

PS High-Resolution Stratigraphy and Structure of an Unusual Woodford Outcrop, Arbuckle Mountains, Oklahoma*

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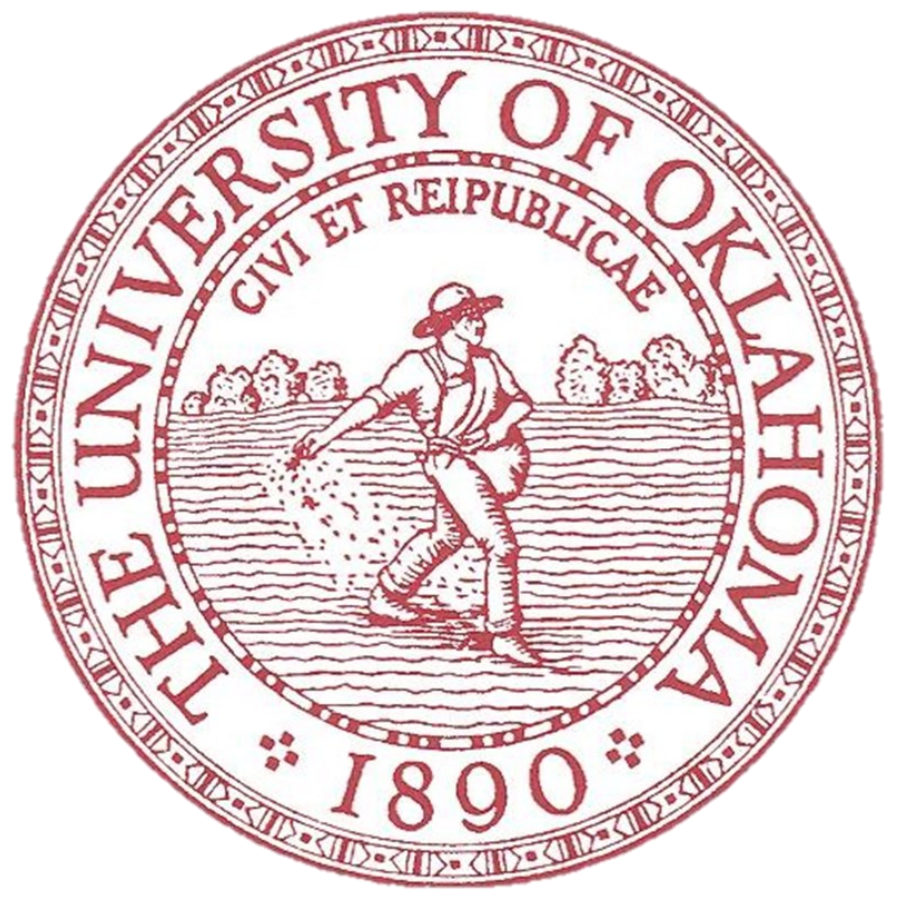
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Abstract

Recent development of the Woodford Shale in Oklahoma has contributed to the domestic and global unconventional resource knowledgebase, furthering the oil and gas industry's understanding of how shale plays produce oil and gas. However, much work is still needed to fully understand the complexities associated with Woodford shale reservoirs, including: facies assemblages, detailed stratigraphy at the local and regional scales as it applies to paleotopography beneath the Woodford, lateral continuity, and contrasts in mechanical competency that can facilitate fracking and/or structural deformation. The aforementioned issues in Woodford characterization are issues that are being addressed by studying an outcrop of the Woodford Shale in the Arbuckle Mountains, Oklahoma which contains a complete Woodford stratigraphic section with associated bounding unconformities at the top Hunton Limestone and base Sycamore Limestone. This outcrop is unusual in that the upper Woodford is highly deformed and repeated above a significant intraformational fault. Also, the unconformity at the top of the Woodford is a well-developed paleosol not previously documented in other outcrops. Measurement of bed thicknesses, coupled with an outcrop gamma ray log, reveal a repetitive set of thickening-upward parasequences. Structural interpretation is focused on relations to regional tectonics of the Arbuckle Mountains. Stratigraphy is being correlated with outcrops at the nearby Hunton Anticline Quarry.



HIGH RESOLUTION STRATIGRAPHY AND STRUCTURE OF AN UNUSUAL WOODFORD OUTCROP, ARBUCKLE MOUNTAINS, OKLAHOMA

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ABSTRACT

Detailed facies analysis and high resolution sequence stratigraphy of the Devonian Woodford Shale were investigated at a previously undescribed outcrop in the Arbuckle Mountains, Oklahoma, which contains a complete stratigraphic section of the Woodford with associated bounding unconformities at the top of the Hunton Limestone and base of the Sycamore Limestone. This outcrop is unusual in that the upper Woodford is highly deformed, containing numerous tight folds, abundant fractures, and significant intraformational faulting. Intense deformation is likely the combined result of early slumping and regional Arbuckle tectonism. The unconformity at the top of the Woodford is marked by a well-developed paleosol, previously undocumented in other outcrops.

