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"Hidden" degassing from streams: estimation of the CO_2 release from the thermal springs of Sperchios Basin, Greece

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Areas located at plate boundaries are characterized by the presence of seismic, volcanic, and geothermal activity, as well as ore deposition. Such processes are enhanced by the circulation of hydrothermal fluids in the crust transporting volatiles from either the deep crust or the mantle to the surface. Intense geodynamic activity is also taking place in Greece giving rise to: (i) the highest seismicity in Europe, (ii) the presence of an active volcanic arc and numerous areas of anomalously high geothermal gradient, and (iii) a widespread occurrence of thermal springs.

Elevated heat flow values are concentrated in Sperchios basin, an area characterised by a system of deeply rooted extensional faults and quaternary volcanic activity. This regime favoured the formation of hydrothermal systems, the surface expression of which are thermal springs with intense bubbling of CO_2-rich gases.

Flux measurements in the bubbling pools were made with the floating chamber method. The highest bubbling CO_2 output is found in Thermopyles and Psoroneria (1 and 2 t/d, respectively). The outgoing channels of these springs have an elevated flow (>250 l/s) of gas-charged water (>15 mmol/l of CO_2). Although no bubbling is noticed along the stream, the CO_2 content decreases by an order of magnitude after few hundreds of metres, indicating an intense degassing from the water. Taking into account the water flow and the amount of CO_2 lost to the atmosphere, the CO_2 output of the outgoing channels is quantified in >10 t/d for Thermopyles and ∼9 t/d for Psoroneria. An estimation is also made at Ypati, Kamena Vourla, Koniavitis and Edipsos, where the mean values reach 1 t/d of CO_2 for each spring. The obtained values are always higher respect to the estimated outputs from visible bubbling, suggesting that most of the degassing is "hidden". Furthermore, the loss of CO_2 from the water determines a shift in dissolved carbonate species as demonstrated by the pH increase along the channel that leads eventually to an oversaturation in carbonate minerals and therefore travertine deposition.

To sum up, the total CO_2 output of the study area is estimated at ∼30 t/d, with the major contribution deriving from the degassing along the outflow channels of the thermal springs. Such output is comparable to that of the single active volcanic systems along the South Aegean Volcanic Arc (Sousaki, Methana, Milos, Santorini, Kos and Nisyros) and highlights the importance of "hidden" degassing along CO_2-oversaturated streams.