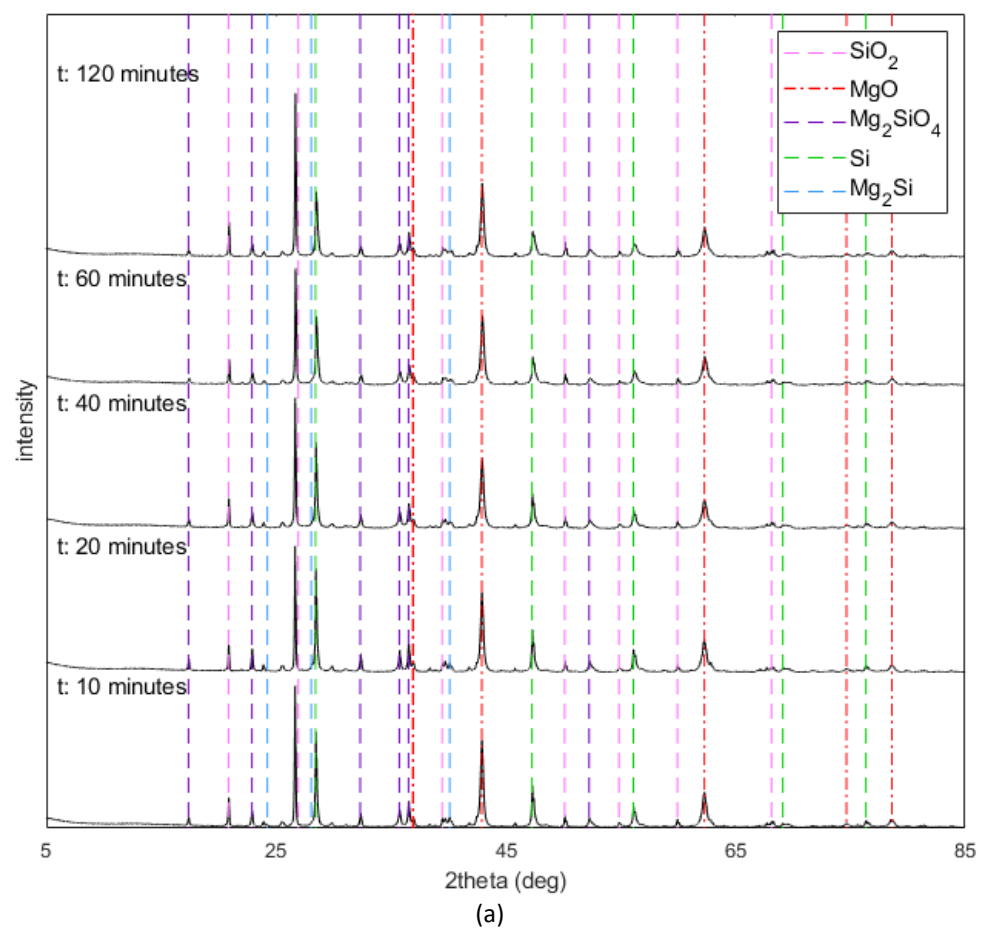


Supplementary material for: Magnesiothermic