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Characterisation and origin of hydrothermal waters at São Miguel (Azores) inferred by chemical and isotopic composition

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Abstract

This study focuses on the characterisation and origin of hydrothermal waters discharging from three main active volcanoes (Furnas, Fogo and Sete Cidades) at São Miguel, where 33 water with temperatures ranging between 13 and 97 °C, and 5 precipitate samples were collected. The developed conceptual model for this active hydrothermal system reveals that all waters can be classified by Na-HCO₃, Na -Cl and Na -SO₄ types and are of meteoric origin. This is confirmed by the stable hydrogen and oxygen isotope data that are positioned close to the local meteoric water line ($-4.1\text{‰} \leq \delta^{18}\text{O}_{\text{H}_2\text{O}} \leq 5.2\text{‰}$; $-17.6\text{‰} \leq \delta\text{D}_{\text{H}_2\text{O}} \leq 20.4\text{‰}$), except for the Na-Cl type water at Ferraria (Sete Cidades area), which is characterized by admixing of seawater. The stable isotope composition of São Miguel hydrothermal solutions ($\delta^{34}\text{S}_{\text{SO}_4}$ range from 21.3 to -3.7; $\delta^{18}\text{O}_{\text{SO}_4}$ range between 0.5 and 10.5 ‰; $\delta^{13}\text{C}_{\text{TDC}} = -4.5 \pm 3.2\text{‰}$) indicate that waters are individually evolved by several processes: evaporation, uptake of volcanogenic sulphur and carbon dioxide, leaching of local volcanic rocks (driven by high

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