Possible fluid-related earthquakes from seismic spectra analysis: detection and mechanism

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Fluid had been considered as a possible factor in triggering earthquakes, but, the evidence in elucidating the behavior and mechanism is still unresolved. Fracture zone associated with fault zone after an earthquake could be considered as a fluid reservoir, which possibly yields to some observations/detections of phenomena associated with pre-, co- or post-seismic of a larger earthquake. The fluid might behave from high pore-fluid saturation within fractured fault zone from fully to partial saturation as a transient feature after a large earthquake. We suspect this process might yield the migration of fluid flow, and thus, related to the occurrence of some aftershocks. Considering that the fluid flow triggering events might have a mechanism from tensile cracks rather than tensile shear, the S/P spectra ratio would be around 2-0.7 rather than higher values of 6-2 for tensile shear. We investigate the spectra ratio of the selected events from the analysis of the recorded broadband waveforms, we found significant association of the S/P spectra ratio of 2-0.7 in about 10-60 days after the Chi-Chi earthquake. It might give the evidence of the tensile crack events in association to the fluid flow and give the migration of the seismicity. These events are mostly in the negative Coulomb stress regime of the mainshock and are in the depth f about 5-8km. Our assumption on this is that the migration of fluid flow increases the pore-pressure, which reduces the normal stress, and, thus, yield the co-seismic negative Coulomb's stress regime to become positive to trigger these fluid flow associated aftershocks. The migration of this aftershock to the distance of the fault is with a speed of about 220m/day for our Chi-Chi case study in about 10-60 days after the Chi-Chi earthquake. More profiles along the fault will be further examined to assure our understanding on fluid migration within the crust. Moreover, if the zone of the fluid triggered events could be constrained spatially and temporally, we might be able to estimate the possible amount of fluid involved during this process.

Keywords: aftershocks, fluid flow, S/P spectra ratio