Reduction of Natural Quartz

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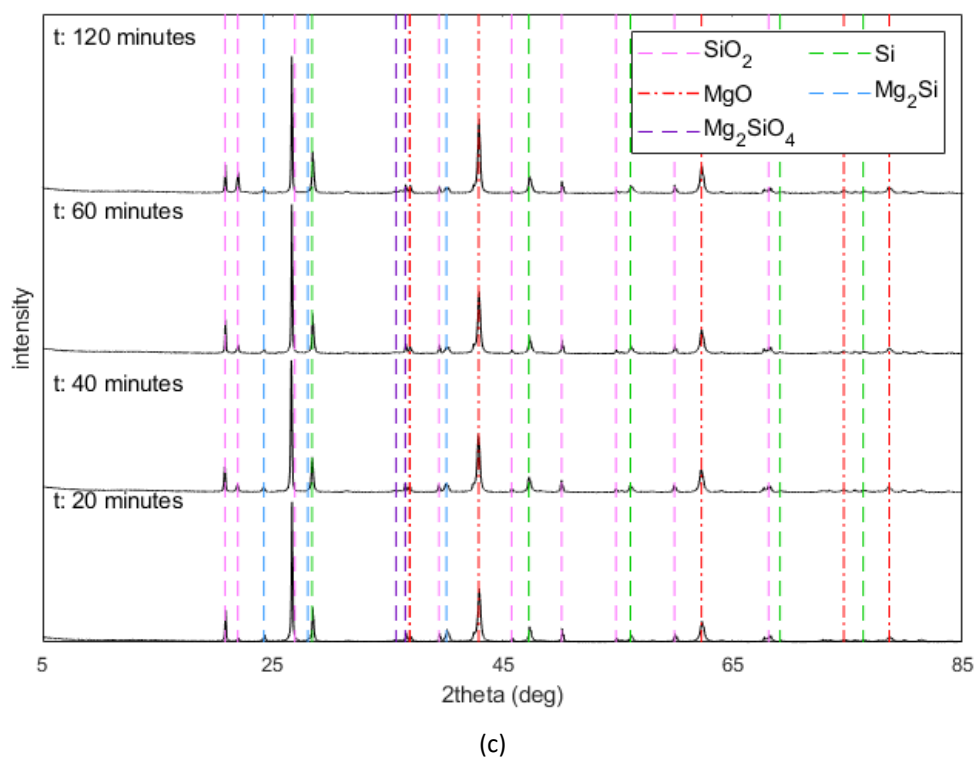
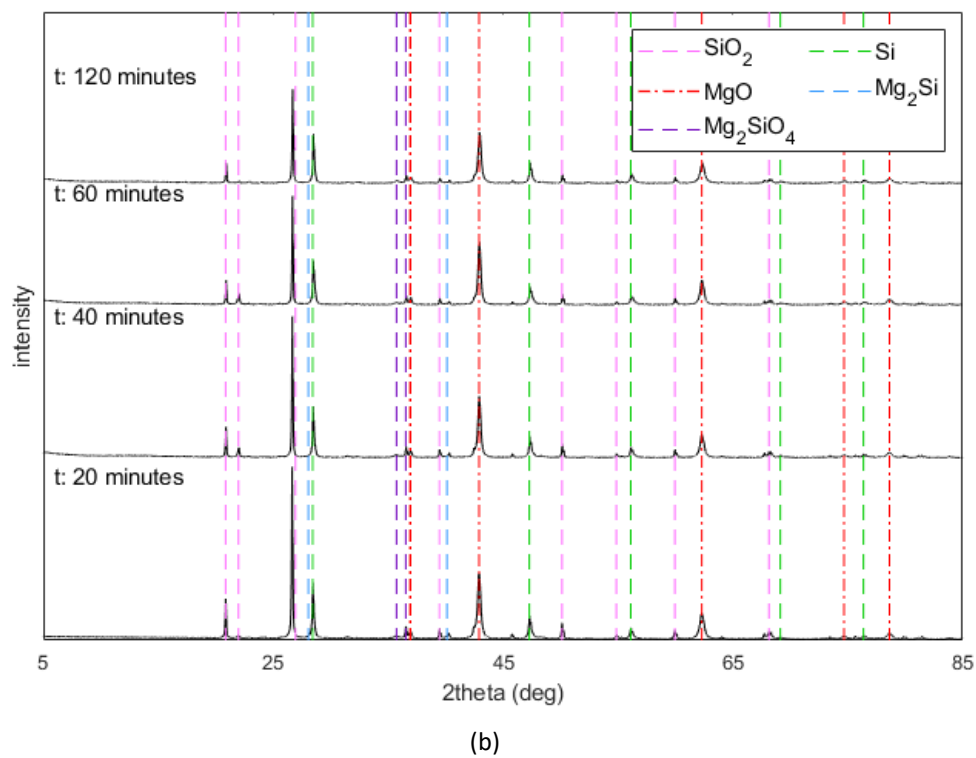
