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Modelling the accumulation of magma prior to the caldera collapse

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The occurrence of large voluminous volcanic eruptions, so called caldera-forming eruptions, pose a threat to humankind and its growing cities located near volcanoes. With today's technology, the underlying processes of large scale magmatic systems can be modelled to further improve the understanding of all phases of an eruption. For those caldera-forming events, the deficit in overpressure and magma stored within the chamber results in a collapse of the ceiling and permanently alters the geomorphology of the region. The processes of magma accumulation, the resulting overpressure and fracturing of the country rock can be modelled using various dynamic magma models. In this study we take a multiphysical approach and apply an open source thermal evolution magma intrusion model and couple it with a pseudo-transient Stokes solver (PT Solver) written in Julia. The model is set up to run in parallel and work on graphics processing unit (GPU) to maximise its efficiency and applicability to the newest generation of high performance computing (HPC) machines. The coupling enables us to model the growth of the magmatic system while also accounting for different complexities in rheology. The model provides an indication on the long-term magmatic evolution, both thermal and volumetric, during the build-up stage prior to caldera-forming eruptions.