Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07602, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07602
EGU General Assembly 2008

Fluid migration in the Umbria-Marche fault system inferred by velocity and attenuation time repeated local earthquake tomography.

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The Umbria-Marche 1997 seismic sequence consists of several multiple mainshocks which ruptured contiguous normal faults. In a small interval of one month, the seismicity spread over a 40 km NW-elongated structure migrating toward the S-SE part of the fault system. This behaviour has been explained as generated by the migration of fluids along the fault system. In this study, we investigate if this migration is identifiable by space and time (4D) variations of velocity and attenuation parameters within the medium. We find and show that 4D seismic tomography, carried out sub-dividing the huge amount of data recorded by a dense local array in sub-epochs, reveal time-resolved anomalies within the target volume. In particular, we note that the SE-ward migration of seismicity is accompanied by transient positive Vp/Vs and negative Qp/Qs anomalies. We interpret these transient perturbations as generated by fluctuating pore pressure along the fault system. When the seismicity is spread over the fault system, following a normal decay, these anomalies are not observed. The increase of pore pressure in fluid saturated fractured rocks creates a transient changes of elastic properties mapped by high and low Vp/Vs and Qp/Qs tomographic anomalies. Furthermore, we show that the transient medium properties, spatially defined by the velocity and attenuation tomography, are predictable considering the time variability of the single event Vp/Vs and Qp/Qs obtained by the wadati regression and by P and S t* computed fitting P and S wave velocity spectra, respectively.