Additionally, bed-thickness data and radiolarite (“chert” bed) data were explored for their use in detailed stratigraphic interpretations. Bed thickness data and radiolarite abundances can provide additional insight into the depositional trends of cyclically interbedded formations, like the Woodford Shale, and have the potential to aid in hydrocarbon expulsion modelling, fracture density prediction, geomechanical modelling, lateral well placement, etc. Although gathered in the field for this study, bed-thickness data are not unique to outcrop- or core-based measurements. By generating a conceptual model, it is shown here that thickness data can be obtained from FMI logs, a tool that is routinely made available in place of core. By integrating FMI-derived measurements into the suite of standard tools used for characterization, the interpreter gains a more precise and robust interpretation of the reservoir of interest.

As always, it is never advised to rely on any one data set as a “magic bullet.” The best interpretations are *always* those made with the most available data. The essence of this project was to provide yet another data set that can be used in this endeavor.

Arbuckle Wilderness Outcrop

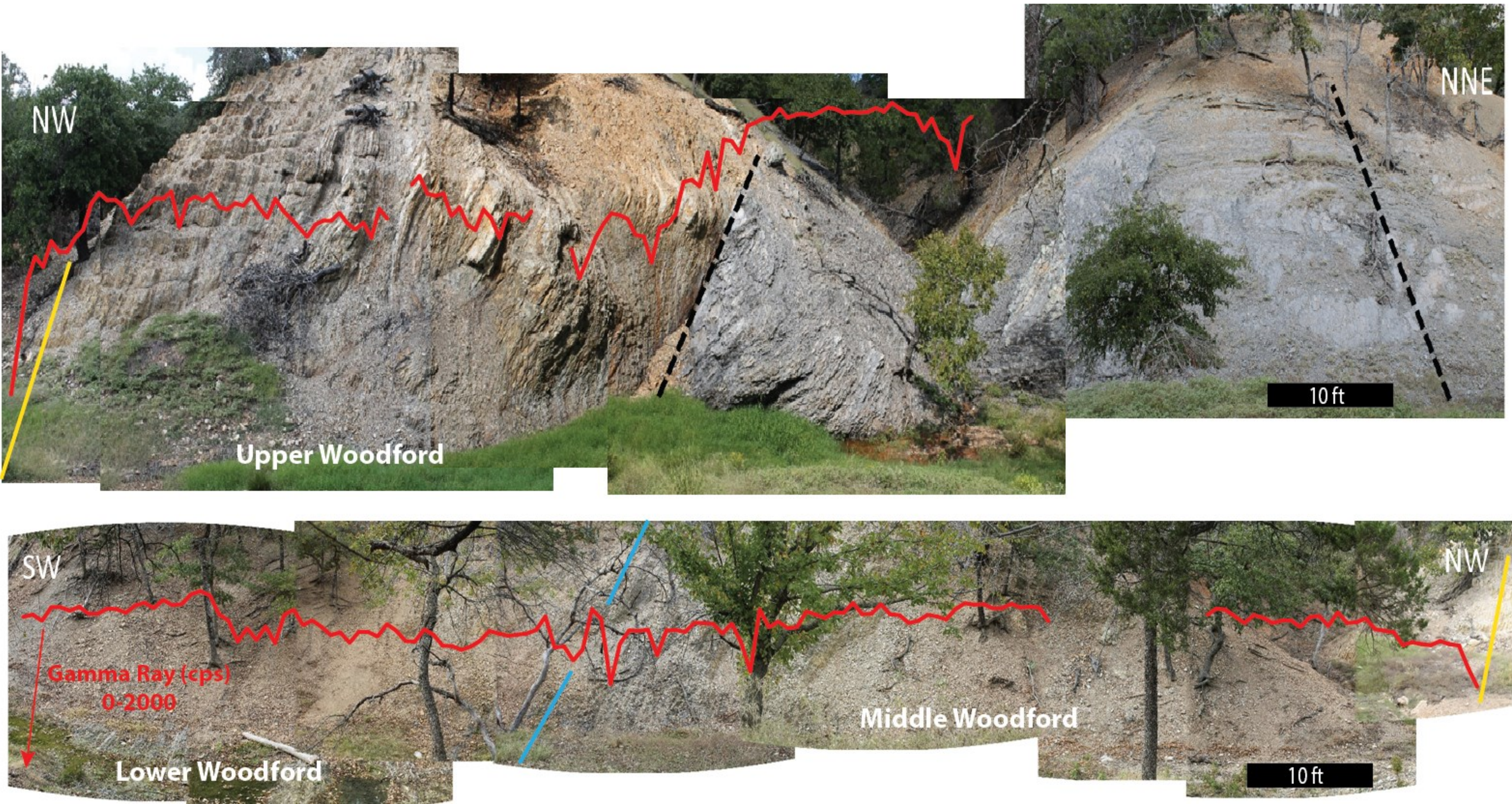


Figure #3. Panoramic showing the Lower, Middle, and Upper Woodford members superimposed with an outcrop gamma ray log. Note that gamma ray (cps) increases downward.



