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Illuminating the architecture of an active volcanic system using a large geochemical dataset

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Following almost 800 years of quiescence, the volcanic systems on Iceland's Reykjanes Peninsula started showing signs of magmatic unrest in 2020 [1]. Eruptive activity began in 2021 with a basaltic fissure eruption in the Fagradalsfjall complex [2], followed by two further eruptions nearby in 2022 and 2023 [3]. In December 2023 the eruptive activity switched to the neighbouring Svartsengi volcanic system [4]. Throughout these events a detailed geochemical and petrological dataset has been generated from the erupted materials, including major and trace elements, radiogenic isotope ratios, mineral compositions, and lava petrography. These datasets have provided valuable insight into the operation of magma reservoirs close to the Moho [2,5] and in the shallow crust [4]. Combining these datasets with the results of intensive remote sensing and geodetic surveys conducted at Svartsengi [6,7], gives us a unprecedented view into the architecture and workings of the Svartsengi magmatic system.

In this contribution we present an expanded geochemical dataset (major and trace elements, and radiogenic isotopes) from across the eruptions at Svartsengi, representing the full spatial extent of the lava field. We combine this with the datasets generated from the Fagradalsfjall eruptions [2,5] to build further insight into the architecture and operation of the complex mid-crustal magma domain beneath Svartsengi we identified following the first events [4]. Leveraging this expanded dataset with quantitative computational techniques, we reveal how the magma reservoirs in this domain are resupplied and interact with one another. Our results provide new constraints on how the Svartsengi magma domain has evolved throughout the eruptive period since 2023, but also in the almost 800 years between magmatic periods.

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