Micro-Raman spectroscopy and microstructural thermometers applied for the evaluation of carbonate mylonites deformation temperature

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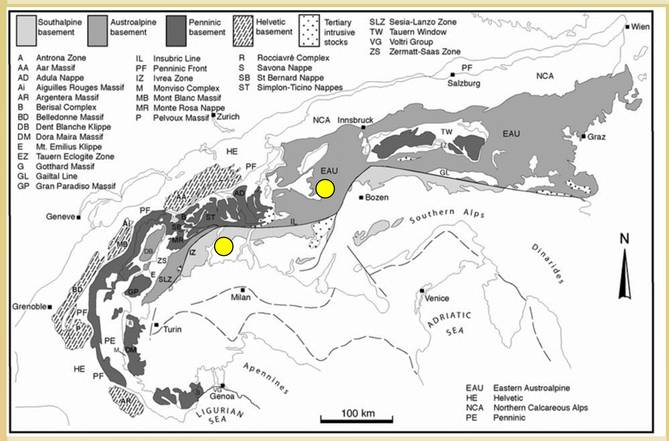
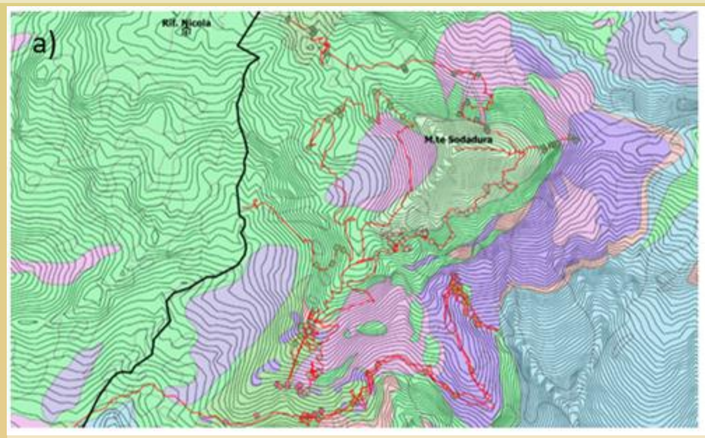
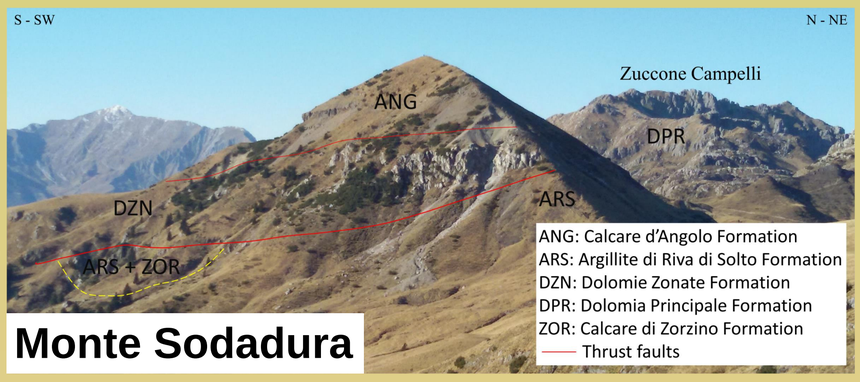
Carbonate mylonites from the Italian Alps were analyzed using Carbonaceous Materials by Raman spectroscopy (RSCM) to infer the deformation temperatures associated with the Alpine thrust tectonic. We investigated three samples from the Central Southalpine Domain (Monte Sodadura) and one from the Central Austroalpine Domain (Braulio Valley).



Tectonic scheme indicating the structural domains of the Alps (Spalla & Marotta, 2007) and sample location.

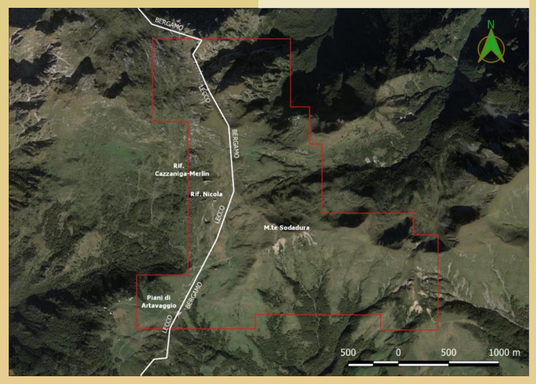


GPS positions in the area of Monte Sodadura where the analyzed samples were collected.



