Rheological Structure on Central Japan: Analysis of Postseismic Deformation of the 1891 Nobi Earthquake

Yuka Asahi[1]; Takeshi Sagiya[2]

[1] Earthsciences,Nagoya Univ.; [2] Environmental Studies, Nagoya Univ.

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Yuka ASAHI and Takeshi SAGIYA

A large earthquake changes the stress in the earth and causes a viscous flow in the asthenosphere. This postseismic relaxation causes postseismic crustal movements. So we can make use of deformation data to infer the viscoelastic structure underground.

We try to infer the rheological structure of central Japan using the postseismic deformation caused by the 1891 Nobi earthquake (M8.0). Leveling surveys have been repeatedly carried out since 1880's. We use leveling data along 6 routes until 1944, when the Tonankai earthquake occurred and the deformation field was largely disturbed. The total number of leveling data is 344.

We calculatethe surface with elastic-viscoelastic strafication by using the software VISCO1D by Pollitz (1997). We test various values of the elastic lithospheric thickness (H) and the Maxwellian viscosity of the asthenosphere to reproduce the observed vertical deformation.

As a result, we estimate the lithosphere thickness to be about 33km and the viscosity of the asthenosphere to be about 1.0 X 10^{18} pa s. The elastic thickness of 33 km implies that the crust is elastic and the underlying mantle is viscoelastic (Iidaka et al.,2003). The estimated viscosity is smaller than that of northern Japan by an order of magnitude (Thatcher et al.,1980). The low viscosity at the mantle wedge may be due to the relatively high temperature caused by the subduction of the hot and young Philippine Sea plate or heterogeneity in the mantle wedge as a result of slab dehydration (Yamasaki & Seno, 2005).