

Title: The Tuscan Quaternary-Miocene magmatic-hydrothermal transect (Italy)

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Summary: Tuscany (Italy) hosts several magmatic-hydrothermal systems developed from Late Miocene to present (Tuscan Magmatic Province). The magmatic-hydrothermal activity progressively migrated from west to east, starting from Elba Island (8.5-5.5 Ma) and ending in Larderello geothermal area (4 Ma-Present), following the eastward propagation of the Apennine compressional fronts and the extensional activity in the Northern Tyrrhenian continental back arc. Since Late Miocene, the progressive eastward migration of tectonic extension produced a differential exhumation of the magmatic-hydrothermal systems, providing the opportunity to observe different crustal levels. The oldest plutonic and subvolcanic units are well exposed in the west (Western-Central Elba Island) while the youngest ones are only partially exhumed in the east, together with ore deposits and some preserved volcanic domes (Eastern Elba, Campiglia Marittima and Larderello). Magmatism has been predominantly of crustal origin (peraluminous, B-Li-F rich granite plutons-laccoliths-dykes and rhyolite domes), while mantle-derived magmas (latites, lamproites) have been emplaced as minor dykes-laccoliths. The hydrothermal activity triggered by the magmatism, formed skarn bodies, tourmalinites, ore deposits (Fe, Cu-Zn-Pb-Ag, Sn-W) and geothermal systems. During this excursion, we will make a westward transect, virtually descending to progressively deeper crustal levels. We will start from the active Larderello geothermal field where an igneous intrusion is still crystallizing-cooling at depth, then moving to Campiglia Marittima area where volcanic-subvolcanic-plutonic felsic rocks and skarn ore deposits were juxtaposed by tectonic exhumation, ending on Elba Island where we will walk through large felsic plutonic bodies, contact aureoles, leucogranite-pegmatite dykes, subvolcanic laccolith-sill-dyke felsic complexes and mafic dyke swarms. Elba Island also offers the opportunity to observe iron ore deposits exploited since Etruscan epoch, skarn bodies and tourmalinites.

When: Post-conference, 5-9 July 2025

Start and finish locality: Florence main station (S.M. Novella), Italy

Program:

Day 1 – Saturday 5 July: arrival to *Firenze* [FLR, individually organised; regular flights (6:17AM; 10:50 AM via Zurich) and trains (7:39 AM) from Geneva in the morning]. Meeting at Florence Train Station at 15:30 and transfer to *Castelnuovo Val di Cecina* (ca. 2 hours). Short introduction to the Quaternary-Miocene Tuscan Magmatic-

Hydrothermal Field (maps, cross sections, and samples of Pliocene-Quaternary magmatic-hydrothermal rocks of the active geothermal areas).

Day 2 – Sunday 6 July: morning, quick overview of *Larderello* geothermal plants and visit to the fumaroles of *Monterotondo Marittimo*. Lunch at *Vapori di Birra* Pub. Afternoon on Pliocene granite pluton, porphyry dykes, rhyolite domes and skarns of *Campiglia Marittima*.

Day 3 – Monday 7 July: transfer to *Piombino* harbour and ferry to Elba Island [Portoferraio]. PLUTONIC ZONE - *Monte Capanne* granite pluton, mafic dyke swarm, and leucogranite – LCT-pegmatite dykes [Late Miocene]. Visit to the pegmatite mineral Museum of San Piero in Campo.

Day 4 – Tuesday 8 July: SUBVOLCANIC ZONE - the subvolcanic laccolith-sill-dyke granite porphyry complex of central Elba Island [Late Miocene]. Morning, laccoliths and sills of *Marina di Campo Bay* cliffs from the boat. Lunch-time and afternoon, walking on laccolith-sill-dyke granite porphyry complex of *Sansone – Capo Bianco* coast.

