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Vein networks record pressurization events in the active hydrothermal system of Lipari Island (Italy)

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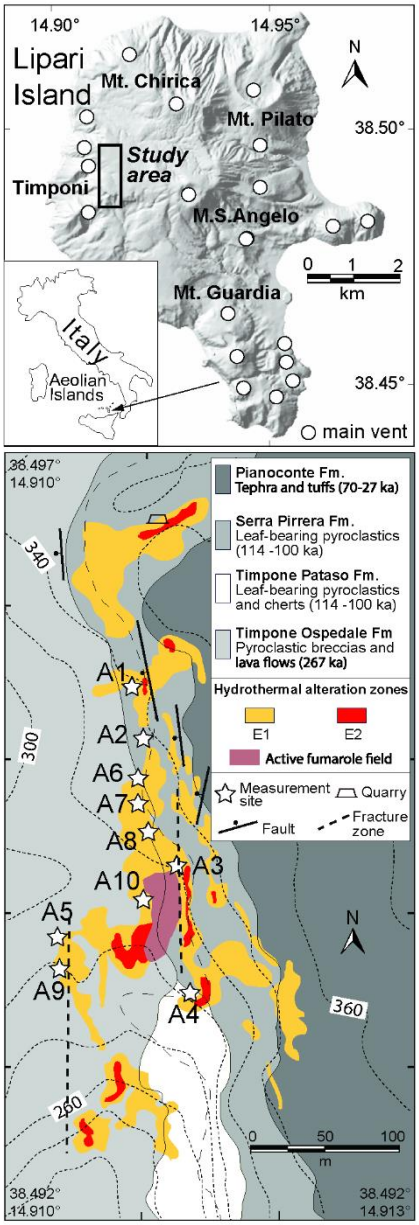
The appearance of fractures and veins on active volcanoes may reflect pressurization events potentially preceding hydrothermal explosions. We study two different sets of gypsum-filled vein networks in the hydrothermal field of the active Lipari volcanic island (267ka-1220 AD, Aeolian Islands, Italy). The older network (E1) consists of sub-parallel, sub-vertical, N-S striking veins cutting a low temperature alteration zone; the younger network (E2), which is associated to higher temperature and acid fluids, consists of quasi-anastomosed veins with variable dip. The E2 veins are thinner and shorter with respect to E1, and they show larger fracture aperture, dilatancy, and finite extension. Also, the fluid pressure required to form E2 is four time higher than that in E1, but the hydraulic conductance and the volumetric flux are lower.



We maintain that this last evidence is due to the larger number of fracture intersections in E2, which slows down the fluid movement and promotes fluid interference effects and pressurization. We calculate 0.8 km and 4.6 km depth for the E1 and E2 hydrothermal sources, respectively and find that the decrease in the fluid flux, the deepening of the hydrothermal source, and the increase of pressurization in E2 are related to the emplacement of a 3-5 km deep magma reservoir. Therefore, a decrease in the fluid discharge in active hydrothermal fields does not contrary, could be a sign of pressurization at depth. This latter process may favor hydrothermal explosions like those occurred at Nisyros Island, Greece in 1871–1888, at Porkchop Geyser in Norris Geyser Basin, USA in 1989, and at Poás volcano, Costa Rica in 1985–1988. We also estimate a. 0.62 m uplift in E2, which reflects a non- magmatic unrest episode. Our methodological approach and the obtained results have important implications for the monitoring of active volcanic-hydrothermal areas.

Figure 1: Location of Lipari Island and map of the alteration zones, fractures and faults, and sites of measurement of veins. The background geological formations, their deposits, and the ages are from Forni et al. (2013). The thin dashed black line indicates the trail.

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