Formation of Corona around Corundum in the Lützow-Holm Complex, East Antarctica

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Corona structures preserve both reactant and product minerals, which gives us information of its formation process including mass transformation. We investigated a corona structure in corundum-bearing ultramafic rocks in Akarui Point of the Lützow-Holm Complex, East Antarctica. The studied samples are composed mainly of calcium amphibole, plagioclase and corundum with minor biotite, spinel and sapphirine. The corundum grains are surrounded by the corona composed of spinel, sapphirine and plagioclase. These minerals are regularly arranged from corundum to the matrix. In the corona, cracks in spinel usually continue to sapphirine, but never extend further into plagioclase nor continue to corundum. We consider that the corona was produced by reaction between corundum and matrix calcium amphibole. Mass-balance in the CaO-MgO-Al_2O_3-SiO_2-H_2O system provides the following equation: corundum + spinel + calcium amphibole = sapphirine + plagioclase + H_2O-fluid. This equation shows spinel as reactant, which is inconsistent with the microstructure. This suggests that the corona was formed in an open system. We employed following additional assumption based on the microstructure. Continuity of cracks in spinel and sapphirine is indicative of former single phase. Provided that sapphirine was formerly spinel, corundum changed to spinel by supply of MgO from calcium amphibole. The remaining components in calcium amphibole may produce plagioclase, and excess SiO_2 would be released. After this reaction, significant amount of spinel was transformed to sapphirine due to supply of SiO_2. Alternatively provided that spinel was formerly sapphirine, corundum and calcium amphibole produced sapphirine and plagioclase. Similar to the former case, this reaction also released SiO_2. After that, sapphirine was partially transformed to spinel and released SiO_2. The net reaction based on both two cases is corundum + calcium amphibole = spinel + sapphirine + plagioclase + H_2O-fluid + SiO_2. This open-system reaction suggests that decrease of SiO_2-activity triggered the corona-forming reaction.

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