Formation process of pegmatitic pyroxenite in the western limb of Bushveld Igneous Complex, South Africa

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In the western limb of Bushveld Igneous Complex, South Africa, there are several discordant ultramafic intrusive rocks which cut the layered sequence of mafic-ultramafic plutonic rocks. We investigated the crystal growth process of the intrusive rock in Tweefontein area within southern part of the eastern Bushveld Igneous Complex. This intrusive rock is located in the upper critical zone in Rustenburg Layered Suite. The outcrop at Tweefontein is well-exposed and pegmatitic (grain size is greater than 2mm) pyroxenite intruded into the host rock, anorthosite. At the boundary between pyroxenite and anorthosite, grain size of the pyroxene is greater than the pyroxene at the core part of the intrusive rock. The pyroxenite consists of clinopyroxene (>80%), orthopyroxene (<10%) and other minor minerals such as plagioclase, hornblende, biotite and chlorite. It is notable that hornblende is present only in the course-grained clinopyroxene. SEM-EDS analysis showed that the end-member proportions of clinopyroxene are 46-47% wollastonite, 43-44% enstatite, and 9-10% ferrosilite and has no chemical zoning between their rim and core. Crystal size distributions (CSDs) of the clinopyroxenes showed linear trend and no local maximum. These trends reflect crystal growth process and absence of local maximum indicates that those clinopyroxenes grew by relatively simple process and neither Ostwald ripening nor annealing occurred. The CSD of coarse-grained pyroxenite has concave up curve and suggests that this trend resulted from crystal coarsening. Cawthorn et al. (2000) reported the ratios of Sr and O isotopes of this ultramafic intrusive rock at Tweefontein and concluded that there is no contribution of external fluid or assimilation of sedimentary rocks. These results suggest that hornblende in the course- grained pyroxenite crystallized as primary phase from the mafic-ultramafic magma which was enriched in water. The viscosity of hydrous silicate melt is much lower than anhydrous one and crystal growth of clinopyroxene can be promoted in the low viscosity magma.

Keywords: Bushveld Igneous Complex, Pegmatitic pyroxenite, Crystal size distribution, Viscosity

