Internal deformation fields due to a mode I crack in an elastic-viscoelastic layered half-space

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We derived the general expressions of internal deformation fields due to an arbitrary indigenous source in a gravitational two-layered elastic-viscoelastic half-space by solving the elastic problem with a generalized propagator matrix method and applying the correspondence principle in linear viscoelasticity to the elastic solution (2002 Joint Meeting). In general, an arbitrary indigenous source expressed in a form of moment tensor can be decomposed into three different types of sources: explosion, opening crack, and shear faulting. Among them, we have already obtained the general expressions for shear faulting. For the explosion source and the opening crack, this was the first success in obtaining the expressions of internal deformation fields.

In this presentation, we show some examples of numerical calculation for the internal deformation fields due to finite opening crack models in a gravitational two-layered elastic-viscoelastic gravitational half-space. The internal deformation fields due to a finite dimensional source are expressed by superposing the effect of point sources distributed over the source area. We numerically calculated the local-scale displacement and stress fields caused by the intrusion of dikes related to volcanic activities and the tectonic displacement and stress fields caused by plate divergence at the center of ridges.

We examined the effects of geometry and size of cracks, thickness of the elastic surface layer, which corresponds to the lithosphere, and gravity. We especially focus on the differences in deformation patterns between the case of the crack extending near to the upper or lower boundaries of the elastic surface layer and the case of the crack entirely cutting off the elastic surface layer. We also focus on the temporal change of shear stress with time caused by stress relaxation in the viscoelastic substratum.