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The significance of "geothermal microzonation" for the correct planning of low-grade source geothermal systems

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Despite the environmental-friendly energy systems are solar thermal technologies, photovoltaic and wind power, other advantageous technologies exist, although they have not found wide development in countries such as Italy. Given the almost absent environmental impact and the rather favorable cost/benefit ratio, low-enthalpy geothermal systems are, however, likely to be of strategic importance also in Italy during the next years.
The importance of geology for a sustainable exploitation of the ground through geothermal systems from low-grade sources is becoming paramount. Specifically, understanding of the lithological characteristics of the subsurface along with structures and textures of rocks is essential for a correct planning of the probe/geo-exchanger field and their associated ground source heat pumps. The complex geology of Eastern Sicily (Southern Italy), which includes volcanic, sedimentary and metamorphic units over limited extension, poses the question of how thermal conductivity of rocks is variable at the scale of restricted areas (even within the same municipality). This is the innovative concept of geothermal microzonation, i.e. how variable is the geothermal potential as a function of geology at the microscale. Some pilot areas have been therefore chosen to test how the geological features of the subsurface can influence the low-enthalpy geothermal potential of an area. Our geologically based evaluation and micro-zonation of the low-grade source geothermal potential of the selected areas have been verified to be fundamental for optimization of all the main components of a low-enthalpy geothermal system. Saving realization costs and limiting the energy consumption through correct sizing of the system are main ambitions to have sustainable development of this technology with intensive utilization of the subsurface. The variegated territory of countries such as Italy implies that these goals can be only reached if, primarily, the geological features of the shallow subsurface (i.e. chemical-physical characteristics of rocks and fluids of the first 100 m below the ground) are appropriately constrained.