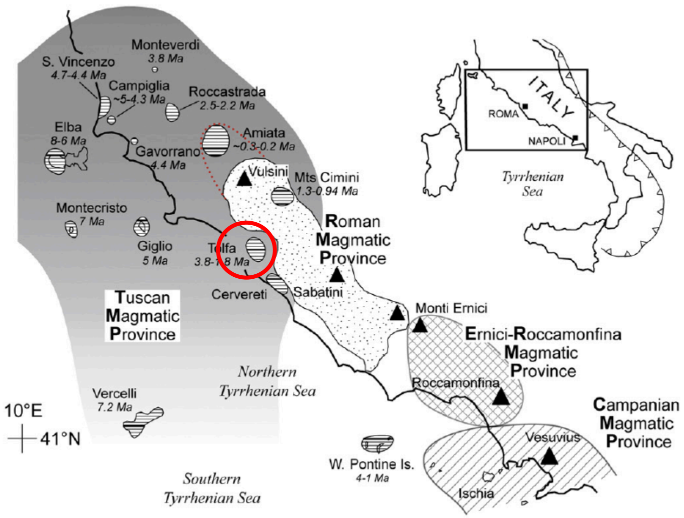
Opaline and cryptocrystalline silica from the Tolfa volcanic region (Latium, Italy)

Giancarlo Della Ventura[1,2], Camilla Napoleoni[1], Alessandra Conte[1,2], Federico Lucci[1], Federico Galdenzi[1,2], Benjamin Rondeau[3]

1 Dip. Scienze, Università di Roma Tre, L. S. Leonardo Murialdo 1, 00146, Rome
2 INFN-LNF, Via E. Fermi 40, Frascati 00044 (Rome)
3 Laboratoire de Planétologie et Géodynamique, Université de Nantes, Nantes, France

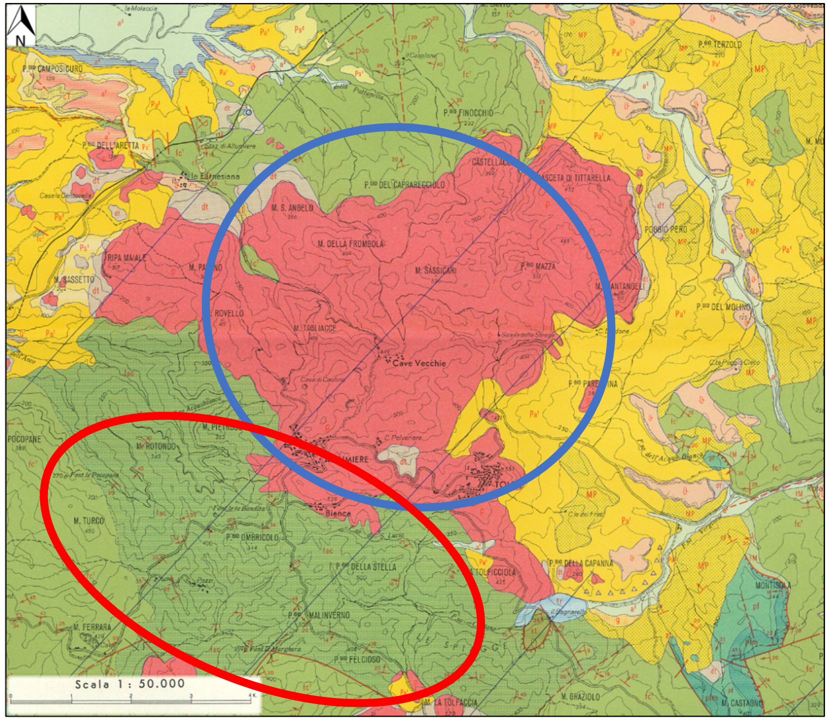
Geological framework



The volcanism along the tyrrenian border of Italy (from Avanzinelli et al., 2009)

The Tolfa volcanic area, comprising essentially trachitic lava domes, is located at the intersection of the basic High-K Roman Comagmatic Region extending from south Tuscany to Naples and the acid Tuscan Igneous Province. The age is 3.5-4 My

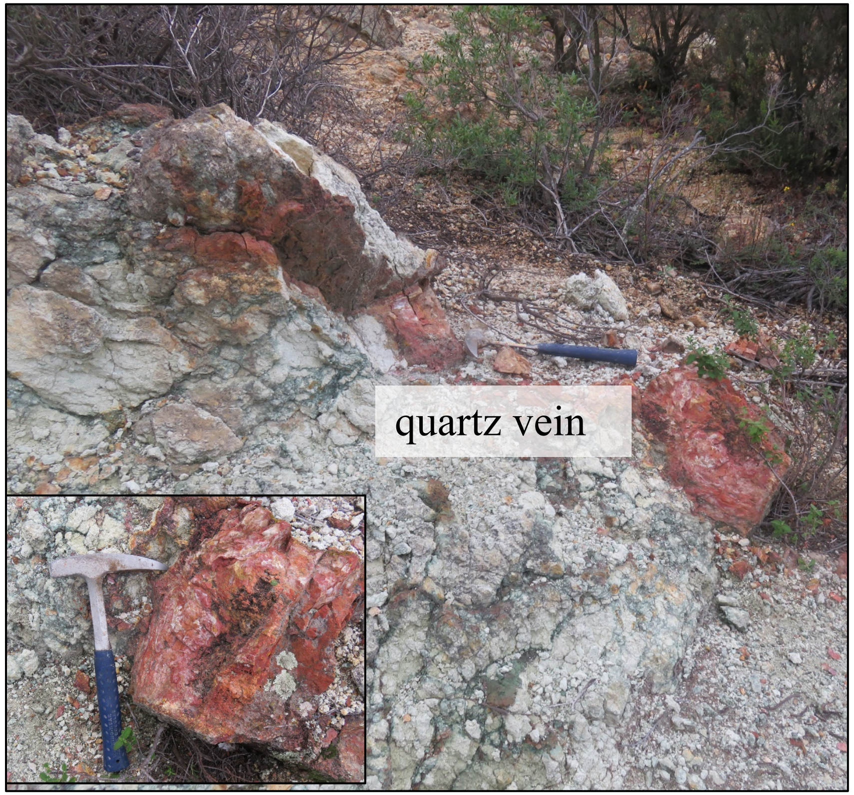
Geologica map of Tolfa volcanic area (from Fazzini et al., 1972). Red: volcanics; yellow to green: sedimentary basement

