

Effect of K₂O Addition on the Viscosity of CaO-SiO₂-Al₂O₃ Melt

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In general, viscosity of silicate melts decreased with the addition of alkali oxides [1], which is due to the depolymerization of the silicate anions. In the case of aluminosilicate melts, the viscosity depends on not only the polymerization degree but also the average bond strength of aluminosilicate framework [2]. Roy and Navrotsky [3] reported that the average bond strength of the aluminosilicate framework could be higher when cations with lower cationic field strength (such as K, Rb, Cs) were present. Therefore, the effect of K₂O on the viscosity of CaO-SiO₂-Al₂O₃ (CAS) melt was investigated to clarify relationship between the viscosity and cationic field strength using rotating cylinder method.

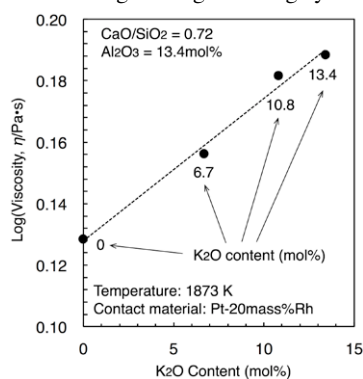


Figure 1: Effect of K₂O addition on the viscosity of the 36.1CaO-50.5SiO₂-13.4Al₂O₃ (mol%) melt at 1873 K. CaO/SiO₂ ratio and Al₂O₃ content were kept constant.

Viscosity of the CAS melt increased with the increase of K₂O. On the other hand, the polymerization degree of aluminosilicate anions should be decreased. (Fig.1) This viscous behavior could be explained by an increase in the average bond strength of aluminosilicate framework with the addition of K₂O.

[1] Mysen & Richet (2005) *Silicate Glasses and Melts*(Elsevier), 191. [2] Dingwell & Virgo (1988) *Geochim. Cosmochim. Acta* **52**, 395-403. [3] Roy & Navrotsky (1984), *J. Am. Ceram. Soc.* **67**, 606-610.

Fluid flow and mineral reaction mechanisms at high pressures: Tauern window, Eastern Alps

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Aqueous fluids play major role as mass transport agents in the lithosphere but diverse approaches such as direct analysis of fluid inclusions, applications of transport theory to reaction progress, experimental mineral solubilities, time scales retrieved from isotopic tracers and microscale observations of dissolution-precipitation mechanisms still do not provide a self-consistent picture about the fluid flow mode and magnitude of intergrated fluid fluxes. We investigate synmetamorphic hydrothermal replacements, segregations and veins developed in eclogites of the Tauern Window, Eastern Alps, as a model case study to address the conditions and modes of fluid flow and efficiency of fluid-mineral reactions at very high pressures (up to c. 610 °C, 21 kbar). These hydrothermal products record a continuous sequence from volume-conserved rock-buffered replacements to fluid-buffered precipitates in open space with unidirectional growth textures recording local anisotropic stress field at peak pressures. We observe: (1) quartz-kyanite-omphacite-rutile-clinozoisite multicomponent segregations indicating nearly congruent mass transport at local scale, controlled by rheological heterogeneities, where extraction volume for immobile elements (e.g., Ti) does not exceed 2-3 centimeter in size, (2) nearly monomineralic omphacite selvages recording focused fluid flow, (3) extensional quartz veins with euhedral omphacite crystals at the wall contact and (4) large transport veins composed of kyanite and quartz, showing little or no chemical exchange with wall rock. Chemical zoning patterns of garnet and omphacite are texture-independent and indicate local interconnectivity *via* the fluid phase, from low-permeable intergranular replacements to fluid-focusing channels and transport veins. Oscillatory zoning patterns in vein omphacite and kyanite reflect pulsed flushing probably related to pressure fluctuations in crack-seal cycles. Modal variations interpreted by conventional transport theory would yield integrated fluid fluxes reaching c. 10⁵ m³ m⁻² but these will not be required when considering coupling of diffusional and advective mass transfer driven by pressure gradients, where precipitation is controlled by distribution and size of permeability inhomogeneities vs. extensional cavities. The observed phenomena provide a cautionary example against simple inversions of reaction progress to flux estimates.