Opaline and cryptocrystalline silica from the Tolfa volcanic region (Latium, Italy)

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Opals and cryptocrystalline silica may be found in a very broad range of geological environments (Chauviré et al., 2017), systematically related to the availability of an aqueous fluid. Due to its conditions of formations, opal may contain abundant H2O, CO2 or both (Sodo et al., 2017), and the presence of these molecules may provide information of their genetic context. In this work we studied a series of samples from the volcanic region of Allumiere-Tolfa, north of Rome (Latium, Italy). This district has a Pliocene-Pleistocene age and is related to the Tuscan acid volcanism. It shows a very intense late-stage hydrothermal alteration that gave rise to two distinct ore basins: one to the south of the Allumiere town, consisting of sulfide (Pb, Fe, Zn, Hg) and Fe-oxide mineralizations, and a second, to the north, mainly consisting of alunite and kaolin. Both ore deposits were intensely exploited during the medieval to recent period. The hydrothermal alteration giving rise to the sulfate and clay deposits is also associated with a pervasive deposition, within the early volcanics, of opaline or microcrystalline silica, consisting of mineral replacements, veins and formation of agate druses. Although the sulphide-sulfate and clay products have been studied, due to their interest as georesources, and relevant petrological, geochemical and isotopic data can be found in the oldest literature (Lombardi and Sheppard, 1977), the silica mineralizations have never been addressed. We studied here a series of samples occurring as vein depositions or as banded crystallizations from different areas in the volcanic district. The samples were examined by using a combination of XRD, SEM-EDS and FTIR + Raman imaging. Opaline silica with different degree of order, from opal AN (hyalite) to opal A to opal CT, was identified. Some samples contain CO2 besides H2O/OH. The banded agates were found to consist of a layering of micro-crystalline and fibrous quartz (chalcedony) with different water contents, interbedded with moganite-rich layers; moganite, in particular was found to be associated to lower H2O contents. The 18O and D/H isotopic data of Lombardi and Sheppard (1977) indicate temperatures around 120-100°C for the hydrothermal process responsible for the hydrothermal deposits, in close agreement with the typical range of T for the formation of opaline silica (Heaney, 1993). The ore forming process can be thus interpreted following the classical model of hydrothermal/metasomatic phenomena at low-depth, accompanied by extensive alteration of the pre-existing rocks, due to mixed magmatic/meteoric fluids, with the formation of kaolinite + alunite + sulfates + silica (Hedenquist et al., 2000).
References


