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Physical interpretation and detection of anomalies associated with crustal processes leading to large earthquakes

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Based on a cellular automata earthquake model proposed by Sacks and Rydelek (1995), we propose an observational approach to the problem of earthquake prediction (short-term). This approach is different from the detection of pre-seismic slip. We propose to revisit the dilatancy model. Previously reported magnitude dependent seismic quiescence (e.g. 1982 Urakawa-OKi earthquake, 1994 Northridge earthquake, 2008 Wenchuan earthquake) can be interpreted as a manifestation of the dilatancy hardening process. By incorporating this process, our model explains the magnitude selectivity. This information may be useful for raising awareness. We note that this phenomenon is not confined to the eventual earthquake zone but covers much wider area. If we advance this line of thinking, dilatancy breakdown can be expected before the eventual large faulting, which should result in fluid diffusion into cracks opened by dilatancy. Mature faults are known to have high permeability and may act to accelerate the process and lead to observable anomalies. Our model needs to include this phase to provide quantitative direction for detection. We propose that the observation of vertical strain will complement the existing multiple-parameter observations to provide useful data related to fluid distribution changes as a short-term precursor.

Keywords: seismic quiescence, dilatancy, cellular automata earthquake model