

Fluid inclusions in Al-phosphates from the Ta-Sn-Nb mineralised Buranga Pegmatite (Rwanda)

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Phosphate minerals are commonly present in evolved lithium-caesium-tantalum (LCT) pegmatites, crystallising from magmatic to hydrothermal stages and supergene environments. Consequently, phosphates are direct proxies for the petrogenesis of pegmatites, and can help constraining the metallogenesis of associated rare-metal mineralisation.

The Buranga Pegmatite in Western Rwanda (Gatumba District) is a highly-evolved Ta-Sn-Nb-mineralised LCT pegmatite of the complex type. It is well-known for its abundancy of phosphate minerals, which can be divided into two main evolutionary series: (1) Fe-Mn phosphates; and (2) Al-rich phosphates.

Based on Raman spectroscopy, Al-rich phosphates in the Buranga core zone show a paragenetic sequence from montebasite, as the highest temperature phase, to trolleite and scorzalite as intermediate phases, followed by lower temperature replacement by bertossaite and burangaite.

Primary fluid inclusions in Al-rich phosphates can be classified into two types, both belonging to the H₂O-NaCl-LiCl-CO₂(-N₂) system. The first group, hosted in trolleite, scorzalite and cogenetic quartz, has a NaCl content around 12 ± 3 wt%, and a LiCl content of 8 ± 2 wt%. The molar composition of the vapour phase ranges from 79% to 85% CO₂ and 15% to 21% N₂. The second group, hosted by bertossaite, contains a NaCl content of 16 ± 2 wt% and a LiCl content around 3 ± 2 wt%. The vapour phase is composed of pure CO₂.

The Buranga Pegmatite core zone shows magmatic fluids of the H₂O-NaCl-LiCl-CO₂(-N₂) system that evolved during crystallisation. The fluid compositional change represents a shift to lower Li and N₂ content in the late-stage bertossaite which may be caused by (1) a chemical buffering due to phosphate crystallisation, (2) reactions between the crystalline phases and the late stage magmatic fluid or (3) a mixture of magmatic fluids with external fluids.