What causes the positive feedback between climate and chemical weathering rates?

E.S. EIRIKSDOTTIR[1], S.R. GISLASON[1] AND E.H. OELKERS[2]

[1]Institute of Earth Sciences, Sturlugata 7, 101 Reykjavík, Iceland (ese@raunvis.hi.is)
[2]LMTG-CNRS-Université Paul Sabatier-IRD-OMP, 31400 Toulouse, France (roncal@lmtg.obs-mip.fr)

Recent fieldwork has demonstrated a strong climate dependence of the chemical weathering rates of eight nearly pristine basaltic river catchments in NE-Iceland [1]. This positive feedback plays an essential role in moderating global climate over geological timescales. Climate may influence chemical weathering rates via two different processes: changing temperature and changing run-off. The goal of this study is to determine the relative influence of these two factors in controlling the feedback between climate and weathering.

Chemical weathering is controlled to a large extent by mineral dissolution. Experimental studies demonstrate that the basaltic glass and Al-silicate mineral dissolution rates are influenced by; 1) an activation energy through the Arrhenius term, 2) the concentration of activated surface sites through surface proton – aluminium exchange reaction, and 3) the saturation state of the dissolving glass [2]. Water samples collected from NE-Iceland was used together with an experimentally generated dissolution rate equation [2] to analyse the effect of temperature and runoff on each of the three factors influencing dissolution. Runoff is found to only influence rates via the solution saturation state, but for the most part this influence is minor due to the strong undersaturation of the natural waters with respect to basaltic minerals. These results suggest that temperature rather than run-off dominates the feedback between climate and chemical weathering in basaltic terrains, and thus may be the most critical parameter controlling CO2 moderation on a global scale.

[1] Gislason *et al*. (2009) *Earth Planet. Let.* **277**, 213-222.
[2] Gislason & Oelkers (2003) *GCA* **67**, 3817-3832.

Along-arc variations in the Aegean: contrasting Aegina-Methana-Poros, Santorini and Nisyros

M.A. ELBURG[1]*, I. SMET[1] AND F. VANHAECKE[2]

[1]Department of Geology and Soil Science, Ghent University, Krijgslaan 281 S8, 9000 Ghent, Belgium (*correspondence: marlina.elburg@ugent.be)
[2]Department of Analytical Chemistry, Ghent University, Belgium

The volcanic islands of Aegina-Methana-Poros, Santorini and Nisyros span the ~400 km from the west to the east side of the Aegean arc. The thickness of the continental crust decreases from west to east, and published isotope data indicate that the amount of crustal contamination of the magmas does likewise. This model is supported by the presence of quartz xenocrysts and zircons in the western volcanic centres, and their virtual absence in Santorini-Nisyros.

Other features do not show such regular variation along the arc. Aegina-Methana-Poros, post-caldera Nisyros and the earliest Santorini deposits resemble each other by consisting mainly of lava domes with abundant enclaves, by the almost ubiquitous presence of amphibole and fairly constant FeO*/MgO ratios with increasing silica content of the magmas. This contrasts with the post-300 ka Santorini deposits, which consist of lava flows and abundant pyroclastic deposits, with few mafic enclaves and virtually no amphibole.

Both Nisyros and Aegina have high contents of Sr for a given degree of differentiation (400-1000 ppm for basaltic andesites), whereas Santorini and Methana-Poros samples never exceed 400 ppm Sr. The high contents of Sr in Aegina are not matched by similar enrichments in other fluid-mobile elements, such as Ba or Rb. The post-300 ka Santorini deposits show a clear increase in Y with differentiation, which is not observed in the other volcanic centres; this may reflect the role of amphibole fractionation.

New radiogenic isotope data will be presented to shed more light on the origin of the geochemical, mineralogical and morphological variations between the islands studied.