

Experimental evidence and mathematical process modelling of biological rock and mineral weathering by mycorrhizal fungi

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This communication summarises publications and ongoing research of biological weathering of minerals and rock by mycorrhizal fungi growing in symbiosis with host plants. Mathematical modelling provides formalised description of reaction mechanisms and parameter values to calculate the rates of biological weathering from nanometric- to planetary-scale.

The results support a biological mechanism of weathering whereby photosynthate chemical energy that is produced by plants is directed, via roots, to a network of fungal hyphae extending to form the reacting solid-biota interface. Axenic microcosms with reacting rock and mineral grains allow quantification of element mass transfer by biota from the grain surfaces without their immersion in aqueous solution.

Significant mass transfer is observed in the form of calcium oxalate crystals that form on the fungal hyphae. Comparison of Ca mass transfer rates with abiotic rates of dissolution demonstrates that the biological weathering is 1-2 orders of magnitude faster. Mathematical modelling of mass transfer kinetics is upscaled to the hyphal activity and mineral contact area in the soil profile. Accounting for geographical variation in plant productivity and parent geology provides a mechanistic description of this biological weathering mechanism at planetary scale.