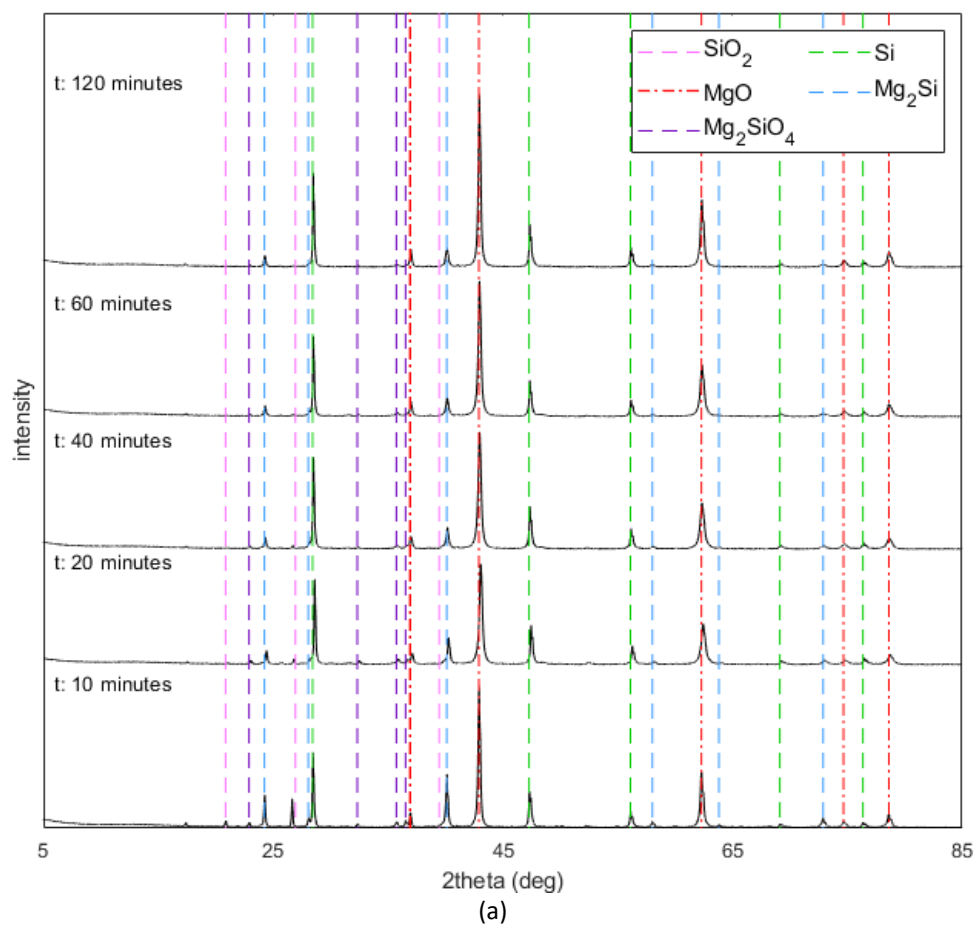
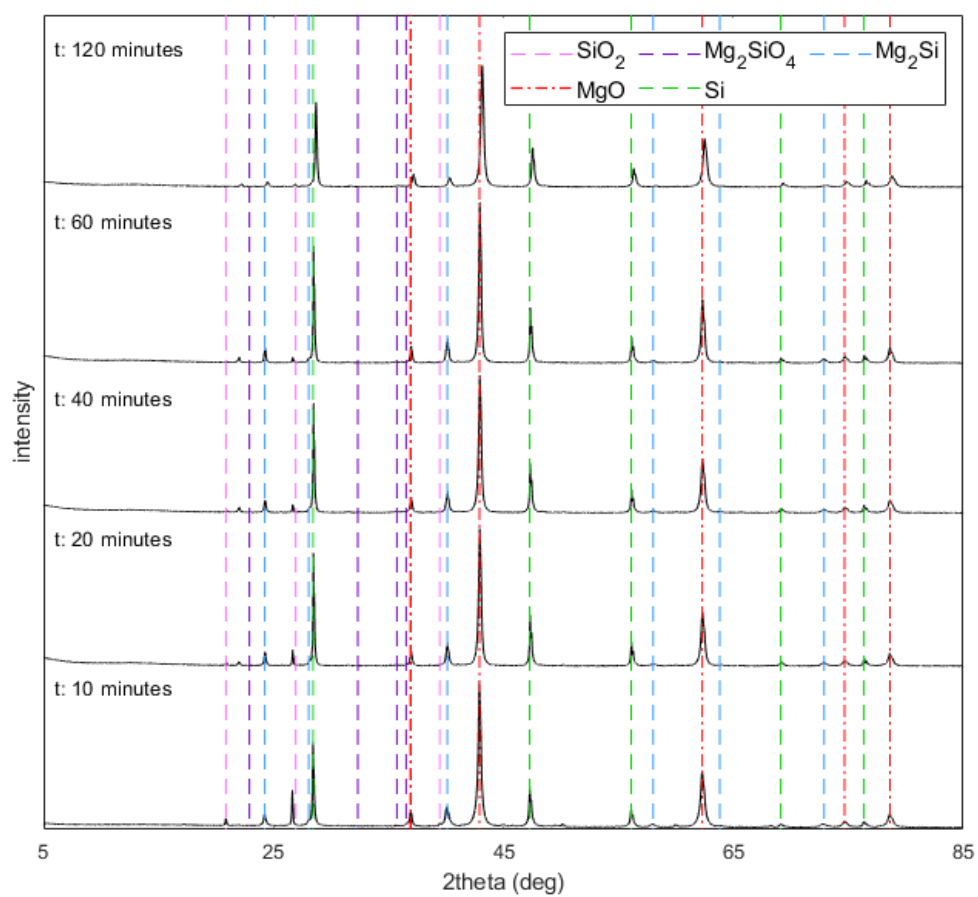


