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

*Tadashi Yamasaki[1], Tomokazu Kobayashi[2]

1. Geological Survey of Japan, AIST, 2. Geospatial Information Authority of Japan

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.