Figure #4. Image showing the intense folding (slumping?) in the Upper Woodford, truncated by a paleosol (green).

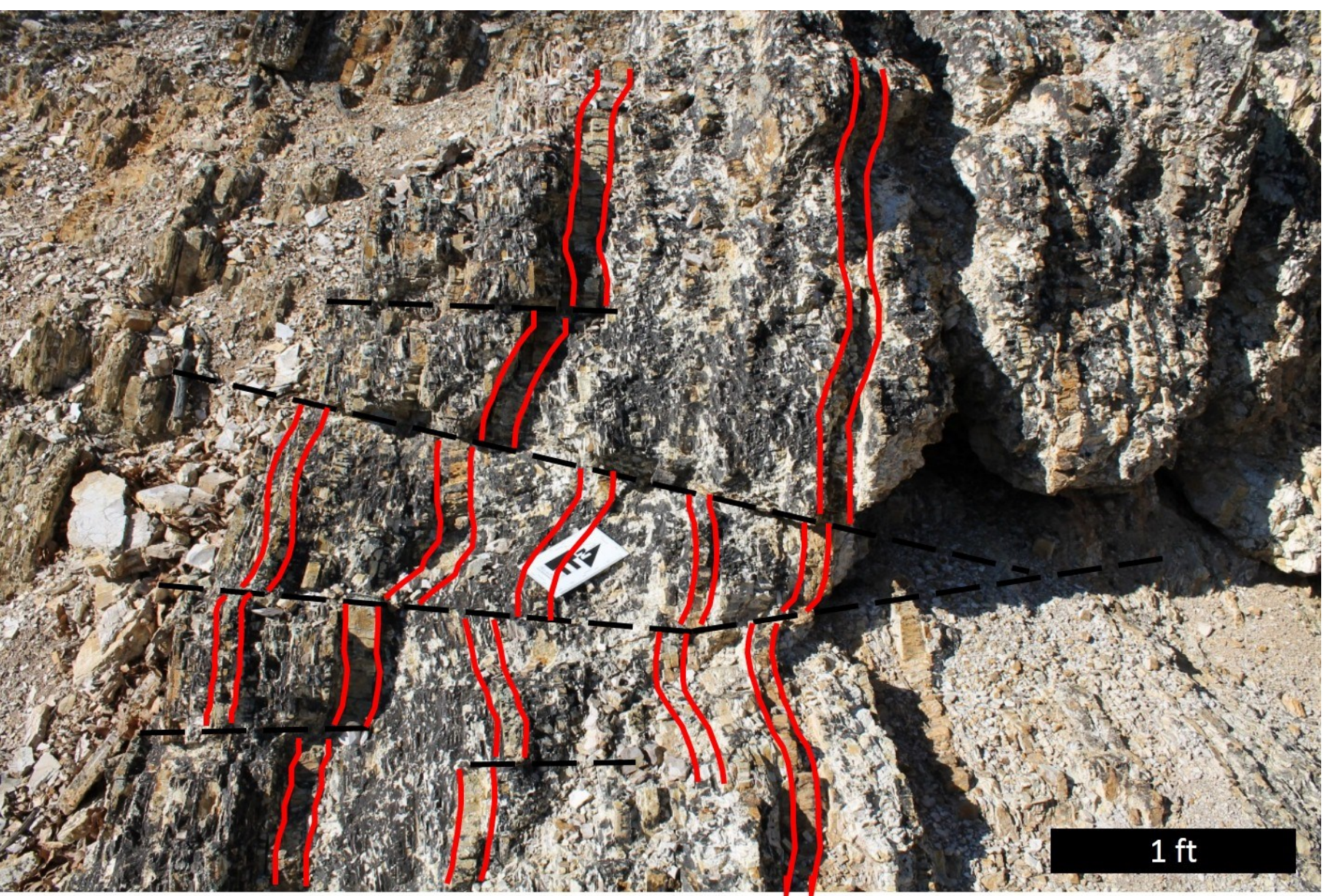


Figure #5. Complex faulting and deformation in the Middle Woodford due to tectonism.

