

An Integrated Approach to Characterization and Modeling of the Jackfork Group at the Baumgartner Quarry Area, Western Arkansas, and Its Implications to Deepwater Exploration and Production*

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Abstract

The Lower Pennsylvanian Jackfork Group deepwater strata in Arkansas and Oklahoma have been the subject of studies, field trips and publications for many years (Figure 1) because the Jackfork is an easily accessible outcrop analog to many deepwater reservoirs worldwide and because it produces gas in southeastern Oklahoma. The latest study is focused within a well exposed, active quarry, named Baumgartner Quarry, near Kirby, Arkansas (Figure 2). The quarry exposes a series of vertical walls in 3-dimensions. Basic information gathered for this study has included the following:

- Measuring seven stratigraphic sections of different walls in the quarry, with particular attention paid to differentiating lobe, levee, and channel facies and their lateral continuity (Figure 3);
- Integrating these sections with prior measured sections (Figure 4);
- Outcrop Gamma Ray logging of all sections;
- Accurate GPS positioning of walls, sections and logs in 3D space;
- Analysis of 24 thin sections from the different facies.

These data have formed the basis for construction of a 3D outcrop geological model using Petrel software which includes facies, gamma ray, porosity, and permeability components (Figures 5 and 6). The geological model was input into ECLIPSE for 'reservoir performance' simulation. A key aspect of this model (and the quarry) is that it can be divided into three stratigraphic intervals: (A) a lower, channel-prone interval, (B) a middle, thick shaly condensed section, and (C) an upper lobe-prone interval. Seismic forward modeling of the Petrel model revealed subtle seismic differences in the channel- and lobe-prone intervals (Figure 7). The Baumgartner quarry 'reservoir model' can serve as an excellent outcrop analog for deepwater reservoirs in the Gulf of Mexico, offshore Brazil, offshore west Africa, and elsewhere because many subsurface, deepwater reservoirs there exhibit similar stratification patterns and internal geometries. The Allegheny field and Tahiti Field in Green Canyon, northern deepwater Gulf of Mexico are two such reservoir analogs with similar stratigraphy and stacking patterns. The Baumgartner Quarry is only part of a complete, 2000-ft Jackfork stratigraphic section from the top of the Upper Mississippian Stanley Shale to the base of the Middle Pennsylvanian Johns Valley Shale. This sequence, coupled with other measured sequences at DeGray Lake Spillway, Hollywood Quarry and Dierks Spillway (Figure 8), provide insight into the depositional environments of the Jackfork during Early Pennsylvanian time.

References

Slatt, R.M., C.G. Stone, and P. Weimer, 2000, Characterization of slope and basin facies tracts, Jackfork Group, Arkansas, with applications to deepwater (turbidite) reservoir management, *in* Weimer, P., Slatt, R.M., Coleman, J.L. Jr. and., Bouma, A.H. eds., Deep-water reservoirs of the world, Gulf Coast Section SEPM Foundation, 20th Annual B.F. Perkins Research Conference, p. 940-980.

