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Heat flow and CO_2 flux from western central Italy

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A regional map of CO_2 Earth degassing of central Italy, recently elaborated on the base of carbon dissolved in to groundwaters of carbonate aquifers, reveals the occurrence of a large scale anomaly of CO_2 flux in the western sector of the region (TRDS, Chiodini et al., 2004). A CO_2 flux of about 12000 t/d to was estimated being associated to the TRDS area estimated extending about 24000 km^2. The relevance of the CO_2 degassing process in TRDS, is also evidenced by the presence of many CO_2 rich gas emissions, carbon rich volcanic aquifers and large travertine deposits. Moreover, a large part of the TRDS is characterised by a regional geothermal anomaly with heat fluxes from 80 mW/m^2 up to 1000 mW/m^2 and by the presence of many geothermal systems. This thermal scenario suggested an alternative approach to the estimation of the deeply derived CO_2 based on the correlation between heat and CO_2 fluxes in regions of high heat flow, proposed by Kerrick et al. (1995) and Seward and Kerrick (1996). This approach assumes that the elevated heat flow measured over the hydrothermal systems mainly arises from fluid convection rather than conduction and that CO_2 remains dissolved in the convecting single-phase fluid (i.e., liquid) until near-surface depths. Considering this model, the CO_2 flux can be estimated from: a) the heat flow, b) the enthalpy of the liquid at the temperature of the top of the potential reservoir and, c) the original concentration of CO_2 dissolved in the liquid. In the case of Central Western Italy, and in agreement with the data of many deep wells, the concentration of CO_2 dissolved in the liquid has been computed assuming that CO_2 partial pressure is externally fixed by the hydrostatic boundary. The computation of CO_2 flux has been performed for a regular grid of 4 km^2 cells, starting from the following data available in literature: the heat flow map, the map of the depth of the potential reservoir, the map of the reservoir temperature and the map of piezometric depth of the potential reservoir. The derived regional-scale map of the CO_2 flux points out the occurrence or regional anomalies of CO_2 flux have NNW-SSE and N-S direc-

tions roughly corresponding to the directions of the main geological structures of the region (i.e., grabens and thrust fronts). A CO_2 output of about 30000 t/d (2.47×10^{11} mol/y) was estimated from the area, resulting of the same order of magnitude than that estimated by Chiodini et al., (2004) on the base of a different approach. This result suggests that is reasonable to consider that in central western Italy the crust is saturated in CO_2.

References: Kerrick et al., 1995. Chem. Geol. 121, 285–293; Seward and Kerrick, 1996. Earth Planet. Sci. Lett. 139, 105–113; Chiodini et al., 2004. G. R. L. 31, doi:10.1029/2004GL019480.