Do magmatic sill intrusions simply liberate the sulphur of the sedimentary reservoirs?

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Résumé

Sedimentary basins are at the interface between deep (lithosphere) and superficial (hydrosphere, atmosphere and biosphere) reservoirs, with the capacity to trap large quantities of volatile elements (e.g. S, C, H, Cl, F) and metals over time through sedimentation and diagenesis. These chemical elements can be mobilised due to contact metamorphism associated to the emplacement of magmatic intrusions in the sediments. The interactions between magma and sediments during sill emplacement are complex and include contact metamorphism and contamination processes, but also the assimilation of sediments into the sill. In this study, we examine the impact of magma-sediment interactions on the sulphur cycle. The Ringvent sill in the Guaymas Basin drilled during Expedition IODP 385, is a funnel-shaped sill that emplaced in soft sediments at the subseafloor, representing an exceptional in-situ natural laboratory for studying magma-sediment interactions. The petrological and geochemical study of the sediments, magmatic rocks and magma-sediment mixtures reveals a high concentration of pyrite at the magma-sediment interfaces. Multiple types of pyrites indicate different sulphur-trapping processes occurring during the emplacement of the sill. Trace elements and isotopic (δ34S and Δ33S) analyses were used to identify the different sources of sulphur and to better constrain the processes. We demonstrate that the assimilation of sediment, porewater and magmatic sulphur in the Ringvent sill enables the formation of these pyrite types before the time of sill emplacement until to late hydrothermal circulations, which remain still active. Such processes enable the storage of sulphur within the sill, while there is minimal evidence of the release of volatiles in the surrounding area, indicating that, under certain conditions, these systems can function as a significant sink for sulphur and potentially metals, instead of trap as generally proposed.

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