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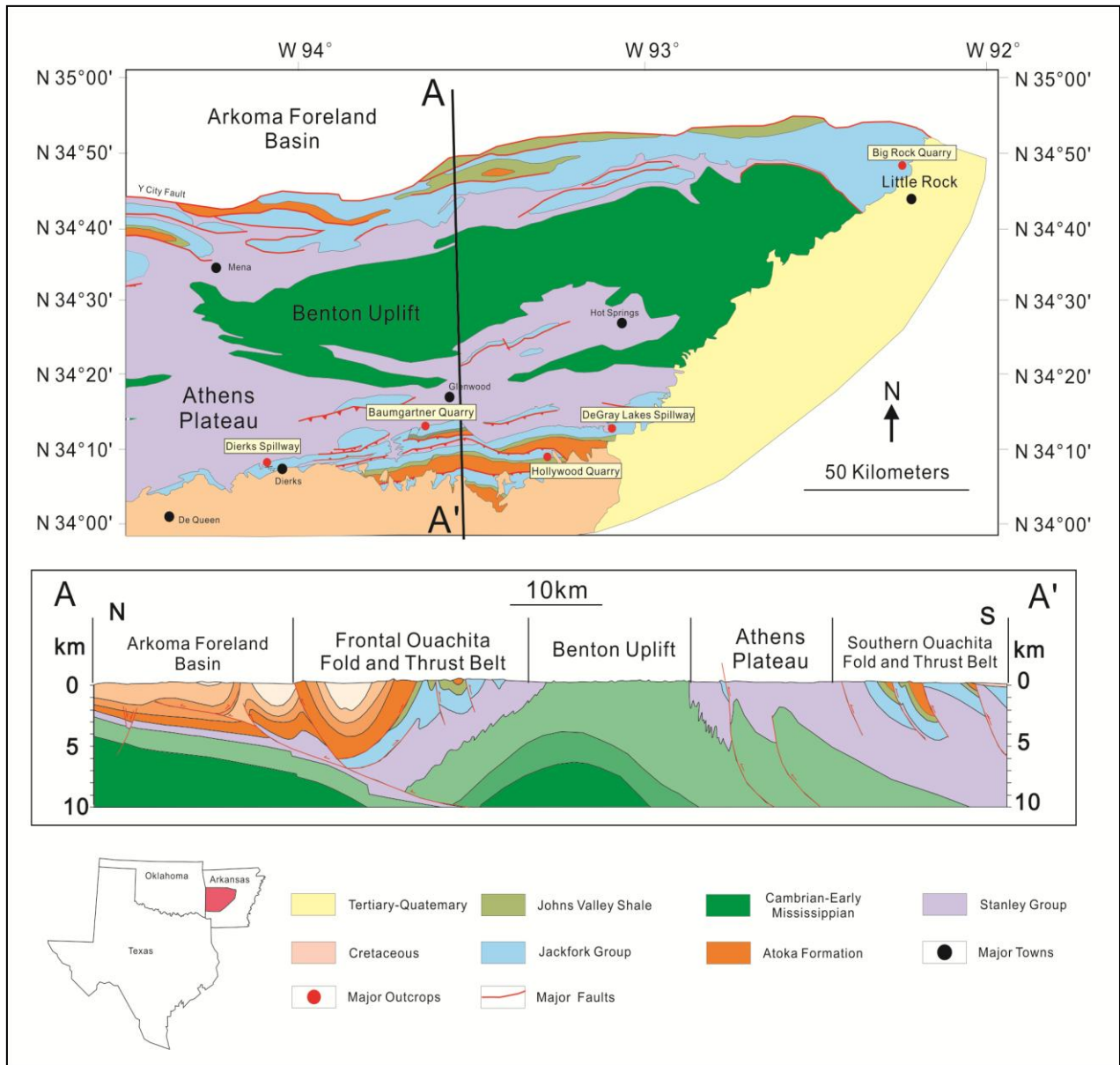


Figure 1. Geological map and regional cross sections of Baumgartner Quarry area, Ouachita Mountains, Arkansas. The location of Baumgartner Quarry is marked by red dot. Modified from Arkansas Geological Maps, Slatt et al. (2000) and Suneson (2008).

