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Sustainability assessment of geothermal exploitation by numerical modelling: the example of high temperature Mofete geothermal field at Campi Flegrei caldera (Southern Italy)

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The active volcanic area of Campi Flegrei caldera has been the site of many geothermal investigations, since the early XX century. This caldera is characterised by high heat flow, with maximum value > 150 mWm-2, geothermal gradients larger than 200°Ckm-1 and diffuse magmatic gases discharge at the surface. These features encouraged an extensive campaign for geothermal investigation, started in 1939, with many drillings performed at Campanian volcanoes (Campi Flegrei and Ischia) and later at Vesuvius. Several wells aimed to the exploitation of high enthalpy geothermal energy, were drilled in the Campi Flegrei caldera, down to a maximum depth of ∼3 km involving mainly two sites (Mofete and S.Vito geothermal fields) located in western and northern sector of caldera respectively. The most interesting site for geothermal exploitation was the Mofete zone, where a number of 4 productive wells were drilled and tested to produce electrical power. Based on data inferred from the productive tests it was established a potential electrical extractable power from Mofete field of at least 10MWe. More recently an empirical evaluation of the whole geothermal potential of the caldera provides a value of more than 1 GWe. The results of AGIP-ENEL exploration at Campi Flegrei highlighted the feasibility of geothermal exploitation.

Here, we show for the first time the results of numerical simulations (TOUGH2 code ®) of fluids extraction and reinjection from the Mofete geothermal field, in order to produce at least 5MWe from zero emission power plant (Organic Rankine Cycle type). The simulation is aimed to understand the perturbation of the geothermal reservoir in terms of temperature, pressure change, and possible related seismicity, after different simulated time of exploitation. The modeling is mainly constrained by the data derived from geothermal exploration and productive tests performed since 1979 by AGIP-ENEL Companies. A general assessment of the maximum potential magnitude related to injection of fluids has been obtained for different radius of the source (approximated to a circular fault) and stress drop ([U+F044][U+F073]), resulting in limiting values of momentum magnitude values (Mw) related to geothermal activity, also in the worst cases, below 3 in this area.