

Table S1 S_{Config} (in $\text{meVK}^{-1}\text{unit}^{-1}$) calculated using Equation 2 for a variety of Ca%, Fe% and pressures.

Also shown is a hypothetical “perfect” system where all configurations of Fe:Ca:Mg have the same energy.

This latter system is invariant to pressure.

Ca%		0	12.5	25	37.5	50	62.5	75	100
25 GPa	Fe free	0	0.000179	0.000275	0.000342	0.000345	0.000346	0.000254	0
	12.5% Fe	0	0.000346	0.000441	0.000485	0.000485	0.000379	0.000347	0
	25% Fe	0	0.000441	0.000520	0.000525	0.000520	0.000442	0.000000	0
75 GPa	Fe free	0	0.000179	0.000269	0.000335	0.000326	0.000347	0.000255	0
	12.5% Fe	0	0.000345	0.000439	0.000482	0.000485	0.000424	0.000345	0
	25% Fe	0	0.000440	0.000519	0.000544	0.000520	0.000442	0.000000	0
125 GPa	Fe free	0	0.000179	0.000264	0.000327	0.000309	0.000346	0.000262	0
	12.5% Fe	0	0.000344	0.000436	0.000477	0.000485	0.000424	0.000347	0
	25% Fe	0	0.000440	0.000519	0.000542	0.000520	0.000441	0.000000	0
Perfect	Fe free	0	0.000179	0.000287	0.000347	0.000366	0.000347	0.000287	0
	12.5% Fe	0	0.000347	0.000442	0.000486	0.000486	0.000442	0.000347	0
	25% Fe	0	0.000442	0.000521	0.000545	0.000521	0.000442	0.000000	0

Table S2 H_{mix} (in eV) determined statically for a system of Ca-pv and Mg-pv various values of Ca% and Fe%. at different pressures (25,75 and 125 GPa).

			enthalpy of mixing(ev)				
		12.5%Ca	25%Ca	37.5%Ca	50%Ca	62.5%Ca	75%Ca
25GPa	Fe free	0.9308	1.6612	2.0161	2.1268	2.1247	1.8347
	6.25% Fe	0.8290					
	12.5% Fe	0.7659	1.3165	1.6789	1.8419	1.8018	1.5636
	25% Fe	0.9051	1.5877	1.8721	1.7584	1.2467	0.3368
75GPa	Fe free	1.2733	2.1968	2.7553	2.9602	2.8229	2.3282
	6.25% Fe	1.210					
	12.5% Fe	1.1658	1.8452	2.2629	2.4042	2.2690	1.8572
	25% Fe	1.1065	1.9895	2.3286	2.1237	1.3749	0.0822
125GPa	Fe free	1.5751	2.7141	3.4174	3.6847	3.5159	2.9111
	6.25% Fe	1.472					
	12.5% Fe	1.4098	2.2438	2.7630	2.8801	2.5944	1.9067
	25% Fe	1.3362	2.4883	2.9335	2.6718	1.7033	0.0278

Figure S1 Formation enthalpies of Mg-end member MgSiO₃ (orange line) and mixed phase Mg_{0.875-x}Ca_{0.125}Fe_xSiO₃ (blue line) as a function of iron.

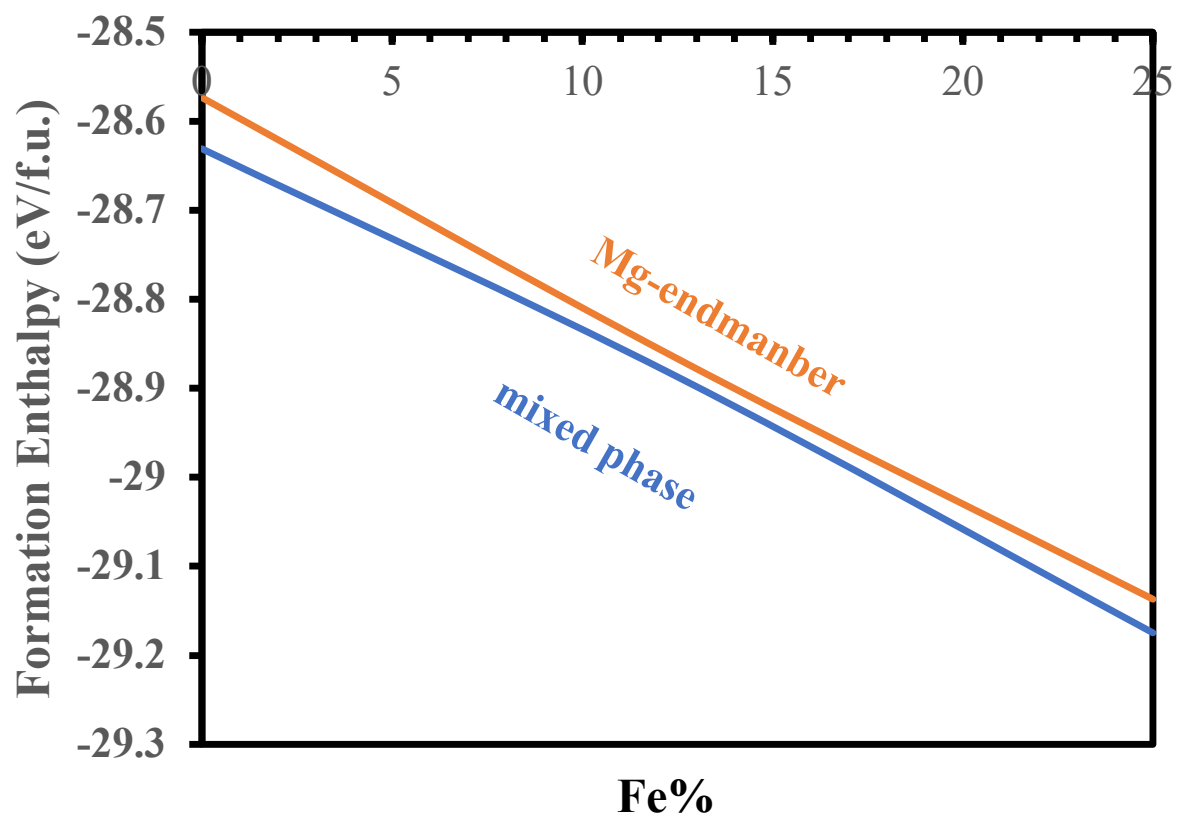


Figure S2 Plot of the mixing temperature (T_{mix}) for a Ca: Mg =1:1 mixture of Mg-pv and Ca-pv phases in Fe free (black line), 1% Fe (yellow line), 6.25% Fe (blue line) and 12.5% Fe (red line) bearing systems. A normal mantle geothermal gradient and the cold subduction slab geothermal is also presented for guidance (Ohtani et al. 2018).