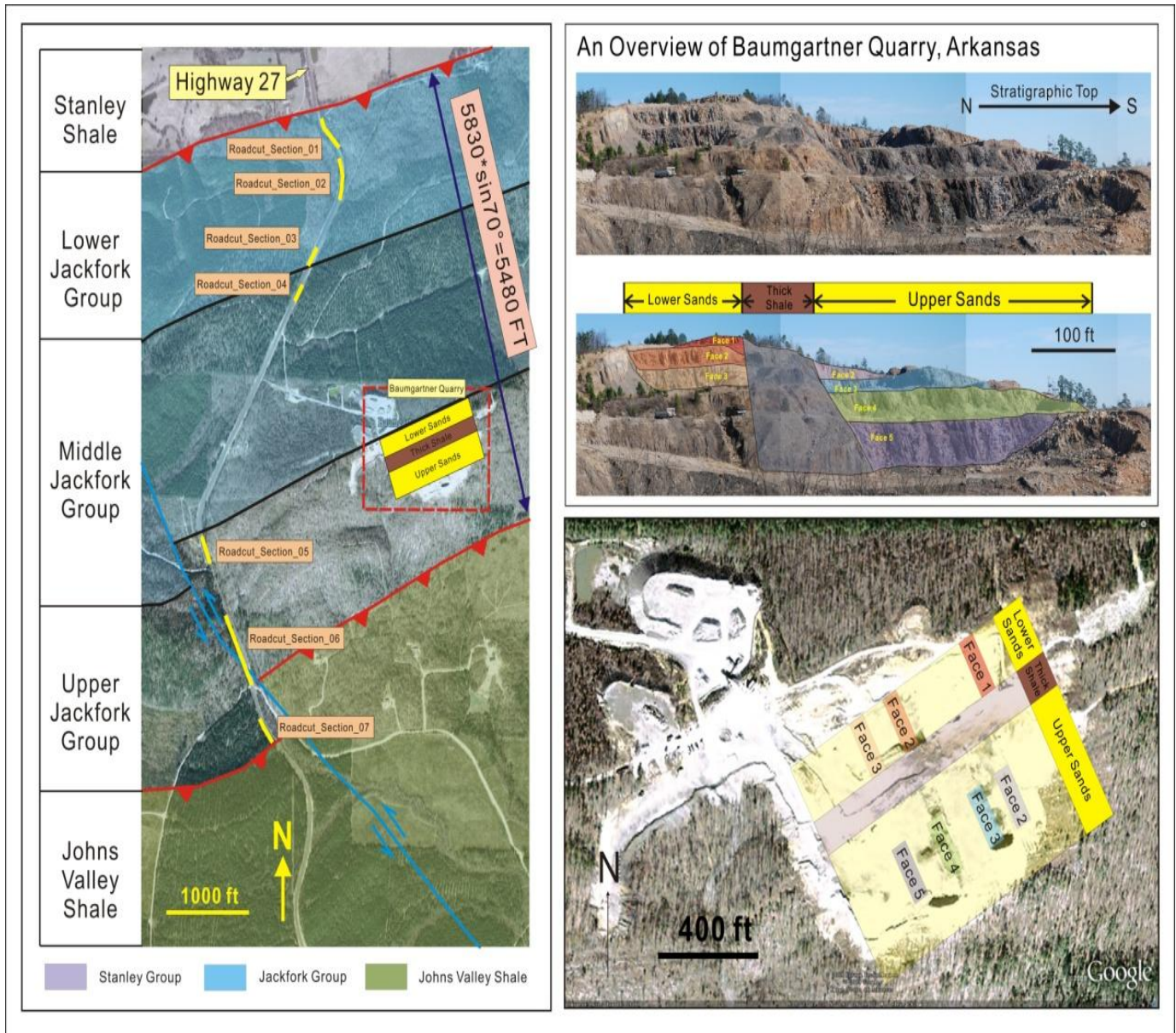
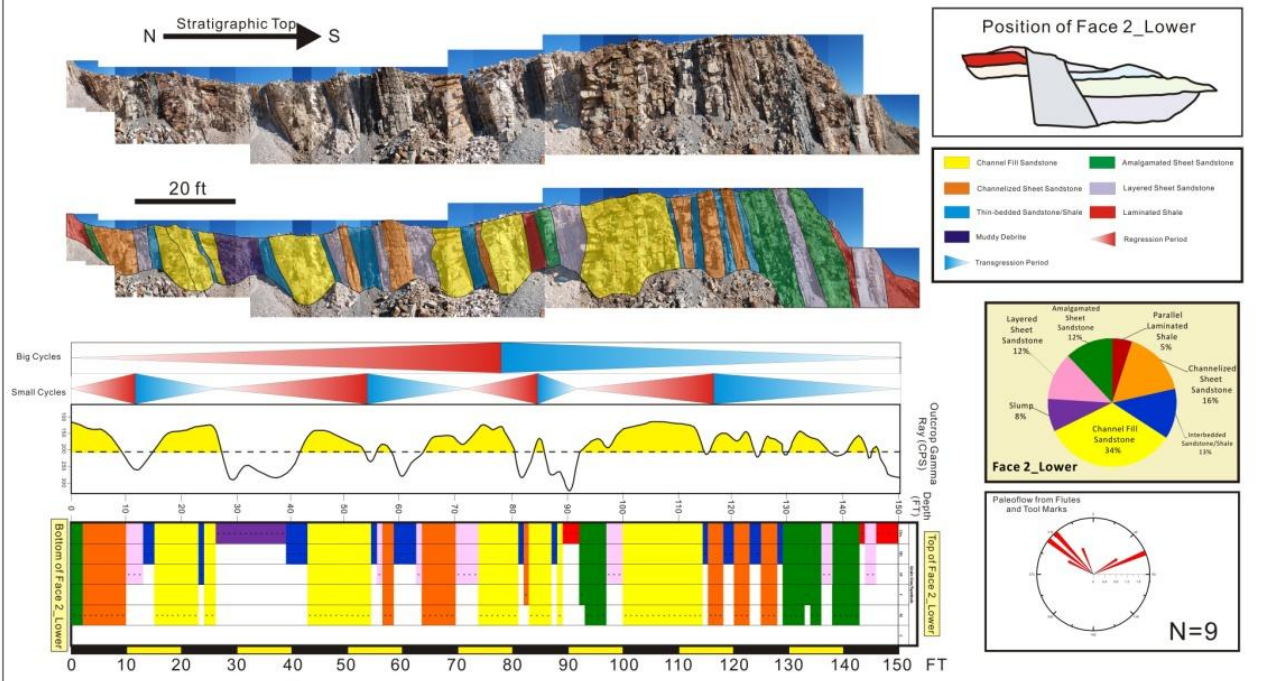


Figure 2. An overview of Baumgartner Quarry Area; the left figure is a detail geological map around the Baumgartner Quarry. The locations of several roadcuts are also marked on the map. The right two figures show an overview of the Baumgartner Quarry.

