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HP/HT deformation experiments of garnet-omphacite aggregates – influence of volume fractions on deformation mechanisms.

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Forming in oceanic and continental subduction zones during high to ultra-high-pressure metamorphism, eclogites play an important role in convergent settings. To improve our understanding of eclogite deformation behaviour with respect to its phase abundance of omphacite and garnet, synthetic eclogite samples containing 25, 50 and 75% volume fraction of garnet have been deformed in a modified Griggs-type solid-medium apparatus. Deformation conditions were set to a confining pressure of 2.5 GPa, 900 °C and $3 \cdot 10^{-6} \text{ s}^{-1}$. Detailed microstructure analysis via optical and electron microscope imaging (SE, BSE and EBSD) served for identification of the dominant active deformation mechanism.

All eclogite samples show a foliation which is defined by a shape preferred orientation (SPO) of omphacite and intercalated foliation sub-parallel garnet aggregates. Another common feature is a weak crystallographic preferred orientation (CPO) of omphacite which is present throughout all samples. In accordance to uniaxial shortening the CPO resembles an s-type texture with a point maximum of [001] axis parallel to the foliation and a maximum of [010] axis perpendicular to the foliation. The stereographic projection of garnet crystallographic orientation is almost distributed randomly. Nevertheless, both phases show an intracrystalline misorientation, indicating activation of crystal plastic processes. With increasing garnet content the grain average misorientation is increasing in both omphacite and garnet crystals. On the other hand, deformation twinning in omphacite is decreasing with increasing garnet content. Further, all samples show indication of brittle deformation of both garnet and omphacite, increasing with increasing garnet content. In samples with a 25% volume fraction of garnet micro-cracks are primarily orientated perpendicular to the foliation, getting more randomly distributed in samples with a 50 and 75% volume fraction of garnet.

In conclusion, all samples show similar microstructures and textures indicating that similar mechanism are active during deformation. However, the overall dominant deformation behaviour is switching from crystal plastic to brittle with increasing garnet content.