CHARGE CONTRAST IMAGE PETROGRAPHY OF ECLOGITE FACIES ROCKS USING THE ENVIRONMENTAL SCANNING ELECTRON MICROSCOPE

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Charge contrast imaging (CCI) exploits the capability of the low vacuum, or "environmental" scanning electron microscope (ESEM) to generate a controlled build-up of charge on the uncoated surface of a polished thin section. Under appropriate operating conditions image contrast patterns appear that are thought to result from variations in the charge-trapping characteristics of the material. Grey-scale variation correlates with major and trace element composition. In phases exhibiting cathodoluminescence (CL), CCI patterns mimic CL, indicating a common physical cause related to the presence of lattice defects. However, CCI patterns are resolvable in some non-luminescent phases, such as those in which CL is suppressed by "quencher" elements like Fe. Charge contrast images are stable and reproducible, and may be acquired in a few seconds.

Pyrope-rich garnets ($Py_{97.6-98.1}Alm_{2.1-1.6}And_{0.3}$) from a coesite-bearing quartzite in the Dora Maira massif have been shown to exhibit oscillatory zoning in CL images, with CL intensity and colour correlating with Fe content (SCHERTL et al., 2004). Minor increases in Fe are sufficient to suppress CL emission. CL patterns are exactly reproduced by the CCI method, suggesting a common fundamental control on both CL and CCI in these garnets.

Almandine-rich garnets ($Py_{15.1-23.7}Alm_{67.7-59.0}Gr_{12.7-16.4}Sp_{4.6-0.8}$) from an eclogite at Kroken, Norway (CUTHBERT & BUCKMAN, 2005) fail to give detectable CL emission, presumably due to the quenching effect of Fe. However, under optimal imaging conditions the garnets give clear CCI patterns with an outer, dark rim zone and an internal network of fine, dark lines. CCI-dark features correspond to areas richer in Ca and Mg and poorer in Fe and Mn, and are interpreted as UHP overgrowths and fracture-fill. CCI-dark garnet is depleted in HREE, Zr, P and Y relative to the older core garnet, and enriched in LREE and Ti, indicating that trace-element substitutions involving the creation of vacancy defects may be the cause of the image contrast pattern.

Charge contrast imaging of garnet using the ESEM has the potential to provide rapid, high-resolution image patterns rich in microstructural and compositional information, even in grains too rich in Fe to give CL emission, and offers a time-efficient reconnaissance method for exploration of garnet microstructure as a basis for application of more time-consuming and costly techniques such as EPMA mapping and SIMS or laser ablation.

References

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