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In situ study of complexation in the system Si-C-H-O at high pressures and temperatures

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Deep carbon cycling affects the long-term global environment and climate. Among the tectonic settings that contribute to the cycling, subduction zone is significant in transporting surface carbon to Earth's interior. The fate of subducting carbon is strongly controlled by the stability and reactivity of involved phases, and the dissolution of carbon-bearing minerals may carry all the subducting carbon to the mantle wedge[1]. Among the minerals, the solubility of graphite in aqueous fluids is relatively low. According to a previous *ex situ* experimental study[2], however, associated silicate minerals may help enhance the solubility of graphite by forming organic complexes. Therefore, it is important to conduct *in situ* experiments to examine the potential complexation.

Combining hydrothermal diamond anvil cell and Raman spectroscopy, this preliminary study reports experimental results with the following five groups of starting materials: graphite + quartz + H_2O, C_{60} + silica glass + H_2O, C_{60} + H_2O, SiC + H_2O, and $Ag_2C_2O_4$ + silica glass + H_2O. The C_{60} and silica glass are adopted to boost the reaction rate, while SiC and AgC_2O_4 provide different carbon sources in addition to zerovalent graphite and C_{60}. Zircon is employed as the pressure sensor, and Re gasket may affect the f_{O2} of the sample chamber. The peak temperatures of the experiments range from 800 to 900°C with corresponding pressures of 10-15 kbar. A Raman band near 1600 cm^{-1} was obtained in all the experiments. Noteworthily, the peak, as well as those of H_4SiO_4 and $H_6Si_2O_7$, was detected in the C_{60} + H_2O experiment, indicating the low solubility of zircon in water[3] was enhanced in the system. Additionally, the peak is close to but distinguishable from those of graphite and C60, implying the existence of an organic complex containing both C and Si. Further work is needed to determine the structure of the complex. Such kind of complexations will refresh our understanding of deep carbon cycling in subduction zones.

[1] Kelemen & Manning (2005), *Proc. Natl. Acad. Sci.* 112, E3997–E4006. [2] Tumiati et al. (2017), *Nat. Commun.* 8, 1-11. [3] Bernini et al. (2013), *Geochim. Cosmochim. Acta.* 119, 178-187.