ΔCFFと歪み速度パラドックスの意外な関係：非弾性歪みからの塑性歪みの分離

Unexpected relationship between ΔCFF and the strain-rate paradox: separation of plastic strain from inelastic strain

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In the field of seismic activity, the phenomena of stress shadow is well known, that is to say, the area with negative ΔCFF after an large earthquake tends to have fewer aftershocks (e.g., Toda et al. 2011, GRL). The concept of ΔCFF is also usful to understand earthquake activity for longer time scales as exemplified by Shikakura et al. (2014, JGR), which shows that large inland earthquakes that happened in western Japan recent 500 years can be very well exlpained by the change history of ΔCFF, which is mainly controled by the repeated occurrences of the Nankai earthquakes and secular increase of east-west compression.

Meneses-Gutierrez and Sagiya (2016, EPSL) have successfully separated the component of inelastic strain from the analysis of pre- and post-seismic GNSS data of the 2011 Tohoku-oki earthquake in the area around the Niigata prefecture. However, when we examine the observed GNSS data in detail, the separated inelastic strain rate is slightly but clearly faster before the Tohoku-oki earthquake. If the inelastic strain is due to viscous flow that depends only on the absolute stress, it is difficult to explain the observed GNSS data, because the stress change due to the 2011 Tohoku-oki earthquake in this area is less than 1 MPa, which is likely to be much smaller than the absolute stress.

Therefore, we consider that the concept of ΔCFF could be applicable not only to seismic activity but also to crustal deformation. In other words, we consider that the change of the inelastic strain rate is caused by plastic strain, which was active before the 2011 Tohoku-oki earthquake but ceased after the earthquake, because the stress level is dropped due to the occurrence of the 2011 Tohoku-oki earthquake, although inelastic strain due to viscous flow occurs essentially in the same manner before and after the 2011 Tohoku-oki earthquake.

If we accept this concept, the strain rate paradox of Japan is viewed differently, that is, the strain rate was exceptionally faster before the 2011 Tohoku-oki earthquake. It might also be possible to issue more effective warnings of large inland earthquakes in western Japan from detailed analyses of crustal deformation data.

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