Figure S-1: X-ray diffraction patterns of samples at a Mg:SiO₂ mole ratio of 1, (a): 57 μm quartz particle size, (b) 704 μm quartz particle size and (c) : 3360 μm quartz particle size.





(b)

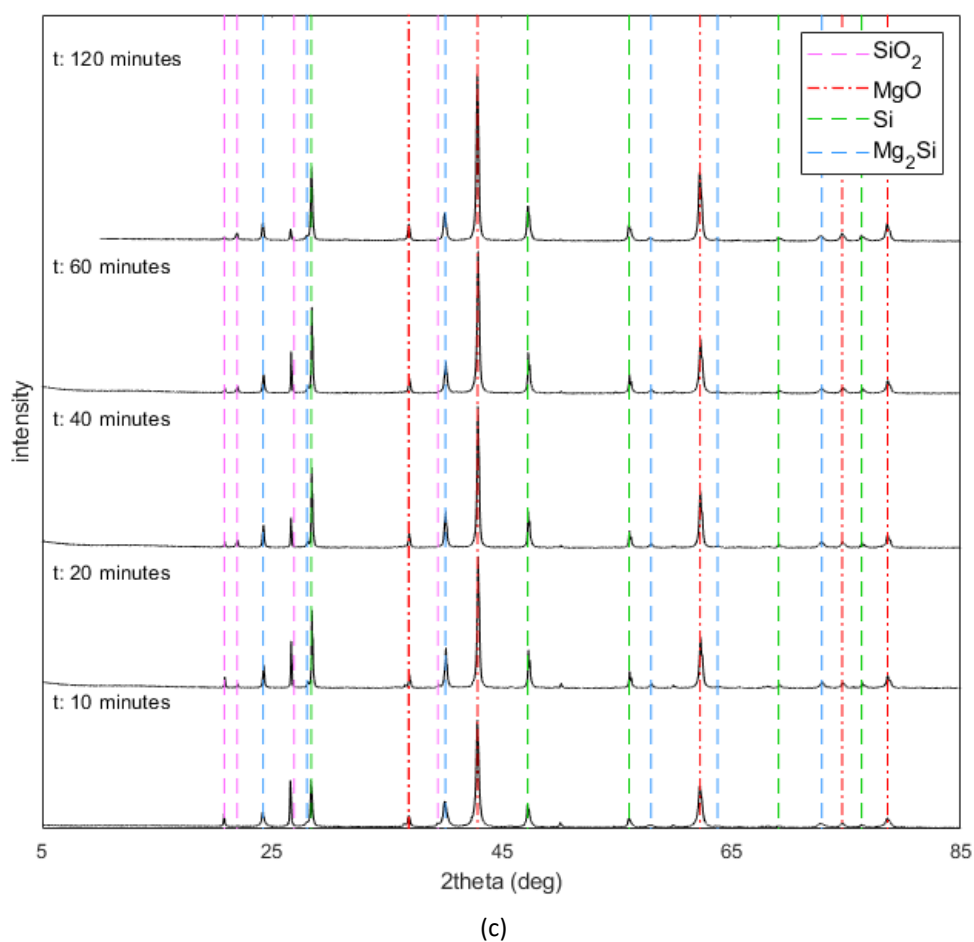
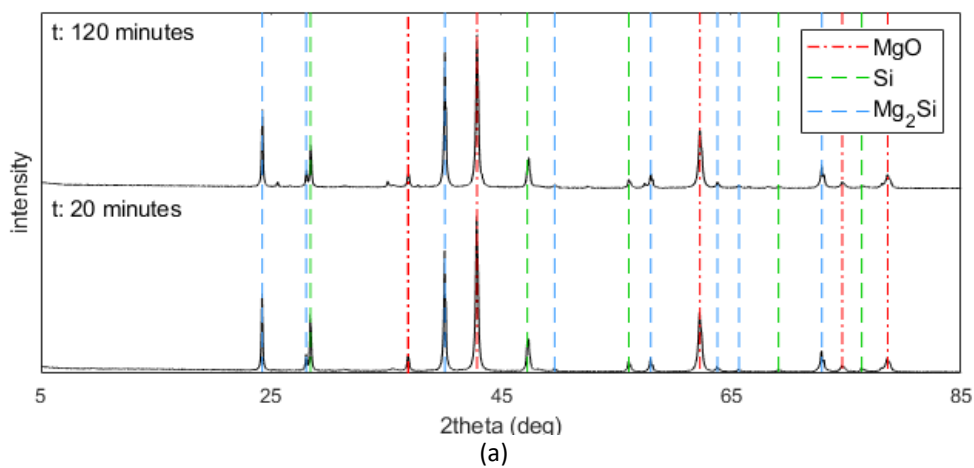


Figure S-2: X-ray diffraction patterns of samples at a Mg:SiO₂ mole ratio of 2, (a): 57 μm quartz particle size, (b) 704 μm quartz particle size and (c) : 3360 μm quartz particle size.



