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Melting and thermoelastic properties of high-pressure ices under conditions of planetary interiors

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H_2O is among the most abundant molecules in our galaxy and exhibits diverse forms as vapor, liquid (water), and solid (ice) in a large variety of planetary environments in our Solar System. It can be a major component that drive the dynamic evolution of the icy satellites and governs their evolutions and dynamics. In this study, we employed a newly developed vacuum enclosure for externally-heated diamond anvil cell with fine-tunning compression and decompression capability and large optical opening, to determine the melting temperature, structure, and thermoelastic properties of high-pressure ices (ice VI and VII) at simultaneously high-pressure and high-temperature conditions. The melting of ice VI and VII was detected from the disappearance and reappearance of shear waves in Brillouin scattering data and single or multi-grain X-ray diffraction peaks upon melting and recrystalization of multi-grain or single-crystal ices during multiple compression and decompression cycles at high temperatures, respectively. We also measured thermal equation of state and single-crystal elasticity of ice VII up to 80 GPa and 1000 K. Our results will provide new insights into the internal dynamics and evolution of water/ice worlds, as well as hydrogen in Earth's interior.