Insights into syndepositional fault movement in a foreland basin; trends in seismites of the Upper Cretaceous, Wahweap Formation, Kaiparowits Basin, Utah, USA

Hannah L. Hilbert-Wolf,* Edward L. Simpson,† Wendy S. Simpson,* Sarah E. Tindall† and Michael C. Wizevich†

*Parkland High School, Allentown, PA, USA
†Physical Sciences, Kutztown University of Pennsylvania, Kutztown, PA, USA
‡Department of Physics and Earth Sciences, Central Connecticut State University, New Britain, CT, USA

ABSTRACT

The Upper Cretaceous Wahweap Formation accumulated in the active Cordilleran foreland basin of Utah. Soft-sediment deformation structures are abundant in the capping sandstone member of the Wahweap Formation. By comparing with well-established criteria, a seismogenic origin was determined for the majority of structures, which places these soft-sediment deformation features in a class of sedimentary features referred to as seismites. A systematic study of the seismite trends included their vertical and horizontal distribution and a semi-quantitative intensity analysis using a scale from 1 to 5 that is based on magnitude, sedimentary structure type, and the predominance of inferred process of hydroplastic deformation, liquefaction or fluidization. In addition, orientations of soft-sediment fold axes were recorded. Construction of a northwest-to-southeast stratigraphic and seismite intensity cross-section demonstrates: (1) reduction in stratigraphic thickness and percentage of conglomerates to the southeast, (2) the presence of lower seismite, middle nonseismite, and upper seismite zones within the capping sandstone (permitting subdivision of the capping sandstone member), and (3) elimination of the nonseismite zone and amalgamation of the lower and upper seismite zones to the southeast. Regional isoseismal contour maps generated from the semi-quantitative analysis indicate a decrease in overall intensity from northwest to southeast in the upper and lower seismic zones and in sandstone within 5 m stratigraphically of the contact between the upper and capping sandstone members. In addition, cumulative seismite fold orientations support a west-northwest direction towards regional epicentres. Isoseismal maps are used to distinguish the effects of intrabasinal normal faulting from those of regional orogenic thrusting. Thus, this study demonstrates the utility of mapping seismites to separate the importance of regional vs. local tectonic activity influencing foreland basin sedimentation by identifying patterns that delineate palaeoepicentres associated with specific local intrabasinal normal faults vs. regional trends in soft-sediment deformation related to Sevier belt earthquakes.