

Figure S1. The sample loading configurations in run-1 and run-2. (a) Single crystal ice-VII grown from melt with ruby and gold, figure modified after (Lai et al., 2020) (b) Single crystal ice-VII which filled the sample chamber with ruby and gold. SCXRD was conducted at different positions in each sample chamber to confirm it belongs to the same single crystal.

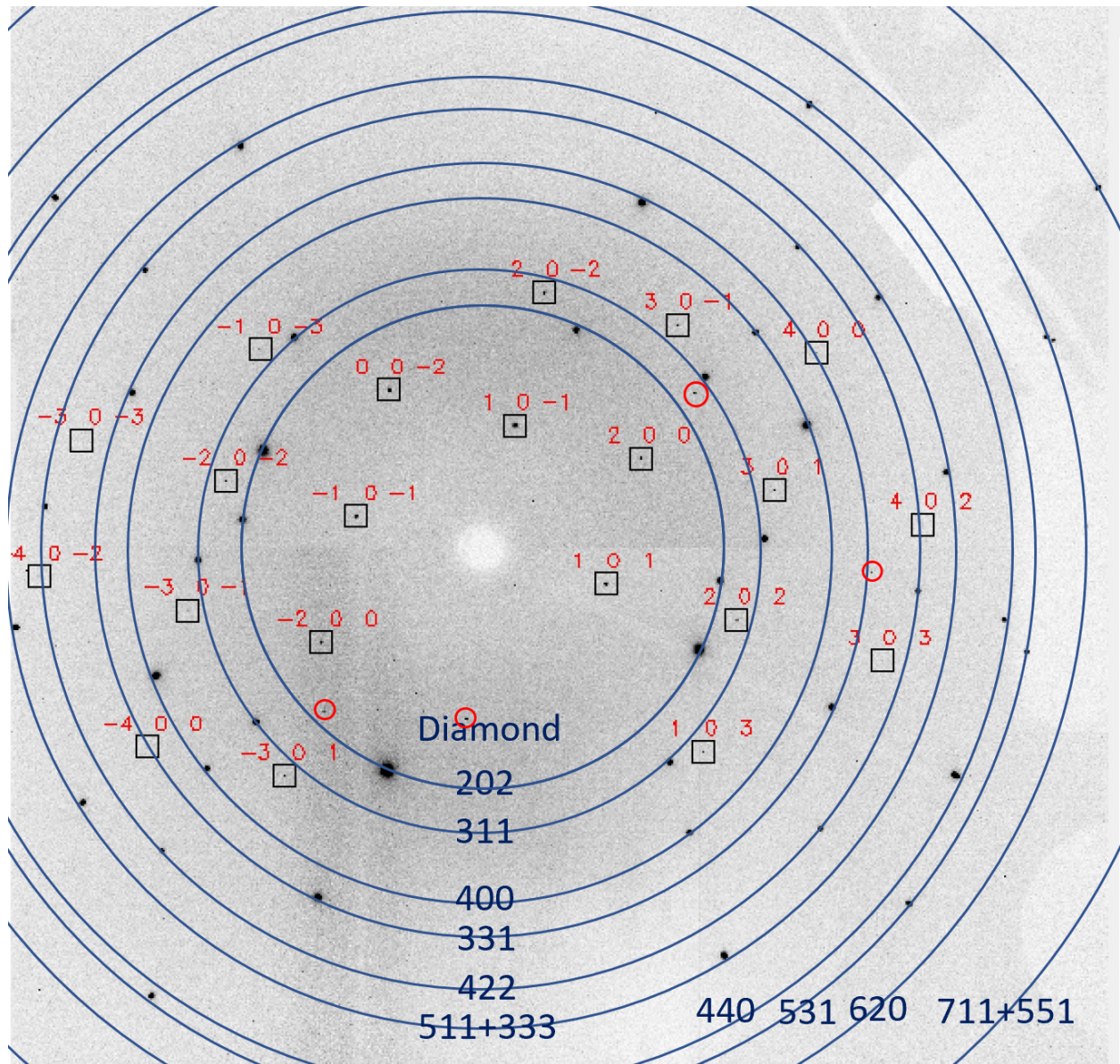


Figure S2. XRD patterns at 5.5 GPa, 300 K in run-1. Diffraction peaks of the ice-VII were marked by black boxes. Red labels correspond to Miller indices (hkl) of the diffraction peaks. Blue rings correspond to the d spacing positions of diamond. Four impurity peaks, which don't shift with pressures or only showed up in this data set, were marked by red circles.

