

The eastern Elba Island magmatic-hydrothermal complex: a *proxy* for the supercritical roots of Larderello geothermal system (Italy)

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Since 1980's, increasing amounts of tourmaline bearing granites and hydrothermal veins have been intersected by deep geothermal wells (2500-4800 m) in the Palaeozoic metasedimentary basement of Larderello (Italy). They represent a partially exhumed system (3.8-1.3 Ma) that has been considered as a fossil analogue of the high temperature system imaged by geophysycs at depth and never reached by direct exploration/exploitation [1]. The existence of a high-temperature, potentially supercritical, reservoir at the top of a recently emplaced batch of granite magma represents a valuable target and a scientific-technological challenge. Any investigation of the usefulness of the natural heat in rock layers below the meteoric steam reservoirs currently exploited at Larderello requires a thorough understanding of petrophysical and geochemical conditions of solids and fluids coexisting at these depths. For this reason we are performing a detailed structural and petrological study of Tuscan fossil magmatic-hydrothermal systems exhumed and well-exposed at surface. In particular, eastern Elba Island provides extensive outcrops of Palaeozoic metasediments pervasively invaded by tabular intrusions of tourmaline leucogranites, cordierite-biotite monzogranites (ca. 6 Ma) and by a network of tourmaline hydrothermal veins/breccias showing notable analogies with high-temperature fossil systems drilled at Larderello [2]. Magmatic and hydrothermal bodies are confined into the inner portion of a widespread contact aureole defining a sub-horizontal paleo-horizon at the top of a major intrusion (not exposed at surface). Tourmaline chemistry and isotopic composition (B, O, H, Sr, Nd) coupled with fluid inclusions and structural data indicate that the building of a multipulse magmatic complex was responsible for the formation of a discrete contact aureole that was sequentially invaded by high temperature, near supercritical fluids of dominantly magmatic origin. Similarly to Larderello, the magmatic hydrothermal system seems to be largely disconnected from the meteoric systems dominating the shallow crust.

[1] Dini, Gianelli, Puxeddu & Ruggieri (2005), *Lithos* **81**, 1-31. [2] Dini, Mazzarini, Musumeci & Rocchi (2008), *Terra Nova* **20**, 318-326.