Structural and Crustal Evolution of the Pre-Mt. Simon Below West-Central Indiana: Evidence from Seismic Reflection

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ABSTRACT

Two distinct seismic reflection sequences below west-central Indiana provide insight to the poorly understood evolution of the eastern U.S. midcontinent basement. The uppermost sequence, termed here the Wilbur, is composed of weak, discontinuous reflections and thins westward. Internal reflections of the Wilbur parallel those of the underlying sequence termed here the Quincy sequence which continues to at least the base of the seismic record at 2 s TWT. This deeper Quincy sequence is composed of high-amplitude, stratified reflections and shallows westward. Stratigraphic (lapouts) and structural (undulating reflections, doming) complexities typify this deeper unit. These sequences may be regional patterns and yield new interpretations of pre-Mt. Simon geology. Weak reflectivity is also characteristic of the Middle Run Formation, a pre-Mt. Simon lithic arenite, below southwest Ohio (Shrake et al., 1991), which overlies and is apparently concordant with a high-amplitude layered sequence of unknown lithology. In southwestern Indiana and southern Illinois COCORP data revealed the Centralia sequence (Pratt et al., 1992), thought to represent layered volcanics/clastics/sills of the Eastern Granite-Rhyolite Province (EGRP). The paucity of deep wells across the region, however, still leaves major questions regarding the overall composition and regional distribution of pre-Mt. Simon rocks. These data suggest two plausible geologic scenarios: (1) Similar weak reflectivity of both the Middle Run and the Wilbur sequence, which both overlie very reflective layered sequences, may indicate regional correlation of these pairs of sequences. This model suggests that pre-Mt. Simon structure was initiated by Grenvillian compression, as new detrital zircon (Moecher et al., 2017) and seismic (Peterman, 2016) research suggest that the Middle Run (~1.03 Ga) pre-dates the Grenville Front compressional event (~0.99 Ga). Regional extent of the Middle Run is favorable of a foreland basin tectonic and depositional environment. (2) The Wilbur and Quincy sequences of west-central Indiana may pre-date the Middle Run entirely and instead be older, sedimentary and/or volcanic units associated with the EGRP. Doming of the Wilber and Quincy sequences may then be attributed to late magmatism associated with the EGRP, the Southern Granite-Rhyolite Province magmatism (1.40-1.34 Ga) and/or the emplacement of 1.27 Ga intrusive suites into the midcontinent basement (Bickford et al., 2015).