STUDY AREA

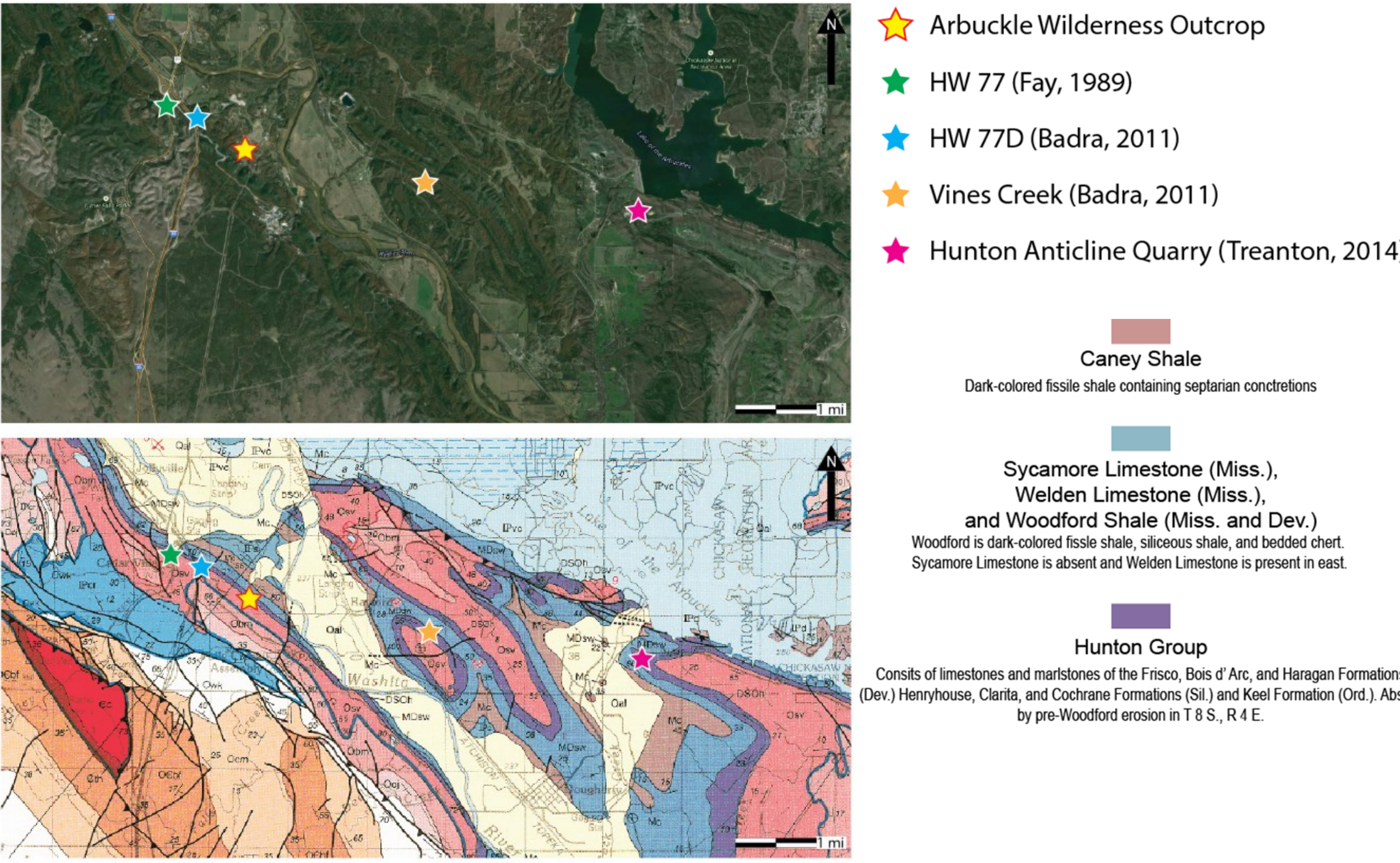
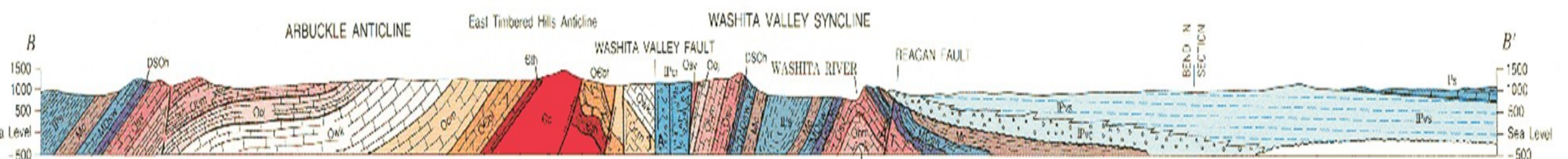


Figure #1 (above): Aerial photo and geologic map outlining the location of this study (yellow star) and the locations of nearby Woodford outcrops. Modified from OGS (1990).

Figure #2 (below): Regional cross-section from southwest to northeast showing the large-scale tectonic setting of the study area. Modified from OGS (1990).



