

Sequence Stratigraphic Analysis of the Uppermost Cambrian and the Lowermost Ordovician Deposits in Illinois: Implications for Recognition of the Poorly Defined Cambro-Ordovician Boundary in the Deep Part of the Illinois Basin

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Recognition of the Cambro-Ordovician boundary in the deep part of the Illinois Basin has been hampered due to continuous carbonate deposition and the apparent lithofacies similarities across the boundary. The Upper Cambrian through Lower Ordovician succession in southern Illinois (over 6000 feet thick) has long been regarded as the undifferentiated Knox Group, which is composed chiefly of fine to coarsely crystalline dolomite. To define this important boundary, sequence stratigraphy and vertical facies trends of the uppermost Cambrian Eminence Formation and the lowermost Ordovician Gunter Sandstone and/or Oneota Dolomite in Illinois have been investigated along a northwest-southeast dip directed transect using subsurface data.

In the north and central part of Illinois, the Eminence Formation (50-250 feet thick) consists of sandy, fine to medium crystalline dolomite and thin sandstone beds. It is overlain, with a sharp contact, by up to 25 feet of the Lower Ordovician Gunter Sandstone followed by 100-300 feet of cherty fine to coarsely crystalline Oneota Dolomite. In the southern third of Illinois, the south-central deep area of the Illinois Basin, the Gunter is absent and the Oneota Dolomite cannot be differentiated from the Eminence Formation. Here, the Eminence Formation and the Oneota Dolomite are very thick and consist almost entirely of fine to coarsely crystalline dolomite with thin shale/clay intervals deposited in a relatively deeper marine setting.

Base on this study, the Cambro-Ordovician boundary is located about 50 feet above an easily recognizable high Gamma ray marker in the upper Eminence. This geophysical marker occurs constantly at about the same depth below the Eminence-Gunter/Oneota contact and becomes more pronounced basinward. In addition, a diagnostic 3-kick Gamma ray signature is present below the Eminence-Oneota contact in the deeper part of the basin. Moreover, the proposed Cambro-Ordovician boundary coincides with the most regressive surface, the sequence boundary separating the Eminence highstand systems tract and the overlying Oneota transgressive systems tract. Recognition of the Cambro-Ordovician boundary facilitates the subdivision of the Knox Group into lower and upper Knox successions consisting of several depositional sequences. The results of this study indicate that regional sequence stratigraphic correlation and recognition of stratigraphic marker horizons within the Knox Group in the Illinois Basin can provide a unique framework in which facies distribution through time can be examined to define potential reservoirs and seals for carbon sequestration.