Monte Sodadura

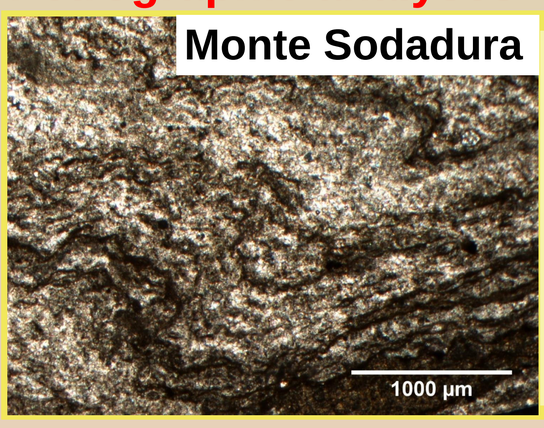
Braulio Valley



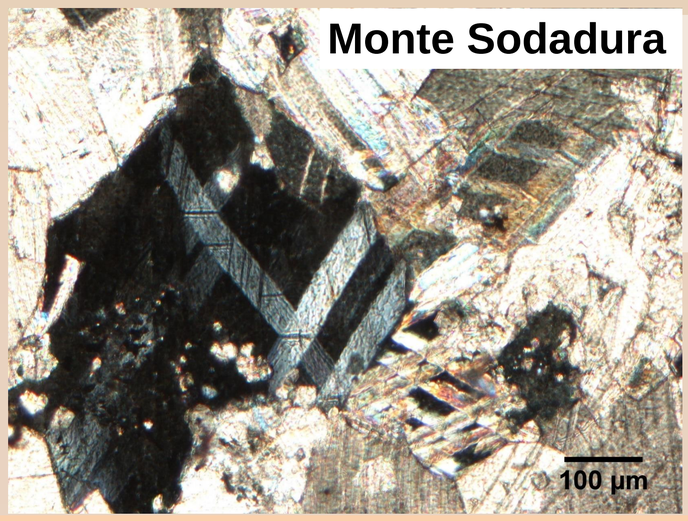
Satellitar image of the Piani di Artavaggio area (by Google Earth). Red lines define the studied area.

In the Sodadura area, mylonites developed within the Calcare d'Angolo Formation (ANG) along the tectonic contacts with the structurally lower Dolomie Zonate Formation (DZN), and appear in centimetric to decimetric levels.
Folds developed within the Argilliti di Riva di Solto Formation (ARS) outcropping at Monte Sodadura's base are compatible with the emplacement of the South – verging thrusts that characterize the Southalpine Domain.

Petrographic analyses



In thin section, mylonitic levels appear foliated and folded, where films are mainly composed by oxides and lithons of fine grained calcite, with minor dolomite found only in few samples.