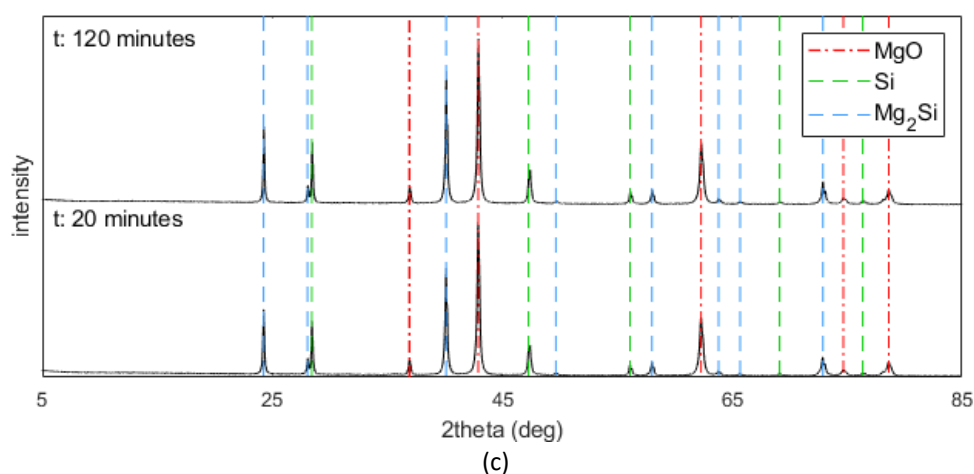
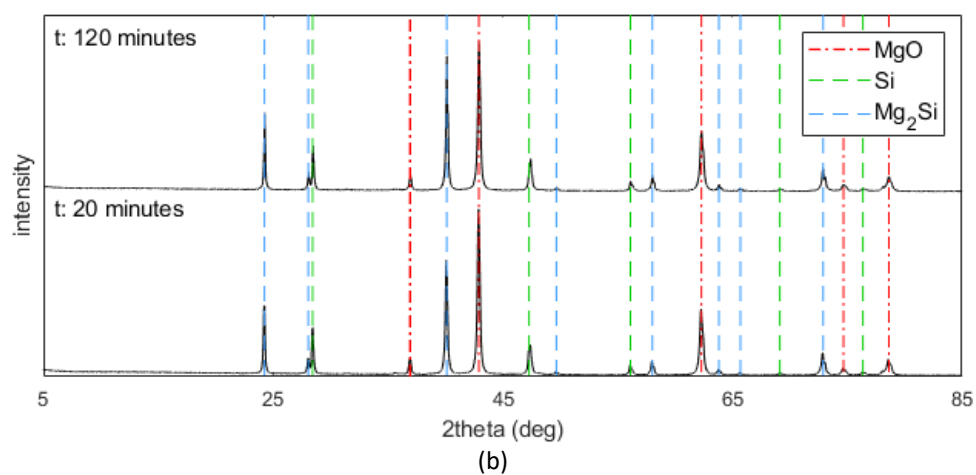


Figure S-3: X-ray diffraction patterns of samples at a Mg:SiO₂ mole ratio of 3, (a): 57 μm quartz particle size, (b) 704 μm quartz particle size and (c) : 3360 μm quartz particle size.

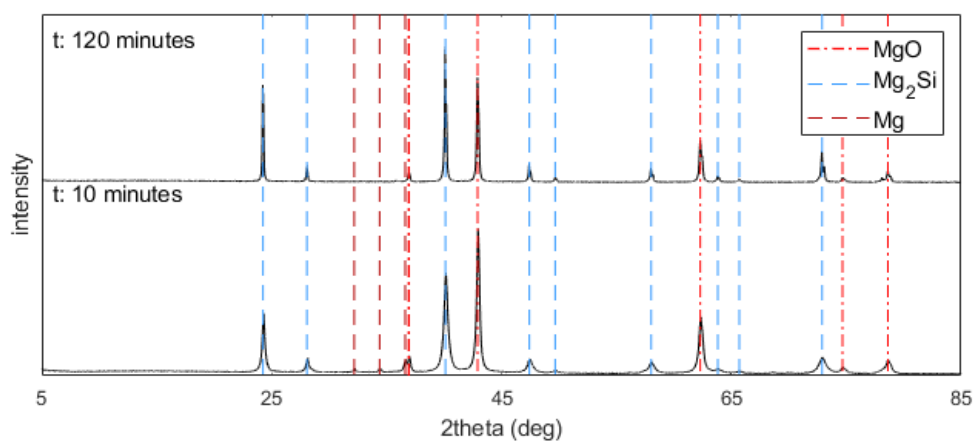


Figure S-4: X-ray diffraction patterns of samples at a Mg:SiO₂ mole ratio of 4 and 704 μm quartz particle.

