屈斜路カルデラ下の低粘性領域

A low viscosity zone beneath the Kutcharo caldera, eastern Hokkaido, Japan

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Geodetically observed volcano deformation has been analysed in terms either of elastic or viscoelastic crustal rheology, for which the presence of a magma has usually been considered as a deformation source. In rheological viewpoint, however, a magma is presumable to be a low viscosity material. This would allow us to detect a magma body as a zone that has rheologically less strength. In Yamasaki et al. (2018, J. Volcanol. Geotherm. Res., 349, 128-145), a spatially invariable crustal viscosity was constrained to be ~4x10^{17} Pa s from the crustal deformation observed in the Kutcharo caldera, implying the presence of a magma effectively lowers the averaged viscosity value of the crust. In the present study, using a 3-D finite element model that an elastic layer is underlain by a viscoelastic layer, we attempt to constrain a first-ordered spatial viscosity variation in the crust beneath the Kutcharo caldera from geodetic data. In the viscoelastic layer, a low viscosity zone (LVZ), whose spatially uniform viscosity is hl and whose thickness and width are Q and R, respectively, is superimposed on a background crust that has a spatially uniform viscosity hc = 10^{19} Pa s. The emplacement of a sill, introduced as a deformation source into the model, is assumed to occur in the same way as that constrained in Yamasaki et al. (2018). The numerical experiment has found that the post-inflation subsidence is well explained in terms of viscoelastic relaxation in LVZ, if the LVZ configuration is characterised as: (1) hl = ~4-5x10^{17} Pa s, (2) zl = 5 km, the top surface of LVZ is immediately below the elastic layer with a thickness of 5 km, (3) Q > ~15 km and (4) R > ~10 km. Such a LVZ may represent the influence from a magma chamber, providing mechanical aspect on geophysically imaged crustal structure beneath the caldera. Our results suggest that the presence of a magma may possibly be detectable from the surface deformation after a magmatic injection into the uppermost crust.

