

Magmatic processes leading to explosive mafic eruptions of Volcán de Colima, Mexico

JULIA CRUMMY^{1*}, IVAN SAVOV¹, DAN MORGAN¹,
CARLOS NAVARRO², MARJORIE WILSON¹ AND
SUE LOUGHLIN³

¹University of Leeds, Leeds, LS2 9JT, UK
(*correspondence: j.crummy@see.leeds.ac.uk,
I.Savov@leeds.ac.uk, D.J.Morgan@leeds.ac.uk,
B.M.Wilson@leeds.ac.uk)

²Colima Volcano Observatory, University of Colima, Colima, Mexico (naoc@ucol.mx)

³ British Geological Survey, Murchison House, Edinburgh, EH3 3LA, UK (sclou@bgs.ac.uk)

We present new geochemical and petrological data for the Holocene tephra deposits of Volcán de Colima. Historically, the volcano is characterised by mostly effusive andesitic lava flows and frequent Vulcanian-style explosions (up to 11 times per day in 2010), producing steam and ash clouds reaching heights of several km. Explosive basaltic-andesitic Plinian eruptions at Colima have occurred throughout the Holocene. The last such event was the 1913 eruption which produced an ash column 23km in height, and pyroclastic flows which travelled 15km from the vent. Ash was reported in the town of Saltillo 725km away. The 1913 eruption lava and ash samples contain magmatic water contents of up to 6.3 wt.%.

Deposits representing highly-explosive activity at Volcán de Colima reveal a tantalising story of magma evolution over a 30,000 year period [1]. We report results concerning the 4,400 and 4,700 yrs B.P. eruptions, which represent the felsic and mafic end-member magma, and show that Plinian-style explosions can occur at Colima over a range of compositions from basaltic-andesite to high-silica andesite, all with a common, high H₂O content of over 4.3 wt.% H₂O.

SEM, EPMA and CSD analyses support the bulk rock dataset and reveal a complex crystallisation history of the 4,400 and 4,700 yrs B.P. magmas. However, Sr isotope analyses indicate a well-established feeder system with little change in ^{87/86}Sr ratios (0.703459 - 0.703735, n=61) over >12,000 years.

At Volcán de Colima, high-MgO magmas (5.61 wt.%) are H₂O rich, implying little mixing and/or very fast ascent rates from source to surface.

[1] Luhr *et al* 2010, *Journal of Volcanology & Geothermal Research*, v. **197**, p. 1-32

U and Sr isotopic variations at a deep underground laboratory, Homestake Mine, SD

M.F. CRUZ^{1*}, K. MAHER¹, N. OLSEN¹, T. JONES²,
M. CONRAD³ AND E. SONNENTHAL³

¹GES Dept., Stanford University, Stanford, CA 94305, USA
(*correspondence: mfcruz@stanford.edu,
kmaher@stanford.edu)

²South Dakota School of Mines, Rapid City, SD 57701, USA
(tessaj@gmail.com)

³Lawrence Berkeley National Lab, Berkeley, CA 94720, USA
(msconrad@lbl.gov, elsonnenthal@lbl.gov)

The U and Sr isotopic composition of groundwater in fracture-dominated flow systems can potentially provide a useful means of quantifying fluid flow, reaction rates and/or the extent of exchange with the bulk matrix. The Deep Underground Science & Engineering Laboratory (DUSEL) at the former Homestake gold mine in South Dakota provides a unique opportunity to assess the behavior of U and Sr isotopes in a fracture-dominated environment. The folded and fractured metapelites are low-permeability with flow localized in fractures and shear zones. Samples from depths up to 5000 ft below the surface were analyzed for major and trace elements, δ¹⁸O, δD, ⁸⁷Sr/⁸⁶Sr and (²³⁴U/²³⁸U),.

The (²³⁴U/²³⁸U) values of waters at the site is 2.99 at the surface, then increases to 3.24 at 800 ft depth, then decreases gradually to 1.94 at 4,850 ft depth. We interpret the initial increase to alpha-recoil enrichment of ²³⁴U, while the subsequent decrease suggests that as temperature increases with depth, mineral dissolution dominates. This is consistent with ⁸⁷Sr/⁸⁶Sr values, which increase with depth from 0.71 to 0.77, approaching the bulk-rock value of 0.76 to 0.8, again suggesting increased reactivity. By coupling Sr and U isotopes with field and geochemical data investigations at DUSEL can provide further insights as to the isotopic exchange processes during fracture-dominated water-rock interactions.