What the Flux? – Water-Rock-Microbe Interactions and Crustal Gases in the Deep Subsurface

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Abstract

The deep, dark fracture zones of the continental crust host a fascinating interplay between water, rocks, and microbes, resulting in the production and consumption of gases, including methane, volatile organic compounds (VOCs), and hydrogen. Various geological factors influence the formation and release of these crustal gases, including the local rock type with its concentration of radioactive elements and carbon, temperature, and the connectivity and dynamics of fracture systems with each other and to the surface.

To understand the formation, accumulation, and release of crustal gases, methodologies of hydrogeochemistry, biogeochemistry, and isotope geochemistry can be employed. Sample collection from drill holes and mines, coupled with on-line monitoring of gas flux rate and composition, provides important data. Furthermore, the integration of molecular biological methods enhances our understanding of the water-rock-microbe interactions that shape the deep subsurface gas realm.

Crustal gases have crucial implications for life in extreme environments, including those outside of our planet Earth, but potentially also pose significant challenges to drilling, mining, and their environmental impact. Moreover, crustal gases hold relevance for the energy sector, contributing to both the long-term safety of geological disposal of nuclear waste, carbon footprint of geothermal wells, and the exploration of hydrogen as a sustainable energy resource.

Keywords

methane, hydrogen, volatile organic compounds, bedrock groundwater

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Conflicts of interest

The authors have declared that no competing interests exist.