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Supporting Information for

Synthesis, elasticity and spin state of an intermediate $MgSiO_3$-$FeAlO_3$ bridgmanite: Implications for iron in Earth's lower mantle

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Introduction

Figure S1 and Table S1 gave the BSE image and chemical analyses of the synthetic sample. Figure S2 showed some representative XRD patterns upon compression. Figure S3 showed the relation between unit-cell volume and Fe-Al content in this and previous studies. Table S2 listed the EoS parameters of the FA50 bridgmanite and other bridgmanites, which appear in Figure 3 and 6.

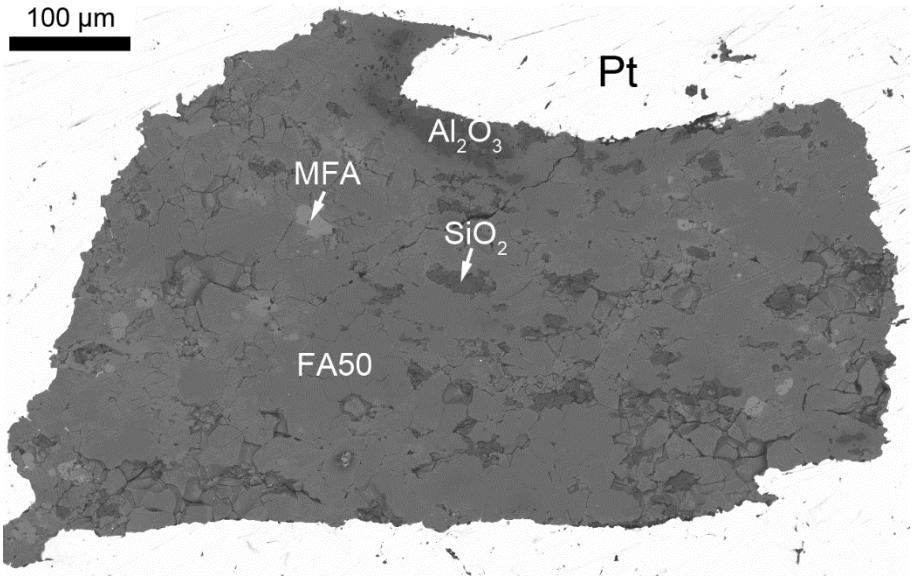

Figure S1. BSE image of the synthetic products of experiment M092116. FA50 represents $(Mg_{0.47\text{-}0.50}Fe_{0.52})(Al_{0.46\text{-}0.47}Si_{0.51\text{-}0.55})O_3$ (bulk sample, gray) and MFA represents $Mg_{1.46}Fe_{2.42}Al_{1.08}Si_{0.14}O_7$ (light gray). Al_2O_3 and SiO_2 are excess materials in the starting mixture (dark gray, similar in brightness).

