Modeling and Interpretation of a High-Relief Precambrian Unconformity on 2D Seismic Reflection Lines near Wabash, Indiana

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ABSTRACT

A study of ten 2D seismic reflection lines recently made available for study by CountryMark in Wabash and Miami Counties of north-central Indiana provides insight into the nature and evolution of the Precambrian unconformity upon the Eastern Granite-Rhyolite Province (EGRP) of the U.S. Midcontinent. The Precambrian unconformity on the ten unmigrated seismic sections occurs at approximately 0.5 second two-way travel time and is characterized by significant undulations, diffractions and classic bow-tie artifacts. Ray-trace modeling using real examples of the relief upon the Precambrian unconformity as exposed in EGRP outcrops of the St. Francois Mountains of southeast Missouri produce strikingly similar undulations, bow-tie structures and diffractions. These comparable seismic patterns and the presence of undeformed granite recovered from drill holes ~8 miles to the NE and ~24 miles to the NW of these seismic lines support an interpretation of undulating paleo-topography carved atop Precambrian crystalline bedrock like that observed in the St. Francois Mountains. This geological comparison is further supported by the potential field map patterns in this part of north-central Indiana which exhibit ring patterns suggestive of caldera complexes like that mapped in the St. Francois Mountains exposures. Elsewhere in Indiana, Ohio, and Illinois seismic reflection data reveal an unconformity of relatively low relief, however, those examples generally occur in areas where layered rocks (likely sedimentary or volcanogenic) lie below the Paleozoic platform cover. A conclusion and prediction of the present study is that the unconformity beneath the Mt. Simon Sandstone in the US Midcontinent may exhibit significant relief in areas underlain by crystalline bedrock and low relief in areas with more easily eroded sedimentary or volcanoclastic strata.