

Geochemical modeling of the formation of kyanite-quartz veins, Alpe Sponda, Central Alps

T. WAGNER^{1*}, T. BEITTER² AND G. MARKL²

¹Isotope Geochemistry and Mineral Resources, ETH Zurich, Switzerland

(*correspondence: thomas.wagner@erdw.ethz.ch)

²Institut für Geowissenschaften, Universität Tübingen, Germany

The extent of aluminum mobility during regional metamorphism and fluid-rock interaction has been the subject of controversial discussions [1–5]. To gain insight into processes responsible for enhanced mobility of aluminum, we have studied the classical quartz-kyanite veins of the Alpe Sponda, Central Alps, Switzerland. We have integrated field observations, fluid inclusion and stable isotope data and combined this with numerical geochemical modeling to constrain the chemical processes of aluminum transport and deposition. The estimated P-T conditions of the quartz-kyanite veins, based on conventional geothermometry (garnet-biotite, white mica solvus and quartz-kyanite oxygen isotope thermometry) and fluid inclusion data, are about $550 \pm 30^\circ\text{C}$ at 5.0 ± 0.5 kbar. Geochemical modeling involved the evaluation of experimental data for aluminum solubility and complexing in aqueous fluids and incorporation into a consistent thermodynamic model for fluid-mineral equilibria at upper crustal conditions. Formation of the kyanite-quartz veins was then modeled through aqueous species predominance diagrams, calculation of kyanite and quartz solubility, and reaction-path simulations. The modeling results demonstrate that (1) for the given chemical composition of the vein-forming fluids mixed Al-Si aqueous species are dominant in transporting Al, and that (2) fluid cooling along a small temperature gradient coupled with a small to moderate pH decrease is able to explain the precipitation of the quartz-kyanite assemblages in exactly the proportions that are observed in the Alpe Sponda veins. We conclude that elevated amounts of Al can be transported due to Al-Si complexing in typical medium- to high-grade regional metamorphic fluids and that immobile behavior of Al is not very likely in advection-dominated fluid-rock systems in the upper and middle crust.

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Superoxide-mediated transformations of iron by cyanobacterial prokaryotes

T. DAVID WAITE^{1*}, AURELIE GODRANT^{1,2},
MANABU FUJII³ AND ANDREW L. ROSE⁴

¹School of Civil and Environmental Engineering, University of New South Wales, Sydney, NSW 2052, Australia

(*correspondence: d.waite@unsw.edu.au)

²Institut Universitaire Européen de la Mer, UMR CNRS 6539, Place Nicolas Copernic, 29280 Plouzané, France (liliodrant@gmail.com)

³Department of Civil and Environmental Engineering, Graduate School of Engineering, Tohoku University, Aoba-yama 6-6-06, Sendai, 980-8579, Japan (m.fujii@unsw.edu.au)

⁴Southern Cross GeoScience, Southern Cross University, Lismore Campus, PO Box 157, Lismore 2480 Australia (andrew.rose@scu.edu.au)

Current models for Fe acquisition by marine microalgae include uptake of unchelated Fe(II) and Fe(III), given that microorganisms can typically assimilate both forms, with reduction of both chelated and unchelated Fe(III) by either photochemical or biological processes in the external medium and/or near the cell surface prior to internalization. There is now increasing evidence that superoxide, which can reduce Fe(III), mediates Fe uptake by marine microorganisms under some conditions [1–3]. In this work, we describe conditions under which superoxide-mediated iron reduction has an impact on iron acquisition by the marine cyanobacteria *Lyngbya majuscula* and *Trichodesmium erythreum*.

In addition, we describe the effect of pH on superoxide induced reduction of Fe(III) to Fe(II) [4] and extend the analysis to examination of the effect of superoxide generation on iron uptake by a toxic strain of *Microcystis. aeruginosa*. Consideration is also given to the role that superoxide-mediated iron cycling might play in induction of toxicity by this organism.

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