The scale factor in the ectomycorrhizal fungal weathering debate

M.M. SMITS[1], Z. BALOGH-BRUNSTAD[2], L. SACCONE[3], H. WALLANDER[4] AND J.V. COLPAERT[1]

[1]Centre of Environmental Science, Hasselt University, Belgium (mark.smits@uhasselt.be)
[2]Hartwick College, Oneonta, NY, 13820 USA
[3]H.H. Wills Physics Laboratory, University of Bristol, UK
[4]Microbial Ecology, Lund University, Sweden

Ectomycorrhizal fungal weathering research has a long history, but with the launch of the term 'Rock-eating Fungi' this research topic attracted increased attention. There is growing evidence that ectomycorrhizal fungi do interact with soil minerals. Carefully designed laboratory experiments show increased mineral dissolution rates in the presence of ectomycorrhizal fungi. Even at the scale of the individual hyphae we gain more insight in the mechanisms of fungal-mineral interactions via sophisticated (ultra)-microscopic and spectroscopic techniques. But the basic question whether ectomycorrhizal fungi have a significant contribution to soil mineral weathering, remains unanswered.

Over the past decades several reviews have been published, some advocating and others opposing the role and significance of ectomycorrhizal fungi in soil mineral weathering. Most of the arguments used in this debate are scale-dependent. The ignorance of the importance of scale has hindered communication and better insight into each other arguments. Key points in the arguments opposing ectomycorrhizal weathering are that mineral dissolution is expected to be mainly driven by water or proton-metal exchange reactions and not through the formation of organic-metal complexes due to extremely low concentrations of organic chelators in soil solutions. Key points in the arguments in favour of ectomycorhizal weathering are that fungi act at the scale of individual hyphae, creating isolated water pockets with probably very dinstict chemistry and showing hyphal-mineral contact interactions.

It is important to realize that in ectomycorrhizal plants, the fungal partner is the main interface between plant and soil. Recent studies show that fungal hyphae preferentially colonize some minerals over others, implicating that plant/fungal interactions with minerals take place in a nonrandom fashion. But fungal hyphae only cover <5% of the mineral surfaces. The scale and heterogeneity of weathering actions should be acknowledged before drawing conclusions in relation to the relevance for the actual soil mineral weathering process.

Excess argon systematics under HP-LT conditions: A tracer for metamorphic fluid connectivity?

A.J. SMYE[1]*, C.J. WARREN[2], M.J. BICKLE[1] AND T.J.B. HOLLAND[1]

[1]Department of Eath Sciences, University of Cambridge, UK (*correspondence: as859@cam.ac.uk)
[2]Department of Earth and Environmental Sciences, The Open University, Milton Keynes, UK

UV laserprobe single-grain fusion apparent $^{40}Ar/^{39}Ar$ ages of phengite from a gl + jd bearing blueschist of the Tauern Window, Eastern Alps range between 35.35 ± 0.37 Ma and 43.67 ± 0.50 Ma (1σ). These ages are between 2—11 Ma older than the age of blueschist-facies metamorphism determined by U—Pb allanite [1] and Rb—Sr [2] multi—mineral geochronlogy. Pseudosection calculations show that the phengite grew close to peak pressure conditions of ~10 kbar at 450° C, before Barrovian metamorphism (~7 kbar, 550°C) at ca. 30 Ma [3]. The anomalously old $^{40}Ar/^{39}Ar$ phengite ages show that the sample contains excess ^{40}Ar, i.e. ^{40}Ar decoupled from parent ^{40}K. Concentrations of excess ^{40}Ar vary on the mm—cm lengthscale.

The incompatible nature of Ar means that high concentrations of fluid—borne Ar are required to facilitate partitioning of Ar into mica. Numerical modelling of Ar diffusion in phengite provides an estimate of the expected $^{40}Ar/^{39}Ar$ age for a mica following the Tauern PTt path. We show that the measured 'older' apparent ages may be reproduced by: 1. an open rock volume, where Ar is fluid—borne within an interconnected grain boundary reservoir, 2. a closed system in which the Ar concentration of the grain boundary reservoir is controlled by metamorphic porosity and whole—rock K_2O content, or 3. a temporal variation between these two end-member scenarios. Collectively, these calculations show that, provided an independent constraint on the timing of mica growth exists, excess ^{40}Ar contamination can be used to investigate degrees of fluid flow and fluid pathway connectivity during a metamorphic cycle.

[1] Smye *et al. In Press EPSL.* [2] Glodny *et al.* (2005) *Contrib. Mineral. Petrol.* **149**, 699—712. [3] Inger & Cliff (1994) *J. Met. Geol.* **12**, 695—707.