Measured Section of Face 2_Lower, Baumgartner Quarry, Arkansas



Measured Section of Face 4_Upper, Baumgartner Quarry, Arkansas

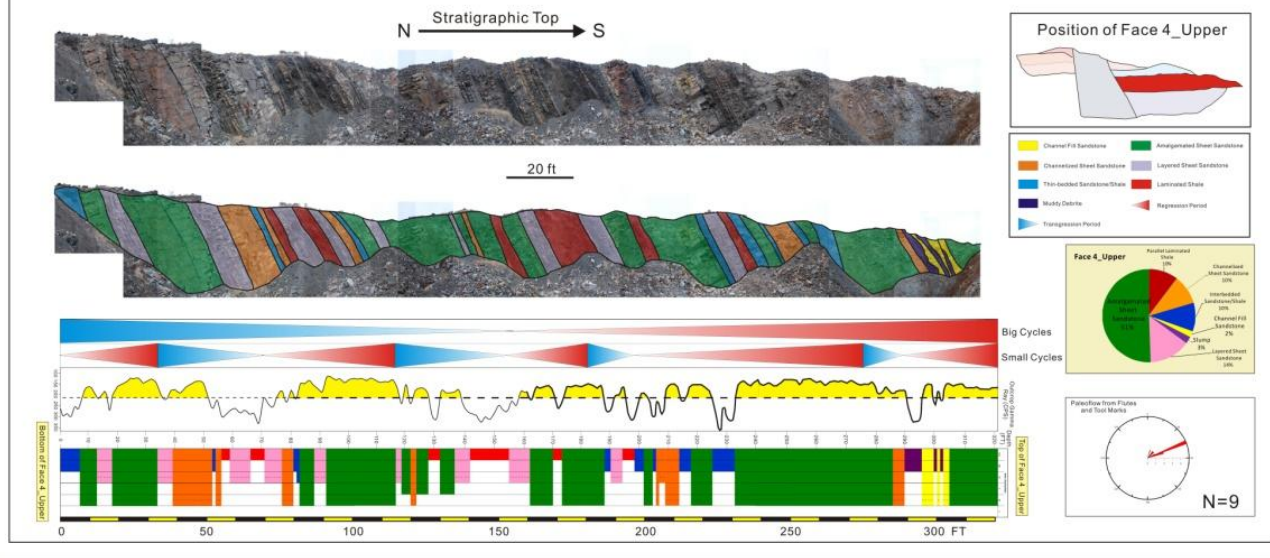


Figure 3. Measured sections of Face2_Lower Sands and Face4_Upper Sands, including lithofacies, grain size, outcrop gamma ray, eustatic sea-level cycles and paleocurrent directions.

