

Distinguish Mainshock from Foreshock with Polarity of Stress Field

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This presentation formalizes “Polarity of Stress Field” and points out the importance in dynamics, relating to distinguish Mainshock from Foreshock.

Focal mechanisms are important to understand dynamic process of seismic activities and available from Japan Meteorological Agency, around Japanese Islands.

Lateral changes in the type of focal mechanism can be observed, for example, normal fault type to lateral fault type in the Pacific Slab along Japan Trench after 2011/3/11 East Japan Megaquake M9.0. The change can be explained by the axes change between neutral N axis & compressive P axis, caused by reducing of vertical compressive stress less than horizontal N component with shallowing. We have to consider the axes exchange for the analysis on focal mechanism.

The difference of the focal mechanism can be quantified with Euler Rotation to fit the 3 orthogonal principal axes between reference and testing focal mechanisms. We can analyse focal mechanism with consideration on axes exchange, to compare not only original but also axes exchanged testing mechanism with reference.

Focal mechanism has 6 cases of principal axes position for fixed directions. The 4 cases can be realized with direct axes exchange. However exchange between compressive P and tensile T Axes reverses the polarity of stress field from the other direct exchange cases. Additional 2 cases need two-step axes exchange and have reversed polarity of stress field.

In the case of the axes exchange with the minimum Euler rotation angle is normal polarity of stress field, we use the Euler rotation angle as stress field polarity angle, but in the case of reversed polarity we use the subtraction of the Euler rotation angle from 180.

The reversal of stress field polarity represents dynamic discontinuity in space and time. The polarity might be kept until main rupture, corresponding to Mainshock of Earthquake.

Reversals of the polarity have been recognized just after the East Japan Mega M9.0, Hamadohri M7.0, Kumamoto M7.4 and Tottori M6.6 Earthquakes.

We conclude the polarity of stress field can be used to distinguish Mainshock from Foreshock.

Keywords: Polarity of Stress Field, Foreshock, Mainshock, Focal Mechanism, Principal Axes Exchange, Euler Rotation

