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Earthquake-induced static stress of the 1985 Nahanni earthquakes, Northwest Territories, Canada

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The 1985 Nahanni earthquakes [05/10/1985 (Mw=6.6), 23/12/1985 (Mw=6.8)] were the largest observed events not only in the Nahanni region but in the NE Cordillera and so appear to represent bursts of crustal seismicity exceptional for the past 100 years. The short duration (about two months) between the two mainshocks and their shallow depth (about 5 km) makes them interesting. I address stress changes and correlate static stress buildup caused by these unexpected events and examine their relationship to present-day seismicity. The changes in the static stresses caused by these events are determined using the Coulomb failure criterion based on dislocation theory assuming uniform slip in elastic half-space. The models of fault specific (with no regional stress) and optimal orientation (with regional stress) are used in the calculation. However, changes in static stresses based on these dislocation models are found to be insignificant. The suggested rupture model of Choy and Boatwright (1988) for the Nahanni earthquakes involves complex ruptures with two sub-events (0 +3.6 sec) and three sub-events (0 +0.8 +3.5 sec) for the first and second mainshocks, respectively. So, static stress changes for each subevent are determined and then combined. The combination for the October event appears to have caused the December event. Regional static stress maps as modified by stress changes caused by the December event, are correlated with subsequent larger events to understand if and how they may be triggered. Static stress changes caused by the sub-events of 1985 events are concluded to be a hazard indicator useful for separating zones of stress encouraged and stress shadow. Furthermore, the shadow zone is found to be about double the area of the stress enhancement zone. The static-stress changes of October 5, 1985 indicates that December fault rupture (as defined by its aftershocks) corresponded to the area of stress enhancement defined by October event. Thus, the December event is suggested to be triggered by October event. A large subsequent event occurred in 1988(M6.2). Its aftershocks are primarily to the south, in a region where increased stress was caused by the 1985 events. The 1988 earthquake is deeper (15 km) than the previous 1985 quakes (5 km) and so activated a deeper part of the crust. The seismicity pattern from

1961-2002 corresponds well with the pattern of earthquake-induced static stress changes caused by 1985 events. The self-similarity between the stress and seismicity indicates that stress-change maps are useful for identifying future mainshock locations for other active faults around the world.
download the poster (3.6 Mb, 36 x 24 inches, Adobe Acrobat pdf format)

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