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TITLE: Eruptive cycles at Icelandic volcanoes: Constraints on inflation/deflation patterns from geodetic measurements and modeling

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ABSTRACT BODY: Understanding of the magmatic plumbing system of volcanoes is a key feature for the forecasting of eruptions and their behavior. In simple cases an eruptive cycle is comparable to a simple version of the earthquake cycle, with gradual build-up of stress in the roof a magma chamber until a critical limit is reached, followed by an intrusion or eruption associated with drop in magma pressure. If magma flow from depth to a magma chamber is constant and the failure criterion remains constant, this process may be repeated in a cyclic manner, associated with gradual inflation due to magma accumulation in a magma chamber, followed by sudden deflation as pressure in the magma chamber drops. Seismicity is a primary indicator of the state of a volcano and can reveal stress increase associated with magma accumulation. Crustal deformation measurements through repeated geodetic measurements are though needed to estimate the volume of magma flow inflow. In Iceland, such measurements have revealed the inflation/deflation pattern of a number of Icelandic volcanoes, including Krafla, Askja, Grimsvotn, Hekla, Katla and Eyjafjallajokull. The measurements include GPS, InSAR, optical leveling, tilt and borehole strain. Extensive measurements and long time series of deformation reveal a more complicated behavior than the simple model explained above. Some of the deviations from this model include: i) Magma flow from depth to recharging magma chambers is variable and episodic, ii) Effects of tectonic stress and host rock strength are variable and evolve through multiple eruptions and intrusions, iii) Compressibility of magma varies so the relation between surface volume change and the volumetric flow of magma is variable, iv) inflation/deflation may relate to other processes than magma flow. Evaluation of the state of a volcano requires thus a detailed monitoring program including geodetic measurements, in conjunction with careful modeling of the magmatic plumbing system and volcano behavior.

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