Geochemistry and tectonic setting of Una-Una volcano, Sulawesi, Indonesia

S. BROOM-FENDLEY*, M.F. THIRLWALL, M.A. COTTAM AND R. HALL

SE Asia Research Group, Department of Earth Sciences, Royal Holloway University of London, Egham, Surrey TW20 OEX, UK
(*correspondence: s.broom.fendley@gmail.com)

Una-Una is an isolated volcano in Gorontalo Bay, North Sulawesi situated in a complex tectonic setting. Previously, Una-Una has been linked to southward subduction of the Celebes Sea under the North Arm of Sulawesi or northward subduction linked to collision in East Sulawesi. These hypotheses have problems with the apparent depth to the Benioff zone and amount of continental underthrusting.

We present new geochemical and Sr, Nd & Pb isotope analyses of volcanic rocks from Una-Una (<~100 Ka) and the nearby Togian islands (~2 Ma). These are both alkaline or high-K calc-alkaline trachytes with elevated Sr, Pb and LILE and depleted HREE, Nb and Ta. Sr and Nd isotopes plot in the enriched quadrant on a Sr-Nd diagram and $^{207}Pb/^{204}Pb$ show a steep trajectory extending from Indian Ocean MORB. The isotopic trends and similar geochemistry indicate that the rocks are genetically related and have similar continental derived components. The elevated isotopic values require an ancient continental contribution to the source. Mixing trends between Sr and Nd isotopes show that contamination is not likely to have come from Celebes Sea sediment compositions and Indian Ocean pelagic sediment is more likely. Contamination could have occurred during Eocene-Early Miocene subduction of Indian Ocean lithosphere. Una-Una is not above a subducted slab, and is at least 200 km above any projected subduction zone. The age of volcanic rocks from the Togian Islands rule out subduction at the North Sulawesi trench as the slab would not have been deep enough.

We propose that Una-Una and the Togian Islands are the product of young extension of Gorontalo Bay due to slab roll-back. This provides a mechanism for upwelling of a pre-metasomatised mantle.

Assessing calcium isotopes as a dietary proxy for terrestrial vertebrates

J. BROSKA[1], T. TÜTKEN[2]*, S.J.G. GALER[3], P. HELD[1] AND K.W. ALT[1]

[1]Institut für Anthropologie, Johannes Gutenberg-Universität Mainz, 5099 Mainz, Germany
[2]Steinmann-Institut, Rheinische Friedrich-Wilhelms-Universität Bonn, Poppelsdorfer Schloß, 53115 Bonn, Germany (*correspondence: tuetken@uni-bonn.de)
[3]Max-Planck-Institut für Chemie, Abteilung Biogeochemie, Postfach 3060, 55020 Mainz, Germany

Vertebrates ingest calcium along with their diet, and during biomineralization the light calcium isotopes are preferentially enriched in the bioapatite of bones and teeth. Therefore, $\delta^{44/42}Ca$ should decrease systematically along a food chain, and display a trophic level effect (TLE). Since calcium isotope signatures of bones and teeth seem robust against strong diagenetic alteration, $\delta^{44/42}Ca$ is a promising proxy for reconstructing both past diets of extinct vertebrates and fossil food webs.

However, in order to be able to use $\delta^{44/42}Ca$ to elucidate the diet of extinct animals, a better understanding of $\delta^{44/42}Ca$ and TLE in modern ecosystems is paramount. With this in mind, we analysed $\delta^{44/42}Ca$ in more than 40 bones of 19 extant mammals with a broad range of well-characterized diets from savannah ecosystems in Africa. The Ca isotope data were obtained by TIMS using a ^{43}Ca-^{46}Ca double spike at MPI. Additional, established proxies for diet and trophic level such as $\delta^{13}C$ and $\delta^{15}N$ of collagen were also analyzed on the same specimens for comparison and to assess dietary differences and trophic level relationships.

A large variability in $\delta^{44/42}Ca$ was observed within each trophic level. Browsers and grazers, and some of the frugivores, had similar $\delta^{44/42}Ca$ values. A significant TLE difference in $\delta^{44/42}Ca$ of –0.36 was found to exist between herbivores (–0.53 ± 0.32‰) and carnivores (–0.89 ± 0.18‰). This TLE difference is smaller than the –0.65 that has been reported thus far, but appears to vary between different areas and geological substrates.

Carnivores with high amounts of bone consumption, such as leopards and hyenas, display the lowest $\delta^{44/42}Ca$, down to –1.2‰ (hyenas). In contrast, ant-eating insectivores, such as the aardvark and aardwolf, have the highest bone $\delta^{44/42}Ca$ (+0.03±0.27‰) observed for extant vertebrates thus far, being significantly higher than found for both herbivores and carnivores. Thus, $\delta^{44/42}Ca$ may potentially be a useful indicator of insectivory in fossil vertebrates.

Combining $\delta^{44/42}Ca$ with $\delta^{13}C$ and $\delta^{15}N$ allows us to refine our interpretation of diet of foodwebs significantly in extant and extinct vertebrates.