Facies Characterization

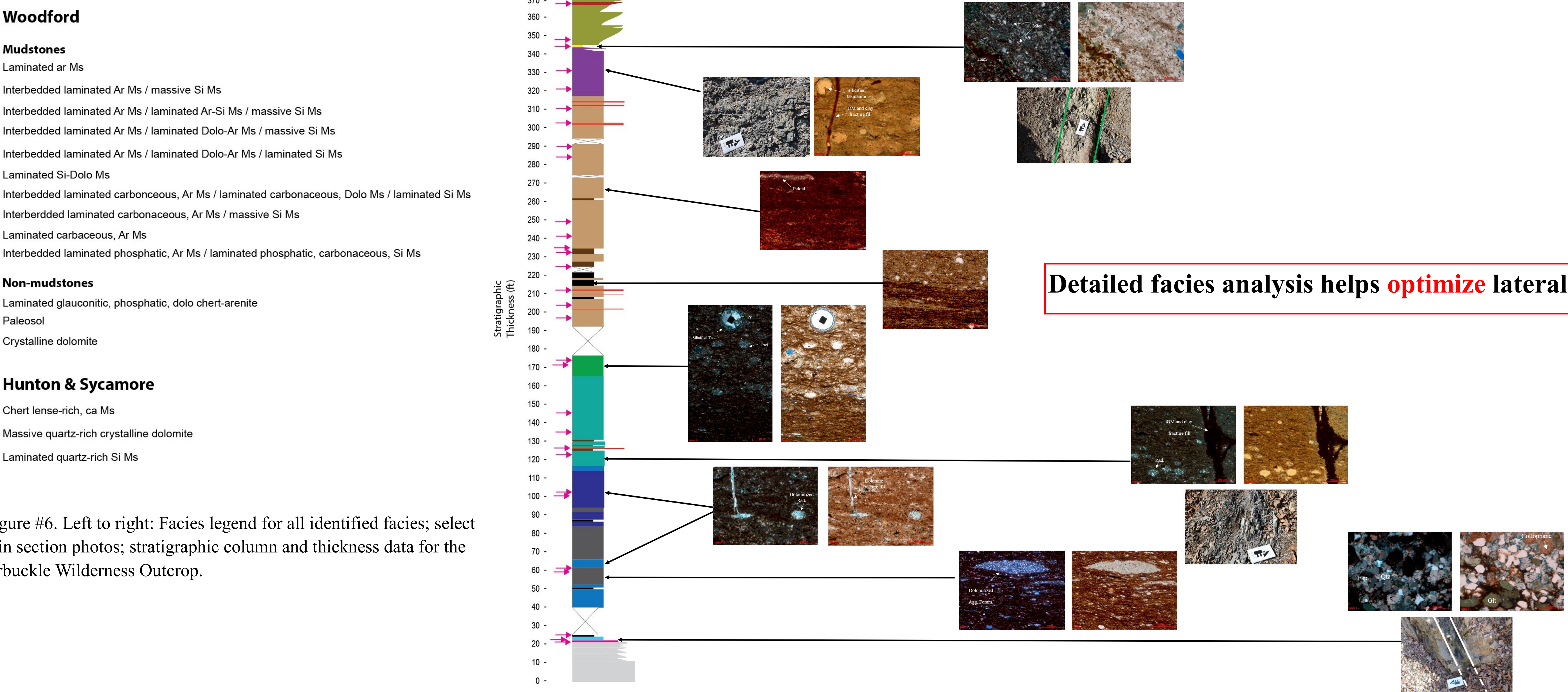


Figure #6. Left to right: Facies legend for all identified facies; select thin section photos; stratigraphic column and thickness data for the Arbuckle Wilderness Outcrop.

