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Elastic and inelastic triggering of earthquakes in the North Anatolian Fault Zone

F. Lorenzo Martín (1), F. Roth (2), R. Wang (2)

(1) Ruhr Universität Bochum, Bochum, Germany, (2) GeoForschungsZentrum Potsdam, Potsdam, Germany (lorenzo@gfz-potsdam.de)

The North Anatolian Fault Zone (NAFZ) is mainly a pure dextral 1500 km long fault zone running along the north of Turkey. Since 1939, 12 moment magnitude Mw $>$ 6.5 earthquakes have occurred on this fault. This sequence provides the unequalled possibility to analyse how the occurrence of an event can trigger following large earthquakes.

Deformation models applied to explain earthquake triggering often assume a pure elastic behaviour for the crust and upper mantle. However, in the real Earth, the mantle and possibly the lower crust as well behave as a Maxwell viscoelastic body. Therefore, since inelastic stress relaxation also leads to changes in the stress distribution, it seems adequate to include inelastic behaviour when analysing stress transfer and earthquake interaction. In addition, if the elastic stress increase would be enough to trigger a later earthquake, this trigger should take effect instantaneously and not many years later. Up to now, pairs of events was studied to see if the first triggers the second one and if the triggering Coulomb stress is increased by post-seismic relaxation. We analysed the sequence of events along the NAFZ to see if one viscosity value can explain triggering of all pairs of events in the series. This means we looked for a parameter which would be representative for the rheology of this fault zone.

In general, we find that the Coulomb stress failure criterion provides good results in this area and for this sequence of events. However, considering only elastic stress changes neglects an important part of the actual stress increase/decrease. Taking the effect of viscoelastic relaxation processes into account shows in some cases to be appropriate to study and describe the time delays between earthquakes. In other cases, however, it is clear that neither the elastic nor the viscoelastic approach can fully

explain the triggering of the following events. More detailed information about the events or the properties of the crust and upper mantle for the region where they took place might lead to improvements when analysing the time delays.

According to our results, the effects of viscoelastic relaxation on the stress field can not be neglected when analysing stress transfer between earthquakes. In several cases, post-seismic relaxation effects are important and greater in magnitude than the co-seismic ones. In these cases, a viscosity of 1 - $3 \cdot 10^{18}$ Pa·s gives the best results. It seems to be at the lower boundary of values usually assumed. This might be an indication that other time-dependent processes can play an important role.