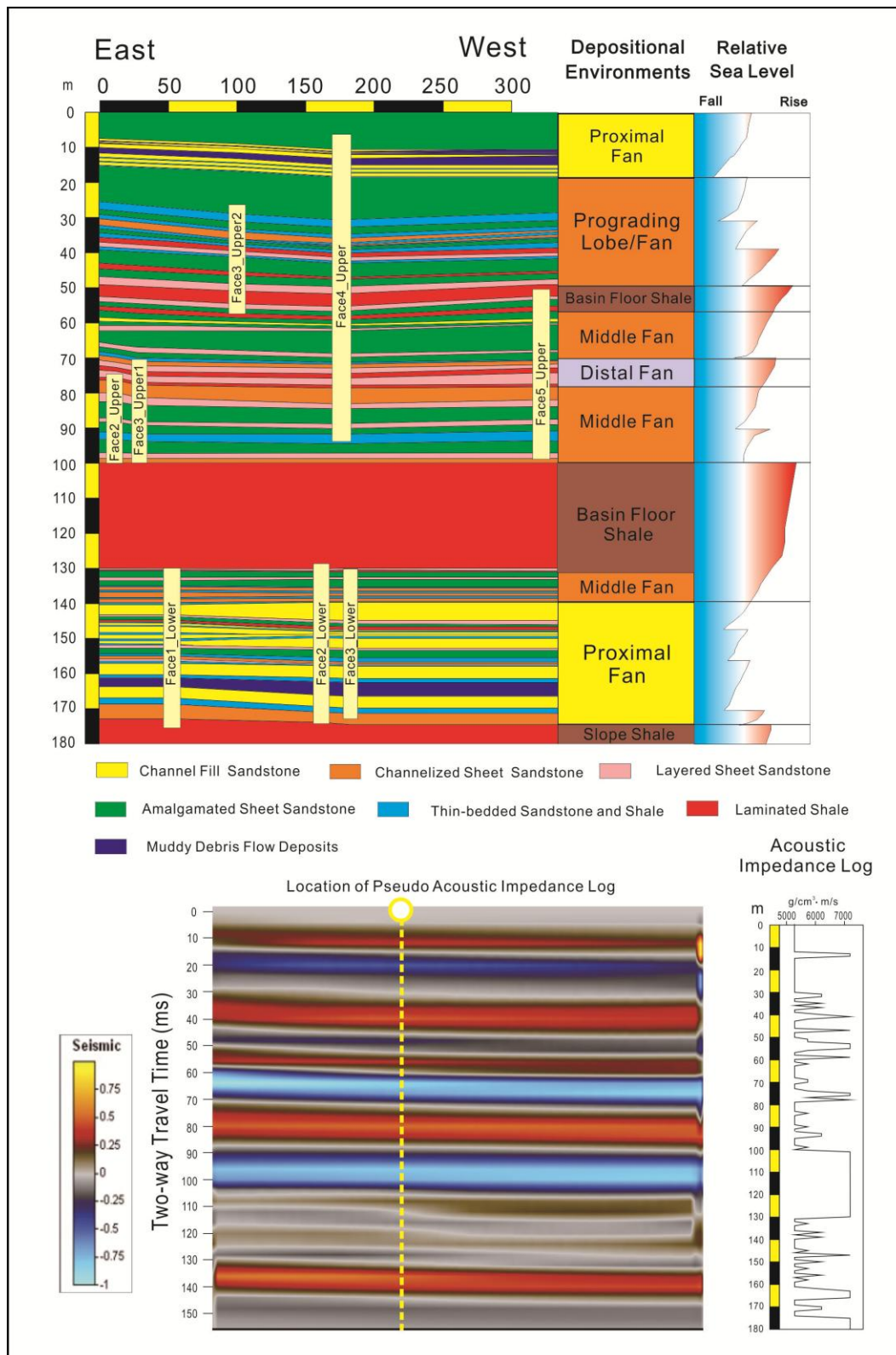


Figure 4. Summary of stratigraphic units of Baumgartner Quarry and the related seismic forward modeling results.

