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# A 2000-year record of migrating earthquakes in North China: Implications for earthquake hazards in continental interiors

Mian Liu (1), Seth Stein (2), and Hui Wang (3)

(1) University of Missouri, Geological Sciences, Columbia, United States (lium@missouri.edu), (2) Northwestern University, Department of Earth and Planetary Sciences (seth@earth.northwestern.edu), (3) China Earthquake Administration, Institute of Earthquake Studies (wanghui500@gmail.com)

Plate tectonic theory provides a good sense of where to expect future large earthquakes on plate boundaries, and of the average time between them. However, no comparable model applies in continental interiors, where damaging earthquakes often pop up in unexpected places. This is well illustrated by the 2000-year record of earthquakes in North China, where large earthquakes are frequent and have migrated between fault systems. No large (M>7) events repeated on the same fault segment during this period. Paleoseismic records show episodic large earthquakes with long gaps in between, as have been reported in other mid-continents. We propose that the spatial migration is intrinsic to mid-continental earthquakes. Using a simple conceptual model, we show that in continental interiors slow tectonic loading is accommodated collectively by a complex system of interacting faults. Failure of one fault affects the entire system, and large earthquakes may shut off one fault and activate another. These processes are fundamentally different from those at plate boundaries where earthquakes are concentrated along the plate boundary faults, and steady-state relative plate motion loads the boundary faults rapidly at constant rates so earthquakes are quasi-periodic. The spatial migration and episodic occurrence of mid-continental earthquakes, and their long aftershock sequences that can extend for hundreds of years, explain why in continental interiors past seismicity can be poor indicators of the sites of future large earthquakes. Consequently, seismic hazard assessment based on the assumption of quasi-periodic earthquakes may fail, as illustrated by the unexpected 2008 Wenchuan earthquake that occurred on a fault that showed little seismicity in the past millennium.