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CO2 fluxes from Earth degassing in Italy

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CO2 Earth degassing is contributed by the combined action of two distinct source processes: active volcanoes (volcanic CO2), and tectonically active areas of the world (non-volcanic CO2). Even if It has long been recognized that Earth degassing may represent a not-trivial contribution to the global CO2 budget, also nowadays, the magnitude of both contributions is however poorly constrained.
Central and southern Italy are affected by an active and intense process of CO2 Earth degassing from both volcanic and non volcanic sources as revealed by recent studies focussed on the quantification of both CO2 fluxes by point emission and soil diffuse degassing, and on the quantification of deeply derived CO2 dissolved by the groundwater.
Regional scale studies in non volcanic areas of central and southern Italy, based on mass balance of carbon dissolved by groundwater, highlights the presence of two large CO2 degassing structures (Tuscan Roman degassing structure, TRDS, and Campania degassing structure, CDS) that, for the magnitude and for the geochemical-isotopic features, were related to a regional process of mantle degassing. Quantitative estimates provided a regional CO2 flux of about 9 Gt/y affecting the region (62000 km2), an amount globally relevant, being $\sim$ 10% of the present-day global CO2 discharge from subaerial volcanoes.
In addition to the large amounts of carbon dissolved by regional aquifers, the TRDS and CDS are also characterised by the presence of many cold gas emissions where the CO2 is released by both vents and soil disuse degassing. Both anomalous soil CO2 degassing and CO2 rich groundwater are different manifestations of the same process. In fact when the deeply produced gas is able to rise toward the surface, it can be dissolved by groundwaters or emitted directly to the atmosphere from gas emissions, depending on the magnitude of the gas flux rate and on the geological, structural and hydrogeological settings.
Measurement performed by the accumulation chamber shows soil CO2 fluxes of order of magnitude higher than the typical biogenic CO2 fluxes, characterise different sized areas which extension and shape are mainly relate to tectonic structures. The first on-line catalogue of Italian gas emissions recently realised, reports on the existence of about 270 gas manifestations. Even if for only a limited number (about 50) of such manifestations quantitative estimations of CO2 fluxes are available considering that these contribute for fluxes in the range of some tenths of a some hundreds tons per day, it is likely that the cumulative contribution of the 270 manifestation would be large, and highly significant to the total CO2 budget.
Large amounts of CO2 is also discharged by soil diffuse degassing at the quiescent volcanoes. Specific surveys on the Campanian volcanoes pointed out the relevance of this process that in the case of Solfatara of Pozzuoli volcano, provide a CO2 flux comparable to an erupting volcano.
The estimations of the fluxes of deep CO2 in Italy points out the relevance of non-volcanic CO2 degassing and of soil diffuse degassing from volcanoes, suggesting the actual underestimation of the Earth degassing process at global scale, arising from the lack of specific and systematic studies in the numerous “degassing areas” of the world.