



Sulphur isotope hydrology in Skeidararsandur, Iceland: Identification of sources and implications for weathering processes

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The hydrochemistry of sulphur in various environments in the active ice-marginal outwash plain of Skeiðarársandur, SE Iceland shows considerable variety reflecting differences in sources and processes, and is investigated in this paper using $\delta^{34}\text{S}$ values of dissolved sulphate and igneous sulphide minerals, $\delta^{18}\text{O}_{\text{H}_2\text{O}}$, electrical conductivity and ionic concentrations in waters. Seawater-derived sulphate is a notable component only in the lower sandur ($\delta^{34}\text{S}_{\text{SO}_4}$ values of $+6.8\text{ ‰}$ VCDT). Sulphur isotope samples from the Skeiðará glacial melt river range from $+3.4$ to $+8.8\text{ ‰}$ $\delta^{34}\text{S}$. The higher values occur during a flood event and reflect geothermal reduced sulphate contributions from the Grímsvötn caldera. Groundwater-fed 'kettle-hole lakes' formed since 1996 form important ecological niches within an otherwise relatively barren region and have the lowest $\delta^{34}\text{S}_{\text{SO}_4}$ values (average -0.8 ‰ $\delta^{34}\text{S}$) attributed to bacterially-mediated sulphide oxidation and coupled to carbonate and possibly silicate dissolution. The hydrochemistry of eastern sandur groundwater is influenced by a hydrothermal source of reduced sulphate from the Grímsvötn caldera or an area of geothermal springs routed beneath the Skeiðará river, and contrasts with the hydrochemistry of the Sulá and Gígjukvísl rivers in the western part of the sandur and the majority of the groundwaters. These have lower concentrations of $[\text{Ca}^{2+}+\text{Mg}^{2+}]$, $[\text{Na}^++\text{K}^+]$ and SO_4^{2-} and $\delta^{34}\text{S}$ values consistent with sulphate derived from the oxidation of igneous sulphides reflecting geochemical evolution and modified weathering processes from that of supraglacial streams. The significant influence of internal contributions of sulphate (rock-derived and geothermal) on Skeiðarársandur means this catchment buffers recent reductions in anthropogenic sulphur emissions.