Ductile to Brittle Shear Localization in the Upper Crust During Thermal Anomaly: the Calamita Complex (Elba Island, Italy)

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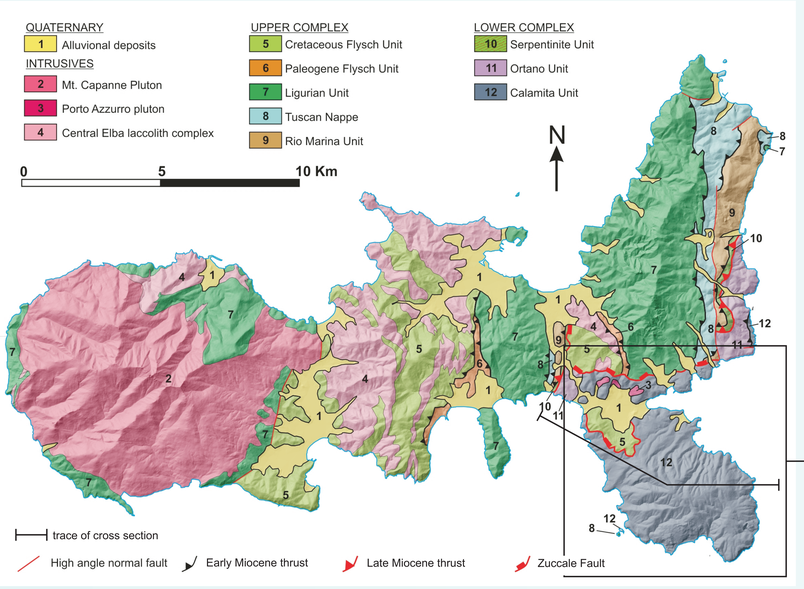
AGU American Geophysical Union VIRTUAL POSTER SHOWCASE

Introduction

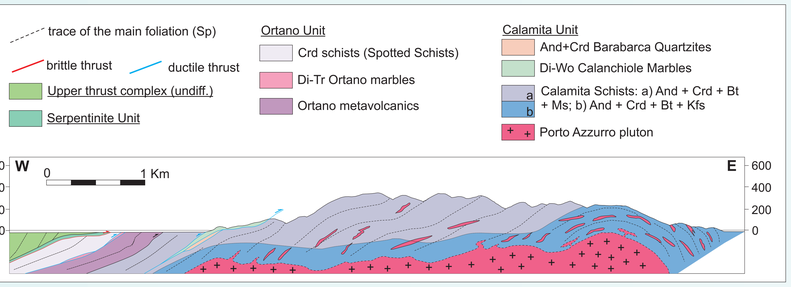
Deformation of rocks has been investigated in the last fifty years through experimental studies, analogue and numerical modelling and field investigations of naturally deformed rocks. Among the latter cases, contact aureoles has proven themselves as natural laboratories to understand the mechanics of rock deformation. A contact aureole represent a volume of rocks subject to a thermal anomaly, usually at fixed pressure, in which the anomaly effect fades through time. An interesting way to view contact aureoles is as gradients (e.g. of temperature or strain; *Paterson et al.*, 1991). Deformation processes were indeed investigated in aureoles as a function of temperature (e.g. *Stipp et al.*, 2002). By doing so, it has been assumed that deformation was homogeneous and that the strain rates remained constant over time.

In this work we present an example of an LP/HT metamorphic unit characterized by the development of multiple cohexisting fabrics as a result of meso- to micro-scale heterogeneous strain distribution.

