^{29}Si NMR at Gigapascal Pressures

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NMR spectroscopy has been shown to be an invaluable technique to experimentally probe geochemical reaction pathways. Combining high-pressure clamp cells with a simple tank circuit design has allowed confirmation of geochemical models of solution speciation at high pressures. However, obtaining high-resolution spectra using superconducting magnet systems is difficult due to the relative insensitivity of high-pressure NMR probes to conventional shimming. With this in mind, we have designed a new probe to fit in a narrow-bore superconducting magnet to reduce the amount of metal in the probe. Along with the narrow design, this new probe is also coupled with a custom-built high-power shim stack provided by Resonance Research, Inc. that allows up to 5A of current on each shim channel. Measured peak widths in the NMR spectra at pressure are generally broadened due to the presence of magnetic impurities in the piston that applies pressure to the cell. With this high-power shim stack, this effect can be counterbalanced to provide high quality data. Herein, we present ^{29}Si data at high enough resolution to investigate the complexation and oligomerization of aqueous silicate at geochemically relevant conditions (up to 1.8 GPa).

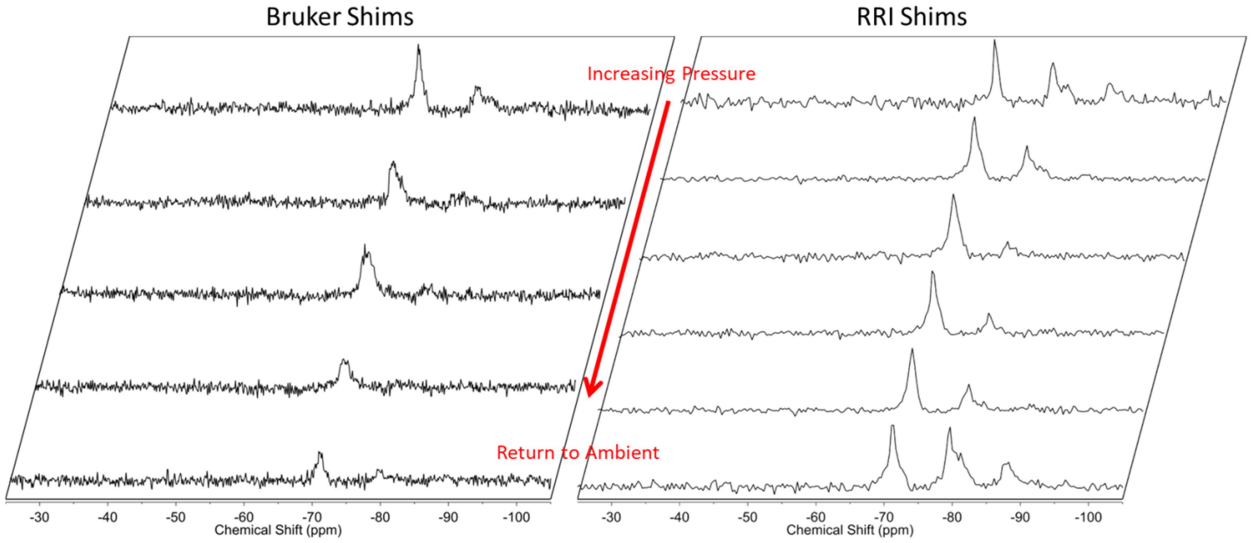

Figure 1: ^{29}Si NMR spectra of ^{29}Si-labeled SiO_2 dissolved in basic solution where [OH^-]:[Si] is 3:1. The silicate monomer (-71 ppm) is seen in solution as well as the dimer (-79 ppm) and the trimer (-88 ppm). On the left is the solution in the high-pressure probe using the standard Bruker BOSS shims while the right shows the solution in the same conditions but using the high-powered shim stack from Resonance Research, Inc.