Material transfer in kelyphitization of garnet (part 2): metamorphic differentiation caused by the internal stress?

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It has been known that when a garnet is broken down to form a fine-grained mineral assemblage called kelyphite, its bulk composition is usually modified from the original garnet. From the observations the kelyphitization of garnet has been generally considered to be a geochemically open-system phenomenon. I have shown a case of a zoned kelyphite, where chemical and mineralogical differentiation took place in a zoned kelyphite from a garnet pyroxenite, Ronda peridotite, Spain (Obata, 2014). In this presentation I present a new model for the mechanism of such a metamorphic differentiation. The kelyphite is composed of an inner zone consisting of spinel (Sp)-plagioclase (Pl)-orthopyroxene (Opx) symplectite and the outer marginal zone consisting of Sp-Cpx-Opx symplectite that lack plagioclase. Bulk microprobe analysis of the symplectites using a broad electron beam (3-10 microns) shows that the inner zone contains more Si and Ca and less Mg and Fe and the outer zone contains more Mg, Fe, and less Si and Ca than the garnet. It is shown that the integration of the two zones, assuming an ultrafine-grained Sp-Cpx-Opx symplectite in the outer marginal zone represents a primary material of this zone, can match that of garnet. I deduced from the garnet and the local kelyphite bulk compositions a two separate metasomatic reactions, which are coupled via element transfer between the two reaction sites. It is suggested that the metamoprhic reactions and the intra-kelyphite differentiation was driven by the internal stress and stress gradient generated by the progress of the volume-increase reactions in the solid media confined in a solid kelyphite shell.
Reference: Obata, M. (2014) Material transfer in the kelyphitization of garnet: a cetrifugal segregation in a chemically closed system. Abstract of 2014 Annual Meeting of Japan Association of Mineralogical Sciences (Kumamoto)

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