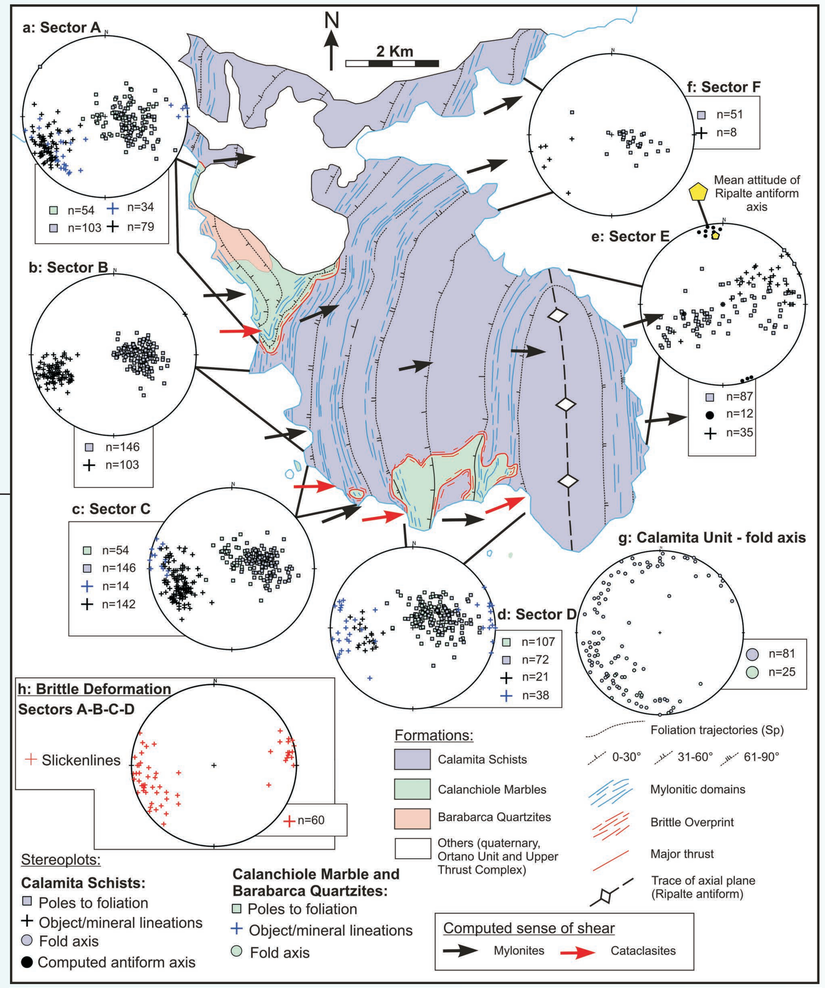
Geological Setting



The Calamita Unit represents the roof of the buried Late Miocene Porto Azzurro pluton. The unit is composed of schists and metarenites at the bottom (Calamita Schists), overlain by tectonic slices of marbles (Calanchiole Marbles) and metasediments (Barabarca Quartzites). Contact metamorphism in the amphibole to pyroxene hornfels facies occurred at 0.2 GPa pressure and Tmax of 600-650 °C and was accompanied by the formation of several top-to-the-E shear zones, producing duplexing of the inner aureole and tectonic delamination of the outer aureole. Age of deformation has been constrained between 6.8 and 6.2 Ma [*Musumeci et al.*, 2015] by means $^{40}Ar/^{39}Ar$ and U/Pb dating.



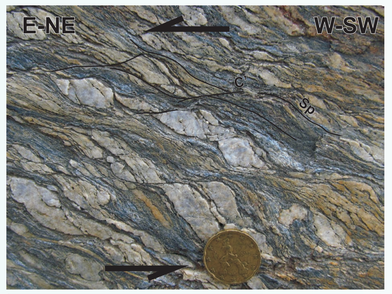
Structural analysis



Tectonic sketch map of the Calamita Unit. Cyan lines denote high strain mylonitic domains; red lines indicates domains of cataclastic overprint. Arrow marks the computed sense-of-shear, for ductile (black) and brittle (red) deformation. Note the constant E-W trend of the lineations in the Calamita Unit.

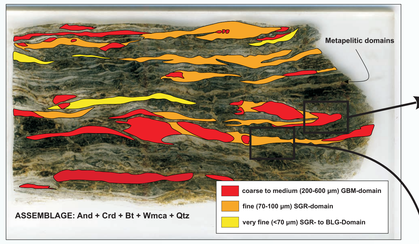
Mesostructures

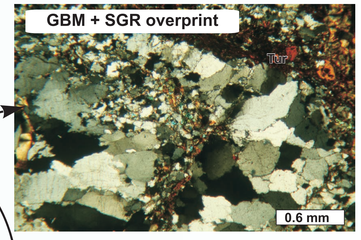
Low Strain Domains: *dominated by folds and S-tectonites. Relatively coarse grained*

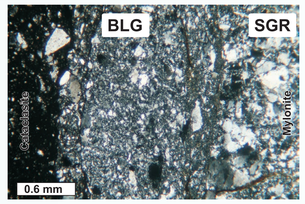


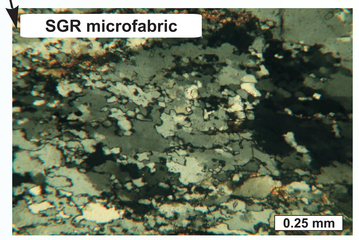
High Strain Domains: *foliated fine-grained layers characterized by stretching lineations and mylonites.*

Microstructures



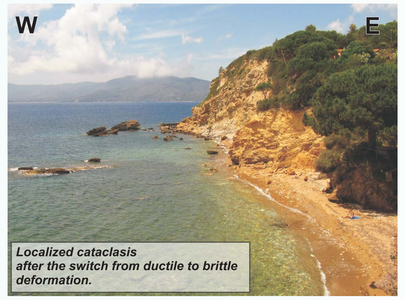


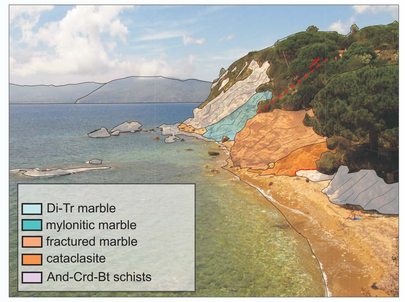




Microfabric: *Qtz microfabric shows different recrystallization mechanisms in different microstructural sites.*

Conclusions





1) The Calamita Unit is an example of LP/HT complex.
2) In space, deformation is concentrated in high strain domains bounded by relatively low strain domains.
3) Over time, deformation switches from ductile to brittle conditions.
4) Microfabrics are consistent with temperature drop during deformation.

Further research

- Deformation processes and mechanisms controlling strain partitioning.
- Fault localization during the switch to brittle conditions.
- Mechanics of the brittle/ductile transition.

Methods: EBSD analyses; Clast size distribution analyses; U/Pb and Ar/Ar dating.

References

Musumeci, G., F. Mazzarini and A.R. Cruden, 2015. The Zuccale Fault (Elba Island, Italy): A new perspective from fault architecture, Tectonics, 34.

Paterson, S.H., R.H. Vernon and T.K. Fowler, Jr., 1991. Aureole Tectonics, In: D.M. Kerrick (Eds.) Contact Metamorphism, Reviews in Mineralogy, vol. 26.

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Aknowledgements

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