

ELEVATED TRACE METALS AND REE CONTENTS IN THE CO₂-RICH GROUNDWATERS OF FLORINA (N. GREECE) A NATURAL ANALOGUE OF CARBON STORAGE SYSTEMS

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The Florina basin, being the main commercial source of CO₂ in Greece, represents a good natural analogue for the study of the impact of geologic carbon storage. It is part of a NNW-SSE trending graben filled with ~600 m Plio-Pleistocene fluvial and lacustrine deposits. The area is characterized by the upflow of great quantities of geogenic CO₂ probably associated to presently extinct Quaternary volcanic activity. The gas originates mainly from crustal sources but has also a minor (~10%) mantle contribution. This strong upflow of nearly pure CO₂ can be recognized in industrially exploitable gas reservoirs, high pCO₂ shallow groundwaters and surface gas manifestations. But the increased CO₂ content has a deleterious impact on groundwater quality. Due to the increased aggressiveness of the low-pH CO₂-rich waters with respect to the aquifer rocks, EU drinking water limits are exceeded for many parameters (e.g. Electric conductivity, pH, Na, SO₄, F, Al, B, Ba, Fe, Mn and Ni). Considering the additional impact of widespread agricultural activities, which is recognizable in sometimes elevated nitrate contents, only few of the sampled waters (4 out of 40) could be used for potable purposes.

Aquifer waters are also characterized by high REE contents with REE up to ~12 µg/l. Shale-normalized profiles show positive La and Y anomalies and Ce negative anomalies probably indicating a main derivation from iron oxyhydroxide dissolution. The positive Eu anomaly evidences also carbonate dissolution while the enrichment in HREE is probably due to the abundant presence of bicarbonate, which increases HREE solubility through complexation.

Future developments of carbon capture and storage programs in the nearby sedimentary basin of Ptolemais and Servia have to carefully take in account the possible deterioration of their groundwater resources due to CO₂ leaks from the storage reservoirs.

Keywords: trace elements, REE, CCS natural analogues