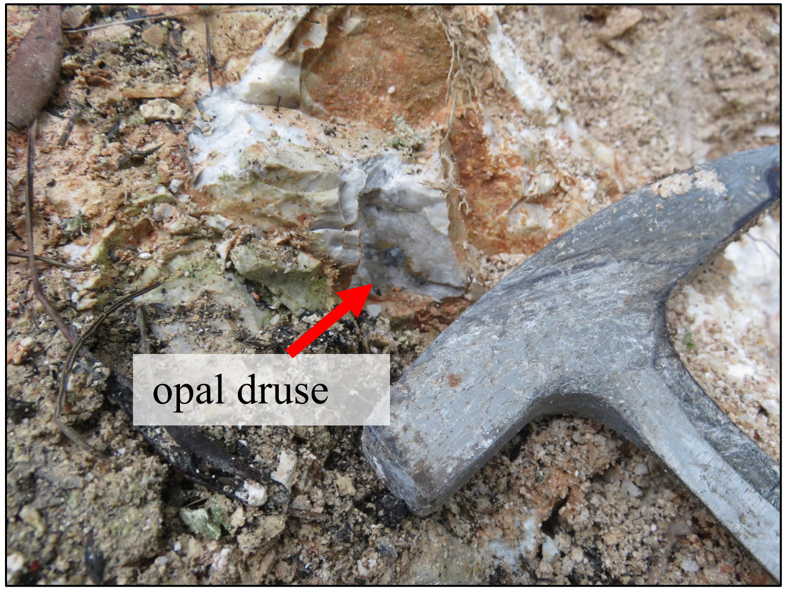


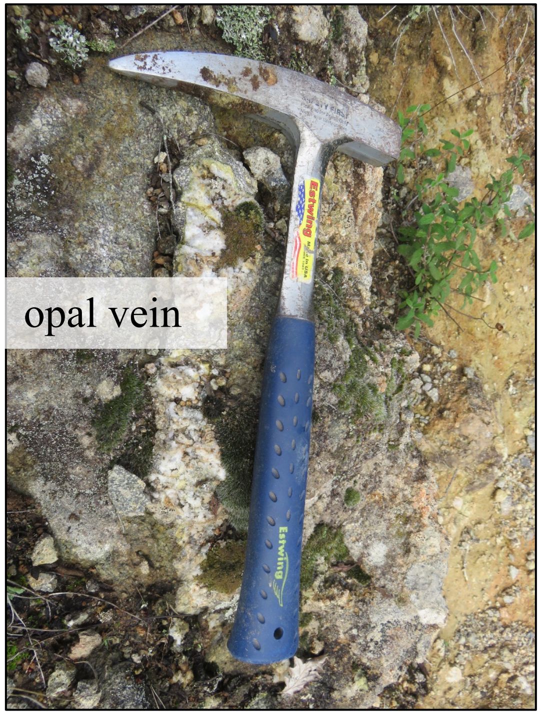
A very intense late-stage hydrothermal alteration gave rise to two distinct ore basins: one to the south of the Allumiere town (indicated in red), consisting of sulfides (Pb, Fe, Zn, Hg) and Fe-oxides mineralizations, and a second to the north (indicated in blue), mainly consisting of alunite and kaolin. Both ore deposits were intensely exploited during the medieval to recent period.

Silica

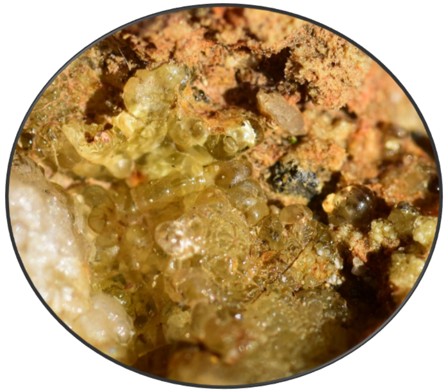
The hydrothermal alteration giving rise to the sulfate and clay deposits is also associated with a pervasive deposition, within the early volcanics, of opaline or microcrystalline silica, consisting of mineral replacements, veins and formation of agate druses.