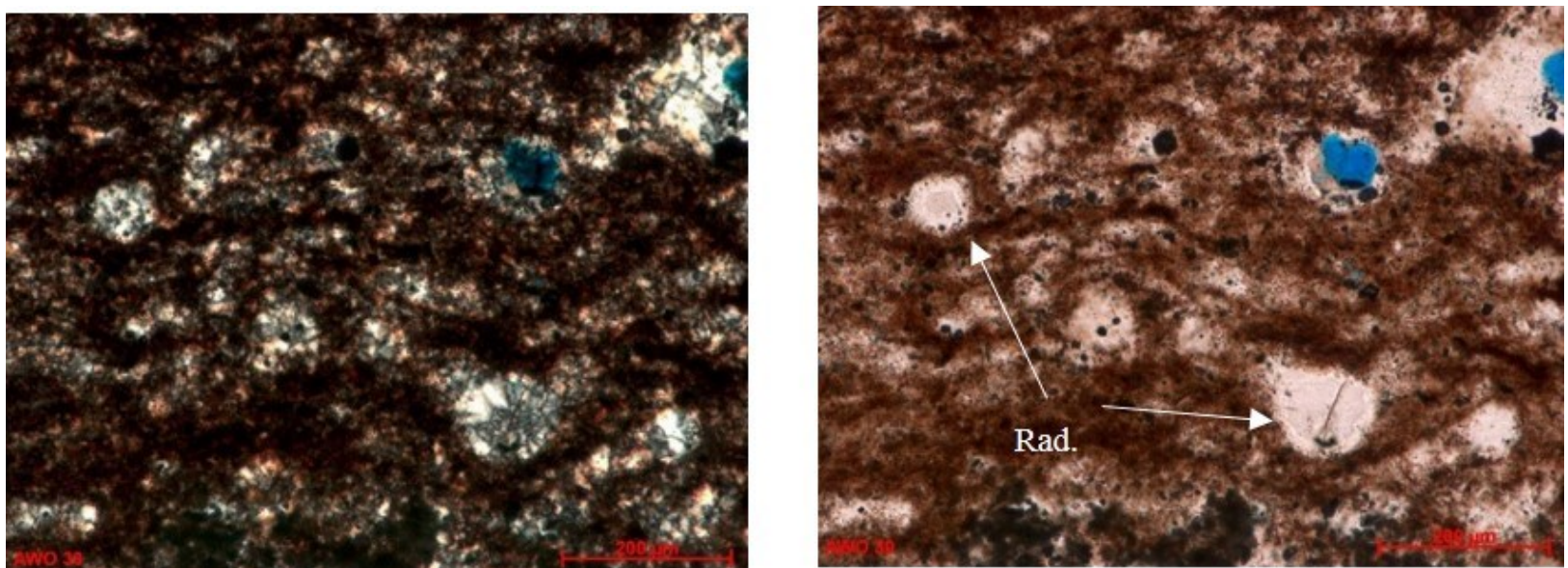


Figure #7. Examples of the siliceous mudstone (or radiolarite) facies in CPO (left) and PPO (right). **BRITTLE** and **GOOD POROSITY!**

