Decades of deflation of the Askja volcano, Iceland, prior to ongoing inflation

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The Askja volcano in Iceland is located at the subaerial part of the North American – Eurasian plate boundary. The activity is dominated by basalt but with occasionally rhyolitic explosive eruptions. The volcano hosts four nested calderas, the largest is 50 km^2 in size and the most recent formed during and following rifting episode and explosive eruption in 1874–1875. Following this, seven basaltic eruptions have taken place, with the most recent 1961. Crustal deformation measurements started in 1966 with a levelling profile which was extended to 1.2 km in 1968. Yearly measurements have been carried out on the profile, except for a ten-year gap 1973–82. The profile is mostly aligned in a radial manner outwards from the 1875 caldera. The leveling shows subsidence (1968–70), uplift (1970–72), subsidence (1983–2021) and uplift since August 2021. Extrapolating the uplift in 1970–72 and the following subsidence suggests a change in 1974. The subsidence rate had an exponential decay from 1983 until August 2021. Geodetic modelling considering a spherical pressure source within a uniform elastic halfspace, using combination of levelling, GPS and InSAR data, infers pressure decrease within a magma body at about 3.0 km depth. Using the height difference between the closest and most distant benchmarks, the amount of subsidence in the center can be determined. Such an approach suggests 2.4 m of subsidence 1983–2021. This translates to a subsurface volume change of about 0.1 km^3. The subsidence is suggested to relate to contraction of a cooling magma body. If a basaltic magma body cools and de-gasses a volume reduction can eventually be up to 10–14%. This would require involvement of a >1km^3 basaltic magma reservoir. It is possible the magma system under Askja has a magma body of rhyolitic composition and can contract to a larger extent. Rhyolitic magma at shallow depth in the crust would be more hazardous than basalt, and the next eruption at Askja could be explosive if a rhyolitic magma body is involved.