Pb, Sr, Nd, Hf isotope geochemistry of South Arch lavas: Origin of the upstream side Hawaiian arch volcanism

T. KANI[1]*, B. B. HANAN[2], R. KINGSLEY[3] AND J.-G. SCHILLING[3]

[1]Kumamoto University, Kumamoto 860-8555, Japan (*correspondence: kani@sci.kumamoto-u.ac.jp)
[2]San Diego State University, San Diego, CA, USA (bhanan@mail.sdsu.edu)
[3]GSO, University of Rhode Island, RI, USA

South Arch volcanic field is located on the crest of a broad swell surrounding the Hawaiian Islands, 200 km south of Kilauea, along the peripheral edge of the radially dispersing mantle plume stream, diverted to the NW by the migrating Pacific lithospheric plate.

Pb, Sr, Nd and Hf isotope compositions of 14 alkali basalts collected at water depths > 4 km by JAMSTEC Kaiko and Shinkai dives (K217 and S697), distinguish these magmas from shield tholeiites, rejuvenated stage, and North Arch lavas. Pb isotope compositions of South Arch lavas are more radiogenic compared to North Arch and rejuvenated lavas, but similar to Kea lavas, confirming plume compositional influence on the upstream plume periphery is stronger than downstream. In Pb-Sr-Nd multi-isotope binary plots the data clusters, with little variation, and no apparent correlation. The $^{87}Sr/^{86}Sr$ is lower and the ε_{Nd} higher than Hawaiian shield tholeiites indicative of a depleted source. Plots of ε_{Hf} against ε_{Nd}, $^{87}Sr/^{86}Sr$ or $^{206}Pb/^{204}Pb$ define trends oblique to the mantle array. The variation is in ε_{Hf} essentially at constant ε_{Nd}, $^{87}Sr/^{86}Sr$ or $^{206}Pb/^{204}Pb$. These relationships cannot be explained by seawater or sediment contamination, but could result from metasomatism. The results suggest that the South Arch basalt source consists of metasomatised oceanic lithosphere and plume components. The isotope characteristics of the South Arch lavas could be interpreted to represent metasomatised Pacific lithosphere, residue of a MORB-related melting event at ~100 Ma, modified by plume fluids and melts. Alternatively, the South Arch mantle source may be ancient recycled oceanic lithosphere, part of the Hawaiian plume.

Diagnosing the hydroclimate influences on soil water $\delta^{18}O$: Precipitation $\delta^{18}O$, evaporation, or moisture transport?

LISA KANNER[1]*, NIKOLAUS BUENNING[1], LOWELL STOTT[1], AXEL TIMMERMAN[2], DAVID NOONE AND LISA SLOAN[4]

[1]University of Southern California, Los Angeles, CA, USA lkanner@usc.edu, buenning@usc.edu, stott@usc.edu (*presenting author)
[2]University of Hawaii, Honolulu, HI, USA, axel@hawaii.edu
[3]University of Colorado, Boulder, CO, USA, dcn@coloradu.edu
[4]University of California - Santa Cruz, Santa Cruz, CA, USA, sloan@ucsc.edu

The stable oxygen isotopic composition of soil water that is incorporated into paleoclimate proxies is often assumed to be the same as precipitation $\delta^{18}O$ in order to obtain information about past hydroclimate variations. For example, the $\delta^{18}O$ of soil water, when taken up by tree roots, is transferred to the $\delta^{18}O$ of xylem water and eventually incorporated into the tree cellulose. Thus, implicit in the use of cellulose $\delta^{18}O$ as a proxy for precipitation $\delta^{18}O$ is that evaporative influences on soil water $\delta^{18}O$ do not overprint the precipitation $\delta^{18}O$ signal.

In this study, we use an isotope-enabled land surface model (IsoLSM) to diagnose environmental influences on soil water $\delta^{18}O$ across seasonal to interannual timescales. An unpeturbed control simulation from 1979-2004 reveals that in many semi-arid regions, such as the southwest United States, the $\delta^{18}O$ of xylem water is only partially related to the $\delta^{18}O$ of precipitation. At these locations, both evaporation and upward moisture fluxes in the soil water column contribute to variations in xylem water $\delta^{18}O$. For typical soil water profiles that are more depleted at depth, soil water tagging simulations reveal that in years with lower precipitation, an upward flux of deep soil moisture can lead to isotopically depleted xylem water. Consequently, this depleted cellulose $\delta^{18}O$ signal may be misinterpreted as reflecting more istopically depleted precipitation or enhanced rainfall due to an inferred "amount effect". Thus, where these soil moisture transport processes are dominant, there is a positive correlation between xylem water $\delta^{18}O$ and relative humidity, even though a decrease in relative humidity would be expected to enrich surface water $\delta^{18}O$. Furthermore, sensitivity experiments demonstrate that for these semi-arid regions, the seasonal cycle in xylem water $\delta^{18}O$ is not driven by the isotopic composition of precipitation but instead by ground evaporation.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.11