Geophysical Research Abstracts
Vol. 12, EGU2010-12870, 2010
EGU General Assembly 2010

Identification of seismogenic structures on faults: Generation and detection of asperities

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Following the definition first given by Lay and Kanamori (1981), asperities are areas of largest co-seismic slip. This makes them particularly interesting for seismic risk and hazard studies. However, the slip distributions on fault planes of large earthquakes can differ significantly from each other when determined by different methods. Therefore, a better insight into asperity generating processes is desirable and proper comparison of results could give an idea of the physics behind the driving mechanism.

In our talk we would like to present results from aftershock data sets in subduction as well as crustal faults using the correlation of various parameter distributions on the faults as a method for asperity detection. The correlations of these distributions with geological and tectonic data give the hint that material inhomogeneities play a major role in asperity generating processes. We compare these results to asperities identified by geodetic data and try to discuss the discrepancies which might give some ideas about the reflection of structural inhomogeneities in the deformational field at depth of a fault and at the Earths' surface.

Further important questions with consequences for future earthquakes are the spatial stationarity and temporal persistency of asperities which involves the discussion whether repeatable earthquakes are possible or whether the earthquake process is in general a rather random process. Here we will show an example from a segment boundary between two large subduction zone earthquakes which seems to be a persistent feature since 400.000 years and therefore recurrently survived more than one seismic cycle. Although a segment boundary determines nucleation and stopping phase of an earthquake rather than areas of large slip, these type of features are most important in terms of the expected size of an earthquake.