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Pore fluid pressure dependence of earthquake size distribution in a young orogenic belt revealed by seismic velocity distribution

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Variation of earthquake size distribution (b-value) is well known to be governed by crustal differential stresses as the most preeminent parameter worldwide. Pore fluid pressure, as one of the secondary parameters, is still poorly understood how does the change affect b-value variation regionally. To know the relationship between b-value and pore fluid pressure, distribution and degree of pore fluid pressure are inferred from crustal seismic velocities based on assumption that pore fluid pressure varies linearly with Vp/Vs ratio. This experiment proceeded from a young orogenic belt, Taiwan, where high-quality seismic datasets and velocity models existed. The b-value dataset was determined from a relocated, declustered earthquake catalog and the seismic velocities were re-estimated to be spatially complementary to the b-values. We found that high and low Vp/Vs ratios are correlated with low and high b-values, respectively, in the crustal range of Taiwan orogenic belt. A clear negative linear relationship between b-value and Vp/Vs ratio indicates that Vp/Vs ratios decrease with increasing b-values. The results could imply a similar b-value dependence on pore fluid pressure regionally, raising the role of pore fluid pressure in b-value variability at potential fluid-activity regions as permeable fault zones, volcanic zones, or brittle-ductile transition zones. We suggest that pore fluid pressure and b-value variability deserved a comprehensive investigation to better understand the processes of earthquake nucleation.