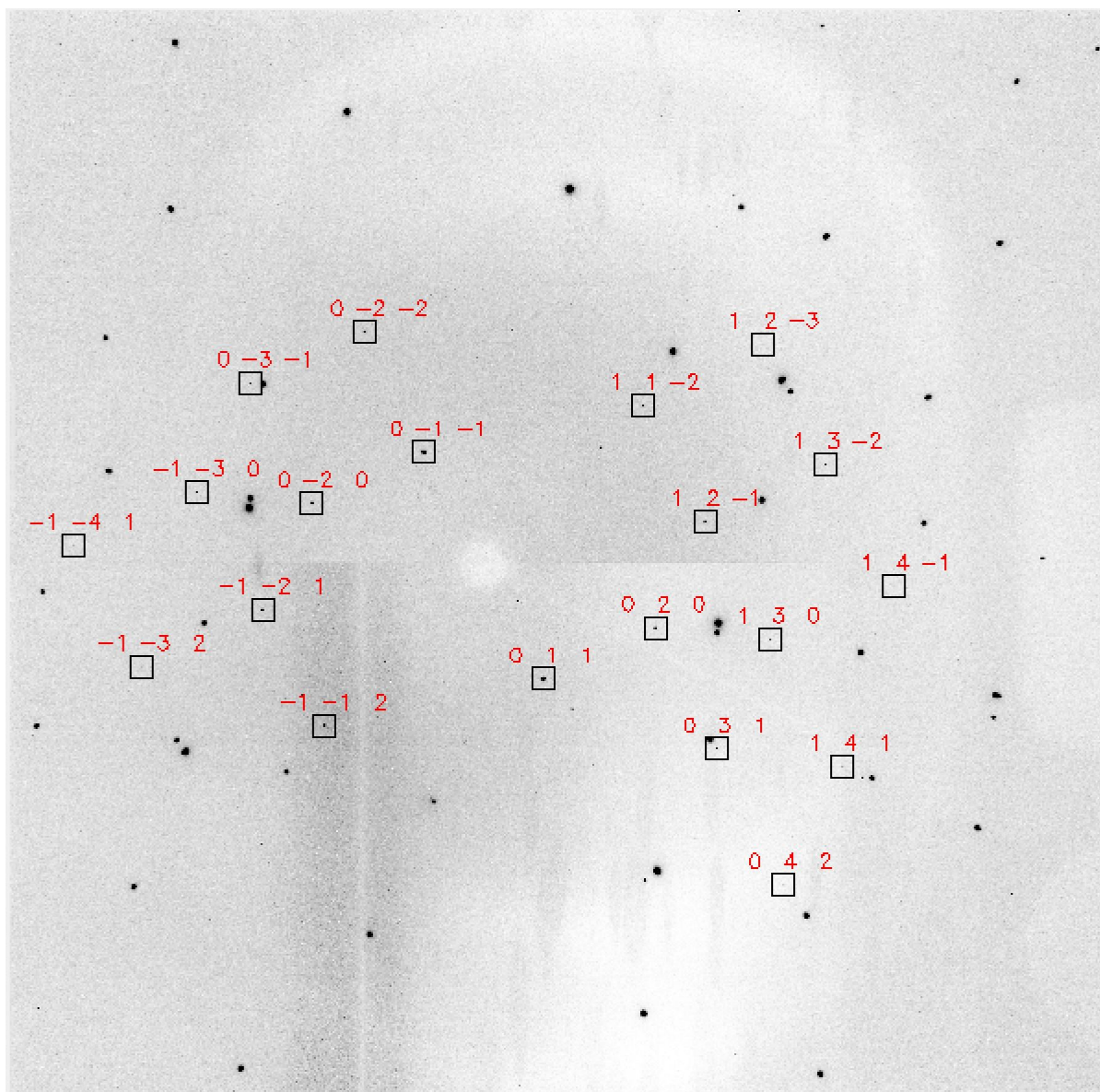


Figure S3. Single-crystal XRD patterns of ice-VII at 3.5 GPa and 300 K in run-2. Red labels correspond to Miller indices (*hkl*) of the diffraction peaks.

