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The long-term evolution at Krafla Volcanic System, Iceland, by time-lapse microgravity.

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The Krafla Volcanic System (KVS) in the Northern Volcanic Zone (NVZ) in Iceland last erupted between 1975 and 1984, during an eruptive period called “the Krafla Fires”. The KVS is composed of a restless caldera, an array of scoria cones along a fissure swarm and is among the best-studied volcanic systems due to the exploitation of its geothermal potential. In 2009, the Icelandic Deep Drilling Project (IDDP) encountered a shallow rhyolitic magma body at 2.1 km depth beneath the caldera. To date, no geophysical method has been able to image this magma body at Krafla within the top 4 km of the crust.

Here we present new micro-gravity data collected in June and July 2022 across a 14-station network of benchmarks in the KVS. Micro-gravimetry is a relative method that records changes in gravity between a reference and a series of benchmarks over both space and time to investigate subsurface mass or density changes via time-series analysis and modelling.

Our 2022 survey highlights negative gravity differences of benchmarks located in the centre of the caldera with respect to a reference located to the south and outside the caldera. The most negative values are found in its eastern part. Positive gravity differences can be found south of the southern caldera wall along a set of past eruptive fissures.

The next steps in data processing include data reduction for deformation effects to link the new data to previous joint deformation and micro-gravity surveys conducted at the KVS since 1965. This should enable us to quantify the long-term evolution of the KVS over more than 50 years providing unprecedented insights into its inner workings.