EGU22-4099, updated on 16 Aug 2022
https://doi.org/10.5194/egusphere-egu22-4099
EGU General Assembly 2022

Mesoarchean nanogranitoids and fluid inclusions in garnet from migmatites of the Kangerlussuaq basement, Southeast Greenland

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Inclusions of anatectic melt and fluids are probes used by geoscientist to investigate, understand and quantify devolatilization, melt production and chemical differentiation during orogenesis and crustal reworking. The large majority of case studies targeting these types of inclusions are in the Phanerozoic eon, whereas the Precambrian is still poorly represented. Here we present the first data on anatectic melt inclusions (*nanogranitoids*) and their associated primary fluid inclusions in garnets from the Mesoarchean basement in Southeast Greenland. Using optical microscope observations, MicroRaman spectroscopy and microprobe investigation we show that these metasedimentary migmatites contain two generations of garnets, a large xenoblastic garnet (Grt^1) and a small idioblastic one (Grt^2). Both garnet types contain clusters of primary nanogranitoids which are characterized by the presence of quartz and feldspar polymorphs + phyllosilicates, a phase assemblage typically observed in this type of inclusions. Nanogranitoids are associated in the clusters to primary CO_2-CH_4 fluid inclusions, which appear to be always affected by post-entrapment modifications with extensive formation of step-daughter minerals such as carbonates and pyrophyllite. Such occurrence proves for the first time that these rocks experienced partial melting with formation of garnet, and that this event took place in presence of COH-rich fluid. The re-evaluation of the metamorphic pressure and temperature conditions with up-to-date phase equilibria modelling, combined with the identification of nanogranitoids and fluid inclusions, suggests metamorphic peak equilibration and partial melting at T> 900 °C and P> 7 kbar. To date, this is the oldest verified occurrence of nanogranitoids as well as of fluid-melt immiscibility during garnet growth in a partially molten environment.