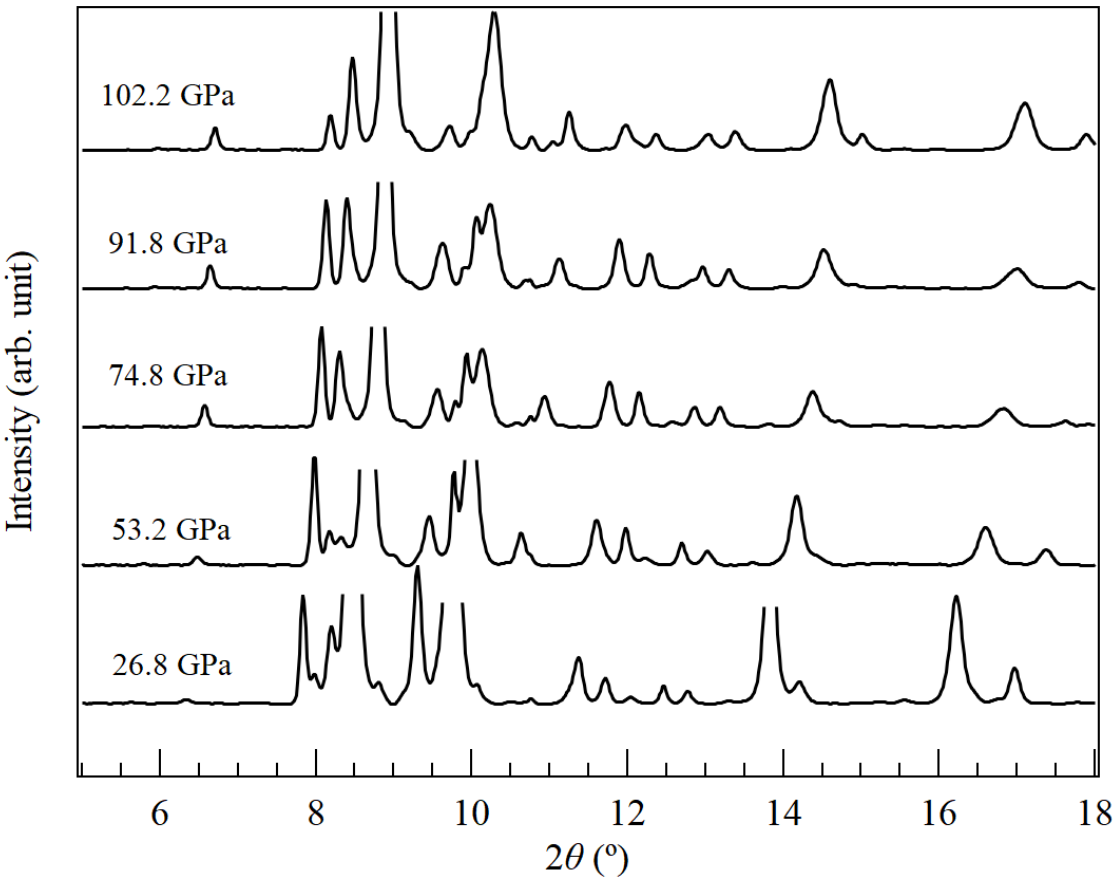

Figure S2. Representative XRD patterns for sample 1 at 300 K. As a result of laser-annealing, the width of the peaks did not increase significantly with pressure. The relative intensity of some peaks changed due to recrystallization during laser-annealing. Some strong peaks, mainly Au (111) peak, were cut for better presentation.