Table S-I: Phase distribution at reaction temperature of 1373 K, calculated by FactSage 7.3.

Mg:SiO ₂ mole ratio	Amount of phases at equilibrium condition (wt%)			
	MgO	Si	liquid	Other phases
1	8.2	17.7	-	Mg ₂ SiO ₄ :74.2
2	71.0	16.3	12.7	-
3	58.3	-	41.7	-
4	48.3	-	51.7	-

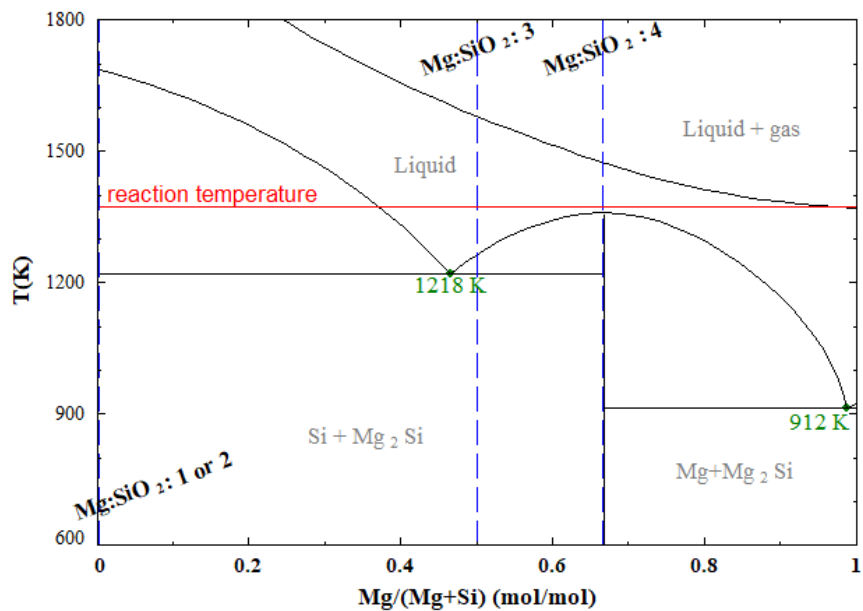


Figure S-5: Binary phase diagram of Mg-Si, calculated by FactSage 7.3.