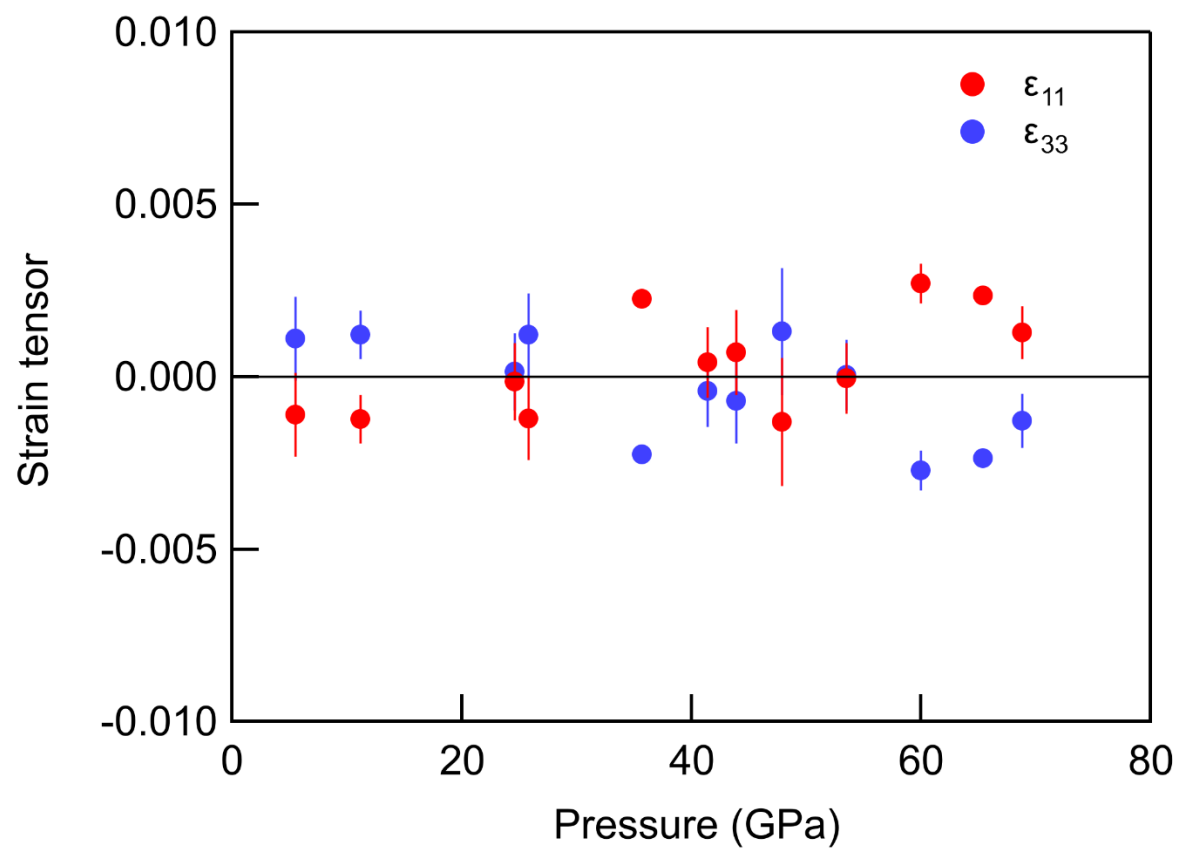


Figure S4. Strain tensor calculated from data at 300 K in run-1.

