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Characterization of hydrothermally altered allanite – TEM study

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Transmitted electron microscopy (TEM) study has been performed on allanite (REE-rich epidote). The investigated samples were collected from the Neoarchean Closepet granite (Dharvar craton, India) which indicates hydrothermal overprinting [1]. Allanite, a common accessory mineral in the Closepet batholith, shows distinctive textural and chemical features, which vary across the granitoid. On backscattered electron images, it consists of domains distinguished on the basis their brightness. Previously performed EPMA and LA-ICP-MS analyses demonstrated large variations in element concentrations and showed domains abundant with MgO (up to 8 wt. %) and REE+Y (up to 45 wt.%). Electron-transparent foils were cut within the domains of allanite using a focused ion beam (FIB) system. The TEM study reveal the breakdown of allanite caused by hydrothermal fluids. TEM analyses show that domains with higher concentration of MgO are areas of chlorite-allanite aggregates, whereas the areas with higher concentrations of REE+Y represent a mixture of allanite and bastnasite with rare nanocrystals of synchysite. Bastnasite is characterized with diffused grain boundaries with allanite. Moreover, the fibrous thorite, nanosized needles of chlorite, randomly located nanometre clusters of galena, single crystal calcite with bastnasite and chlorite veins, and newly formed needles of allanite reprecipitated in the allanite matrix. Additionally, allanite shows a high degree of lattice damage (metamictization) due to the alpha decay of radioactive nuclide – Th. TEM study also reveals the leaching of REE from allanite along the fracture and reprecipitation of newly formed allanite crystals of columnar structure along the boundary with pyrite. Intensive porosity is very common and noticed along domains' transition, and within allanite and calcite crystals.

Joint geochemical analyses and TEM study enables the identification of the secondary minerals recrystallized at the expense of allanite, thereby demonstrating mechanisms of phase transition. The results provide a basis for characterization of the percolating fluid in terms of temperature, composition, element mobilization, and oxygen fugacity.

1 Słaby, E. *et al.* (2021), *Lithos* 386–387

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