不均質レオロジー構造を考慮した中部日本における歪集中と山地形成過程のモデル化
Modeling strain concentration and mountain building processes in central Japan considering heterogeneous rheological structure

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Recent analysis of crustal deformation using GEONET data has revealed the existence of several strain concentration zones in the Niigata–Kobe Tectonic Zone (Sagiya, et al., 2000), in the Ou backbone range (Miura et al., 2004), in Kyushu, and San-in (Nishimura et al., 2018), etc. Many large inland earthquakes have occurred in the strain concentration zones. Elucidating the mechanism of strain concentration leads to understanding generation processes of large inland earthquakes. We develop a model of strain concentration and mountain building in the island-arc crust of central Japan, where several high mountain ranges have been formed by active crustal deformation. We use the finite element code with nonlinear viscoelasticity and plasticity based on Mohr-Coulomb criterion (e.g. Shibazaki et al., 2016). We consider gravitational force as a body force because the plasticity and the flow law depend on absolute stress.

Based on dense geothermal gradient data from Hi-net (Matsumoto et al., 2007) and the Geological Survey of Japan (Tanaka et al., 2004), we develop a thermal structure. We also consider a thick sedimentary layer where the friction coefficient is low based on the J-SHIS deep subsurface structure (NIED). Numerical results show that under the compressional tectonic setting, mountains are reproduced along high geothermal gradient regions. We can reproduce the Hida mountain range, Chikuma mountain, Echigo mountain range, and others, where a geothermal anomaly exists. Our model can also reproduce strain concentration in the Hida region. Furthermore, we can reproduce a strain concentration zone by setting the frictional coefficient to be low in the basement of the Niigata region.

However, the model cannot reproduce the strain concentration zone in the Atotsugawa and Kinki regions where strike slip faulting is dominant; therefore, we consider the boundary condition that yields the stress state of the strike-slip faulting and the effect of water distribution or rheology of partial melting based on seismic velocity anomalies (Nakajima and Hasegawa, 2007). We can reproduce strain concentration along the seismic velocity anomalies. Our results suggest that the Niigata-Kobe strain concentration zone is developed by several factors: thermal anomaly, pre-existing rift structure, and the presence of fluid and partial melting in the crust and the upper mantle.

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