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The origin of orthopyroxene/biotite + plagioclase coronas from the Bolangir anorthosite complex (India), and implications for reconstructing *P-T* paths

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ABSTRACT

Mineralogical-textural analysis of a multi-layered plagioclase (Pl) + orthopyroxene/biotite (Opx/Bt) vermicular microstructure around garnet from the Bolangir anorthosite massif is presented. X-ray images demonstrate the garnet was zoned prior to decomposition, with Mg decreasing toward its rim, and Mn, Ca, and X_{Fe} [= Fe/(Fe + Mg)] increasing. On decomposition, the Ca zonations in garnet were truncated by the consuming garnet margin. By implication, the retreat velocity of the garnet margin was faster than the diffusive velocity for Ca within the garnet. By contrast, the pre-decomposition Fe, Mn, and Mg variations in garnet were considerably modified adjacent to Opx + Pl, but were unaffected adjacent to Bt + Pl intergrowths. In the corona, X_{Fe}^{Opx} and X_{Fe}^{Bt} decrease toward garnet, whereas the An content in associated Pl increases from An_{50} to $An_{80\text{-}83}$. Thermo-barometry involving nearest neighbor Opx, Grt, Pl, and Qtz indicate that the corona formed at 6.0 ± 1.0 kbar, 750 ± 50 °C. At the isothermal-isobaric condition of decomposition, the compositional variation across the Bt + Pl corona is explained best by the inward retreat of the garnet margin at a velocity faster than the fastest diffusing element (Fe, Mn). In zones where garnet decomposed to Opx + Pl, the velocity of the consuming garnet margin was such that the intra-garnet Fe, Mn redistribution was aborted in transit.

The compositions and volume proportions of vermicular orthopyroxene and plagioclase in the multi-layered corona are best approximated by the NCFMAS reaction Grt_{ss} + Pl_1 (± Qtz) → Opx + Pl_2. The early formed/matrix plagioclase (Pl_1) and inward-retreating garnet (Grt_{ss}) margin provided the necessary components for successive Opx + Pl_2 layers to grow at Grt-Pl_1 interfaces. Tie-line topology in ACFN space indicates Pl_2 to be An-rich relative to Pl_1. The mineralogical relations indicate the CFMAS reaction, Grt_{ss} + Qtz → Opx + An, to be an inadequate analogue of the actual decomposition. Consequently, to assume that the texture indicates near-isothermal decompression across the low-dP/dT CFMAS reaction is possibly an oversimplification.