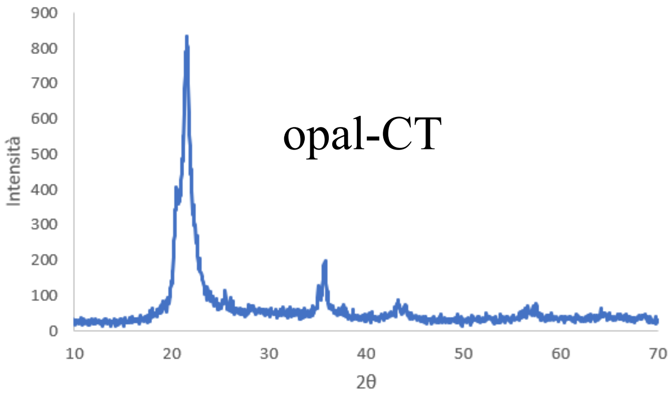


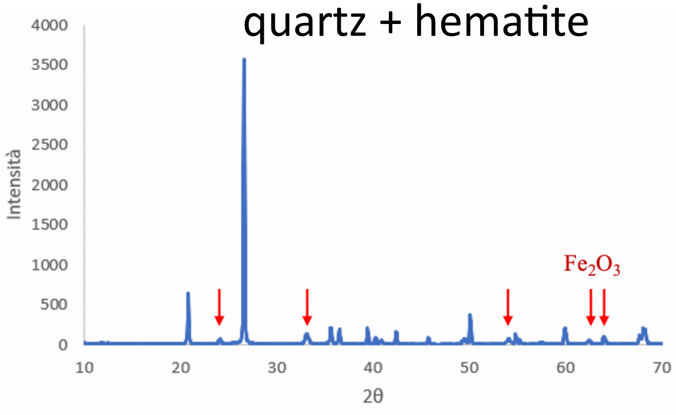


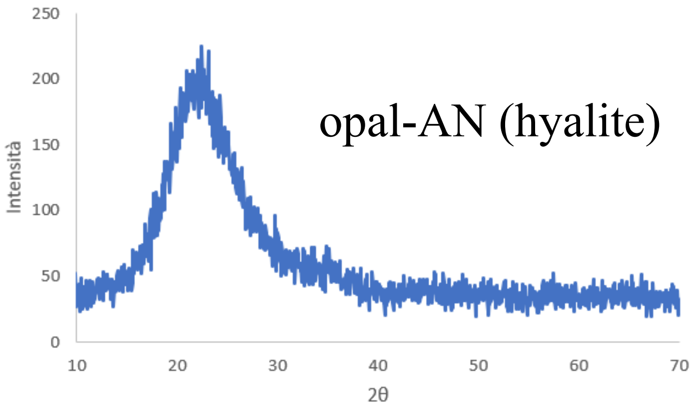


The different samples have been characterized by a combination of methods: XRD

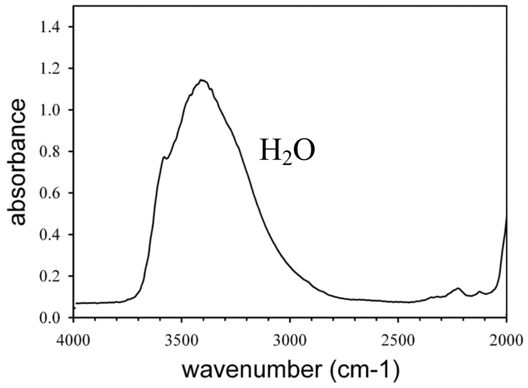


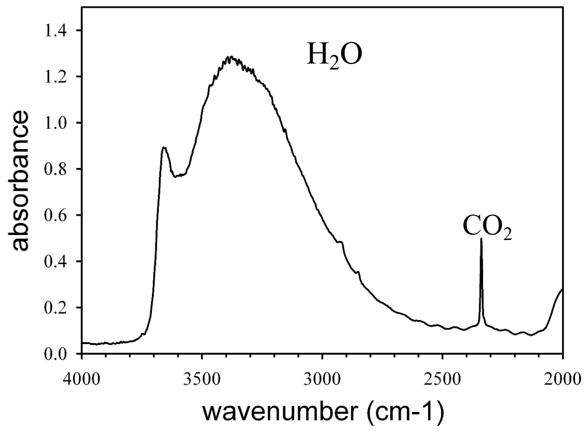


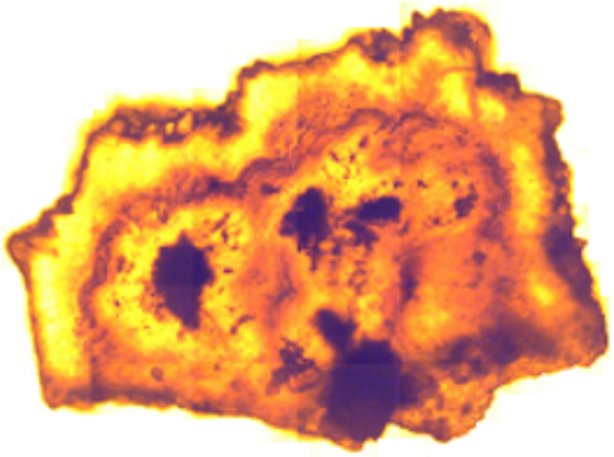


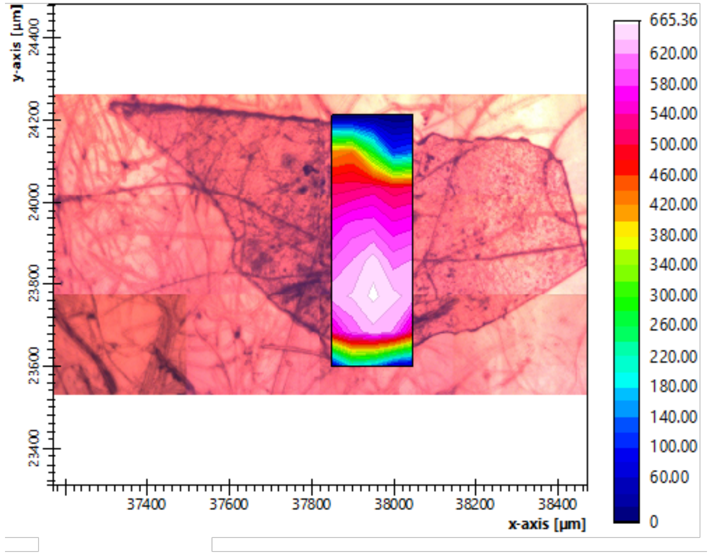


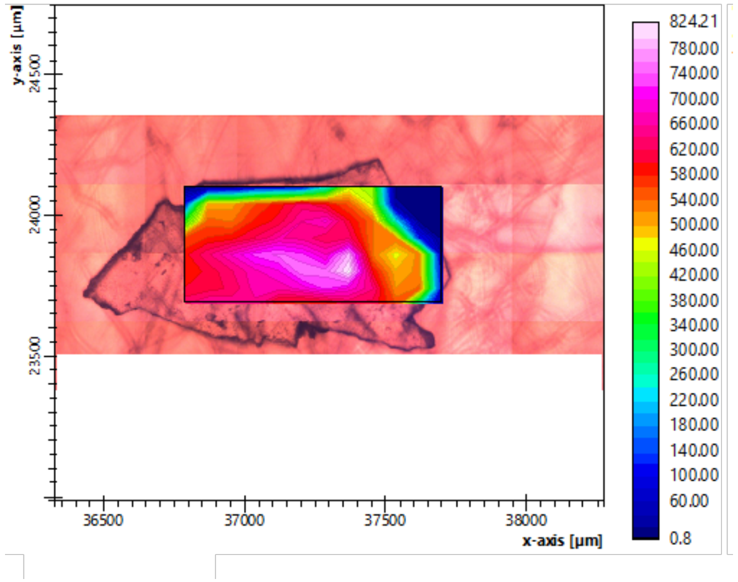
Presence and distribution of volatiles: FTIR

