Simultaneous Earthquake Pulses along the Main Himalayan Thrust

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The Nepalese Seismological network records a dense midcrustal microseismicity along the front of the high Himalayan topography. Its time structure is complex but mostly dominated by some seasonal oscillations, winter seismicity being twice as dense as summer. Various sources of natural and cultural seismic noises are suspected to affect the detection capacities of the network and therefore cause a large part of this seismic-event rate modulation. Among them, the high-frequency seismic noise generated by debris flow (Burtin and others, 2009) and the sediment transport in the rivers during the summer monsoon (Burtin and others, 2008) have been recognised as major contributors to the noise level in the region. However, a significant part of the seasonality at intermediate magnitude (2<ML<4) appear to be genuine and modulated by seasonal stress variations (Bollinger and others, 2007). An important contributor to these stress variations is the hydrological loading-unloading of the India plate, a mechanism evaluated using gravimetrical and continuous GPS time series (Bettinelli and others, 2008). Despite these conclusions, further examinations of the seismic catalogue are required to better constrain the sensitivity of the microseismic midcrustal cluster to spatiotemporal modulations of stresses induced by various forcing.

For this purpose we investigate further the seismic catalogue and focus on the period 1996-1997, encompassing the most dramatic seasonal variations ever recorded. These variations appear dominated by the simultaneous development in December-January of three distinct seismic swarms, located hundreds of kilometres from each other, along the Main Himalayan Thrust (MHT). Their normalised time structures appear very similar, including a pre-swarm decrease in seismic events rate and a pre-mainshocks microseismicity pulse. Another similarity comes from their location at midcrustal depths, at the front of the high topography and within the trace of Southern Tibetan grabens prone, a few months later, to a large seismic crisis. In a Mohr-Coulomb criterion space, these places along the Himalayan arc appear more sensitive than others to small strain perturbations, particularly to slip-rate accelerations on the creeping part of the Main Himalayan Thrust, being sites of the occurrence of subtle transient events.

References

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