Strontium stable isotope variations in lunar basalts

CHELSEA N. SUTCLIFFE[1*], KEVIN W. BURTON[2], IAN J. PARKINSON[3], DAVID COOK[1], BRUCE L. A. CHARLIER[3], DON PORCELLI[1], FATIMA MOKADEM[1], ALEX N. HALLIDAY[1]

[1]Department of Earth Sciences, University of Oxford, Oxford , UK chelsea.sutcliffe@st-annes.ox.ac.uk (* presenting author)
[2]Department of Earth Sciences, Durham University, Durham, UK
[3]Department of Earth and Environmental Sciences, The Open University, Milton Keynes, UK

In the terrestrial environment strontium stable isotopes may experience significant fractionation, both at low- and high-temperatures (e.g. [1,2]). Recent data for lunar basalts suggests that these rocks may possess light Sr stable isotope compositions (δ^{88}Sr = +0.16±0.07) [2] relative to mantle derived terrestrial basalts (δ^{88}Sr = +0.30±0.07) [2,3]. However, few samples have been analysed thus far, and at the ±50 ppm precision of these measurements, obtained using an MC-ICP-MS [2,3] smaller variations that may exist cannot be clearly resolved.

This study presents high-precision double spike TIMS data for ^{87}Sr/^{86}Sr (±5 ppm) ^{88}Sr/^{86}Sr (±10ppm) and ^{84}Sr/^{86}Sr (±20 ppm) for a suite of lunar basalts and highland rocks. These data indicate that there are significant and resolvable variations in δ^{88}Sr ranging from +0.30 for a ferroan anorthosite to +0.10 for a high-Ti Mare basalt. The lunar highland rocks (including anorthosites, troctolites and norites) possess a relatively small range of δ^{88}Sr values from +0.30 to +0.24 (0.06‰) whereas the mare basalts are distinctly lighter and encompass a larger range of δ^{88}Sr values, from +0.26 to +0.10 (0.16‰). The Mare basalts all possess negative Europium anomalies consistent with having been derived from a plagioclase depleted source, whereas the anorthosites are plagioclase rich. These observations suggest that the preferential incorporation of heavy Sr stable isotopes in plagioclase is the dominant mechanism controlling stable isotope fractionation in lunar basalts (similar to that seen in evolved terrestrial basalts [2]). Preliminary ^{84}Sr/^{86}Sr data suggests that the lunar rocks may possess slightly lighter compositions than terrestrial rocks, but this cannot be resolved at the present level of analytical precision. Taken together, these results clearly indicate that for the Moon primary igneous processes alone can generate significant variations in δ^{88}Sr, without the biological fractionation and recycling that may occur on Earth.

[1] Fietzke & Eisenhauer (2006), *Geochem. Geophys. Geosyst.* **7**, Q08009 [2] Charlier et al. *Earth Planet. Sci. Lett*. Submitted (2011) [3] Moynier et al. (2010) *Earth Planet. Sci. Lett.* **3-4,** 359-366

Exclusive use of a soil gas hydrocarbon geochemistry to vector towards mineral deposits

DALE SUTHERLAND

Activation Laboratories Ltd., Ancaster, Ontario, Canada, dalesutherland@actlabsint.com

This Soil Gas Hydrocarbon (SGH) geochemistry has been scientifically shown to detect those hydrocarbons released from the decomposition of bacteria at the end of their life cycle. From a "you are what you eat" perspective, the 162 specific hydrocarbons in the C5 to C17 carbon series range that are able to be detected provide an information rich forensic signature of identification from the bacteria that were directly growing on specific types of mineral deposits.

The forensic signature has been tested through projects administered by the Canadian Mining Industry Research Organization (CAMIRO) as well as those conducted by the Ontario Geological Survey. The use of the hydrocarbon signature has been able to differentiate between barren and ore bearing conductors and geophysical targets of mineralization or kimberlites from naturally occurring signals such as from granite gneiss.

Although the SGH name implies the exclusive use of soils, this geochemistry is also able to use other sample media such as humus, peat, sand, till, submerged sediment, and even snow. As these hydrocarbons are relatively neutral species the state of the flow of hydrocarbons that migrate and geochromatographically disperse through the overburden can be captured by the surface area of the sample media taken in a survey. This capability is vital in areas of difficult terrain where a complete sample survey may cover swamps, lakes, peaty areas as well as high ground. This multi-media survey can be processed and mapped together without data leveling, thereby significantly reducing the bias in interpretation represented by areas where sampling was formerly not warranted.

Several independent studies have also illustrated the successful depiction of blind mineralization that is shallow or to depths in excess of 700 metres. Figure 1 illustrates additional penetrating capability of this nano-scale geochemistry at dramatically delineating gold mineralization beneath a basalt cap. Similar results have been shown over areas of permafrost.

As a forensic signature the identification and vectoring capability of SGH provides a high level of confidence. The robustness of this geochemistry has allowed it to be used to discover new resources in not only greenfield applications but has also delineated mineralized extensions in brownfield surveys.

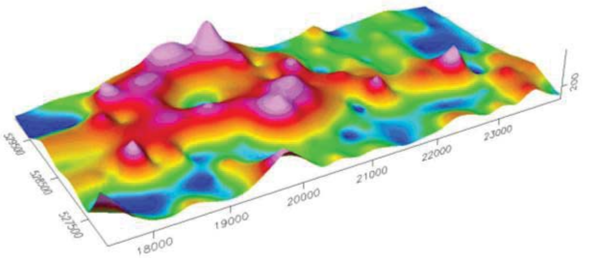

Figure 1: SGH gold anomaly below basalt cap, Mali, Africa