

The Depositional System of the Green River Oil Shale in Western Colorado*

By

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Abstract

The Green River Fm, an Early Eocene lacustrine system, contains the richest and thickest oil shale deposits in the world. This study focuses on the Piceance basin in Western Colorado, a small Laramide foreland basin. The depositional history of the lake was reconstructed by correlating depositional sequences at the basin margin to the basin center in the subsurface, using well logs. The correlation is based on gamma ray signal which is controlled by the amount of U and Th in K- feldspars that are delivered to the basin from the hinterlands. The sequences were picked in the subsurface by comparing the log signature of nearby wells and identifying the geometries of the depositional surfaces. The log characteristic of the typical sequence begins with a drop in the gamma signal after a prominent gamma ray high. This indicates the increased productivity and sediment supply that follows a lake-level fall and that brings the detrital-rich sediments into the lake. The correlated surfaces are thus time significant.

The facies distribution in the basin shows a direct connection between these reconstructed lake-levels and the geochemistry of the lake waters. As lake-level fell, a sequence boundary formed and the lake water was restricted to the basin center. This increased salinity enabled the precipitation of halite, nahcolite, and dawsonite in the basin center. As lake-level rose, influx of fresh water diluted the upper part of the water column. Restricted bottom water provided the perfect conditions for organic matter preservation leading to the rich oil-shale deposits. As lake-level reached the basin margin, shallow-water carbonates were deposited. These transgressive carbonates are associated with oil-shale-rich beds toward the basin center.