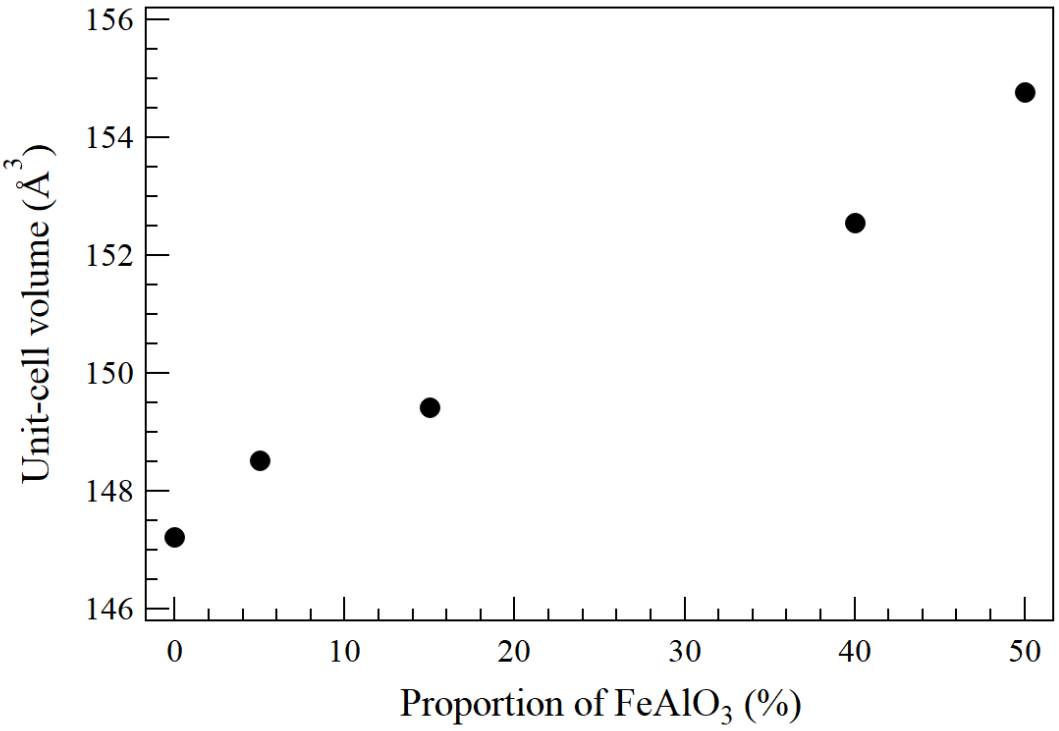

Figure S3. The unit-cell volume of bridgmanite at 30 GPa increases with the amount of Fe-Al incorporation. The volumes are calculated from the EoS presented in Fig. 3a.

Table S1. Composition of the experimental products.

	Mg	Fe	Si	Al	O
			M092116		
FA50	10.02±0.72	10.35±0.80	10.15±0.78	9.45±0.81	60.01±0.11
Formula			$Mg_{0.50\pm0.04}Fe_{0.52\pm0.04}Al_{0.47\pm0.04}Si_{0.51\pm0.04}O_{3\pm0.01}$		
MFA	12.09±0.35	20.00±1.69	1.18±0.10	8.91±1.45	57.82±0.08
Formula			$Mg_{1.46\pm0.04}Fe_{2.42\pm0.20}Al_{1.08\pm0.18}Si_{0.14\pm0.01}O_{7\pm0.01}$		
			M102916 (50% ^{57}Fe)		
FA50	9.31±0.72	10.27±0.80	10.88±0.76	9.23±0.78	60.31±0.23
Formula			$Mg_{0.47\pm0.04}Fe_{0.52\pm0.04}Al_{0.46\pm0.04}Si_{0.55\pm0.04}O_{3\pm0.01}$		

Note: Oxygen is calculated by stoichiometry.

Table S2. Equation-of-state (EoS) parameters of bridgmanites at 300 K.

Composition	Pressure range (GPa)	V_0 (Å^3)	K_0 (GPa)	K_0'	References
FA50[a]	26.8-102.2	172.1(4)	229(4)	4(fixed)	this study
FA50[b]	27.5-103.6	170.7(3)	240(3)	4(fixed)	this study
FF50 (HS)	24.7-43.1	183.5(3)	176(2)	4(fixed)	Liu et al. (2018)
FF50 (LS)	52.5-61.4	178.5(7)	186(5)	4(fixed)	Liu et al. (2018)
FA40	0-74.4	168.93(5)	240(2)	4.12(8)	Boffa Ballaran et al. (2012)
FA15	0-120.48	164.96(18)	252(1)	4(fixed)	Nishio-Hamane et al. (2008)
FA5	0-59.7	162.7(1)	255(2)	4(fixed)	Andrault et al. (2001)
$MgSiO_3$	0-76.8	162.36(4)	251(2)	4.11(7)	Boffa Ballaran et al. (2012)

[a]Laser annealed at each pressure step
[b]Cold compressed for the whole pressure range
FA50 - $(Mg_{0.5}Fe_{0.5})(Al_{0.5}Si_{0.5})O_3$; FF50 - $(Mg_{0.5}Fe_{0.5})(Fe_{0.5}Si_{0.5})O_3$, FA40 - $(Mg_{0.6}Fe_{0.4})(Al_{0.4}Si_{0.6})O_3$;
FA15 - $(Mg_{0.85}Fe_{0.15})(Al_{0.15}Si_{0.85})O_3$; FA5 - $(Mg_{0.95}Fe_{0.05})(Al_{0.05}Si_{0.95})O_3$.