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Carbon Dioxide degassing from the geothermal systems of Latera caldera (Italy): Quantification and modeling of gas release.

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In the last decades a great interest has been addressed to the CO_2 Earth degassing, mainly for studies related to the carbon global cycle, and to the monitoring of quiescent active volcanoes. These studies highlighted that, at the surface, the gas is mainly released by soil degassing from well defined areas, recently named diffuse degassing structures (DDS), that usually are related to recent tectonic and volcanic structures. Central Italy, especially in the Perityrrhenian sector, is characterized by the presence of numerous DDSs located in not volcanically active areas. This region is also characterized by an intense geothermal anomaly highlighted by several geothermal systems from high to low enthalpy, to which frequently DDS are associated at the surface. A detailed study has been performed at Latera caldera, including soil gas flux survey and geochemical-isotopic investigations. Over 2500 measurements of soil CO_2 flux revealed that anomalous degassing of endogenous CO_2 occurs from a NE-SW band (Latera DDS) of 3.1 km^2, coinciding with a structural high of fractured Mesozoic limestones hosting a water-dominated high-enthalpy geothermal reservoir. The chemical and isotopic composition of cold dry gases emitted from the Latera DDS indicates their provenance from the geothermal reservoir. The composition of the gases was used to estimate the T-P conditions of the reservoir that results at T $\sim$ 200-300˚C and P_{CO2} $\sim$ 100-200 bars, reproducing the T-P values actually found in the geothermal reservoir by the deep wells. The total deeply derived CO_2 degassing from the system has been estimated to 350 t/d, an amount that is in the range of the CO2 degassing of

active volcanoes. Geochemical and geological data have coupled together to derive a conceptual model of the fluid circulation that includes the occurrence of convective cells of fluid ascending toward the surface. Because the decompression the convective, ascending fluids can separate a CO_2-rich gaseous phase that feed the degassing at the surface. This conceptual model, which has been tested by a physical-numerical simulation by the Though2 code, is the base for the assessment of the geothermal potential of the system. The CO_2 flux of 350 t/d implies, under different assumptions, a geothermal liquid flux from 128 to 263 kg/s, to which is associated an available heat flux of 119 MW and 239 MW respectively.

This study highlights the potentiality of soil CO_2 diffuse degassing investigations as an excellent tool both to locate active geothermal reservoirs at depth and to asses their geothermal potential.