Modelling SiO_2 solubility over wide P-T conditions: advances and open problems

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Fluids in the Earth's crust and upper mantle constantly change chemically, physically, and catalyze different processes, such as mass transfer, with implications for large-scale geodynamics. Silica solubilization has profound implications for mass transfer over a wide range of geologic environments, from upper crustal levels down to the deepest portion of subducting slabs and at the hot base of large orogens. Here I investigate, by using electrolytic fluid thermodynamic modelling, the solubility and speciation of SiO_2 in H_2O at 100–1400 °C and 0–10 GPa, with a particular focus on the geothermal gradients typical in subduction zones and collisional orogens. I show how SiO_2 solubility strongly increases with temperature, reaching dissolved loads between 5 wt% and >70 wt%, within subducting slabs. Similarly, results indicate that fluids with dissolved SiO_2 ranging from 3 to 57 wt% along Barrovian and Buchan-type P-T gradients can be expected, questioning the long-standing assumption of the isochemical nature of regional metamorphism. Additionally, an assessment of the capability of novel thermodynamic modelling in reproducing solubility experiments allows establishing the reliability of such models in investigating solute-bearing fluids over a wide range of P-T conditions. A by-product of this investigation is the tracking of the source of mineralizing fluids responsible for widespread fluid inclusion-rich quartz veins back to the deeper and hotter roots of orogens where amphibolitic to granulitic-facies conditions are encountered.