Confined to unconfined deepwater fan architectures: a case study in the Pennsylvanian
Jackfork Sandstone and Atoka Formation of the Ouachita to Arkoma Basin transition.

Pengfei Hou, 2nd Year PhD

The changes throughout the Lower, Middle and Upper Atoka indicate an evolutionary response
to tectonic compression and subsidence, increasing confinement, localized accommodation, variations in
basin geometry, natural maturing of the feeder systems during the progression of the transition from
Ouachita Trough to Arkoma Basin. Comparative studies of the Atoka and the Jackfork in the same basin
have important implications of deciphering deepwater successions of early foreland basin deposits. Such
transitions are common throughout basin evolution records worldwide and the Atoka lends an
opportunity for improved understanding of source-to-sink system response to such changes.
The methodology in this study involves examining the lithologic facies, stratigraphic architectures, trace
fossils, petrography and paleocurrent in both outcrop and subsurface, and analyzing the spatial and
stratigraphical difference across the study area to find the impact of the feeder systems, then compare
the Atoka system (emerging active margin setting) with the Jackfork (passive margin setting).
Several important questions being addressed in this study include:

- What is the difference between the deep-water fan systems in passive / extensional margin
  settings versus those in active / compressional margin settings?
- How do the deep-water fan systems differ stratigraphically with different feeder systems updip:
  deltaic versus shoreface?
- How do those differences affect the reservoir quality, continuity and distribution of the deep-water
  systems?

Current observations show Atoka consists of sediments from deep to shallow water origins and
recorded the transition from a rifted continental margin to a rapidly subsiding foreland basin. This study
focuses on the lithofacies, stratigraphic architecture, paleocurrent, and ichnofacies early foreland basin
based on 23 outcrops in western Arkansas.

The Atoka is informally divided into Lower, Middle, and Upper intervals in lithologic and
chronostratigraphic sense. The Lower Atoka is a fine-grained, sand-rich deepwater complex. Both axial fan
and transverse fan systems are predominantly fine-grained turbidite sandstones and mudstones. The
main architectural elements are lobes, inter-lobes, MTD for the axial fan, and channels, levees and
overbank for transverse fan. Net to gross is high for individual fan, but decreases westward. Paleocurrent
shows overall E-W for axial fan, N-S for transverse fan. Trace fossils are identical of *Nereites*
ichnofacies.

The Middle and Upper Atoka are mud-rich shelf, deltaic and shallow marine deposits. They are
predominantly fine- to medium-grained sandstones sandwiched in thick ripple- or planar-laminated
mudstones, with some carbonaceous and fossiliferous horizons. The main architectural elements include
sandstone and mudstone sheets, channels, bars. Combined influences of wave, tide, and traction currents
are common. Paleocurrent shows bidirectionally N-S or E-W. Trace fossils are very abundant, mostly
identical of *Cruziana* and *Zoophycos* ichnofacies.