resulting conduit structure has a novel `lobate' zonation. By mapping ^{208}Pb*/^{206}Pb* distribution within the melting zone of the Hawaiian plume we predict that Loa-trend volcanoes should have higher ^{208}Pb*/^{206}Pb* than Kea-trend ones. Moreover, the calculated ^{208}Pb*/^{206}Pb* time evolution is distinct, namely, in a Loa-trend volcano, shield-stage lavas are expected to have higher ^{208}Pb*/^{206}Pb* than pre- and post-shield lavas. In contrast, in a Kea-trend volcano, ^{208}Pb*/^{206}Pb* should progressively decrease from pre- to post-shield stages. Our simulations show that any large-scale north-south ^{208}Pb*/^{206}Pb* increase in the TBL causes bilateral zonation of plumes sheared in the direction of the Pacific plate motion.

[1] Weis, D., Garcia, M.O., Rhodes, J.M., Jellinek, M., Scoates, J.S.,(2011) *Nature Geoscience, DOI:10.1038/NGEO1328.* [2] Huang, S., Hall, P.S., Jackson, M.G., (2011). *Nature Geoscience, DOI:10.1038/NGEO1263.*

Effect of redox oscillations on iron and manganese behavior in a bank filtration setting

CLAIRE FARNSWORTH[1,2*]

[1]California Institute of Technology, Pasadena, CA, USA, claire.farnsworth@gmail.com (* presenting author)
[2]EAWAG, Swiss Federal Institute of Aquatic Science and Technology, Duebendorf, Switzerland

In bank filtration, groundwater is extracted from a well adjacent to a river or lake, thereby inducing infiltration from the surface water body into the shallow groundwater. The infiltrate is exposed to variable redox conditions along the flow path, from oxic surface water to reducing shallow sediments, followed by the re-introduction of oxygen in the vicinity of the production well as it cycles on and off. The natural processes along the infiltration flow path lead to nutrient, organic carbon, and pathogen removal, thereby improving the quality of the water recovered. However, manganese (Mn) and iron (Fe) can be released into bank filtrate along its flow path to the production well to an extent that necessitates drinking water treatment after extraction, as observed at various well fields in Canada, Germany, and the Netherlands.

The behavior of Mn and Fe were investigated at a lake bank filtration site (Lake Tegel, Berlin, Germany) subject to water table fluctuations and seasonal organic carbon loads, resulting in transient redox oscillations in the shallow groundwater. Field data will be compared with the potential of Mn and Fe for release in the reducing shallow sediments and for sequestration in the aquifer adjacent to the production well. The conditions under which transient redox oscillations in shallow groundwater can drive the release and sequestration processes in alluvial sediments will be presented.