The Depositional System of the Green River Oil Shale in Western Colorado

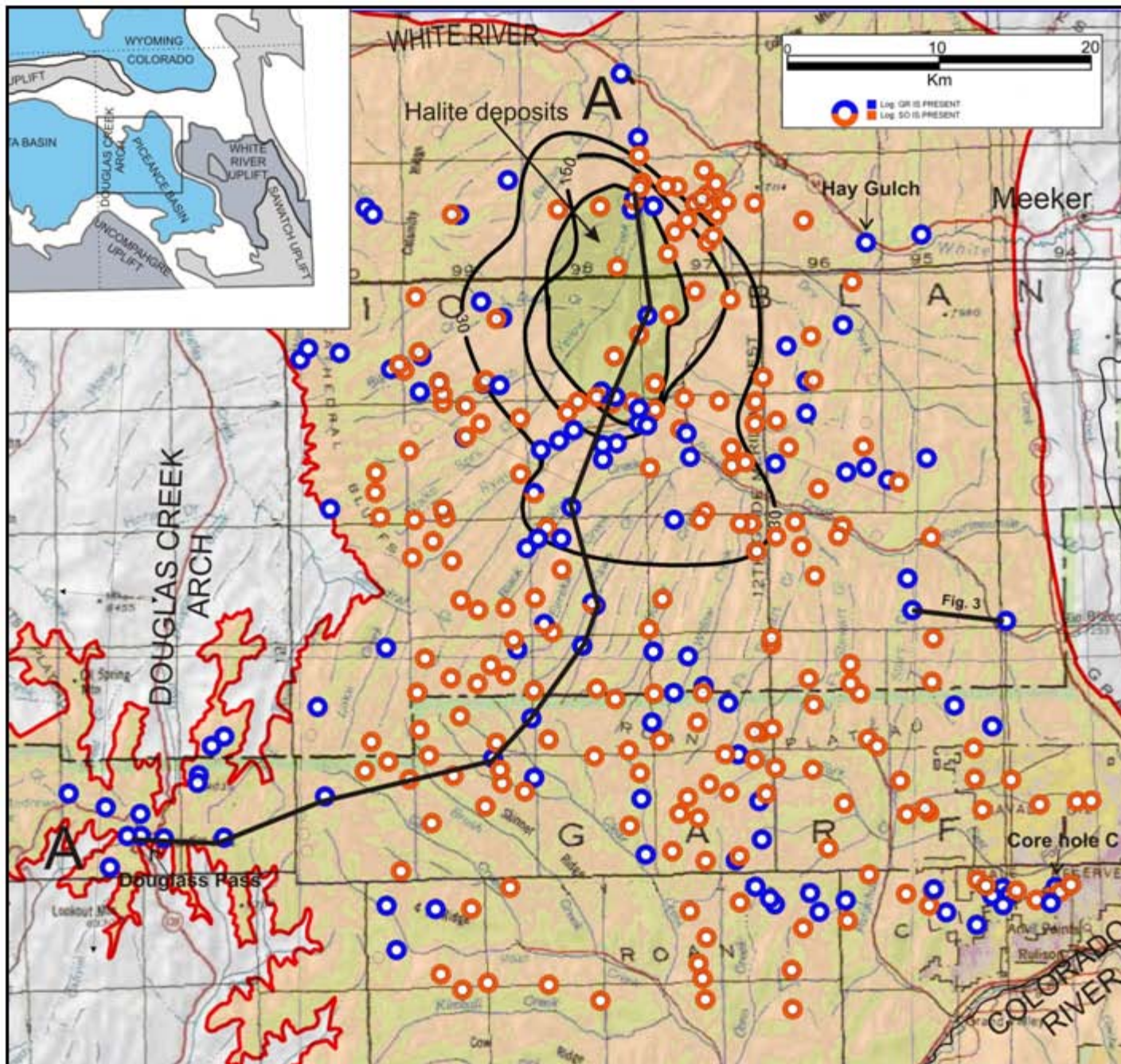
Y. Bartov, D. Nummedal and J.F. Sarg

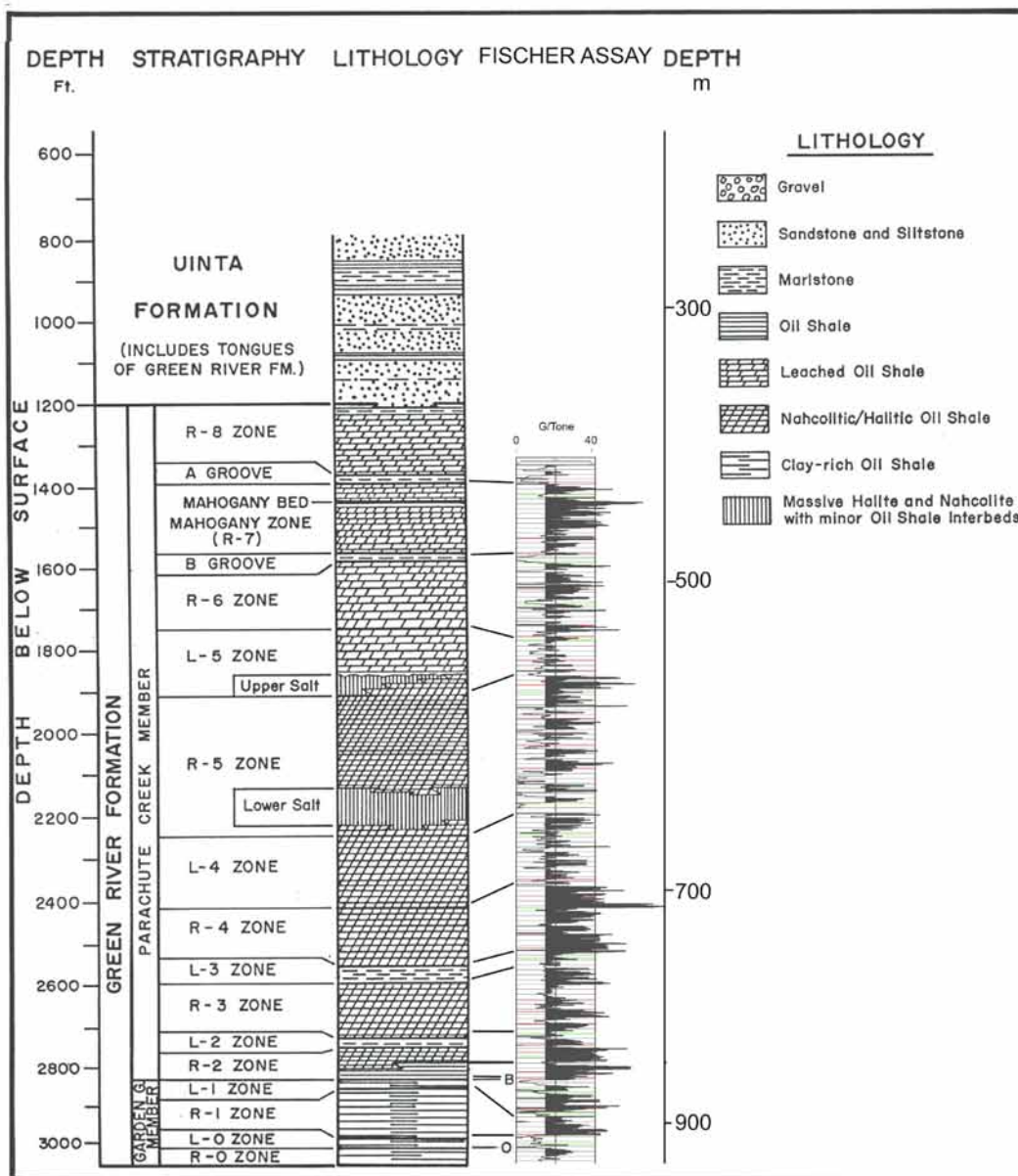
The Colorado Energy Research Institute – Colorado School of Mines



