[EJ] Evening Poster | S (Solid Earth Sciences) | S-CG Complex & General

[S-CG57]Dynamics in mobile belts

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The dynamic behaviours of mobile belts are expressed across a wide range of time scales, from the seismic and volcanic events that impact society during our lifetimes, to orogeny and the formation of large-scale fault systems which can take place over millions of years. Deformation occurs on length scales from microscopic fracture and flow to macroscopic deformation to plate-scale tectonics. To gain a physical understanding of the dynamics of mobile belts, we must determine the relationships between deformation and the driving stresses due to plate motion and other causes, which are connected through the rheological properties of the materials. To understand the full physical system, an integration of geophysics, geomorphology, and geology is necessary, as is the integration of observational, theoretical and experimental approaches. In addition, because rheological properties are greatly affected by fluids in the crust and fluid chemical reactions, petrological and geochemical approaches are also important. After the 2011 great Tohoku-oki earthquake, large-scale changes in seismic activity and regional scale crustal deformation were observed, making present-day Japan a unique natural laboratory for the study of the dynamics of mobile belts. This session welcomes presentations from different disciplines, such as seismology, geodesy, tectonic geomorphology, structural geology, petrology, and geofluids, as well as interdisciplinary studies, that relate to the dynamic behaviour of mobile belts.

[SCG57-P14]An estimate of the contraction rate of central Japan through the deformation of the Philippine Sea slab

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It has been widely recognized that the main part of Japanese islands are currently situated under the stress field of east-west compression. However, it is not easy to quantitatively estimate the contraction rate of Japanese islands in a long term, though this is a fundamental quantity to understand the tectonics of Japan. For example, GNSS data provide accurate estimates of the east-west contraction rate, but the observation period is less than a few decades (e.g., Sagiya 2004). Traditional triangulation and trilateration data covers more than a century. However, it is still unclear that the observed deformation rates can be extrapolated to a geological time scale. From moment release rate due to historically recorded large inland earthquakes and long-term slip rates on active faults, Wesnowsky (1982) estimated the E-W contraction rates of Honshu island. However, the recurrence interval of large inland earthquakes is much longer than several hundred years large, and inland earthquakes have often happened on faults that have not been identified as active faults before the earthquakes.

By the way, a slab usually descends into the mantle with little deformation as indicated by the iso-depth contours, which are nearly parallel to the trench in most subduction zones. Little deformation of slabs is reasonable from the view point of elastic energy. But the Philippine Sea slab is an exception; large deformation beneath central Japan has been estimated (e.g., Hashimoto et al. 2004; Shiomi et al. 2008; Hirose et al. 2008). The reason for the horizontal deformation of the Philippine Sea slab is not known, but it is likely that E-W compression applied to Japanese islands is the cause of the horizontal deformation. The Philippine Sea slab severely deforms beneath central Japan, while the deformation is much smaller beneath western Japan. Such characteristics well correspond to geological, seismological and geodetic data.

If the deformation of crust is well correlated with the deformation of the slab beneath the crust, we can use the deformation rate of the slab as a proxy to estimate the contraction rate of the crust, which is not easy to constrain well. The advantage of this method consists in the simplicity of the initial configuration of a slab. Continental crusts generally have very long history, and so, it is a difficult task to extract deformation that occurred only recent a few million years. On the other hand, an oceanic plate is subject to almost no horizontal deformation before the subduction. Therefore, we can consider that the currently observed deformation of the Philippine Sea slab has been formed only after the subduction along the Nankai trough.

This study is the first attempt to estimate the horizontal contraction rate of the Philippine Sea slab. Through the deformation of the Philippine Sea slab, we will show the estimate of the contraction rate of central Japan.