

## Challenges and opportunities in dating young tholeiitic basalts: Example from new $^{40}\text{Ar}/^{39}\text{Ar}$ ages from the HSDP-2 core, Hawaii

FRED JOURDAN<sup>1</sup>, WARREN D. SHARP<sup>2,3</sup>  
AND PAUL R. RENNE<sup>2,3</sup>

<sup>1</sup>Western Australian Argon Isotope Facility, and JdL-CMS, Curtin University of Technology, GPO Box U1987, Perth, WA 6845, Australia. (f.jourdan@curtin.edu.au)

<sup>2</sup>Berkeley Geochronology Center, 2455 Ridge Rd., Berkeley, CA94709, USA

<sup>3</sup>Department of Earth and Planetary Science, University of California, Berkeley, CA94720, USA

The Hawaii Scientific Drilling Project recovered a 3.5 km deep core from the shields of Mauna Loa and Mauna Kea volcanoes. The cores have provided crucial information on chemical and physical characteristics of the Hawaiian mantle plume through time. However, models of the plume inferred from these data are dependent on the growth rates of the volcanoes. The accumulation rates of the Mauna Loa and post-shield phase of Mauna Kea volcanoes are relatively well-defined at  $\sim 2.5$  m/ka and  $0.9 \pm 0.4$  m/ka respectively. Those rates are based on precise  $^{40}\text{Ar}/^{39}\text{Ar}$  age constraints from K-rich basalts [1]. On the other hand, deriving a precise accumulation rate for the shield stage of Mauna Kea (95-98% of the volume) through  $^{40}\text{Ar}/^{39}\text{Ar}$  dating is extremely challenging due to the late Quaternary age, low  $\text{K}_2\text{O}$  content ( $0.4 \pm 0.1$  wt%) and large amount of trapped  $^{40}\text{Ar}$  ( $\pm$  active gases) of the tholeiites [2].

We applied the laser and furnace  $^{40}\text{Ar}/^{39}\text{Ar}$  dating techniques in two different laboratories (BGC & WAAIF) on two groundmass samples from 2 lava flow units located in a deep section of the core ( $\sim 3.1$  km). The four isochrons, that for some are the combination of several replicates, yielded four concordant ages that range from  $612 \pm 160$  to  $871 \pm 302$  ka, all with  $P \geq 0.90$ . The combination of these data yield an age of  $656 \pm 120$  ka ( $P = 0.77$ ). This new age, when combined with previous  $^{40}\text{Ar}/^{39}\text{Ar}$  isochron ages obtained higher along the core yield a linear growth rate of  $8.4 \pm 2.7$  m/ka ( $n=8$ ;  $P=0.32$ ) for the tholeiitic stage. The combination of these data allows deriving a more precise age for any given depth (e.g.  $629 \pm 84$  ka at 3.1 km) via an increase in the counting statistics. The new growth rate supports previous interpretations of [2] suggesting that the eruption of the shield stage took place on a longer timescale than initially assumed and are compatible with a steady linear growth rate.

[1] Sharp *et al.* (1996) *JGR* **101**(11), 607–11, 616. [2] Sharp & Renne (2005) *Gcubed* **6**, Q04G17.

## Evaluation of Pu solubility using the mixed redox phase $\text{PuO}_{2+x}$ : Modeling of existing experimental data

CARLOS F. JOVÉ COLÓN<sup>1</sup> AND ROBERT FINCH<sup>2</sup>

<sup>1</sup>Sandia National Laboratories, P.O. Box 588 MS 1369, Albuquerque, NM, 87185-1369, (cfjovec@sandia.gov)

<sup>2</sup>Sandia National Laboratories, P.O. Box 588 MS 1373, Albuquerque, NM, 87185-1373 (rfinch@sandia.gov)

Plutonium is one of the more important radionuclides in assessing performance of a geological repository for spent fuel and high-level nuclear wastes. Solid  $\text{PuO}_2$  is believed to control dissolved Pu concentrations in many scenarios; however, the potential that a more-oxidized solid may control dissolved Pu has been the subject of considerable debate. Neck *et al.* [1] provided new thermodynamic data for Pu (IV) colloids and the  $\text{PuO}_{2.5}$  component of  $\text{PuO}_{2+x(\text{am})}$ , testing their hypothesis against measured Pu concentrations from several studies. Their results appear promising; however, they did not assume complete system equilibrium when modeling equilibria between aqueous and solid Pu species. While such an assumption on system disequilibria may be valid for short time frames relevant to laboratory timescales, this becomes untenable when applied to the very long time scales relevant to the assessment of repository behavior. In order to examine how the hypothesis of Neck *et al.* [1] might be applied in a fully equilibrium approach, we conducted reaction-path modeling using the computer code EQ3/6, in which we were able to successfully reproduce experimental solution concentrations and redox measurements by allowing equilibrium among all species above pH 7.2 (colloids plus two Pu solids). However, due to the extraordinary high solubility of the Pu (IV) colloid, this required suppressing two aqueous Pu species in order to obtain agreement with observed Pu concentrations:  $\text{PuOH}_3^+$  and  $\text{Pu}(\text{OH})_4(\text{aq})$ . Below pH 7.2 Pu (IV) colloids were absent from the simulation, which is in overall agreement with experimental evidence for their decreasing importance in more acid waters. Below pH 3.3 the  $\text{PuO}_{2.5}$  component of  $\text{PuO}_{2+x}$  becomes depleted ( $x$  becomes zero) and  $\text{PuO}_2$  is the solubility-controlling solid in more acid waters. Our results required that the system be modeled as being 'closed' to the atmosphere, consistent with experiments conducted in closed/sealed vessels.

[1] Neck *et al.* (2007) *Radiochimica Acta*, Vol. **95**(4), 193–207.