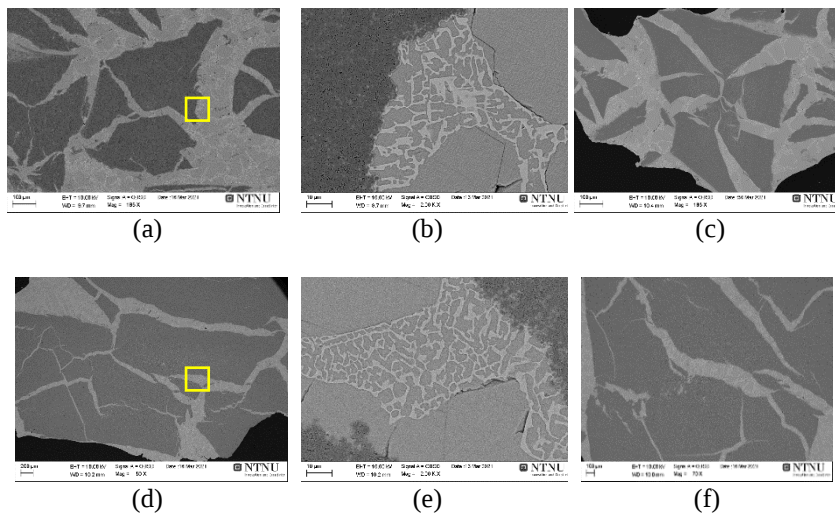


Figure S-6: Backscattered electron image of samples at a Mg:SiO₂ mole ratio of 3 and different quartz particle sizes and reaction time, (a) 704 μm quartz particle and 20 minutes reaction time, (b): higher magnification of area shown in the yellow square in figure (a), (c): 704 μm quartz particle and 120 minutes reaction time, (d): 3360 μm quartz particle and 20 minutes reaction time, (e): higher magnification of area shown in the yellow square in figure (d), (f): 3360 μm quartz particle and 120 minutes reaction time.

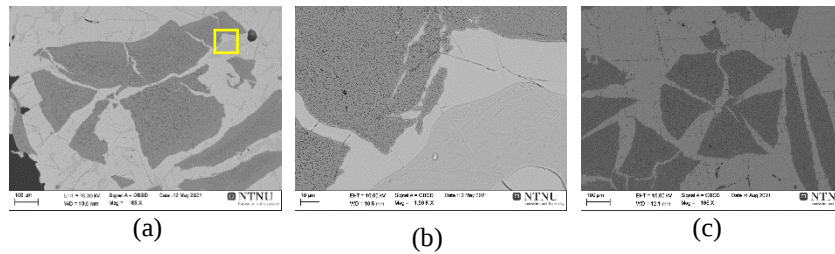


Figure S-7: Backscattered electron image of samples at a Mg:SiO₂ mole ratio of 4, 704 μm quartz particle size and two different reaction times, (a): 10 minutes reaction time, (b) higher magnification of area shown in the yellow square in figure (a), (c): 120 minutes reaction time.

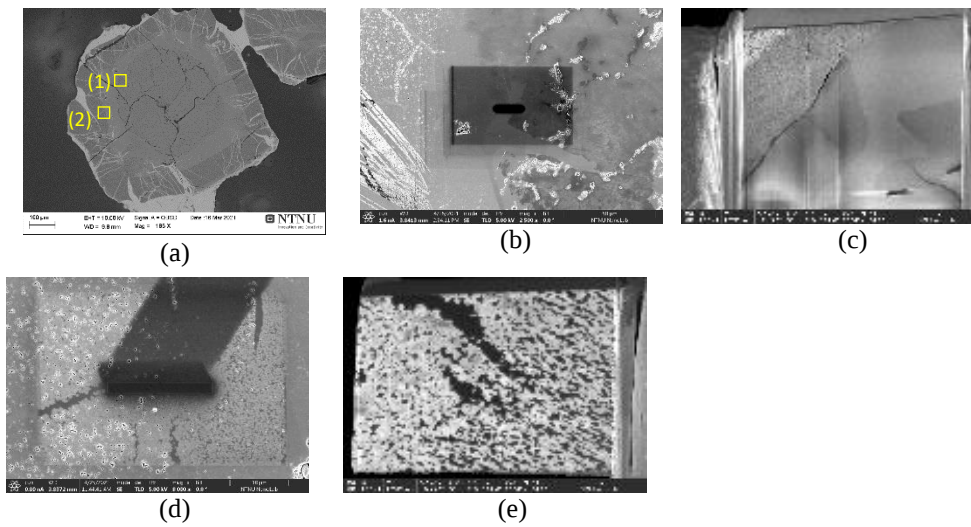


Figure S-8: (a) Backscatter electron images of the sample with 704 μm quartz particle size and a $\text{Mg}:\text{SiO}_2$ mole ratio of 2 illustration where lamellas were taken. (b): secondary electron image from the interface of quartz and product (area (1)) after taken sample by FIB, (c): secondary electron image of lamella from area (1), (d): secondary electron image from the interface between intermediate layer and outer layer (area (2)) after taken sample by FIB, (e): secondary electron of lamella from area (2).