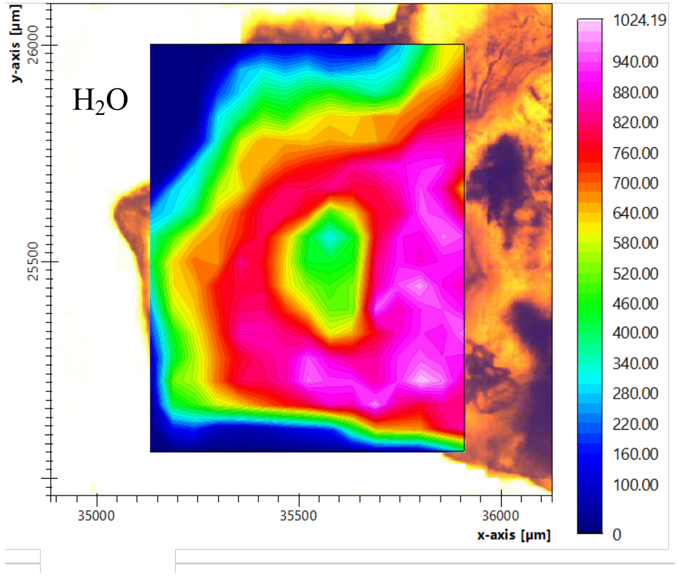




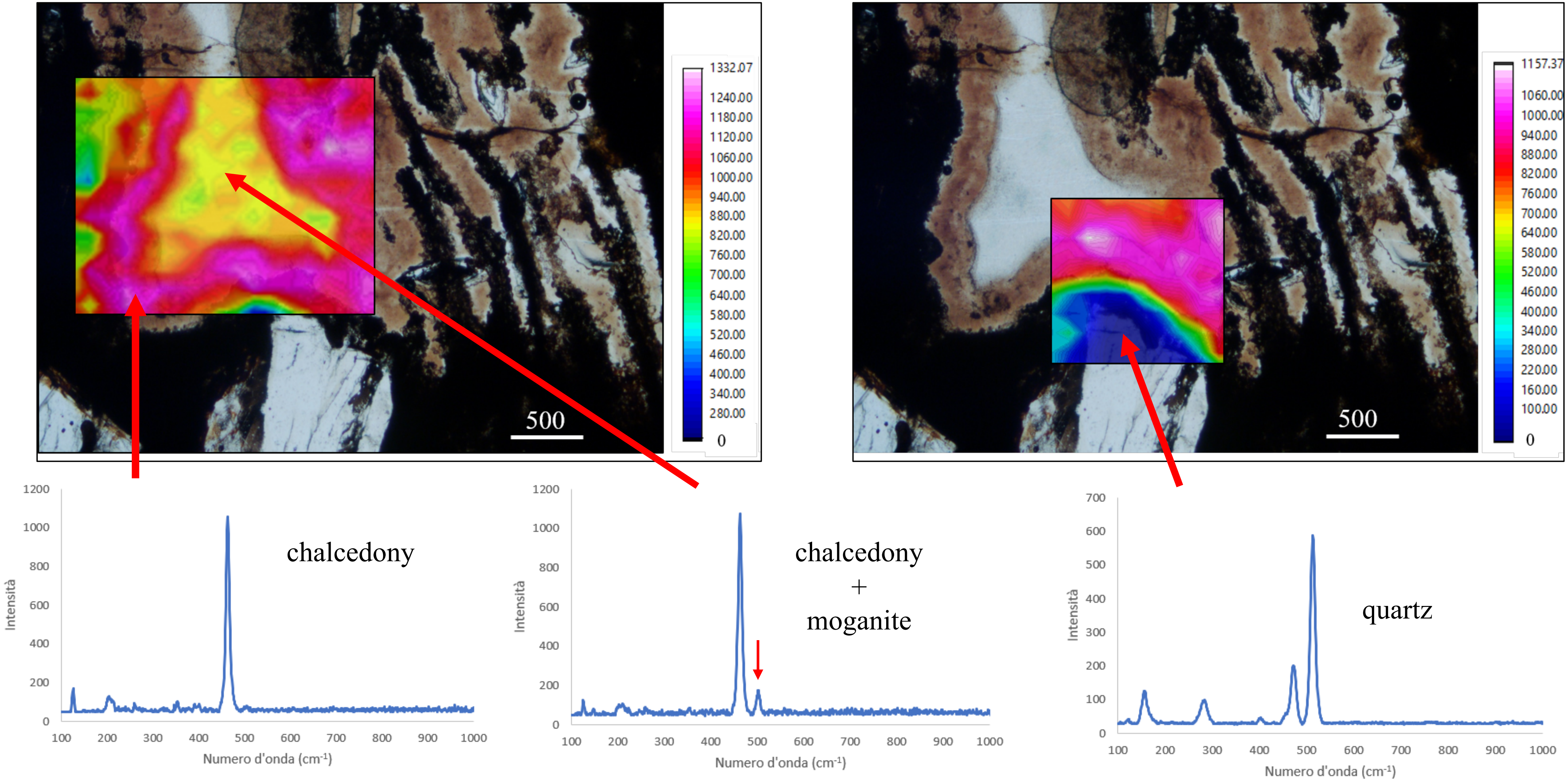






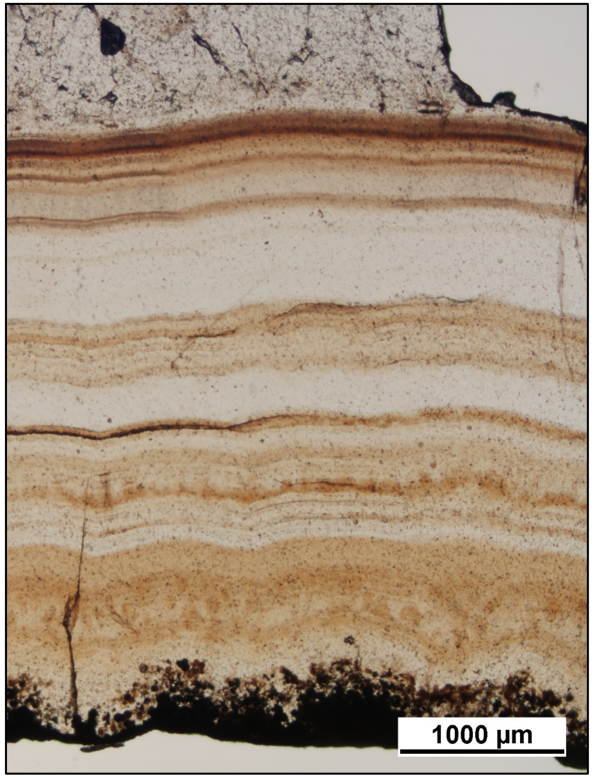


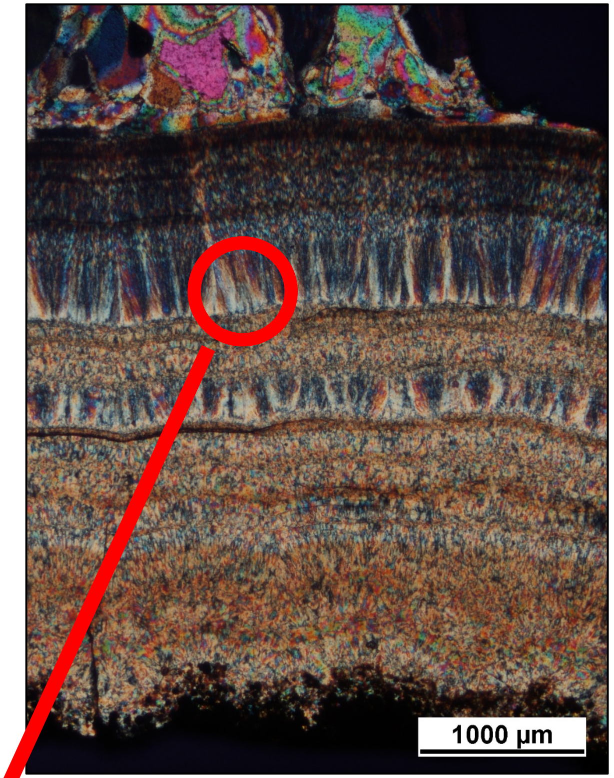
Silicified trachite from Monte Rovello: FTIR and Raman spectroscopy