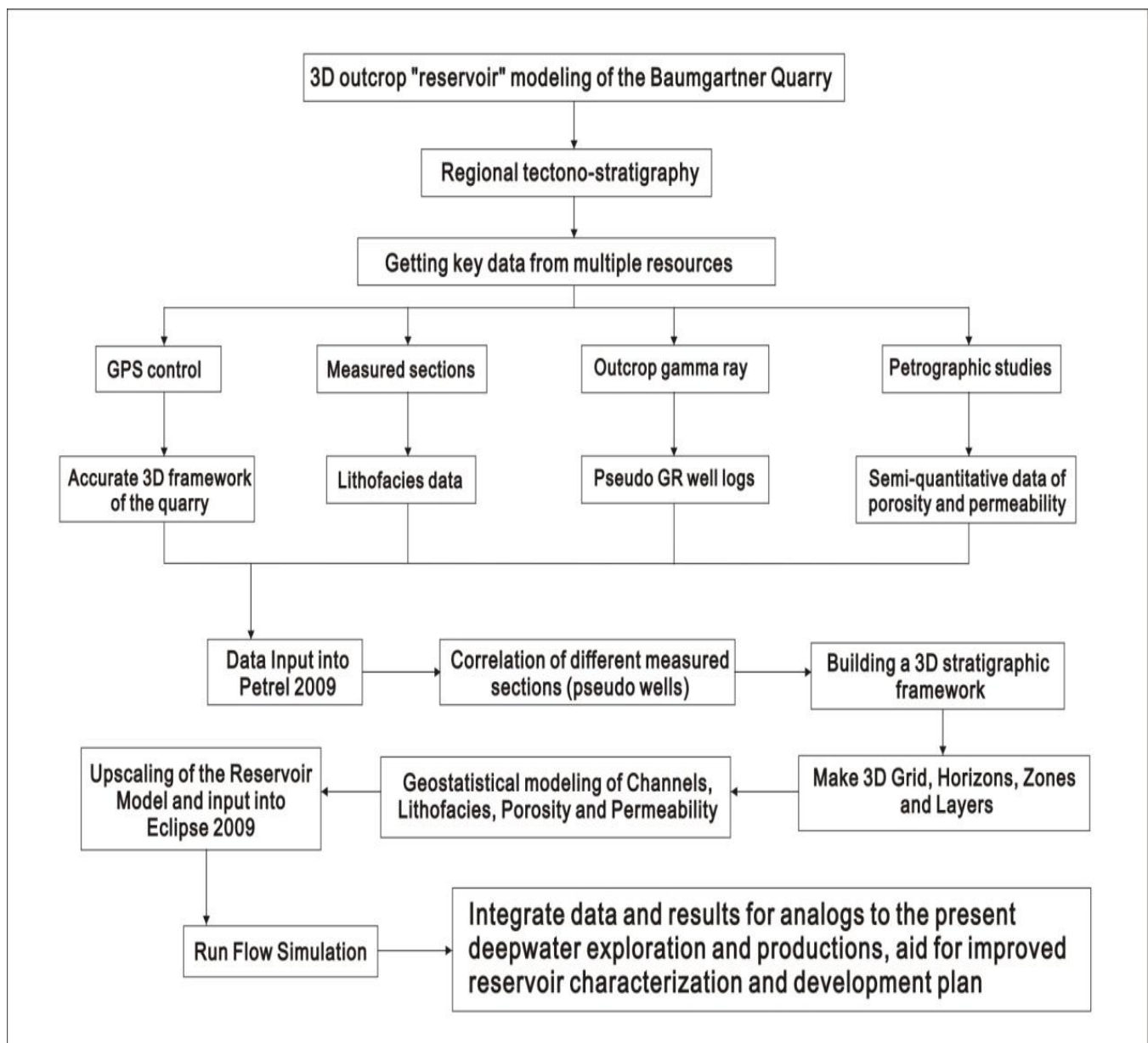


Figure 5. The workflow of 3D outcrop “reservoir” modeling of the Baumgartner Quarry starts from field measurements and observation, to the data integration, and to the 3D reservoir modeling and simulation.

