Modeling a circular lava flow on top of a deflating magma chamber shows that the crust will adjust to the load towards final relaxed response. During this process gradual subsidence may mistakenly be interpreted as due to pressure decrease in the magma chamber only; both processes show a very similar deformation pattern. This poses a problem when characterizations of a magma chamber are to be derived.

In this study the Mogi model and Green’s functions are used to compare the crustal response to a deflating hypothetical magma chamber to the deformation pattern emerging due to the final relaxed response to lava flows at the surface. We find that ongoing adjustment to surface loads can be misinterpreted as subsidence due to a deflating magma chamber. To avoid misleading interpretations, we suggest that both the horizontal and vertical displacements should be examined carefully.

To confine surface changes due to variations of a point source of pressure, we apply the Mogi model. Using the volume of the lava flow as volume of surface change, \( V_0 \), we can calculate the source depth, \( d_s \), underneath the point of maximum vertical displacement, \( h_0 \), as
\[
d_s = \frac{V_0}{d_0 h_0^2}
\]
From this we can calculate the source strength: \( C = h_0^2 \) [Sigmundsson, 2006] and have all parameters of the Mogi model fixed.

The theoretical depth of \( d_s = 12 \) km is not supported by results of seismic studies at Hekla which would hint at a mixed deformation signal that would lead to a deeper maximum elastic ratio due to a surface load. The Mogi model is always larger than the final relaxed response and the maximum difference is 6 cm at about 7.6 km from the center (Fig. 3c).

Figure 2 shows the simulated horizontal and vertical deformations for both the final relaxed response to the disk load and the Mogi model with a calculated source depth of \( d = 12 \) km and a source strength \( C = 0.031 \) km

Comparison of models in term of the ratio \( C/d \) corresponds to Fig. 2a (red), 2b (blue), 2c (black). Red circle marks maximum difference. Figure 3a displays a section to the edge of Figure 2c and underlines these findings. For the horizontal deformation the difference is even more obvious as shown by Figure 2d,e.f. The Mogi model is always larger than the final relaxed response, and the maximum difference is 6 cm at about 7.6 km from the center (Fig. 3c).

The introduction of additional factors posed by the surface load must be considered and constrained by careful measurements and interpretations of observations and eruptions histories to correct the recorded data for composed signal sources.

**References**

Grapenthin, R. (2007), Crustal deformation and divergent plate tectonics, 228 pp., Springer-Praxis, Chichester, UK.