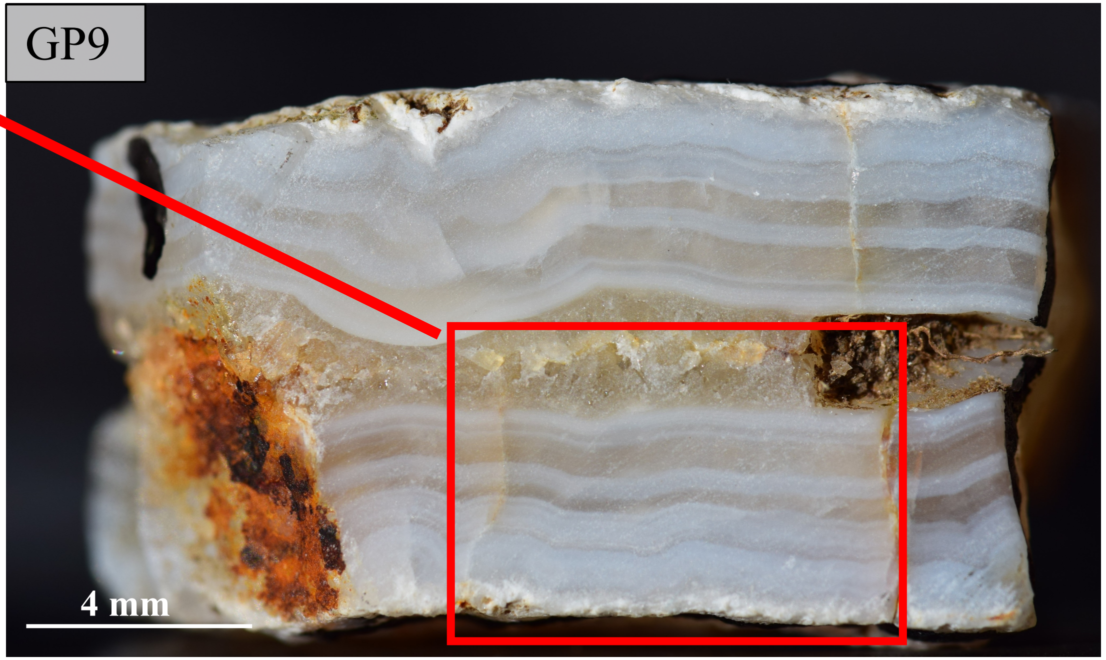


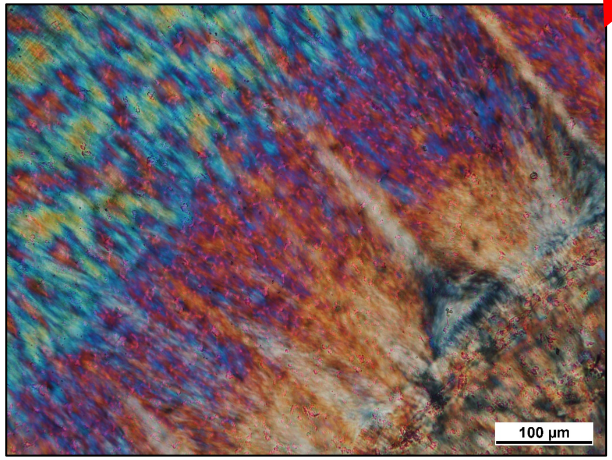
Agate from Monte Rovello: PLM

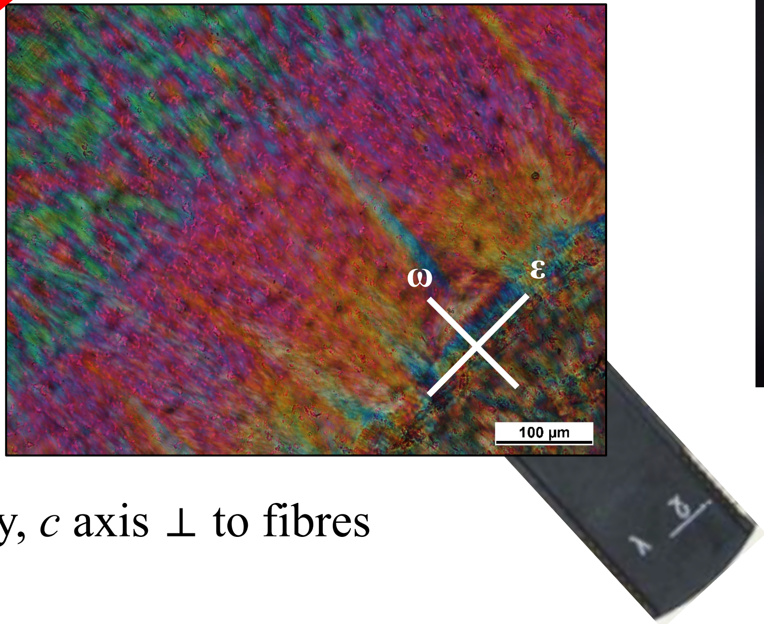
Layered sequence of cryptocrystalline silica → fibrous chalcedony → quartz





