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Secondary hydrothermal mineral system in the Campi Flegrei caldera, Italy

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Mineral systems generally develop around the deep root of the volcanoes down to the degassing magma chamber due the selective enrichment process of elements within the host-rock. The mineralization process depends on i) volcanic structure, ii) magma and fluid chemistry, iii) host-rock type and texture, iv) temperature and pressure conditions, and v) action timing that affect the transport and precipitation conditions of elements in the solution. Firstly, it generates a hydrothermal system that in a later phase may generate considerable metallogenic mineralization, in terms of both spatial extension and specie abundance. The study of secondary assemblages through depth and, possibly, through time, together with the definition of the general geological, structural, mineralogical and petrological context is the background to understand the genesis of mineral-to-metallogenic systems. We report our study on the Campi Flegrei volcano of potassic Southern Italy belt. It is a sub-circular caldera characterized by an active high-temperature and fluid-rich geothermal system affected by seismicity and ground deformation in the recent decades. The circulating fluids originate at deeper level within a degassing magma body and give rise at the surface up to 1500 tonnes/day of CO_2 emissions. Their composition is intermediate between meteoric water and brines. Saline-rich fluids have been detected at $\sim$3000 in downhole. The hydrothermal alteration varies from argillitic to phillitic, nearby the caldera boundary, to propilitic to thermo-metamorphic facies towards its centre. The Campi Flegrei caldera was defined as analogue of mineralized system such as White Island (New Zealand) that is an example of an active magmatic and embryonic copper porphyry system.
In order to enhance the knowledge of such a type of embryonic-like metallogenic system, we have carried out macroscopic and microscopic investigations, SEM-EDS and electron microprobe analyses on selected samples from deep wells drilled in the ‘80s by the Agip Oil Company at the Campi Flegrei caldera. The new data have been merged with those available in the current volcanological, mineralogical and petrological literature in order to generate an innovative model and define the relationship between the caldera structure and the secondary mineralogy.