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Soil and groundwater discharge of magmatic/hydrothermal CO_2 and He on south-western Ischia Island (Central Italy)

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Ischia Island is a most-active volcanic complex in the Campanian Magmatic Province (CMP). The volcano is currently undertaking a period of quiescence lasting since the 1302 effusive Arso eruption, its still-ongoing activity being testified by the widespread occurrence of surface hydrothermal manifestations and by the extensive release of both thermal energy and deep-derived magmatic fluids. Thermal manifestations on the Island have been interpreted as reflecting the surface discharge of a complex and multi-reservoir hydrothermal system, where fluids of formerly meteoric and/or sea-water origin get-heated and chemically modified by the interaction with magmatic volatiles (Panichi et al., 1992; Caliro et al., 1998; Inguaggiato et al., 2000; Chiodini et al., 2004). Here, we combine the results of recent soil and hydrogeochemical measurements, in the attempt to provide a comprehensive geochemical characterisation of the south-western sector of Ischia, and to quantitatively evaluate the budget of volatiles released in this most-actively degassing area on the Island. Soil measurements, carried out by use of the Valenza and Gurrieri (1988) method, have revealed a fair dependence of CO_2 soil degassing on tectonics and structural features, with a main area of CO_2 release at the intersection of NW-SE-trending regional faults with N-S-trending faults bordering the Mount Epomeo resurgent block. In this anomalous area, soil CO_2 fluxes range 180-505 g•m^2•day^{-1}, largely exceeding the background flux of about 55 g•m^2•day^{-1}. By integrating the above measurements over the whole investigated area

(6 Km^2), we evaluate a total CO_2 emission of about 400 t•day^{-1}. The remarkable degassing activity of the area is also supported by the widespread occurrence of gas-rich thermal waters (T up to 80˚C). Major ion and stable isotope compositions suggest that meteoric water and seawater both contribute to the deep ($>$ 200m) thermal aquifer, while the magmatic/mantle derivation of dissolved CO_2 and He is constrained based on their isotopic signature (δ^{13}C up to -2 ‰ vs. PDB and R/Ra $\approx$ 3, respectively). Combining groundwater composition data with the aquifer discharge rate, we evaluate CO_2 and He groundwater discharges of 0.6-1.2 and 0.5-1•10^{-4} t•day^{-1}, respectively.