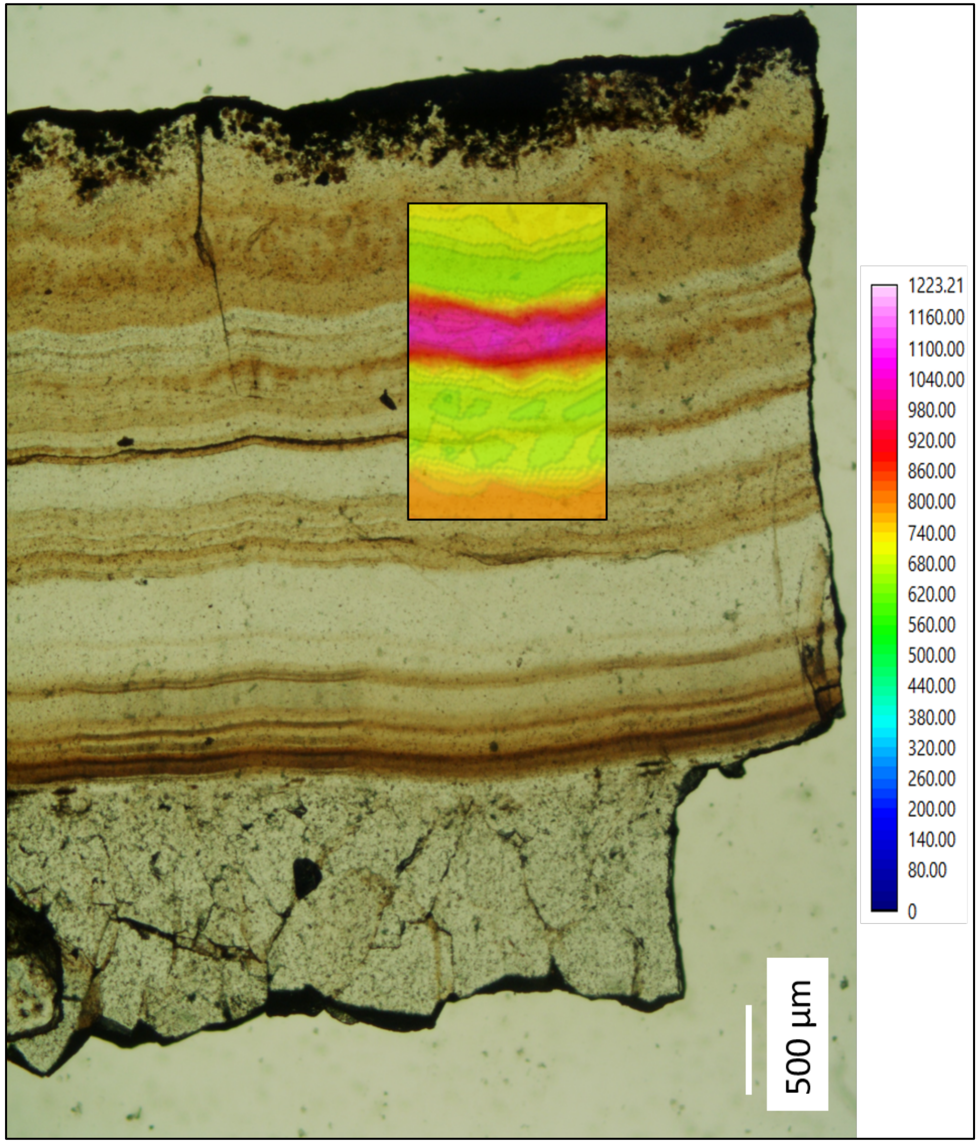


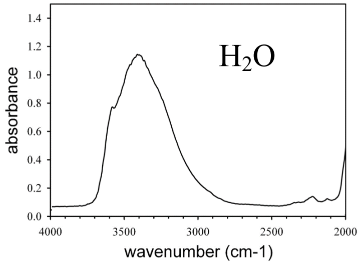




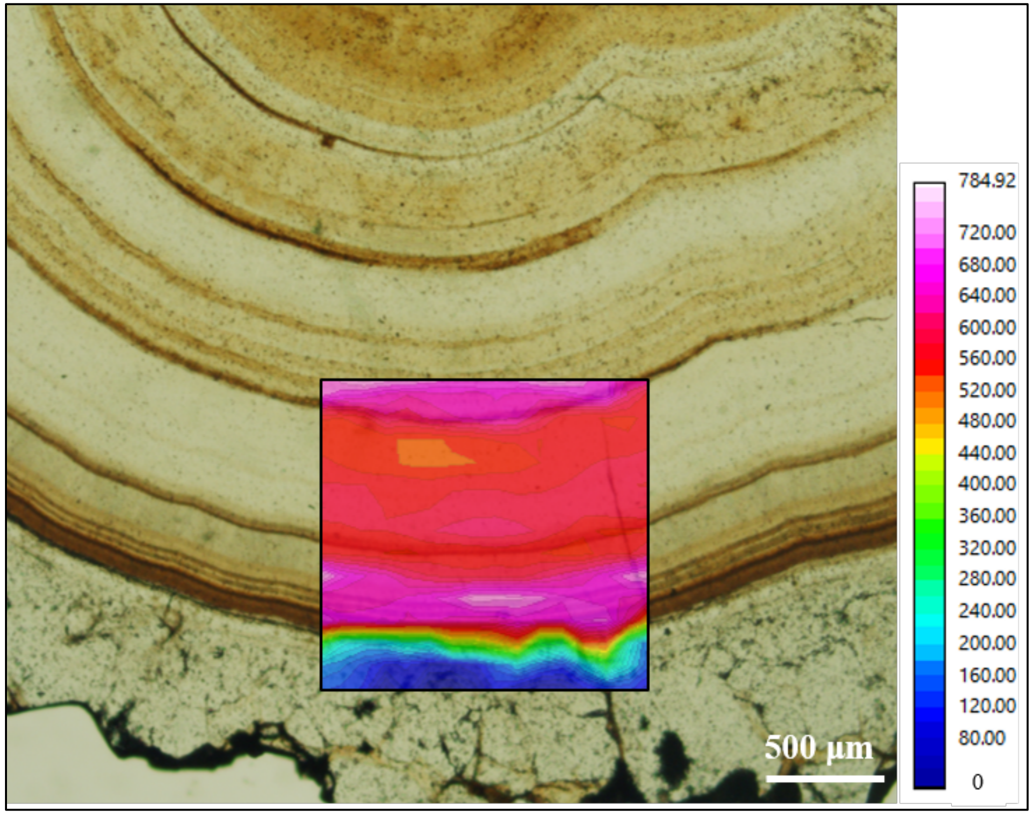
lenght-fast chalcedony, *c* axis ⊥ to fibres

