Viscosity of carbon dioxide-bearing silicate melt at high pressure

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Knowledge of the viscosity of silicate melts at high pressure is of importance for modeling igneous processes in the Earth's interior. In natural magmas, volatiles are dissolved and affects physical properties. It has been known that volatiles reduce the viscosity of magmas. However, very few studies have been performed to investigate the effect of volatiles on the viscosity at mantle pressures. In the present study, the viscosity of carbon dioxide-bearing jadeite melt has been determined up to 4 GPa. We adopted the falling sphere method for viscometry. Experimental detail has been described elsewhere[1, 2]. X-ray radiography technique enables us to measure the falling velocity of a platinum sphere in situ. Experiments were performed at the NE7A station at the High Energy Accelerator Research Organization (KEK). We used a Kawai type multi anvil apparatus driven by a DIA type guide block installed on the MAX-III apparatus. A charge-coupled device (CCD) camera with a YAG:Ce fluorescence screen was used as an X-ray camera. The present study shows that an addition of carbon dioxide produces a viscosity decrease.

[1] Suzuki *et al*. (2002) *Phys. Chem. Miner.* **29**, 159-165. [2] Suzuki *et al*. (2011) *Phys. Chem. Miner.* **38**, 59-64.

Unveiling key players in the geological disposal environment

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Introduction

It is well established that the speciation, distribution and transport of radionuclides is profoundly influenced by microbial activities in the shallow aquifer. However, it remains to be challenging to predict microbial influences on radionuclide migration in the deep aquifer for geological disposal of radioactive wastes. Currently, there are two major gateways to the deep biosphere through long vertical boreholes from the surface or short horizontal boreholes from the underground tunnel. Neither approach is exempt from the disturbance of the steady biogeochemical state and microbiological populations established through the long evolutionary history within the fracture networks. Despite the disturbance, it is very critical to identify indigenous microbial populations that potentially affect the long-term behavior of radionuclides (e.g. biosorption and redox transformation) and contaminant ones playing short-term roles during the recovery from the disturbance by consuming artificially introduced oxidants.

Underground research laboratories for comparison

The Grimsel Test Site (GTS), central Switzerland, has been in operation since 1984. The GTS provides 400-500-m deep granitic groundwater from boreholes that vary in age from 1 to 25 years. The Mizunami URL (MIU), which is being constructed in central Japan, provides 200-400-m deep granitic groundwater since 2007. The microbial comparison of the URLs associated with freshwater groundwater might result in the clarification of microorganisms commonly associated with the deep granitic subsurface.

Key indigenous and contaminant microbial populations

16S rRNA gene sequence analyses were conducted for groundwater samples from the GTS and the MIU. Sequences related to "*Candidatus* Magnetobacterium bavaricum" of Nitrospirae were predominant in all GTS boreholes, while β-proteobacterial sequences were only obtained from 1-2 year old GTS boreholes. Similarly, the predominance of β-proteobacterial sequences was gradually shifted to that of Nitrospirae sequences within several years after horizontal drilling at the MIU. The detection of the common microorganisms from the geographically distinct URLs suggests that these microbes are cosmopolitan in the granitic aquifer, radionuclide interactions with which should be clarified to provide general and reliable information for the safety of geological disposal in granitic repositories.

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