Experimental constraints on the behaviour of High Field Strength Elements in melts and fluids

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High field strength elements are important geochemical indicators in many geological settings. Mineral phases, which are known to incorporate the high field strength elements are rutile, ilmenite, Fe-Ti spinels, and other Ti-rich phases such as pyroxenes or amphiboles. A number of recent studies investigated the partitioning of HFSE between accessory phases and silicate melts [1-5]. In this talk I will give a general overview about experimental constraints on the behaviour of the high field strength elements in various magmatic and metamorphic systems. Whilst the behaviour of Zr, Hf, Nb, Ta in magmatic systems seems to be relatively well understood, there are considerable problems with experimental data in fluid-rich systems. Furthermore, experimental partitioning data for the more unusual HFSE such as W or Sb are scant and more quality experimental data are clearly needed. The mobility of the high field strength elements in metamorphic rocks depends critically on the solubility of rutile and other Ti-rich minerals in metamorphic fluids. I will also present some preliminary results on rutile solubility in high-temperature fluids, which indicate much higher solubility of rutile than previously anticipated.

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Re-evaluating boron speciation in biogenic calcite and aragonite using ^{11}B MAS NMR

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Understanding the partitioning of aqueous boron species into marine carbonates is critical for constraining the boron isotope system for use as a marine pH proxy. Previous studies have assumed that boron was incorporated into carbonate through the preferential uptake of tetrahedral borate $B(OH)_4^-$.

In this study we revisit this assumption through a detailed solid state ^{11}B magic angle spinning (MAS) nuclear magnetic resonance (NMR) spectroscopic study of boron speciation in biogenic and hydrothermal carbonates. Our new results contrast with those of the only previous NMR study of carbonates insofar as we observe both trigonal and tetrahedral coordinated boron in almost equal abundances in our biogenic calcite and aragonite samples.

In addition, we observe no strict dependency of boron coordination on carbonate crystal structure. These NMR observations coupled with our earlier re-evaluation of the magnitude of boron isotope fractionation between aqueous species suggest that controls on boron isotope composition in marine carbonates, and hence the pH proxy, are more complex that previously suggested.