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Diffusion, discontinuous precipitation, metamorphism, and metasomatism: The complex history of South African upper-mantle symplectites

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Abstract

Symplectites composed of Cr-rich spinel plus one or more of the minerals orthopyroxene, clinopyroxene, pyrope garnet, Mg-rich amphibole, and phlogopite, are common in depleted peridotites recovered from kimberlites. The symplectites are unusual for being fine-grained intergrowths in a much coarser matrix of grains, and for having high concentrations of Ca and Al in an environment generally depleted in these elements. Various processes, and combinations of processes, including diffusion, discontinuous precipitation, metamorphism, and metasomatism create and alter the symplectites. Clinopyroxene + spinel symplectites are the most basic symplectites and are assumed to be precursors to all other types of symplectites. These symplectites resemble cellular intergrowths formed in alloys during cooling, by processes of diffusion and by discontinuous precipitation. Garnet in symplectites is interpreted to form by prograde mineral reactions between matrix minerals and symplectites. Symplectites containing amphibole and phlogopite are pyroxene + spinel ± garnet symplectites that have been modified by metasomatism.

Keywords: Symplectite, discontinuous precipitation, garnet, harzburgite, mantle