

Sound velocity measurements in water at high pressures: Application to water at lower mantle conditions

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Introduction

Water is one of the fundamental elements of Earth and icy large planets. Therefore, the knowledge of its thermodynamic equation of state is a key to understand many phenomena in the interior of these planets. Sound velocity measurement in a diamond anvil cell is one of the potential methods to obtain density of liquid water under static conditions up to lower mantle pressures. In this study, we extend the experimental pressure and temperature range to 25 GPa and 900K using a laser heated diamond anvil cell with a combined system of Brillouin scattering and synchrotron X-ray diffraction at SPring-8, Japan [1].

Results

Simultaneous measurements of Brillouin scattering and X-ray diffraction were conducted at the range of pressure and temperature, 5-25 GPa and 550-900 K, along the melting curve of ice.

Obtained sound velocities in water were in good agreement with previous data obtained by external heating experiments [2, 3]. The sound velocities were converted to density with Murnaghan's equation of state and bulk modulus of water at 1 GPa (after [4]) by fitting a parameter of its pressure derivative. Results are in good agreement with the prediction by the previously reported equation of state for water based on sound velocity data up to 6 GPa [2].

Present results can apply the water generated by dehydration of hydrous phases in subducting slabs at lower mantle conditions.

[1] Murakami *et al.* (in press) *Phys. Earth Planet. Int.*

[2] Abramson & Brown (2004) *GCA*, **68**, 1827-1835.

[3] Decremps *et al.* (2006) *Ultrasonics* **44**, 1495-1498

[4] Wagner & Pruß (2002) *J. Phys. Chem. Ref. Data* **31**, 387-535.

Quantification of microbial communities in groundwater using real-time PCR

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On deep geological environment, microbes affect the changes in the redox of groundwater which is one of the most important properties to estimate the condition of a geological disposal system for high-level radioactive waste. It is necessary to quantify microbial biomass on the geological environment as input data in numerical model to evaluate the redox condition. The real-time PCR assay will apply to rapid and simple method as one of the quantification methods. Thus, we applied this method to estimate microbial biomass related to microgeochemical processes in groundwater.

The groundwater was obtained at the depth of -35m and -500m from the borehole H17-1-01 and HDB-10, respectively at Horonobe area, Hokkaido, Japan. SYBR Green-based real-time PCR assay using the LightCycler Systems (Roche) was performed to quantify based on the gene copy number of nitrite reducers (*nirS* and *nirK* gene), denitrifiers (*nosZ* gene), Geobacteraceae including Mn(IV)- and Fe(III)-reducers (16S-rRNA gene), sulphate reducers (*dsr* gene), methanogens (*mcrA* gene), Bacteria (16S-rRNA gene) and Archaea (16S-rRNA gene).

The dominant members of microbes at the depth of -35m (H17-1-01) were Mn(IV)- and Fe(III)-reducers and sulphate reducers. On the other hand, the dominant members of microbes at the depth of -500m (HDB-10) were sulphate reducers and methanogens. The results of real-time PCR assay showed the same tendency as seen in the results of the cultivation-based methods and 16S-rRNA clone analysis. This result suggested that the real-time PCR will be useful for quantification of microbial biomass on the geological environment.

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