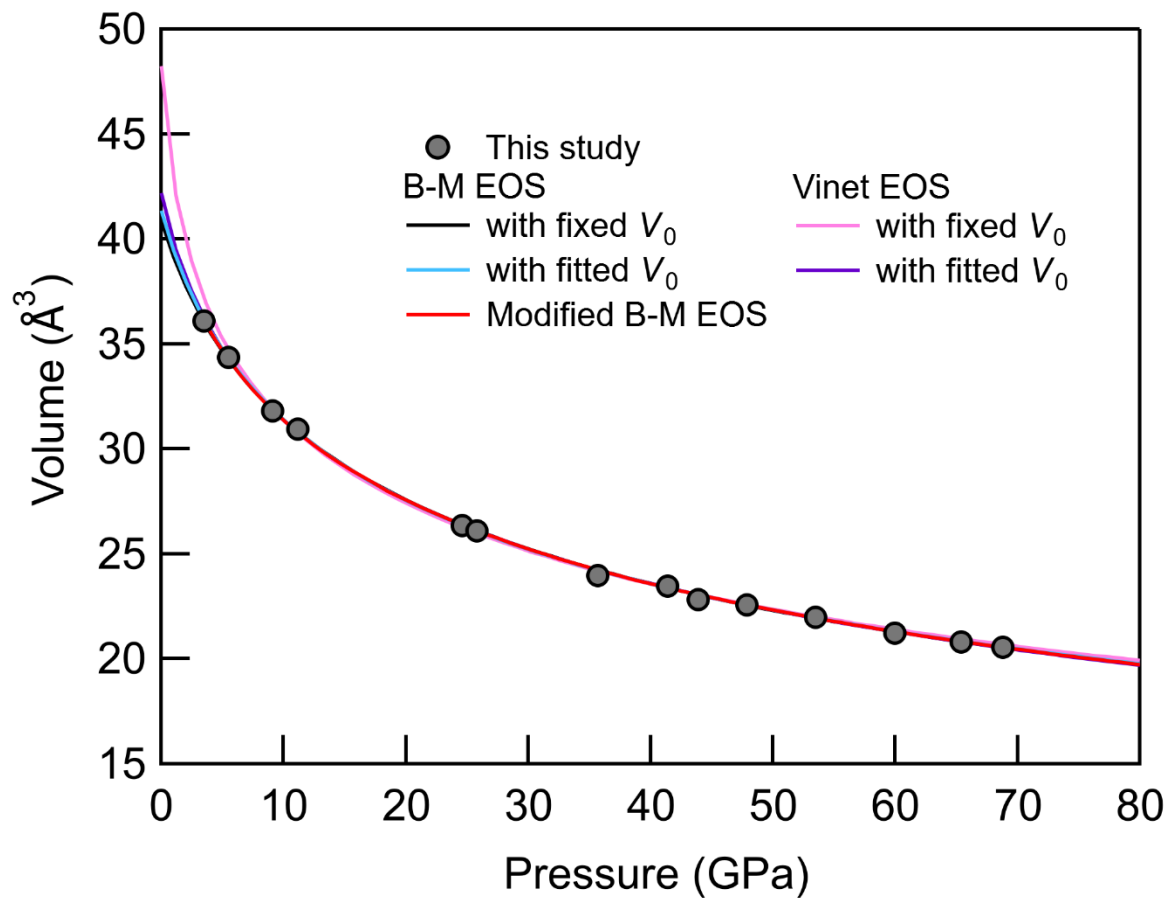


Figure S5. Pressure-volume data in this study and the fitting lines by different equation of states.

