Lithofacies and Reservoir Assessment for the Thirteen Finger Limestone, Hugoton Embayment, Kansas*

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Abstract

The Atokan Thirteen Finger Limestone is a widely distributed and mappable subsurface unit with a distinct wireline log signature. In the Anadarko Basin and Hugoton Embayment of western Oklahoma and Kansas, the Thirteen Finger Limestone is interpreted using log characteristics and bit cuttings as a package of thin interbedded carbonates and radioactive shales that is in sharp contact with the underlying Morrowan shale. The contact between the Thirteen Finger Limestone and overlying Desmoinesian Cherokee Group is more difficult to determine. Fortunately, the complete section of the Thirteen Finger Limestone was cored in the Amoco Rebecca Bounds well drilled in Greeley County, KS. This core, which resides at the Kansas Geological Survey, was examined and sampled to establish stratigraphic boundaries and assess reservoir potential. The base of the Thirteen Finger Limestone was placed at a prominent exposure surface at 5019 feet. Immediately above this surface is a thin coal followed by marine shale and limestone. The top of the Thirteen Finger Limestone was placed at an exposure surface at 4936 feet. The 83 feet of Atokan strata contains limestones (70%) separated by fossiliferous dark gray shale (10%) or black shales (20%) with few macroinvertebrates. Seven prominent flooding surfaces and two hardgrounds help define Atokan high-frequency cycles that consist of dark shale (initial flooding) that transitions upward shallower-water limestone. The dark uranium-rich shales are likely source rocks. Adjacent limestones are dominantly dense wackestones and packstones with average matrix porosity and permeability values of 0.8% and 0.1 md, respectively. However, these limestones contain numerous open- and healed-vertical fractures that may provide the pore network necessary to produce oil and gas.
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ABSTRACT

The Thirty-Finger Limestone is a widely distributed and marketable subsurface unit with a distinct member log signature. In the Arkansas basin and Hugoton Embayment of western Oklahoma and Kansas, the Thirty-Finger Limestone is interpreted using log characterizations and cored outcrops as a package of the sandstone- 
dominated carbonates and calcarenites shales tied in sharp contact with the underlying Mississippian shales. The contact between the Thirty-Finger Limestone member and underlying DeGrayan Section shales is not as easy to determine. The Thirty- 
Finger Limestone is uppermost part of the DeGrayan Section of the Morrowian age. The Thirty-Finger Limestone is well-drilled in Gray County, KS. 

This study which involved the Kansas Geological Survey was examined and sampled to establish stratigraphic 
boundaries and assess reservoir potential. The base of the Thirty-Finger Limestone was placed at a pronounced surface at 255 ft. The upper contact of this surface is a clay pinch-out followed by marine shale. The 


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Geochronology

W.B. data show times of enrichment and diagenesis of Hg, Zn, Pb, Sr, and Eu. Values in comparison to the Taylor and McLennan (1985) post-Archean shale (red line) values of the PAH values signify enhanced arsenic conditions. Values of the PAHs significantly diminishment due to scavenging.

Conclusions

1. The Thirty-three Finger Limestone (Pennsylvanian) is a thin section that can be identified near the western edge of the Arkansas basin on seismic sections and in outcrops in the central part of the Thirty-Finger Limestone is included in the DeGrayan Section, which is the uppermost part of the DeGrayan Section of the Morrowian age.

2. Thirty-Finger Limestone is composed of thin-line 

stones and interbeds. 

Examined outcrops at the surface and in the subsurface, especially along the eastern edge of the basin, where the Thirty-Finger Limestone is exposed. 

3. The distribution of black shale could favor the 

formation of petroleum through hydrolysis.

4. Based on this section, microporosity is not 

true in the outcrops.

Future Work

Borehole studies are currently underway to determine 

stratigraphic controls on the Thirty-Finger Limestone. Additional work needs to be done to correlate this section with outcrops in the DeGrayan Section of the Thirty-Finger Limestone. Additional work needs to be done to correlate this section with outcrops in the DeGrayan Section of the Thirty-Finger Limestone.

Figure 2 - Structural field photo showing Thirty-Finger Limestone features and core location (Modified from Young, 1998).

Figure 3 - Tracing the Thirty-Finger Limestone in the field at the S. Kansas location.

Figure 4 - Tracing the Thirty-Finger Limestone in the field at the E. Kansas location.

Figure 5 - Tracing the Thirty-Finger Limestone in the field at the W. Kansas location.

Figure 6 - Tracing the Thirty-Finger Limestone in the field at the N. Kansas location.

Figure 7 - Tracing the Thirty-Finger Limestone in the field at the S. Kansas location.

Figure 8 - Tracing the Thirty-Finger Limestone in the field at the E. Kansas location.

Figure 9 - Tracing the Thirty-Finger Limestone in the field at the W. Kansas location.

Figure 10 - Tracing the Thirty-Finger Limestone in the field at the N. Kansas location.

Figure 11 - Tracing the Thirty-Finger Limestone in the field at the S. Kansas location.

Figure 12 - Tracing the Thirty-Finger Limestone in the field at the E. Kansas location.

Figure 13 - Tracing the Thirty-Finger Limestone in the field at the W. Kansas location.

Figure 14 - Tracing the Thirty-Finger Limestone in the field at the N. Kansas location.

Figure 15 - Tracing the Thirty-Finger Limestone in the field at the S. Kansas location.

Figure 16 - Tracing the Thirty-Finger Limestone in the field at the E. Kansas location.

Figure 17 - Tracing the Thirty-Finger Limestone in the field at the W. Kansas location.

Figure 18 - Tracing the Thirty-Finger Limestone in the field at the N. Kansas location.

Figure 19 - Tracing the Thirty-Finger Limestone in the field at the S. Kansas location.

Figure 20 - Tracing the Thirty-Finger Limestone in the field at the E. Kansas location.

Figure 21 - Tracing the Thirty-Finger Limestone in the field at the W. Kansas location.

Figure 22 - Tracing the Thirty-Finger Limestone in the field at the N. Kansas location.