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Fluid inclusion analysis of chert veins from the Mendon Formation, Barberton Greenstone Belt, South Africa

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Strongly silicified volcanic rocks and overlying sediments are a common feature in the Mesoarchean Barberton Greenstone Belt, South Africa. The silification predominantly occurs at the top of mafic to ultramafic lava flows at the contact to sedimentary chert horizons, and has been interpreted as a result of fluid circulation in shallow subseafloor convection cells (Hofmann & Harris, 2008). Six samples of silicified rocks of the Mendon Formation were used for a fluid inclusion study to better constrain the conditions of formation and the source and physico-chemical evolution of the fluid that might have been responsible for the alteration.
The studied samples consist of silicified ultramafic rock and chemical precipitates with abundant chert and/or quartz veins. The silicified ultramafic rocks are mainly made up of quartz, Cr-muscovite and Cr-Spinell. Tourmaline and chlorite are locally present. Sedimentary cherts are nearly pure quartz with minor accessory minerals such as rutile and Fe-(hydr)oxides.
Fluid inclusions are present in coarse-grained quartz in mainly bedding parallel syntaxial veins. Primary fluid inclusions occur as clusters in the crystal's core with an average size of 5-10 μm. They occur as two phase aqueous (liquid-vapour) inclusions at room temperature with a relatively constant vapour fraction (c.15-20 vol.%).
Most fluid inclusions from veins crosscutting the silicified ultramafic rocks have a salinity between 0.5 and 11.0. wt.% NaCl equiv., one sample additionally contains inclusions with distinctly higher salinities (18 - 30 wt.% NaCl equiv.). Homogenization into the liquid phase occurs from 110°C to 210°C; with most values ranging between 150 and 180°C. The sample showing two distinct groups in salinity shows the lowest Th ranging from 110°C to 150°C.
The sedimentary cherts show substantial differences i.e. the presence of a phase that prohibits freezing with a N-cooled freezing stage; probably CH4 or N2.
Independent temperature estimates were derived from chlorite thermometry and illite cristallinity. Chlorite thermometry yielded temperatures of 250-350°C, whereas a Kübler index of $< 0.25\ \Delta^\circ 2\theta$ means the samples belong to the Epi-zone. Excluding the high salinity and sedimentary samples, the pressure during fluid inclusion entrapment is calculated at 1.6 - 2.4 kbar, corresponding to a depth of 5 - 8 km. These values argue against a shallow water deposition, yet could mean that the crystalline parts of the veins formed after burial during a later deformation or a late stage fluid infiltration event. However, if the veins formed at ca. 150 - 180°C during early seafloor alteration, the primary fluid inclusions may have also survived any subsequent thermal event.