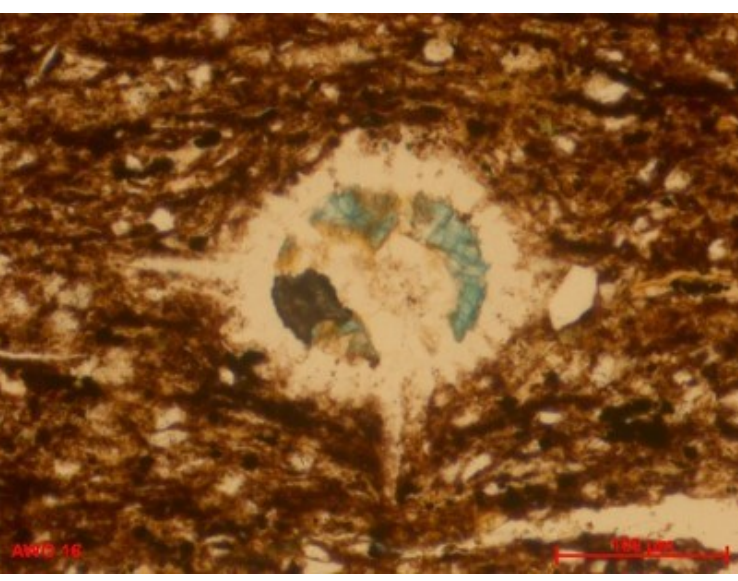


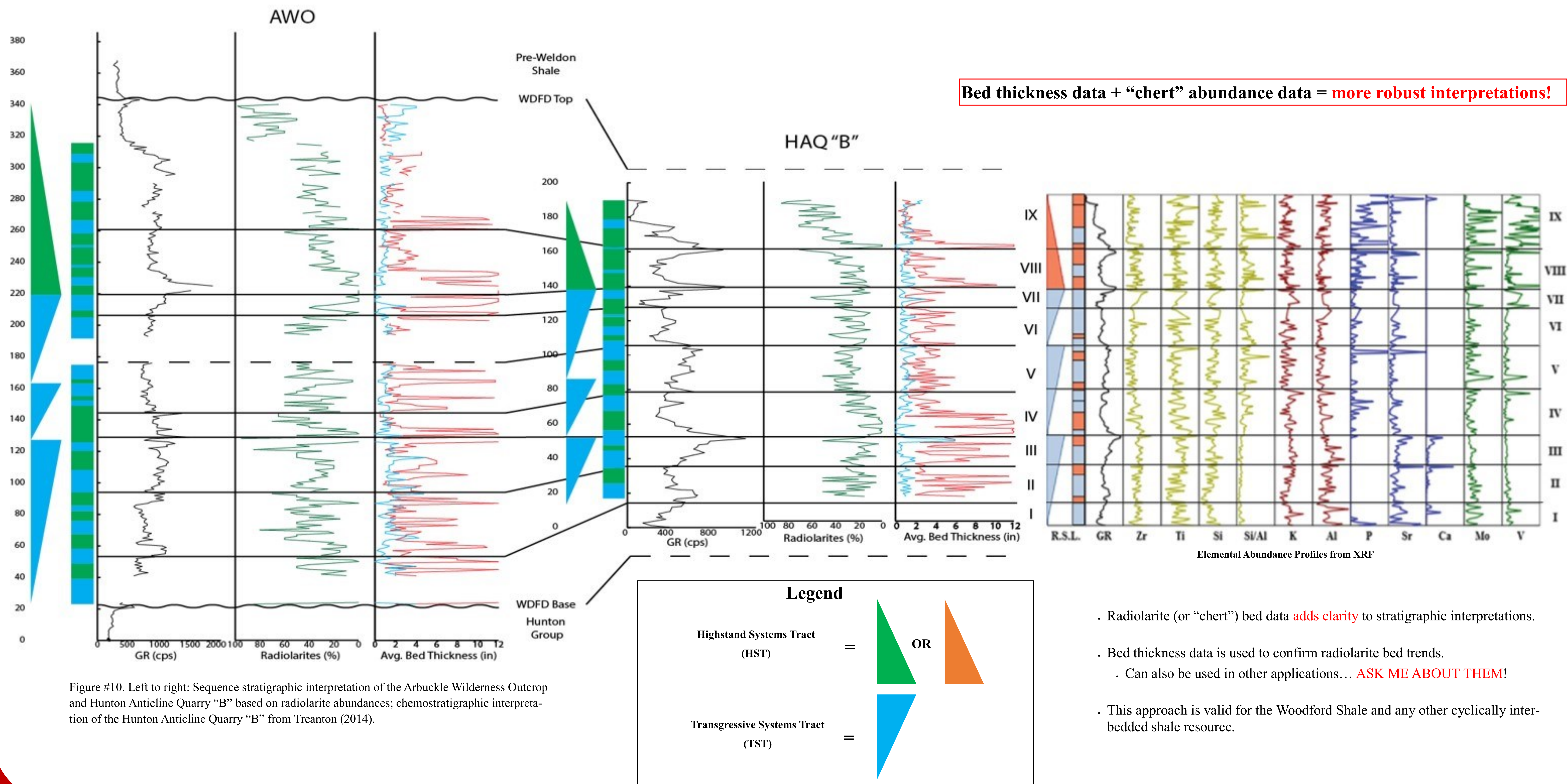
Figure #8. Well preserved silicified radiolarian centered with ferroan dolomite.