Agate from Monte Rovello: FTIR mapping for H_2O

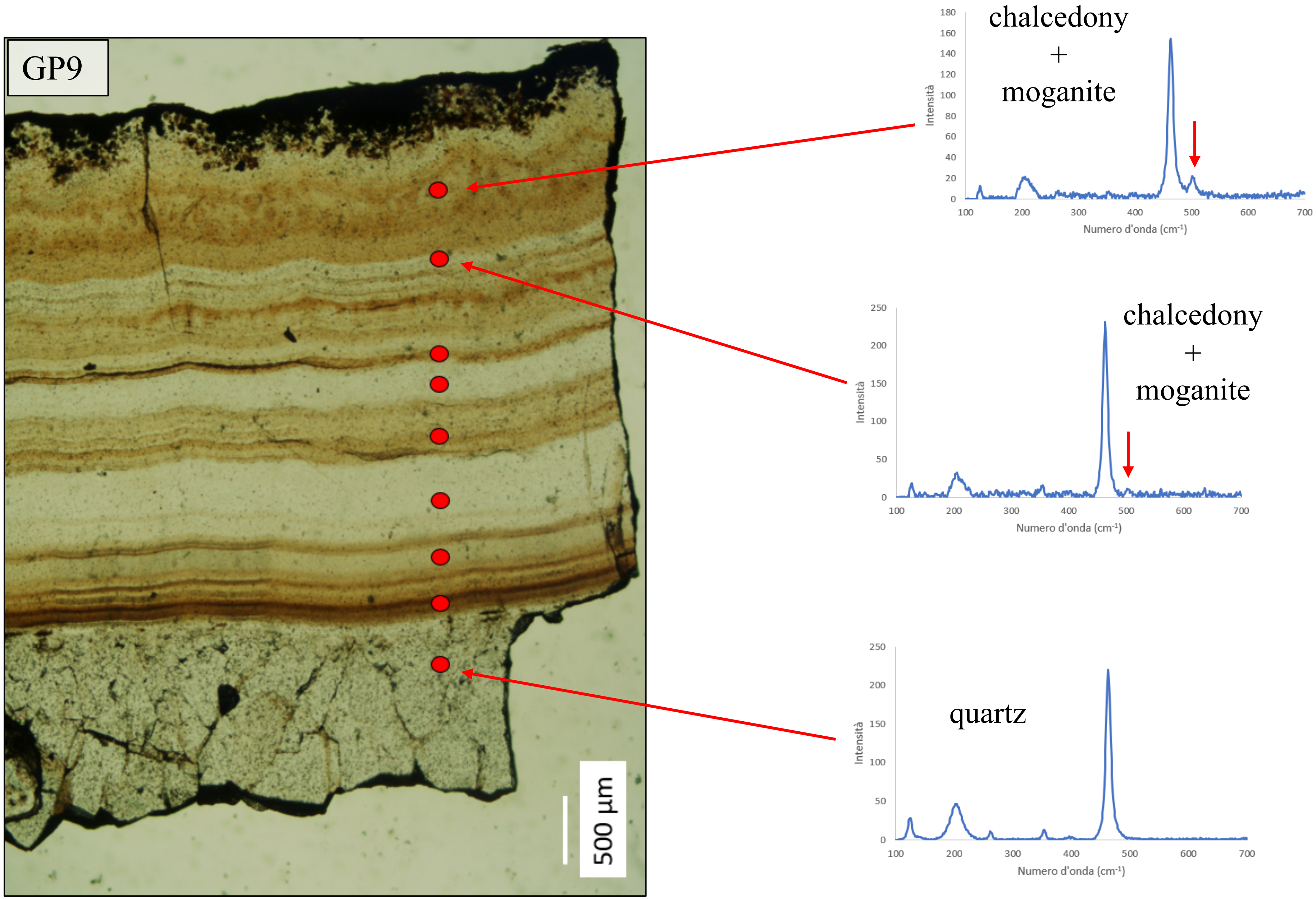




FTIR mapping shows that the layers (except quartz) are all hydrated and have different H_2O contents



