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Water-Rock Interactions in the Peridotite Aquifer of the Oman-UAE Ophiolite: Strontium Isotopic Ratio and Geochemical Evolution of Groundwater

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The peridotite aquifer in Wadi Tayin, Sultanate of Oman, is a perfect example of natural carbonation of ultramafic rocks. *In situ* mineral carbonation is considered the most safest and permanent option of CO_2 Capture and Sequestration (CCS). However, the process itself is yet to be characterised and a better understanding of the mechanisms involved in natural mineral carbonation is needed before geo-engineering it. We used the $^{87}Sr/^{86}Sr$ system to follow the water-rock interactions along the groundwater flowpath in the peridotite aquifer and to determine the sources of divalent cations (Mg^{2+}, Ca^{2+}) required for mineral carbonation.

The Sr-isotope data of groundwater show that the aquifer rocks are the main source for divalent cations (Mg^{2+}, Ca^{2+} and Sr^{2+}) and secondary carbonates are their main sink. The groundwater $^{87}Sr/^{86}Sr$ ratio evolves with its pH: from $^{87}Sr/^{86}Sr = 0.7087$ (n=3) to 0.7082 (n=8) between pH 7 and 8, and from 0.7086 (n=6) at pH 9 to 0.07075 (n=9) at pH 11. This evolution seems to support a two-step model for the water-rock interactions in the peridotite aquifer. From pH 7 to 8, secondary Ca-carbonate precipitation buffers the pH rise resulting from peridotite serpentinisation. From pH 9 to 11, peridotite serpentinisation drives the pH to alkaline condition. The change from a Mg-rich to a Ca-rich groundwater at pH 9 seems to confirm the two-step model.