Day 5 – Wednesday 9 July: HYDROTHERMAL ZONE - Morning, walking from *Barbarossa Bay* to *Terranera Bay* (30'). Leucogranite-monzogranite sill-dyke complex, tourmalinites, skarn, Fe oxide-pyrite ores and their relationships with tectonic structures. Afternoon, visit to the Mineralogical Museum of Rio Marina mining Park, Ferry from *Rio Marina* to *Piombino* and transfer to Florence airport (FLR) or main station.

Level of fitness: Light to medium, walking over uneven terrain and along coastline in shallow seawater will be required.

Required equipment: Passport or ID-card valid for Italy, hiking boots, swimming suite, light running shoes for walking in the sea, wind and waterproof jackets, sun protection, day pack.

Accommodation type:

Day 1 - *Hotel dei Conti, Castelnuovo Val di Cecina*

Day 2 – *Hostel Gowett, Campiglia Marittima*

Day 3-4 – *Hotel Rio sul Mare, Rio Marina*.

Rooms to be defined (double and triple/quadruple rooms with private bathroom (single room at extra costs), breakfast included.

Number of participants: 24 maximum.

Costs: 525 € (for transport from/to Florence, accommodation with breakfast, entry fees, Park-Museum access, Touristic boat. **lunch and dinner excluded**)

Web Cover picture:

Fumaroles, well heads, pipelines and cooling tower at Monterotondo Marittimo (Larderello geothermal field), looking to the west towards the fossil magmatic-hydrothermal systems of Campiglia Marittima and Elba Island (background). Photo credit: Andrea Dini.

Additional pictures:

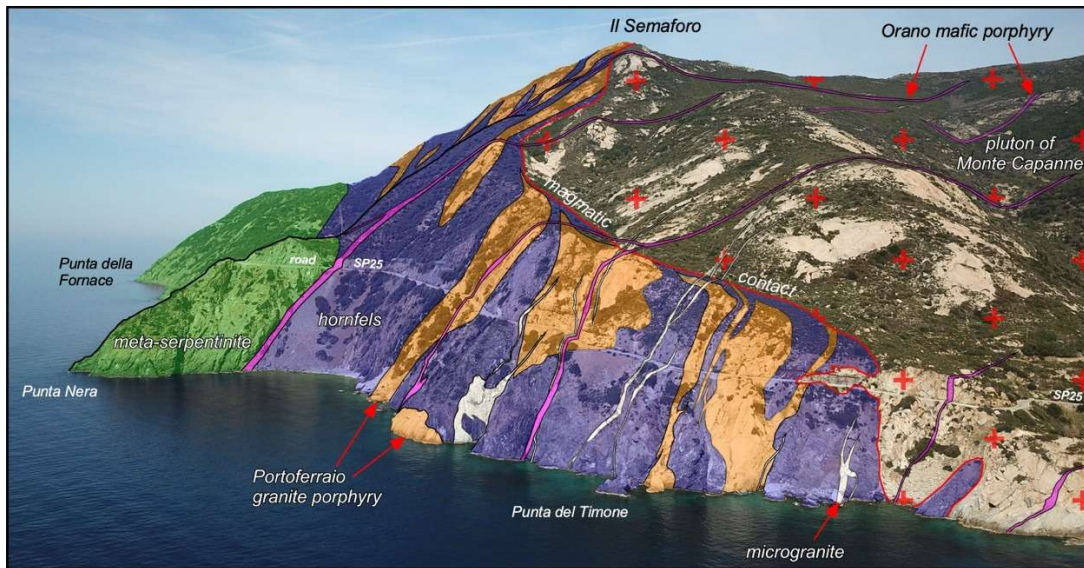
Day 1 - A sample of cordierite bearing monzogranite (3.6 Ma) with tourmaline spots, cored at around 4000 m depth in the Larderello geothermal field. Photo credit: Andrea Dini.



Day 2 - Rheomorphic structures in a cordierite bearing, rhyolite dome (4.5 Ma) near San Vincenzo (Campiglia Marittima area). Note the vesiculated latite enclaves (brownish in color). Photo credit: Andrea Dini.



