Geochemical characteristics and petrogenesis of Cenozoic igneous rocks in the Georgian Caucasus

YU-HAN CHANG[1]*, SUN-LIN CHUNG[1], AVTO OKROSTSVARIDZE[2] AND ZURAB JAVAKHISHVILI[2]

[1] Department of Geosciences, National Taiwan University, Taipei, Taiwan (*correspondence: r01224107@ntu.edu.tw)

[2] Institute of Earth Sciences, Ilia State University, Tbilisi, Georgia

Cenozoic magmatism in the Caucasus-Iran-Anatolia (CIA) region can simply be divided into two main stages that pre- and post-date, respectively, the onset of the Arabia-Eurasia collision. The pre-collisional stage has been generally related to the Neotethyan subduction. The post-collisional stage has been ascribed to rollback and then breakoff of the subducted slab or other geodynamic processes such as delamination of thickened lithosphere. In Georgia, located ~500 km north of the Zagros suture zone, the pre-collisional rocks, with SiO_2 ranging from ~45-64 wt.%, are more heterogeneous in certain incompatible elements such as potassium and LREE than the post-collisional rocks, despite the latter show a wider range of SiO_2 (45-72 wt.%). Thus, in contrast to the post-collisional rocks that plot in the median- to high-K calc-alkaline suite, the pre-collisional rocks are dominantly of intermediate compositions ($SiO_2 \approx 60$ wt.%) and vary from low- to high-K calc-alkaline to shoshonitic in nature. However, rocks from both stages are characterized by the "arc signature" including enrichment in LILE (e.g., Rb, Ba) and depletion in HFSE (e.g., Ti, Nb, Ta). While isotopic determination is still in progress, Sr-Nd isotope data obtained so far from post-collisional rocks indicate that they have an isotopically uniform mantle source similar to other post-collisional magmas in the CIA region. We are also working on precise dating of the pre-collisional rocks. The result, together with geochemical and isotopic constraints, will hopefully help us better understand the petrogenesis that we suspect to have affiliated with a back-arc system.

Understanding controls on Ca isotopes in human blood and urine

M.B. CHANNON[1]*, G.W. GORDON[1], Q. SHOLLENBERGER[1], J.L.L. MORGAN[2], J.L. SKULAN[3], S.M. SMITH[2] AND A.D. ANBAR[1]

[1]Arizona State Univ., Tempe, AZ 85287 (#correspondence: mchannon@asu.edu)

[2]NASA Johnson Space Center, Houston, TX 77058

[3]Geology Museum, Univ. of Wisconsin, Madison, WI 53706

Calcium isotopes fractionate during bone formation, favoring light Ca isotopes. During bone resportion, Ca isotopes are released into the blood and soft tissue with little or no discrimination. This fractionation process may be a powerful biomarker for diseases that effect the skeletal system such as osteoporosis, multiple myeloma, and cancers that metastasize to bone. However, in order to translate this biomarker to a clinical setting, we must understand all the factors contributing to the Ca isotopic composition of blood and soft tissue in the body.

It was previously shown that Ca isotopic composition of urine reflects changes in bone mineral balance correlated to bone loss during bed rest [1-2]. The most recent study [2] involved 12 patients on bed rest for 30 days with a controlled diet. Both urine and blood were collected from participants throughout the study, as well as meal and beverage samples for isotopic analysis. This study showed that the Ca isotopic composition of urine becomes lighter as bed rest progresses, in correlation with bone resorption. Here we present new data of blood, meals, and additional urine analyses from this study.

We find variable Ca isotope ratios among meals that tend towards heavier values for breakfasts, lighter values for dinners, and intermediate values for lunches. We also find a large range within and between beverages. We investigate whether the compositional differences in meals is reflected in urine isotope ratios over a 24 hour period by measuring each urine void from the same participants for one full day of the study.

We also find that blood has a systematically lighter isotopic composition than urine. We explore the possibility of a renal fractionation [3] involving Ca-binding proteins that might explain the difference between the Ca isotope ratios of blood and urine. Nevertheless, blood tracks the same trend as urine during the progression of bed rest, and therefore the compositional difference between blood and urine does not obscure the signal of bone resorption.

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www.minersoc.org
DOI: 10.1180/minmag.2013.077.5.3