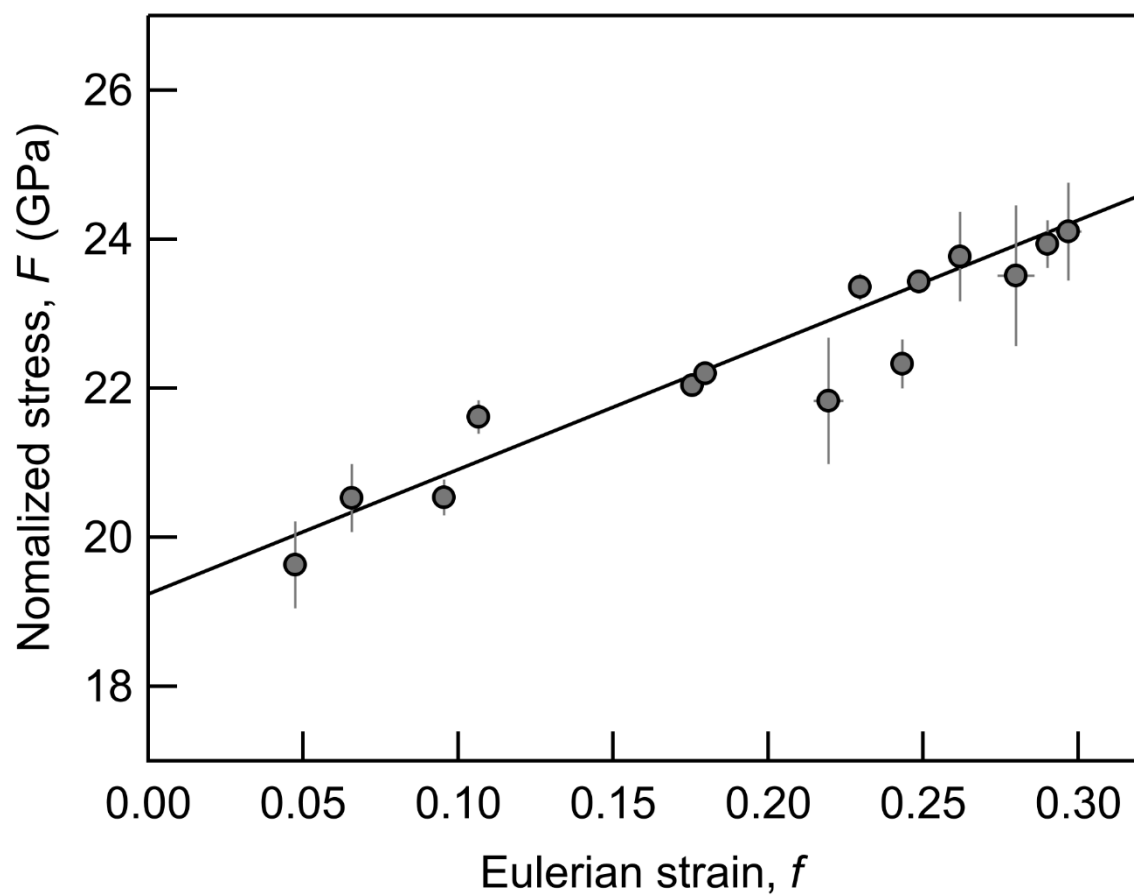


Figure S6. The F - f plot of data at 300 K using the parameters of the third order B-M EoS with a fitted V_0 in this study. Solid line is the linear fitting.

Table S1 Lattice parameters of high-pressure ice obtained by high-pressure and high-temperature single crystal X-ray Diffraction.

Pressure (GPa)	Temperature (K)	<i>a</i> (Å)	Volume (Å ³)	Run #
5.5(1)	300	3.2510(10)	34.36(6)	Run-1
11.2(1)	300	3.1392(6)	30.94(3)	Run-1
24.6(1)	300	2.9749(3)	26.33(2)	Run-1
25.8(1)	300	2.9654(3)	26.08(2)	Run-1
35.7(2)	300	2.8824(48)	23.95(24)	Run-1
41.4(3)	300	2.8622(1)	23.45(1)	Run-1
43.9(1)	300	2.8361(18)	22.81(9)	Run-1
47.9(1)	300	2.8261(1)	22.57(1)	Run-1
53.5(3)	300	2.8012(30)	21.98(15)	Run-1
60.0(3)	300	2.7684(49)	21.22(24)	Run-1
65.4(4)	300	2.7505(13)	20.81(7)	Run-1
68.8(3)	300	2.7392(32)	20.55(16)	Run-1
3.5(1)	300	3.3046(5)	36.09(3)	Run-2
9.1(1)	300	3.1686(3)	31.81(2)	Run-2
6.8(1)	400	3.2314(6)	33.74(3)	Run-1
18.5(2)	400	3.0508(3)	28.39(2)	Run-1
27.3(2)	400	2.9623(4)	26.00(2)	Run-1
43.9(2)	400	2.8519(23)	23.20(11)	Run-1
57.7(2)	400	2.7871(24)	21.65(12)	Run-1
61.4(5)	400	2.7709(12)	21.28(6)	Run-1
67.2(8)	400	2.7504(4)	20.81(2)	Run-1
11.5(5)	400	3.1377(3)	30.89(2)	Run-2
11.2(4)	500	3.1617(6)	31.60(4)	Run-1
27.0(1)	500	2.9712(14)	26.23(8)	Run-1
30.6(3)	500	2.9461(7)	25.57(4)	Run-1
45.7(3)	500	2.8464(20)	23.06(10)	Run-1

63.9(3)	500	2.7651(19)	21.14(9)	Run-1
65.6(1)	500	2.7542(14)	20.89(7)	Run-1
70.0(6)	500	2.7441(6)	20.66(3)	Run-1
12.5(4)	500	3.1311(4)	30.70(2)	Run-2
40.2(4)	600	2.8841(3)	23.99(2)	Run-1
47.5(3)	600	2.8384(10)	22.87(5)	Run-1
67.7(3)	600	2.7450(4)	20.74(5)	Run-1
69.4(3)	600	2.7533(20)	20.87(10)	Run-1
68.1(2)	600	2.7539(31)	20.89(15)	Run-1
73.6(5)	600	2.7390(31)	20.55(15)	Run-1
13.1(4)	600	3.1251(12)	30.55(6)	Run-2
47.2(2)	700	2.8403(12)	22.91(6)	Run-1
50.4(1)	700	2.8266(25)	22.58(12)	Run-1
78.2(4)	700	2.7328(17)	20.41(8)	Run-1
15.5(2)	700	3.1025(6)	29.86(3)	Run-2
25.8(5)	800	3.0047(26)	27.13(15)	Run-1
14.6(5)	900	3.1577(27)	31.49(15)	Run-2
29.7(5)	900	2.9738(30)	26.30(16)	Run-2
31.4(5)	1000	2.9676(10)	26.14(6)	Run-2
24.2(5)*	1000	3.0365(28)	28.00(16)	Run-2

*Data collected when decompression at 1000 K