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Groundwater flow and fluid/groundwater geochemical characterization at Ischia Island: a new strategy for the mitigation of the volcanic risk

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The volcanic system of Ischia is characterized by an intense hydrothermal activity, documented since the early 16th century by the study of Iasolino (1588), which represents the first systematic analysis of the thermal springs of the island for therapeutic purposes. Later studies partially contributed to the enhancement of knowledge on the volcanic, hydrogeological and hydrothermal features of the island, highlighting the strong interaction between hydrothermal flowpaths and volcano-tectonic processes. The reconstruction of the hydrothermal system becomes, therefore, a fundamental element for territorial planning, not only in terms of management of the huge water and geothermal resource, but also and above all in a perspective of prevention and mitigation of volcanic risk. Thermal springs, fumaroles and clay deposits due to the hydrothermal alteration of volcanic products testifies for the existence of an active deep hydrothermal system. Commonly, the geochemical characterization of fluids and groundwater has been used for the definition of the origin and structure of hydrothermal systems, when hydrogeological information is incomplete. However, volcanic hydrothermal systems, such as that characterizes the island of Ischia, are particularly difficult to analyze and outline, as the groundwater resources are the result of an articulated and dynamic interaction among meteoric water, sea water and fluids of deep origin. In such cases, the need for an interdisciplinary approach is evident, involving knowledge and research methods ranging from geology to volcanology, geophysics, geochemistry and hydrogeology. With particular reference to the functional and structural representation of the geothermal system of the island of Ischia and the resulting correlations with the volcano-tectonic processes, the examination of previous information highlights the need to update and improve the knowledge on groundwater hydrodynamics and mineralization processes.

Therefore, this study represents the result of a strong interdisciplinary action that, starting from the design and implementation of a database on the existing geological/volcanological and hydrogeological information, contributes to highlight the critical issues, defines an operating scheme of the hydro-geo-thermal system of the island of Ischia, and aims at upgrade its hydrogeological, geochemical and volcanic monitoring system, in order to contribute to the mitigation of natural risks.

Moreover, this study well fits into the framework of the ongoing researches on volcanic hazard at Ischia and is integrated with the actions planned by the Italian Department of Civil Defense. The knowledge of groundwater dynamics and pathways is of fundamental importance for understanding the water/magma interaction processes in case of re-alimentation of the shallow magmatic system, and the assessment of the possibility of phreatic explosions occurrence.