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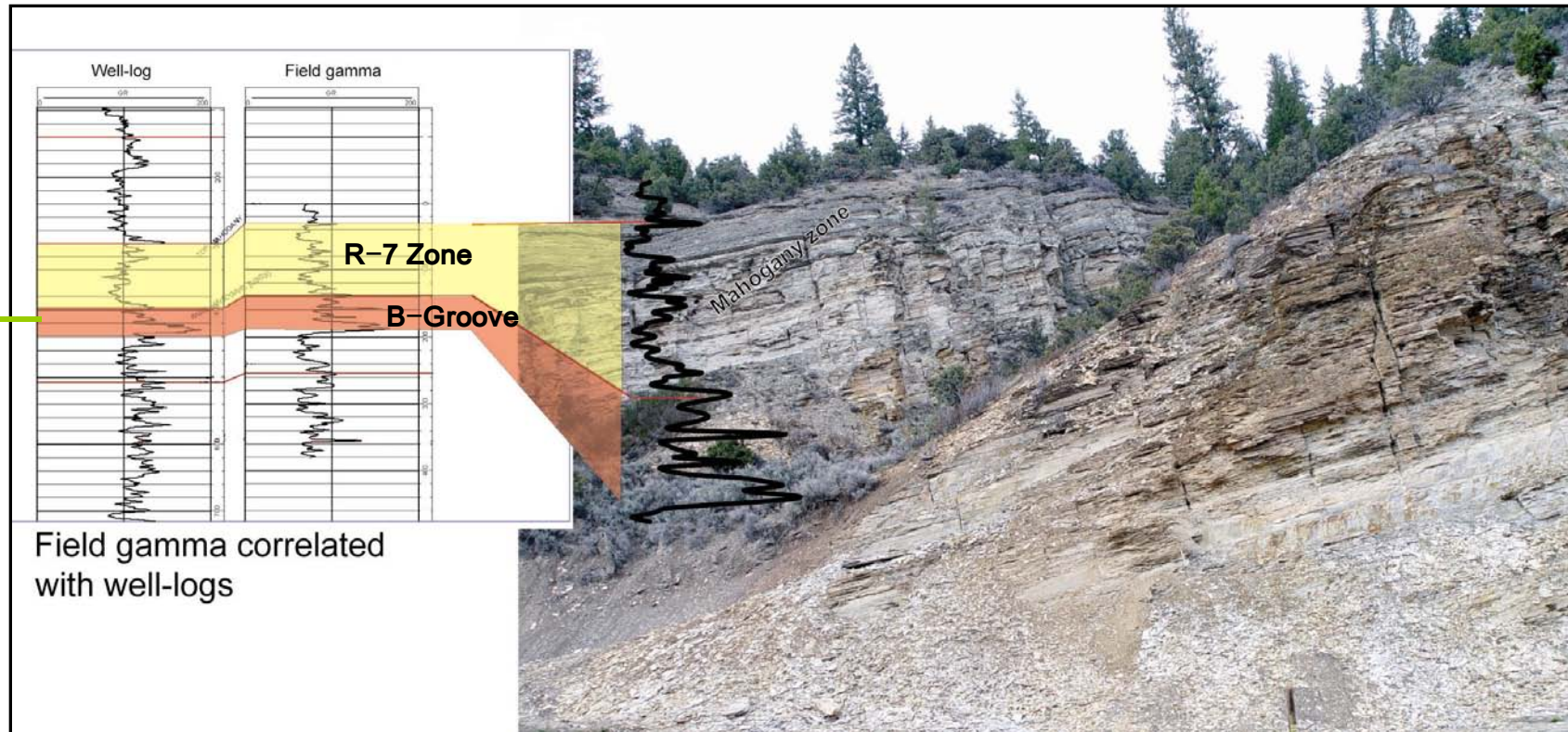


