Pb sources of bivalves from Western Canada, Mexico and Hawaii

A.E. SHIEL, A.C. BYRNE AND D. WEIS

PCIGR, EOS, Univ. of British Columbia, Vancouver, BC V6T 1Z4, Canada (ashiel@eos.ubc.ca)

Bivalves from British Columbia (Canada), Hawaii (US) and Baja California (Mexico) show human-related trace metal input that we track with Pb isotope 'fingerprinting'.

Oysters from both Desolation Sound (BC mainland) and Barkley Sound (west coast of Vancouver Island) have relatively low Pb contents (0.05–0.22 μg g^{-1} dry weight) with Pb isotopic signatures (^{206}Pb/^{207}Pb = 1.1483–1.1744) indicating large contributions from anthropogenic sources. The Pb isotopic ratios can be explained by mixing of modern anthropogenic Pb emissions with natural Pb end-members (e.g. Coast Plutonic Complex [1]). The Pb isotopic signatures of the BC oysters are also consistent with those of BC atmospheric aerosols (recorded by lichens [2]) and road dust collected from highways in the lower BC mainland [3]. More specifically, Desolation Sound oysters have higher Pb contents and lower ^{206}Pb/^{207}Pb values than those from Barkley Sound. The lower ^{206}Pb/^{207}Pb ratio exhibited by the BC mainland oysters is attributed to contributions of anthropogenic Pb emissions from a source that is characteristically unradiogenic (low ^{206}Pb/^{207}Pb), potentially emissions from ore smelting in a nearby facility [4].

The Pb isotopic signature (1.1652 for ^{206}Pb/^{207}Pb) of Hawaiian oysters (Honolulu Harbor) is comparable to that exhibited by BC oysters, despite significantly higher Pb concentration (5.7 μg g^{-1} dry weight). Lead contents (0.07–0.42 μg g^{-1} dry weight) of Mexican bivalves (Baja California) are within the range of those of BC bivalves with Pb signatures (^{206}Pb/^{207}Pb = 1.1788–1.2088) closer to natural values.

The similarity between the Pb isotopic compositions of bivalves from BC, Hawaii and Mexico suggests comparable anthropogenic Pb sources across the NE Pacific, e.g. from unleaded motor gasoline and diesel fuel. Even with the low Pb levels found in some bivalves (e.g. BC oysters), Pb isotopes can be used to identify emissions from industrial processes and consumption of fossil fuels as important Pb sources.

[1] Cui and Russell (1995) *GSA Bull* **107**, 127–138. [2] Simonetti *et al*. (2003) *Atmos Environ* **37**, 2853–2865. [3] Preciado *et al*. (2007) *Water Air Soil Poll* **184**, 127–139. [4] Shiel *et al*. (2010) *Sci Total Environ* **408**, 2357–2368.

Structure and petrology of the mantle beneath Hawaii constrained by seismic discontinuity imaging and mineral phase relations

S.-H. SHIM[1], Q. CAO[1], R.D. VAN DER HILST[1] AND M.V. DE HOOP[2]

[1]Massachusetts Institute of Technology
[2]Purdue University

Hawaiian volcanoes has been regarded as the archetype of the surface representation of deep mantle plume. Yet, the structure and chemisty of the plume remain uncertain. Our GRT imaging of velocity discontinuities combined with phase relations studied in mineral physics provides new constraints on the structure and petrology of the mantle between 200 and 1000 km depths.

While only small topographic changes were found directly beneath Hawaii, large depth variations of the *410*, *520*, and *660* discontinuities were found up to 2,000 km west of Hawaii. The deepening of the *410* and *520* discontinuities are consistent with high-temperature response of the α-to-β and β-to-γ transformations due to their positive Claepyron slopes. Westward from Hawaii the *660* discontinuity changes from anomalously shallow to anomalously deep, suggesting a lateral transition from the post-spinel to a post-garnet transformation (in pyrolitic mantle) across a high temperature anomaly near the base of the transition zone. The large spatial scale of *660* topography (compared to *410*) is consistent with a regional-scale boundary layer and ponding of hot material at 660-km depth.

Our images also reveal reflectors at 300 and 800 km depths and splitting of the *520* discontinuity. Splitting of the *520* discontinuity can occur if the host rock is significantly enriched with Ca and Si. The *300* discontinuity can be related to a silica transition, requiring Si-enrichment. The *800* discontinuity can be related to either the post-stishovite transformation or post-garnet transformation in an Al, Si-rich rock. Therefore, these structures indicate significant presence of non-pyrolitic components in the top 1000 km of the mantle beneath Hawaii, and the composition that is responsible for these structures is likely basaltic. Our study provides first seismic evidence for the significant existence of recycled components in the mantle beneath Hawaii.