

The 2021-23 Fagradalsfjall and 2023-? Sundhnúkur Fires, Reykjanes Peninsula, Iceland

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On the evening of 19 March 2021, after 781 years of quiescence, the Reykjanes Peninsula (RP), Iceland, entered into its 4th Eruption Period in 4000 yrs when an eruption began on a 180-m-long linear vent system at the Fagradalsfjall volcanic complex. This event also marks the onset of the 2021-23 Fagradalsfjall Fires, which featured three effusive eruptions: the 19.03-18.09.2021 Geldingadalir, 03-21.08.2022 Meradalir, and 10.07-05.08.2023 Litli-Hrútur events. Collectively they erupted $135 \times 10^6 \text{ m}^3$ (DRE) of generally enriched, olivine tholeiite lava (8-8.5wt% MgO) that was extracted from a $\sim 100 \text{ km}^3$ magma storage zone situated at 9-12 km depth beneath Fagradalsfjall and containing an estimated $\sim 15\text{-}25 \text{ km}^3$ of melt (i.e., Bindeman et al 2022; Troll et al 2024). The 2021 Geldingadalir eruption also expelled depleted olivine tholeiite magma at the start (e.g., Day et al 2024).

Late in 2023 the unrest shifted from Fagradalsfjall and onto the Sundhnúkur tectono-volcanic lineament that reaches across the RP between the towns of Grindavík and Vogar. As of February 26, 2025, the 2023-ongoing Sundhnúkur Fires have featured seven effusive eruptions. Collectively, they have produced $\sim 170 \times 10^6 \text{ m}^3$ (DRE) of enriched and depleted olivine tholeiite lava (6.0-6.8wt% MgO) that has erupted from a $\sim 2.5\text{-}3.5 \text{ km}^3$ magma storage situated at $\sim 5 \text{ km}$ depth beneath Svartsengi. This shallower magma storage is supplied from the deeper Fagradalsfjall magma storage described above. An intriguing attribute of the Sundhnúkur data set is that in the first three events the volume of erupted lava is smaller by factor 0.65-0.9 than the volume calculated to have accumulated into the shallow Svartsengi magma storage prior to the eruptions. In the four events that followed the volume of erupted lava is factor 1.5-2 greater than the accumulated magma volume. Geochemical data indicates that the additional erupted volume comes from depleted magma that resided in the magma storage from times well before the onset of the current unrest and got heated and remobilized by the repeated magma injections that preceded all the events of the Sundhnúkur Fires.

References