Equation of state of water and melting curve of Ice VII based on simultaneous measurements of sound velocity and X-ray diffraction of Ice VII to 19 GPa and 873 K

L. SANG[1]*, D.L. FARBER[2,3], C.R. ARACNE[2], J. ZHANG[1], V. PRAKAPENKA[4], I. KANTOR[4], S. TKACHEV[4], K. ZHURAVLEV[4] AND J.D. BASS[1]

[1]Department of Geology, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA (*correspondence: sang1@illinois.edu)
[2]University of California, Lawrence Livermore National Laboratory, Livermore, California 94550, USA
[3]University of California, Santa Cruz, Santa Cruz, California 95064, USA
[4]GSECARS, Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois 60439, USA

We have measured the sound velocity of H_2O by Brillouin spectroscopy using membrane-style diamond anvil cell with resistance heating at elevated temperatures and pressures up to 873 K and 19 GPa. The unit cells of Ice VII and Au were determined by synchrotron X-ray diffraction, using Au as an *in situ* pressure gauge. All our samples were contained within and chemically insulated from the Re-gasket hole by a gold liner. Measurements of the sound velocity in liquid water have been extended to 8.0 GPa and 873K. We observed, generally, lower velocities (up to 10% at 723 K) than those given by previous studies [1, 2]. The melting of Ice VII was determined by monitoring the sound velocity drop and the disappearance of diffraction pattern of Ice VII upon melting. Our determination of the melting temperatures differ significantly from those given by previous studies [3, 4], with an observed discrepancy of 130 K at 8 GPa. Given the care taken in the present experiments to avoid potential contamination of the water sample due to reactions at high temperatures between the sample and the gaskets and/or pressure gauges, our new measurements likely provide the first measurements on pure water which displays an extended stability field of the solid phase. Thus, our new measurements suggest that the melting curve of H_2O at high pressure needs to be reevaluated.

[1] Abramson & Brown (2003) *GCA* **68**, 1827–1835. [2] Decremps *et al*. (2006) *Ultrasonics* **44**, 1495–1498. [3] Datchi *et al*. (2000) *Phys. Rev. B* **61**, 6535–6546. [4] Lin *et al*. (2004) *J. Chem. Phys*. **121**, 8423–8427.

Solid - liquid Equilibria in the quaternary $K_2B_4O_7$-K_2SO_4-KCl-H_2O system at 323 K

SHI-HUA SANG*, XIAO ZHANG AND DAN WANG

College of Materials and Chemistry & Chemical Engineering, Chengdu University of Technology, ChengDu 610059, P.R. China (*correspondence: sangsh@cdut.edu.cn)
Mineral Resources Chemistry Key Laboratory of Sichuan Higher Education Institutions, ChengDu 610059, P.R. China

Introduction

A huge store of underground brine was discovered in Sichuan western basin of China. Sodium chloride, potassium and boron are the major chemical compositions of the underground brines. For exploiting brine resources of the underground brines, the measurement of mineral solubilities at different temperatures is used widely.

Discussion of Results

The solid - liquid equilibria in the quaternary system $K_2B_4O_7$-K_2SO_4-KCl-H_2O at 323 K were studied experimentally using the method of isothermal solution saturation. Solubilities and densities of the solution of the quaternary system were measured experimentally. In the phase diagram of the quaternary system $K_2B_4O_7$ -K_2SO_4-KCl-H_2O at 323 K, there are one invariant point E and three univariant curves E1E, E2E and E3E, and three crystallization fields corresponding to KCl, $K_2B_4O_7{\cdot}4H_2O$ and K_2SO_4 in the studied quaternary system. The experimental results show that K_2SO_4 has the biggest crystallization field (E2EE1 field) in the phase diagram (Figure 1).

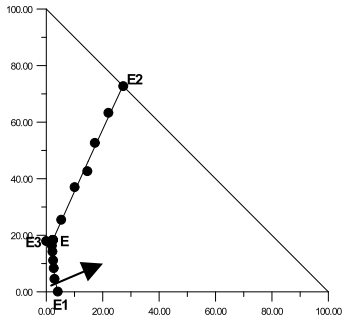

Figure 1: Phase diagram of the quaternary system $K_2B_4O_7$ - K_2SO_4-KCl-H_2O at 323 K(KB: $K_2B_4O_7{\cdot}4H_2O$)

This project was supported by the National Natural Science Foundation of China (No. 40973047), the Young Science Foundation of Sichuan Province in China (08ZQ026-017), and the New Century Excellent Talents in Universities of China (NCET-07-0125).