Day 2 - Banded hedenbergite-ilvaite skarn that totally replaced a fractured mass of pure marble, Temperino mine, Campiglia Marittima. The large residual pocket (upper-left part) was later invaded by mafic magma forming a massive infill of grey porphyry and producing recrystallization of the skarn. Photo credit: Andrea Dini.



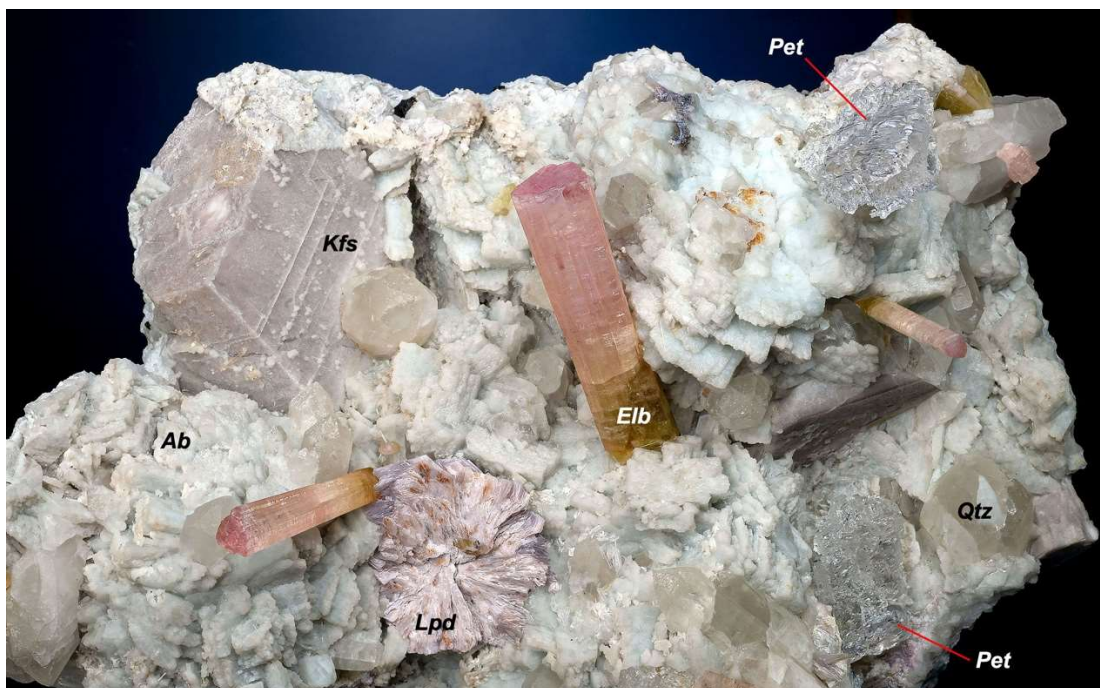
Day 3 - Western magmatic contact of Monte Capanne monzogranite pluton (ca. 7 Ma). The contact aureole is made of metasedimentary hornfels and metaserpentinites previously intruded by the Portoferraio granite porphyry (8 Ma). Both pluton and contact aureole are then crosscut by a dyke swarm of Orano mafic porphyry (6.85 Ma). Photo credit: Andrea Dini.



Day 3 - Spectacular outcrop of Kfs megacryst-rich monzogranite (Sant'Andrea Facies, Monte Capanne pluton) showing many plurimetric mafic microgranular enclaves. Photo credit: Andrea Dini.



Day 3 - Detail of the axial zone of a LCT pegmatite dyke near Grotta d'Oggi (San Piero in Campo) showing an elongated pocket partially filled by clay. Note the chemical evolution of tourmaline at the hanging-wall, from Fe-rich black schorl, to green and pink elbaite inside the pocket. The pale blue feldspar at the pocket footwall is albite. Photo credit: Andrea Dini.