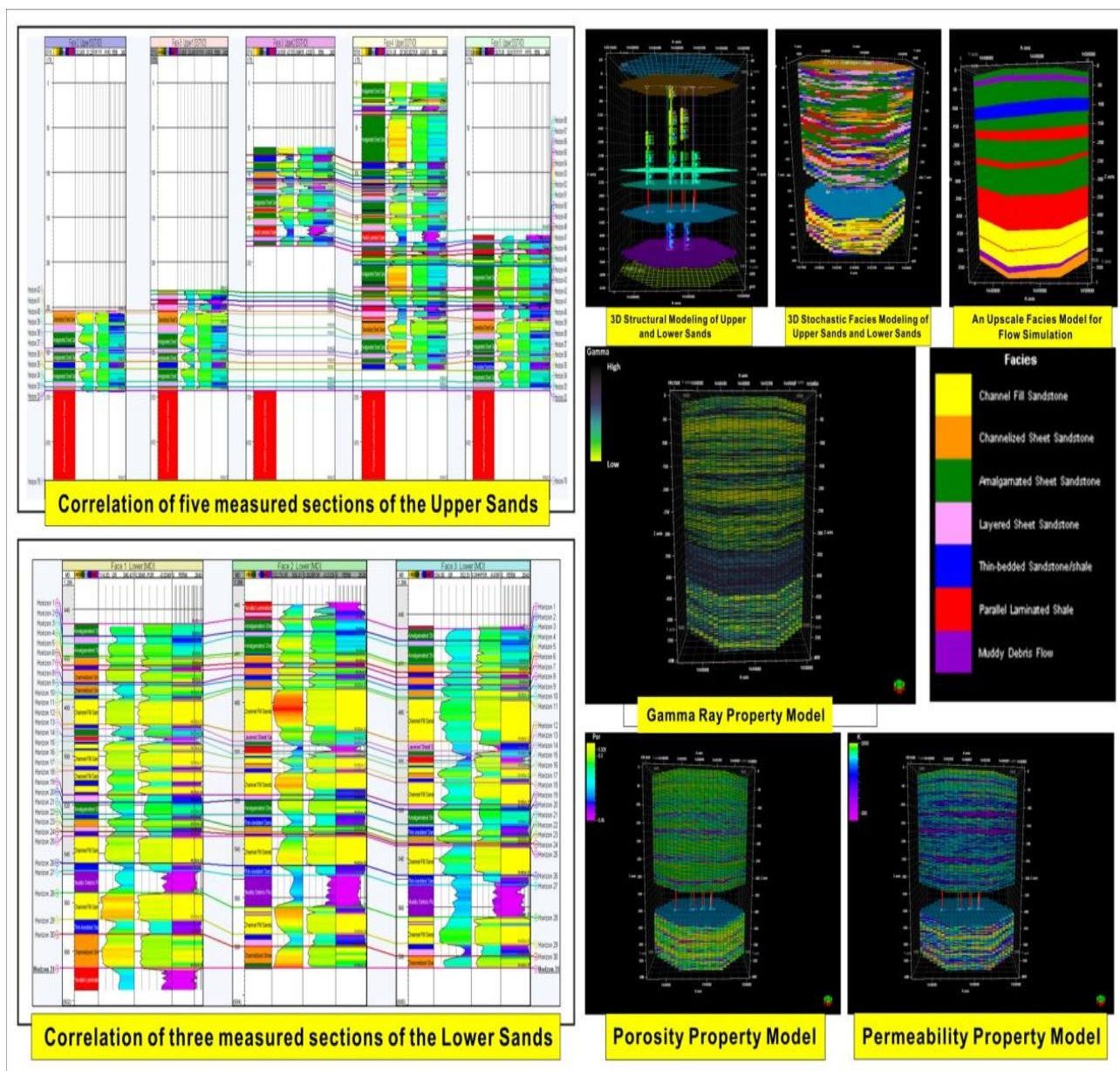


Figure 6. Correlation of all the measured sections (left) and 3D geological modeling results (right), including facies modeling, gamma ray modeling as well as porosity and permeability modeling.

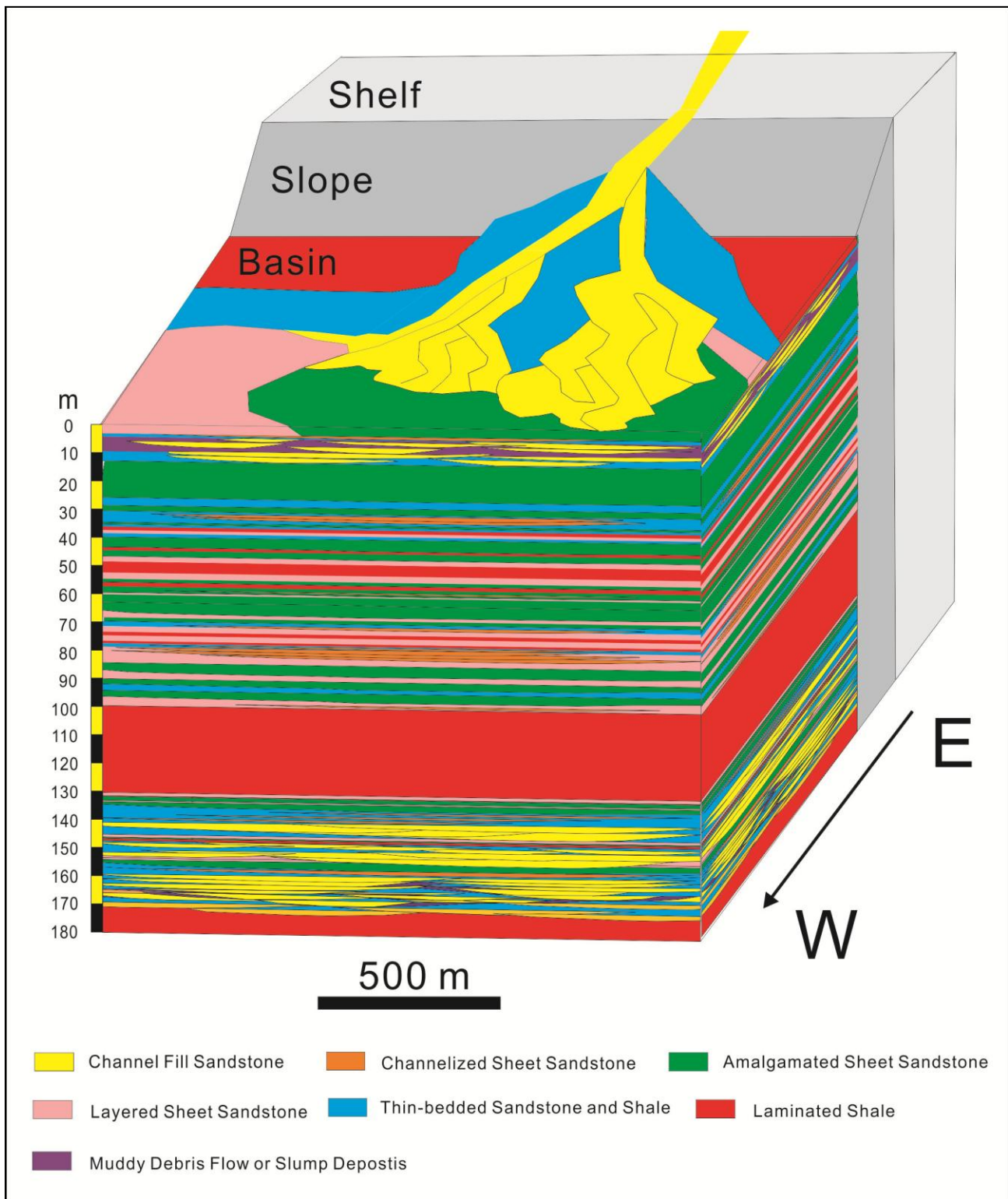


Figure 7. Schematic depositional model of the Baumgartner Quarry-Type basin.