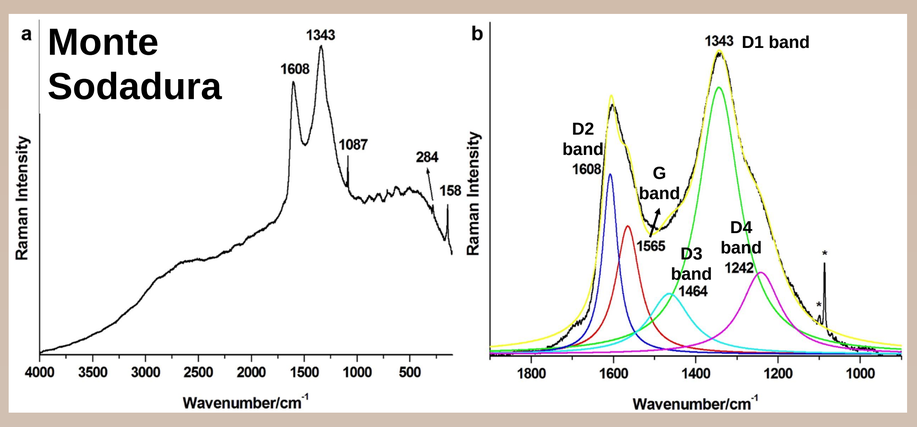


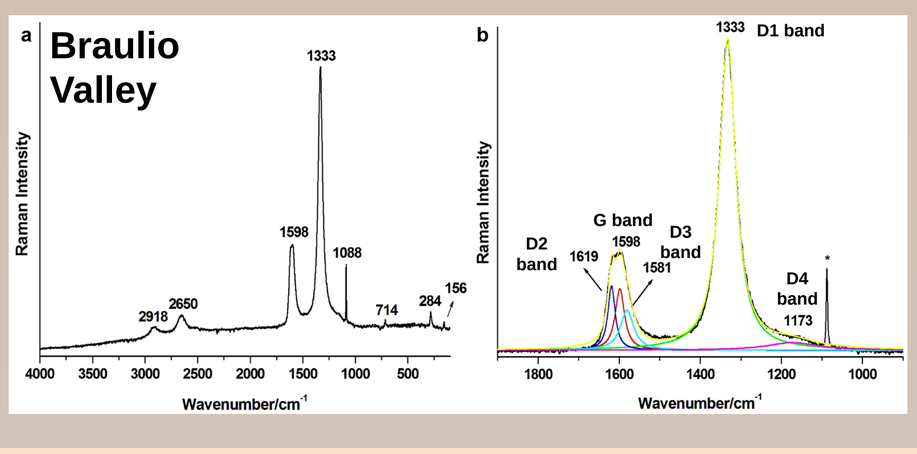
Some bigger calcite grains show typical recrystallization features such as mechanical twinning, bulging and subgrain rotation, suggesting deformation temperatures major than 200°C for all the studied samples.

Temperature estimations of 200 – 300°C have been suggested by Berra & Cirilli (1997) for the mylonites of the Braulio Valley, considering the Thermal Alteration Index of spores and pollens in these rocks.

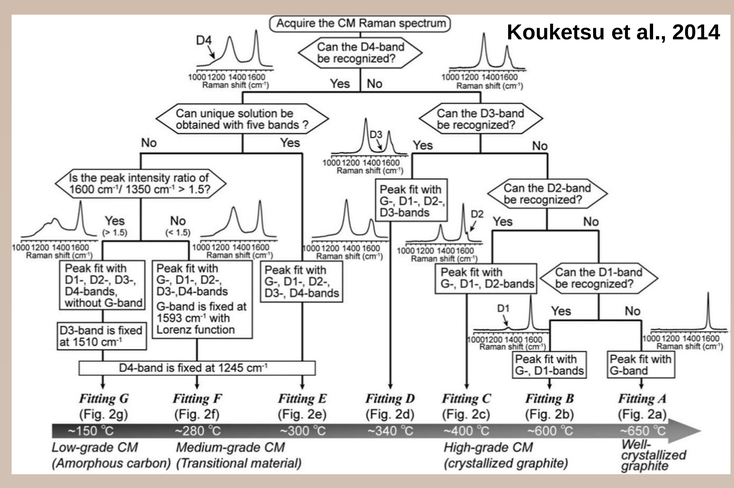
Raman carbonaceous material geothermometer

On different areas of each studied sample, twenty micro-Raman spectra were recorded using a Jobin Yvon HR800 LabRam μ-spectrometer at room temperature. The instrument was equipped with an Olympus BX-41 Optical Microscope (OM), a HeNe 20mW laser working at 632.8 nm, and a charge-coupled device air-cooled detector. Considering the first order Raman bands of the CMs (1700-1200 cm^{-1}), it is possible to evaluate their grade of crystallization and, therefore, their temperature formations).





Band deconvolution was performed applying a five way fitting, considering the first order bands of carbonaceous materials (G, D1, D2, D3, and D4 vibrational modes).



Applying the equation proposed by Kouketsu et al., 2014, the obtained temperatures for the samples are:

- ranging **from 217±46°C to 238±44°C**, for samples from **Monte Sodadura area**;
- **348±54°C** in the analyzed sample from **Braulio Valley**.

These results are confirmed by the morphology of the CM bands.

Conclusions: micro-Raman spectroscopy applied to the characterization of crystalline degree of Carbonaceous Materials allowed to estimate temperature formation in two areas of the Alps, suggesting to reconsider the geometry and timing of thrust-fault systems, incorporating these new data.

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SIMP Società Italiana di Mineralogia e Petrologia
SGI Società Geologica Italiana
SOGEI Società Geochimica Italiana

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