Sector zoning in garnets as growth mechanisms indicator.

Gauchat Karine & Baumgartner Lukas.

Institut de Minéralogie et Géochimie, Université de Lausanne, Suisse

Garnets from graphite rich meta marls of the Nufenen Pass area in the Swiss Alps display textural and chemical sector zoning, and irregular birefringent lamellae normal to the sector growth. The metamarls were collected in the Kalkschiefer from the Termen zone (Liskay; 1965) and underwent lower amphibolites pressure-temperature conditions (Kamber; 1993). The metamarls contain up to 1.6 wt% and have an assemblage consisting of garnet, biotite, white mica, clinozoisite, carbonates (calcite and ankerite), ilmenite, pyrite and accessories minerals such as zircon, tourmaline and apatite.

Garnets are dodecahedral porphyroblasts with a size of 0.6 mm to 4.8 mm. Their diameter is larger in S1 schistosity plane. All garnets display two distinct zones. The outer zone is graphite rich and has clinozoisite, carbonates, and quartz inclusions. The width of the graphite rich rim decrease with an increase of garnet diameter. The central zone shows 6 sectors without graphite inclusions and radiating from the centre of the crystal. The sectors contain a few quartz rods oriented normal to the garnet growth face. Irregular birefringent lamellae oriented also normal to the face of the crystal can be observed in the sectors. The width of the lamellae varies from one to twenty microns and their length can reach up to 500 microns. The sectors and birefringent zones are absent in the smallest garnets (d<1.5mm).

Element X-ray maps and profile were made on centrally cut garnets of different sizes. Compositional profiles show a decrease of Mn and an increase of Fe and Mg from core to rim. Mn X-ray maps and profiles document a chemical sector zoning in agreement with the inclusion sector zoning.
Ca X-ray maps (fig. 1) show in sectors anomalous Ca richer lamellae oriented normal to the garnet faces. Those zones correspond to the anomalous birefringent lamellae. These lamellae do probably not represent exsolution, since they only occur within the six sectors. They are also parallel to the quartz rod inclusions. The most likely explanation is that these Ca-rich lamellae are growth structures linked to the interaction of the garnet surface with the graphite rich matrix. This implies that garnet composition is, on a second order, influenced by surface kinetics. In the graphite rich rim, the Ca zoning is parallel to the garnet faces and indicates a close to equilibrium growth process.

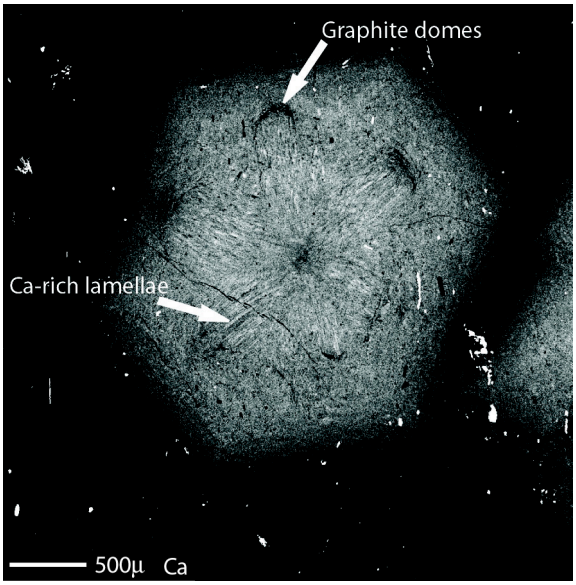

Figure 1. Ca X-ray map showing graphite domes and Ca-rich lamellae

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