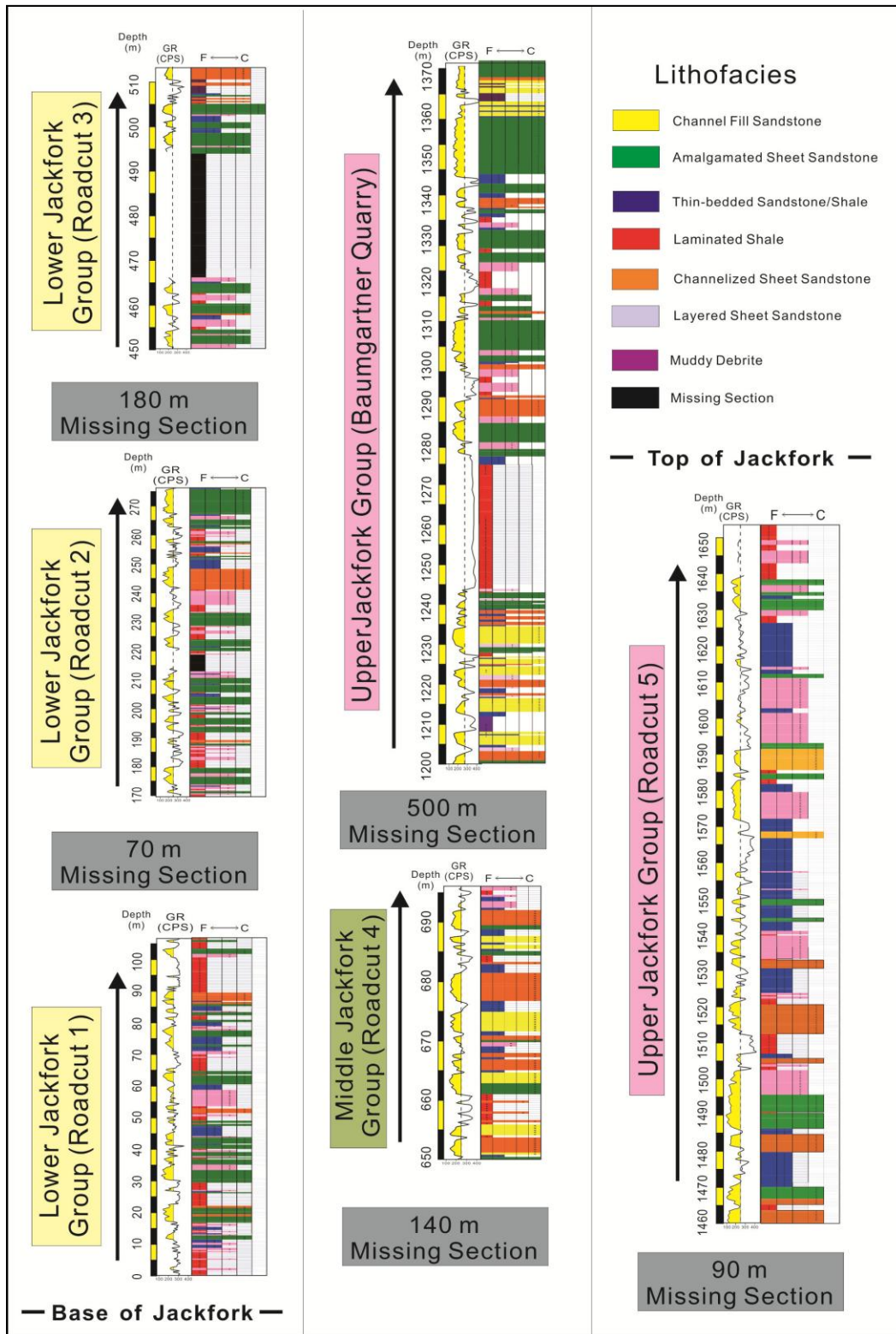


Figure 8. Long-Section of Jackfork Group including roadcuts and Baumgartner Quarry south to Kirby, Arkansas; for locations, see [Figure 2](#).