Agate from Monte Rovello: Raman spectroscopy

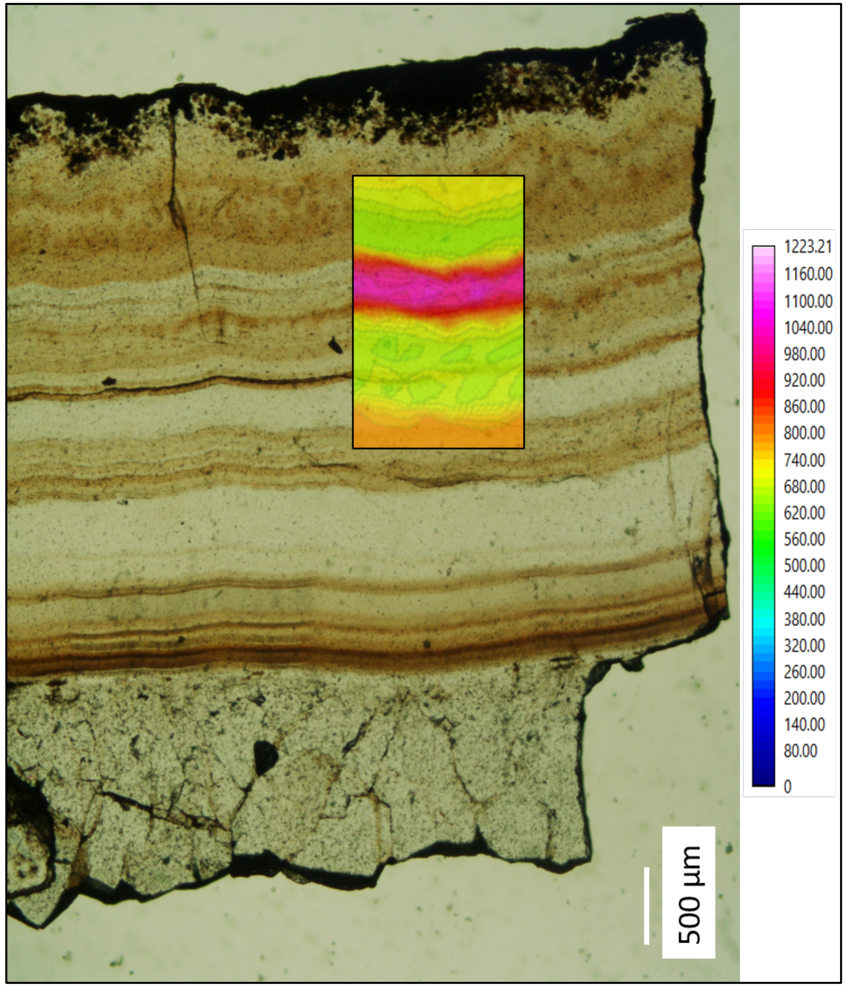


Raman spectroscopy shows the presence of moganite associated with calcedony in the single layers

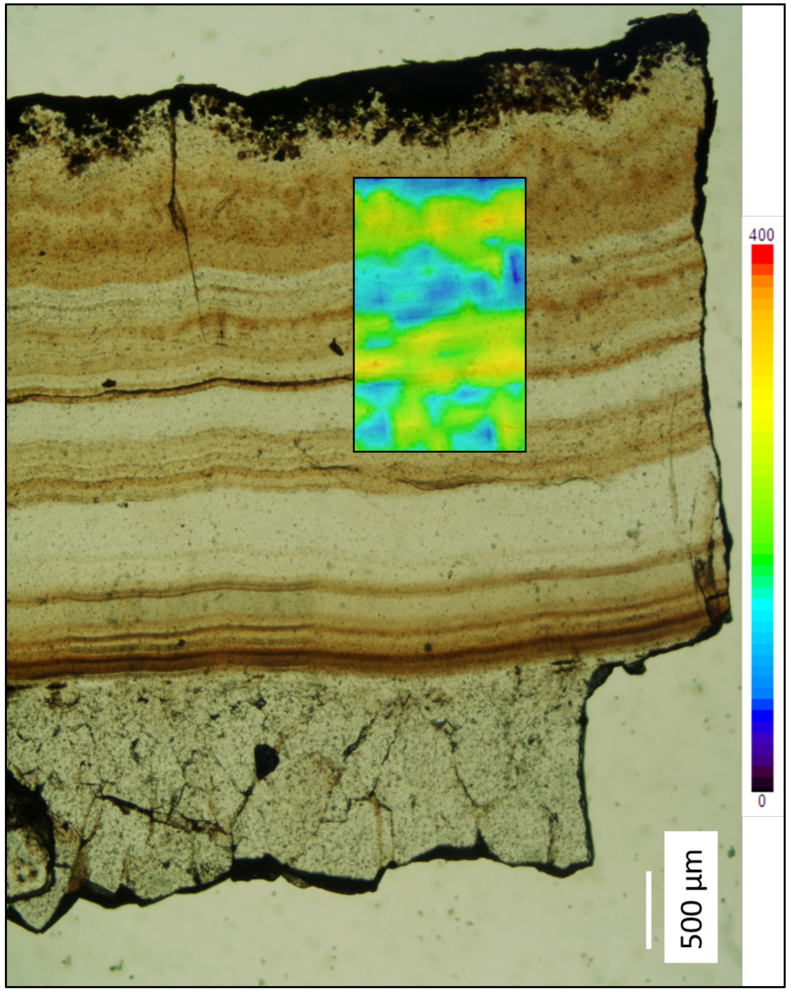
Monte Rovello: FTIR vs Raman mapping

Raman mapping shows that moganite is associated with layers having lower H_2O contents

FTIR map for H_2O (int. range 3700-2900 cm^{-1})



Raman map for moganite (peak at 503 cm^{-1})



Conclusions

- We studied 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 CT, occasionally containing CO_2 besides H_2O/OH, was identified. 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 H_2O contents.

- The ^{18}O and H isotopic data of Lombardi and Sheppard (1977) indicate temperatures around 120-100°C for the processes responsible for the hydrothermal deposits which is within the typical range of T for the formation of opaline silica (e.g. Heaney, 1993).

References cited
Avanzinelli, R. et al. (2017) Geol. Field Trips, Vol. 9 No.1.1, 158 pp.,
Fazzini, P. et al. (1972). Mem. Soc. Geol. It., 11, 65-144.
Lombardi, G. and Sheppard, S.M.F. (1977) Clay Miner. 12, 147-161.
Heaney, P.J. (1993) Contrib. Mineral. Petrol., 115, 66-74.