Platinum-Group-Elements and Total Organic Carbon in hyperalkaline springs at the Ronda peridotites (Malaga, Spain) as proxies of the origin of dissolved methane gas

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The serpentinization of ultramafic rocks is a process in which minerals of ferromagnesian nature (e.g., olivine) are transformed into serpentine and produce groundwater with a very high pH. In these settings, CH_4 can be produced by combining H_2 from serpentinization and CO_2 from the atmosphere, soil, carbon-bearing rocks, or mantle, although the microbial generation of CH_4, mediated by methanogens utilizing CO_2, formate and/or acetate can be another source in these aquifers. In this sense, the hydrochemistry of hyperalkaline springs can provide valuable information about gas origin. The Ronda peridotites (Malaga province, Spain) are one of the world's largest outcrops of the subcontinental mantle (~450 km_2). Hyperalkaline springs (pH>10) emerging along faults present a permanent low outflow (<1 L/s), Ca^{2+}- OH^- facies and residence times exceeding 2,000 years. The fluids, poor in Mg^{2+} and rich in K^+, Na^+, Ca^{2+} and Cl^-, also contain significant concentrations of dissolved CH_4 and other hydrocarbons. Water samples have been collected from eight hyperalkaline springs and analyzed for major, minor and trace elements, including Platinum Group Elements (PGE) and Total Organic Carbon (TOC). The most mobile PGEs (Pd and Rh) are present in all the springs, indicating the existence of potential catalysts for the abiotic synthesis of CH_4. High TOC concentrations are observed in some studied springs where previous analyses (i.e., bulk CH_4 isotopes) have indicated a microbial CH_4 origin.

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