Brittle-ductile couplets are visible at nearly every scale...

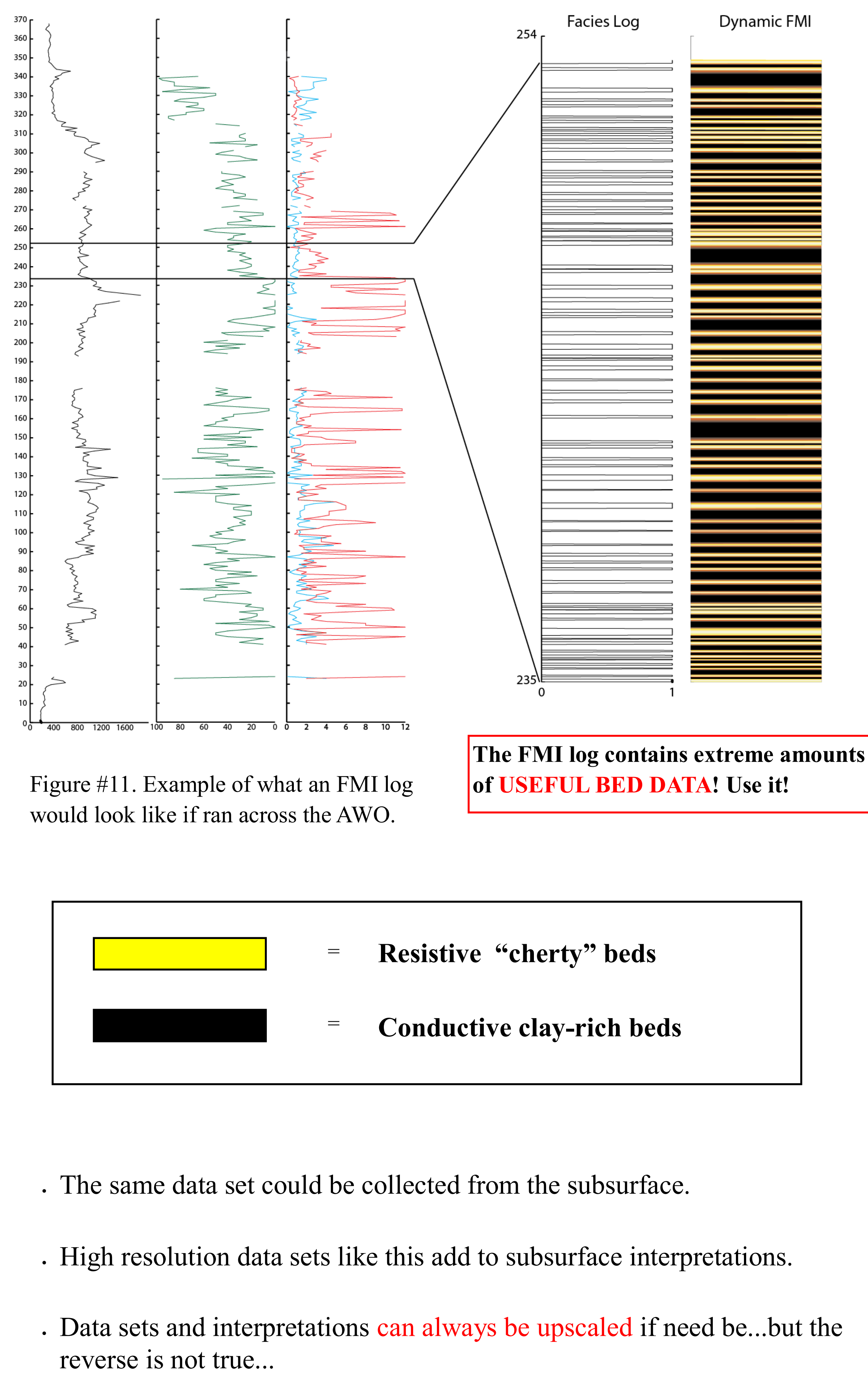


Figure #9. Outcrop example of interbedded siliceous mudstone and argillaceous mudstone.

Stratigraphy

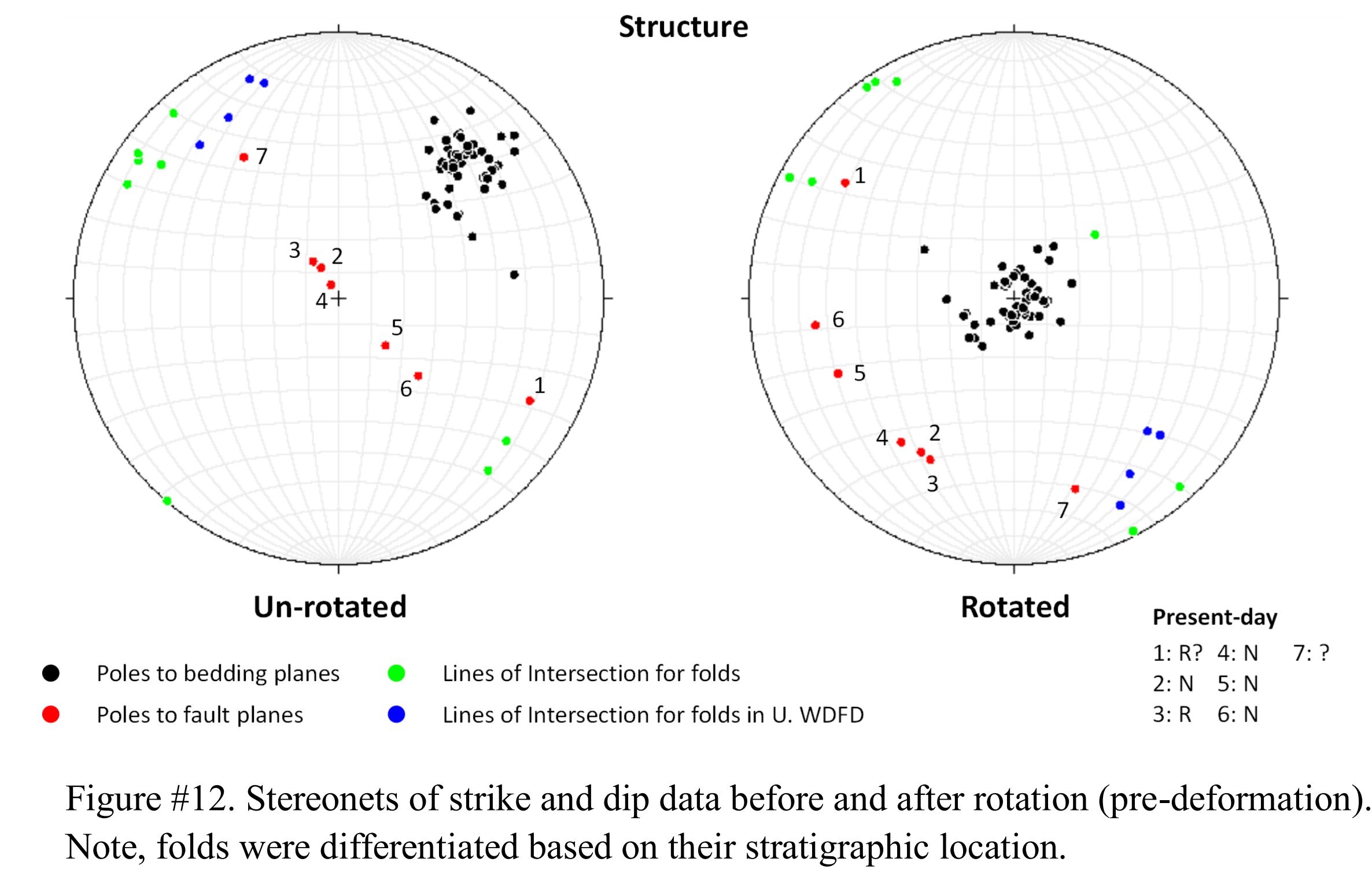


Subsurface Application



Ask Me Questions!!!

Structural Analysis



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