

Incised valley fill reservoirs, from outcrop analogue to subsurface interpretations (Upper Carboniferous, Kentucky, USA)

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Incised valleys are extensive geomorphological features with a high potential of encasing coarse grain sediments in muddy environments, therefore representing an interesting reservoir potential. Even though incised valleys have been recognized throughout the geological record, most of our knowledge on the geometry, genesis and infill of incised valleys comes from Quaternary case studies. This has led to a rather good understanding of the mechanisms of formation of incised valleys, but their internal stratigraphic architecture still needs investigation. From a reservoir point of view, the understanding of the stratigraphic architecture of the infill of incised valleys is necessary in order to better predict heterogeneities, as well as geometry and dimensions of sand-prone facies.

In order to improve the understanding of geometries, dimensions and heterogeneities of subsurface reservoirs, outcrop and modern analogues have proven to be a very useful tool. However, due to the size of incised valleys (up to several kilometres in width and tens of meters in height), ancient examples observable at outcrop are scarce and subsurface investigations of modern or recent cases are limited by data resolution and areal coverage (such as seismic and well data).

In this context, Pennsylvanian successions of eastern Kentucky, a well-known as an outcrop analogue for Carboniferous fluvio-deltaic reservoirs in coal-bearing strata (e.g. Southern North Sea and onshore Europe), appears as an excellent field laboratory for the study of ancient incised valleys. The Breathitt Group is a coarsening- and shallowing-upward succession of Lower to Middle Pennsylvanian shallow-marine and fluvial deposits, representing the infill of an elongated foreland basin developed during the Alleghanian Orogeny punctuated by basin-wide marine units which allow the subdivision of the entire succession into eight formations. Stratigraphic cyclicity in the Breathitt Group is commonly attributed to high-magnitude glacioeustatic fluctuations driven by Gondwanan glaciations. Well-established, high-resolution correlations and previous work on regional geology make for an excellent stratigraphic framework, as well as extensive roadcuts and a large database of well/core data available from the Kentucky Geological Survey, enables detailed 3D analysis of architectural geometries and heterogeneities.

In this paper we are comparing field and well-logs data from the Upper Carboniferous of southeastern Kentucky with subsurface data from the Pennsylvanian of the Southern North Sea focusing on stacking patterns, dimensions and stratigraphical architecture of incised valleys.

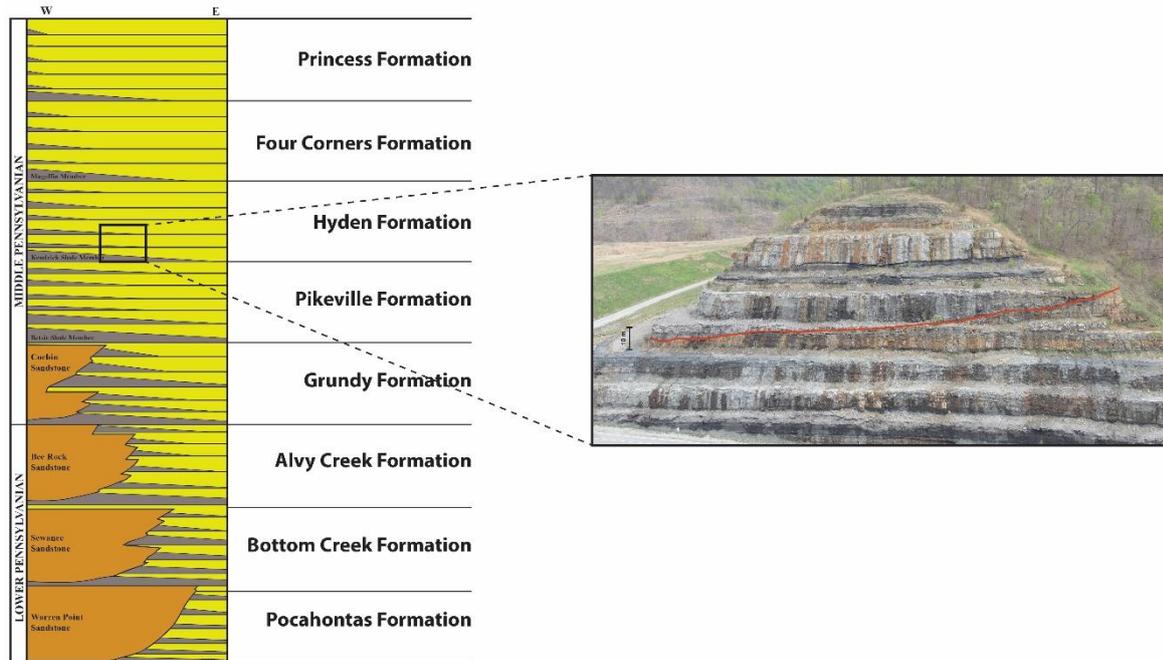


Figure 1. Stratigraphy of the Breathitt Group (left), example of an incised valley in the Hyden Formation (right). Red line shows the base of the incised valley fill.