Geophysical Research Abstracts
Vol. 14, EGU2012-13200, 2012
EGU General Assembly 2012

The far-field deformations associated with the seismic cycle: The lessons from the postseismic deformations of the recent giant subduction earthquakes

O. Trubienko (1), L. Fleitout (1), JD Garaud (2), and C. Vigny (1)

(1) ENS, UMR CNRS 8538, Paris, France (trubienko@geologie.ens.fr), (2) ONERA, Chatillon and UMR CNRS 8538, ENS Paris

The strains associated with the seismic cycle are often modeled using an elastic behaviour: For example, elastic backslip is often used to model the interseismic phase. The study of the huge post-seismic deformations following the Aceh earthquake has unambiguously shown that relaxation in the asthenosphere with transient viscosities of the order of 3. 10^{18}Pas is necessary to reproduce the pattern of far-field deformations.

With the help of 2D and 3D finite element programs, we compute the deformations through the whole seismic cycle for recurring earthquakes in the case where the asthenosphere deforms according to the viscoelastic rheology deduced from the postseismic of Aceh. We show that there are sizable perturbations of the horizontal interseismic velocities over a zone much broader (broader than 1000 km) than in the elastic backslip case. Morover, for subduction earthquakes, postseismic centimetric subsidence is predicted in the far-field while a slight upward velocity is expected at the end of the cycle. The typical interseismic velocity pattern across a fault consists in a region with a sharp gradient over a few hundred km from the fault and a region with a smaller gradient but extending typically more than 1000km from the fault. The predicted extent and relative velocity accomodation across this broad low velocity gradient region is function of the period of seismic cycle.

We reinterpret the GPS velocities measured before the three recent giant subduction earthquakes as the counterparts of the present-day observed postseismic velocities: the northward velocities of the Sunda block with respect to South China observed before 2004 are shown to have the same amplitude as the velocities predicted for the interseismic phase of the Andaman-Sumatra subduction seismic cycle. The same is true for the pre-2011 westward velocity of the west coast of Honshu with respect to the Amurian plate. As a consequence, the estimates of the long-term shortening velocity across the Japan basin should be revised. The eastward velocity with respect to a South-America reference frame, observed before 2010 as far East as Buenos Aeres, is also the counterpart of the westward post-seismic velocity presently measured in Argentina.

The velocity pattern measured by GPS a few thousand km away from faults generating large earthquakes is strongly affected by the seismic cycle.

.