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The suitability of the Pieve Fosciana hydrothermal system (Italy) as a detection site for geochemical seismic precursors

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Abstract

The Serchio valley is one of the regions of highest seismic risk in Tuscany, Italy. As a part of a seismic prevention/prediction pilot project funded by Regional Government of Tuscany, the geochemical and hydrologic processes that control the composition of the thermal waters emerging near the Pieve Fosciana village (Prà di Lama site), have been investigated to assess the suitability of the site for the monitoring of geochemical precursors of earthquakes. The investigation protocol considered the coupled use of chemical analyses on water aliquots sampled during discrete surveys, and of continuous signals for selected physical-chemical parameters acquired via an automatic station equipped with a suite of parameter-specific sensors. Concentrations of major inorganic dissolved aqueous components have been processed with geochemical modeling techniques to obtain a quantitative description of water–rock interactions occurring at depth in local Mesozoic aquifers. The geochemical background of the system was defined by combining these data, and an integrated hydrogeological and geochemical model of the hydrothermal aquifer feeding the springs was elaborated. Based on the very low variability of physical and geochemical parameters over a long observation time, the relatively long and deep underground circulation paths of discharged waters under confined conditions, the site-specific sensitivity of monitored parameters to local crustal strain, and the proximity to seismically active neotectonic structures, the Pieve Fosciana system ranks as a favorable site for recognizing fluids possibly connected to energy release and/or permeability variations induced by seismogenic processes at depth. The integrated geological, hydrogeological, geochemical and modeling approach presented here could be profitably applied for the design of similar projects elsewhere.

Keywords: water-rock interaction; geochemical modeling; discrete and continuous monitoring; seismic precursors; Pieve Fosciana; Italy