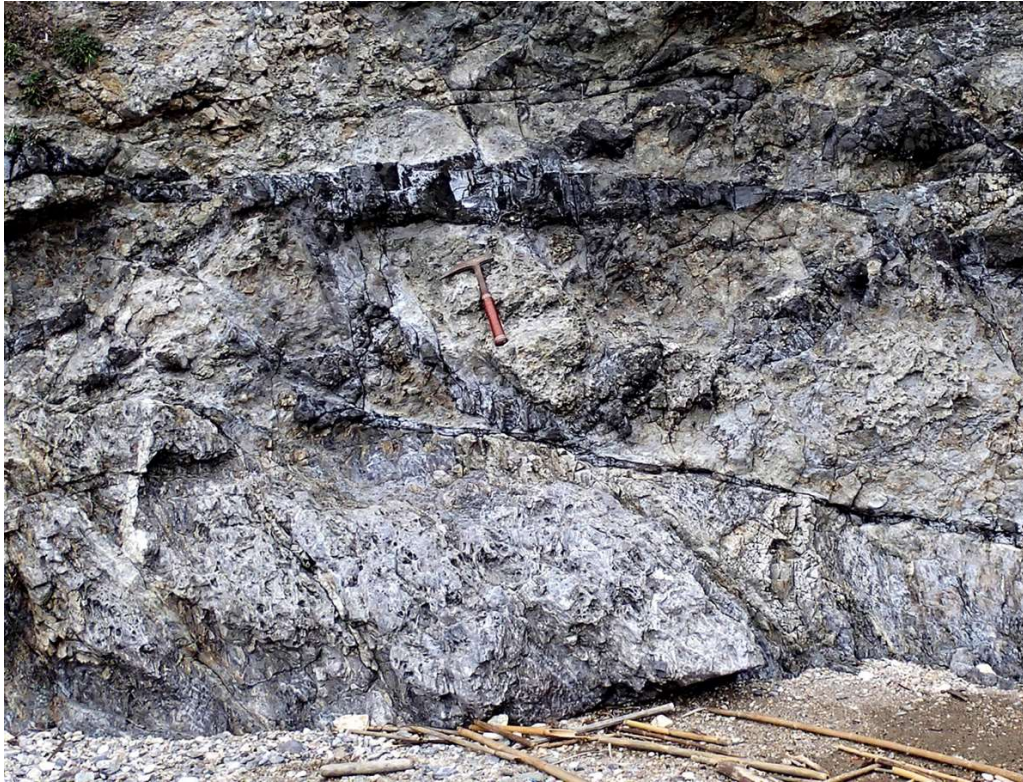
Day 3 – A typical specimen extracted from the LCT pegmatite dykes of San Piero in Campo with polychrome elbaite crystals up to 4 cm (Elb). Pet: petalite, Lpd: lepidolite; Ab: albite; Kfs: orthoclase; Qtz: quartz. Photo credit: Andrea Dini.



Day 4 - A monzogranite porphyry laccolith at Capo Poro (near Marina di Campo). It was emplaced by intrusion in approx. 2 km depth into a folded sequence of Cretaceous flysch. Age of intrusion is 7.5 Ma. Photo credit: Andrea Dini.



Day 4 – The Li-B-F-rich alkali feldspar granite porphyry near Capo Bianco (8.5 Ma). This is the oldest peraluminous magmatic product of the Tuscan Magmatic Province. Note the rheomorphic structures, the layering and the black tourmaline orbicules. Pink portions are rich in interstitial zinnwaldite. Photo credit: Andrea Dini.



Day 5 - Black tourmalinite metasomatic bodies developed along sub-horizontal tectonic structures crosscutting pelitic hornfels in Eastern Elba Island. Photo credit: Andrea Dini.



Day 5 - Tourmaline bearing leucogranite dykes crosscutting pelitic hornfels in Eastern Elba Island. Photo credit: Andrea Dini.



Day 5 - A pocket containing large pentagonododecahedral crystals of pyrite inside a mass of fine- to coarse-grained lamellar hematite; Valle Giove stope, Rio Marina mine, Elba Island. Photo credit: Andrea Dini.



Day 5 - A cluster of iridescent, rhombohedral crystals of hematite (up to 3 cm) associated with quartz. Bacino stope, Rio Marina mine, Elba Island. Photo credit: Andrea Dini.