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# Using Soft-Sediment Deformation to Characterize and Constrain Paleozoic, Marine, Epicontinental Seismicity: Central Kentucky Ordovician, East-Central United States

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The use of soft-sediment deformation to interpret seismicity in areas associated with active and formerly active plate boundaries is well-known. However, craton-interior, or epicontinental, seismicity is currently a subject of intense study in the central United States, where interest in determining epicentral areas, recurrence intervals and likely triggering structures for the historic and prehistoric New Madrid seismic region is ongoing. Seismites, or seismically induced soft-sediment deformation, abound in terrestrial sediments from this region, where the triggering structures are reactivated parts of Precambrian rift systems that run through Kentucky and other craton-interior areas. A growing body of evidence indicates that these structures have been active in Kentucky and other areas throughout the Phanerozoic right up to the present, and yet the possibility of seismites in marine, epicontinental, Paleozoic rocks, especially carbonates, has not be widely recognized. Much evidence from the marine Paleozoic record is in the form of soft-sediment deformation, which has been systematically overlooked or misinterpreted. By using the concurrence of four criteria — deformation consistent with a seismogenic origin, widespread deformation in temporally and stratigraphically constrained horizons, patterns of increasing deformation intensity toward likely epicentral areas, and excluding other likely causes — ambiguity as to seismogenic causes can be reduced. In particular, it is the ability to map the intensity of deformation across widespread areas that supports the possibility of epicontinental paleoseismicity in the Upper Ordovician Lexington Limestone of central Kentucky, U.S.A., and in some circumstances, enables the approximation of epicentral areas and paleoearthquake magnitudes. Mapping deformation intensity in two deformed Lexington horizons also shows likely structural control of deformation facies by distinct faults and concentration of soft-sediment deformation near those same faults, suggesting that they were the likely seismic triggers. Although soft-sediment deformation in central Kentucky was nearly 1000 km away from any active Taconic tectonism at the time, it is likely that Taconic far-field forces reactivated existing Precambrian basement faults in the area, generating the probable seismic triggers.

Clearly, paleoseismicity is an aspect of the fossil sedimentary record, the presence and significance of which has been often overlooked in the Paleozoic, marine, epicontinental record. I would like to suggest that based on some types of soft-sediment deformation, craton-interior seismicity should be recognized as another important aspect of marine epicontinental sedimentation, that in some circumstances its effects can be quantified, and that its historic significance can contribute to an increased understanding of mid-continental earthquake hazards.