The stability of majoritic garnet depending on garnet composition

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Garnet is one of the main phases in the Earth's upper mantle, and is stable well into the transition zone. At high pressure (>5GPa), garnet forms a solid solution with pyroxene, resulting in a garnet with excess silica, a so called majoritic garnet. The excess silica is incorporated into the octahedral site of the garnet structure, partially replacing aluminium. The majorite component in garnet gradually increases with increasing pressure [1].

Garnets with a majorite component are sometimes found as inclusions in diamonds [2]. In orogenic peridotites, exsolution textures are found in garnets which are interpreted to represent a former majorite component [3]. The garnets that are found in diamond inclusions display a range of compositions. Most are of eclogitic lithology while peridotitic garnets are relatively rare. The majorite component may be used to estimate the depth of origin of these samples [2].

In addition to pressure, however, majorite stability may also depend on composition. If garnet composition has a significant effect, this implies that majoritic garnets of different lithologies (peridotitic and eclogitic) can not be directly compared when estimating the pressure.

To investigate the stability of majoritic garnets in depleted peridotitic compostitions, we performed high pressure high temperature experiments in a Walker-type multi anvil press at pressures between 6 and 14.5 GPa, and temperatures between 1400 and 1700 °C. Starting materials consist of silicate glasses or oxide mixes in the system Cr_2O_3-CaO-MgO-Al_2O_3-SiO_2, with varying Cr/(Al+Cr) ratios. Major and minor element concentrations of the phases present were determined by electron microprobe.

All experiments yielded garnet, olivine, and opx and/or cpx as stable phases. Our results indicate the composition of the garnet has a small but significant effect on the stability of majorite. We combine our experimental data with available literature data to derive an empirical fit function that can be used to determine the pressure of origin of majoritic garnets, depending on their composition.

[1] Akaogi and Akimoto (1977) *Physics of the Earth and Planetary Interiors* **15**, 90-106. [2] Stachel (2001) *European Journal of Mineralogy* **13**(**5**): 883-892. [3] Scambelluri, Pettke and van Roermund, *Geology* **36**(**1**): 59-62.