

Experimental Method

Ice-Ih powder is squeezed with the diamond-anvil cell in liquid nitrogen. Pressure gasket is not used. The cell is then clamped and warmed. When we see the sample from the top, the sample pressure is high in the center. O. Mishima, K. Takemura, K. Aoki, *Science* 254, 406 (1991).

The ice phases are assigned by using available information. C. G. Salzmann, E. Mayer and A. Hallbrucker, *Phys. Chem. Chem. Phys.* 6, 5156 (2004); T. Loerting, I. Kohl, C. Salzmann, E. Mayer, and A. Hallbrucker, *J. Chem. Phys.* 116, 3171 (2002).

