

# New high-pressure phases in the $\text{Al}_2\text{O}_3\text{-SiO}_2$ system

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We recently clarified the phase relations of  $\text{Al}_2\text{SiO}_5$  by multi-anvil experiments at pressures of 13-23 GPa and temperatures of 2000-2900 K and discovered two new high-pressure forms of  $\text{Al}_2\text{SiO}_5$  at temperatures exceeding 2400 K or higher in the pressure ranges of 14-17 and 17-23 GPa, respectively. The new phases are new members to the well-known  $\text{Al}_2\text{SiO}_5$  polymorphs (andalusite, sillimanite, and kyanite), and they are tentatively named kyanite II and III, respectively. In this presentation, I will first briefly talk about the phase relations of  $\text{Al}_2\text{SiO}_5$  and the crystal structures of the new phases.

I am looking at the  $\text{Al}_2\text{O}_3\text{-SiO}_2$  system via multi-anvil experiments at the stability conditions of kyanite II and III to clarify the phase relations and search for other new phases. Preliminary experiments yielded an unknown  $\text{Al}_2\text{Si}_2\text{O}_7$  phase, which is the third newly discovered intermediate compound in the  $\text{Al}_2\text{O}_3\text{-SiO}_2$  system, in addition to  $\text{Al}_2\text{SiO}_5$  kyanite II and III. With increasing temperature, the phase transitions of  $\text{Al}_2\text{Si}_2\text{O}_7$  occur as follows:  $\text{Al}_2\text{O}_3$  corundum (Cor) + 2  $\text{SiO}_2$  stishovite (St)  $\rightarrow$   $\text{Al}_2\text{SiO}_5$  kyanite (Ky) III (or II) +  $\text{SiO}_2$  St  $\rightarrow$   $\text{Al}_2\text{Si}_2\text{O}_7$ . Similarly, with increasing temperature, the phase assemblages in the  $\text{Al}_2\text{SiO}_5\text{-Al}_2\text{Si}_2\text{O}_7$  system include Cor + St, Ky III (or II) + St, and Ky III +  $\text{Al}_2\text{Si}_2\text{O}_7$ ; those in the  $\text{Al}_2\text{Si}_2\text{O}_7\text{-SiO}_2$  system are Cor + St, Ky III (or II) + St, and  $\text{Al}_2\text{Si}_2\text{O}_7$  + St. In the  $\text{Al}_2\text{O}_3\text{-Al}_2\text{SiO}_5$  system, the phase assemblages of Cor + St and Cor + Ky III (or II) were obtained, and it was also found that the  $\text{SiO}_2$  solubility in Cor significantly increased above 2400 K.

Because of the very high stability temperatures of Ky II, III, and  $\text{Al}_2\text{Si}_2\text{O}_7$  beyond the typical geotherm, I am suffering from searching for any potential implications in geoscience. I am looking forward to being inspired by you.

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