Application Of Micro-Raman Spectroscopy To The Study Of Apatite From The North Qôroq Centre, South Greenland

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Micro-Raman Spectroscopy (RS) is the study of the inelastic scattering of light, creating a pattern of bands and peaks that can be used to investigate mineral compositions. RS is particularly useful for fluid inclusion studies as it provides a chemical signature unique to a particular sample. This study investigates the application of RS in twenty-five apatite host crystals from a range of rock types throughout the North Qôroq centre of South Greenland. The area represents a Precambrian alkaline igneous complex that underwent extensive metasomatism, with two dominant fluid-types being responsible for mobilising rare earth elements (REEs) and critical metals; a sodium-chloride brine (fluid A) and a calcium-fluoride-rich fluid (fluid B), that is also $(CO_3)^{2-}$ and $(PO_4)^{3-}$-bearing. Samples were chosen to include rock types from specific units within the intrusive complex, covering the quartzite/ meta-volcanic country rocks and igneous nepheline syenite rocks. The results show that the rare earth element-bearing species within fluid inclusions in the apatite crystal hosts are predominantly møsandrite-(Ce) in the metasomatised nepheline syenites (with yttrium-niobium and xenotime phases) and parisite-(Ce) within the fenitised country rocks. Further geochemical analysis of these fluid inclusions have shown a strong presence of transition metal species associated with the rare earth bearing minerals identified in the nepheline syenite apatite, suggesting fluid B is the dominant metasomatic control in the igneous rocks. In contrast, there is a strong presence of alkali metals in the quartzite/ meta-volcanic apatite, suggesting metasomatism only occurred through fluid A in the country rocks, possibly as a direct consequence of the igneous intrusion events. These results show that RS is an accurate and valuable tool for REE/ mineral identification, fluid chemistry and in elucidating metasomatic processes.