After Daub and Associates

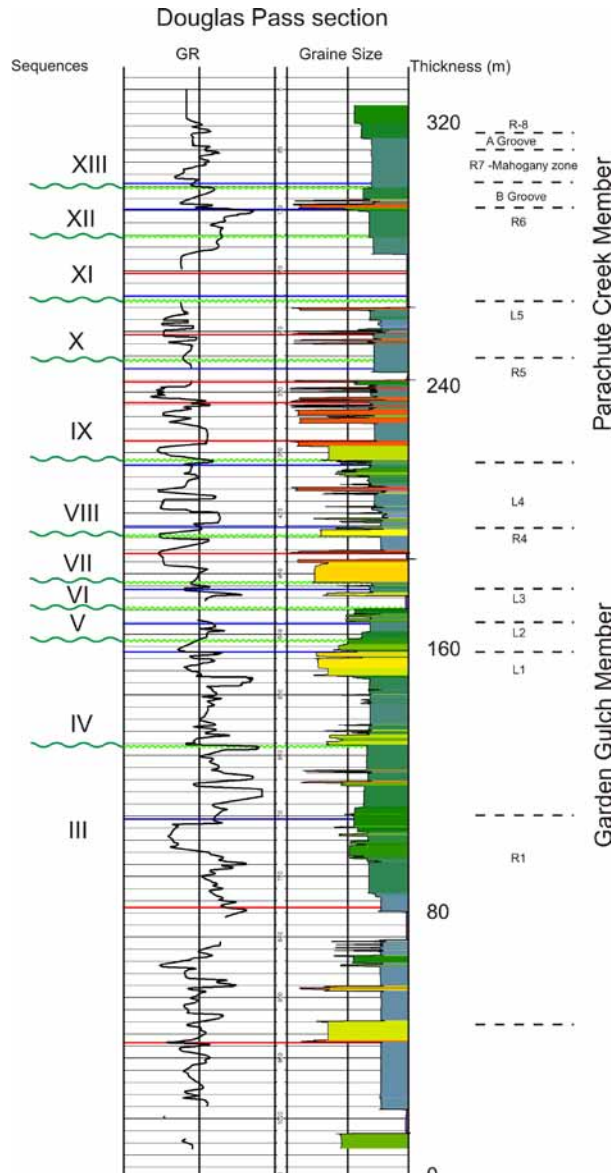
Rio Blanco: Outcrop-GR Correlation

Seq 13


Seq 12



Douglas Pass: Outcrop-GR Correlation



- Douglas Pass locality represents basin margin lacustrine environment
- Depositional facies include fluvial sandstones, shallow lake carbonates, marlstones and minor oil shale
- Field GR helps correlate outcrop stratigraphic section to subsurface data
- Basin-center open lacustrine oil shale and marlstone are correlated to outcrop section

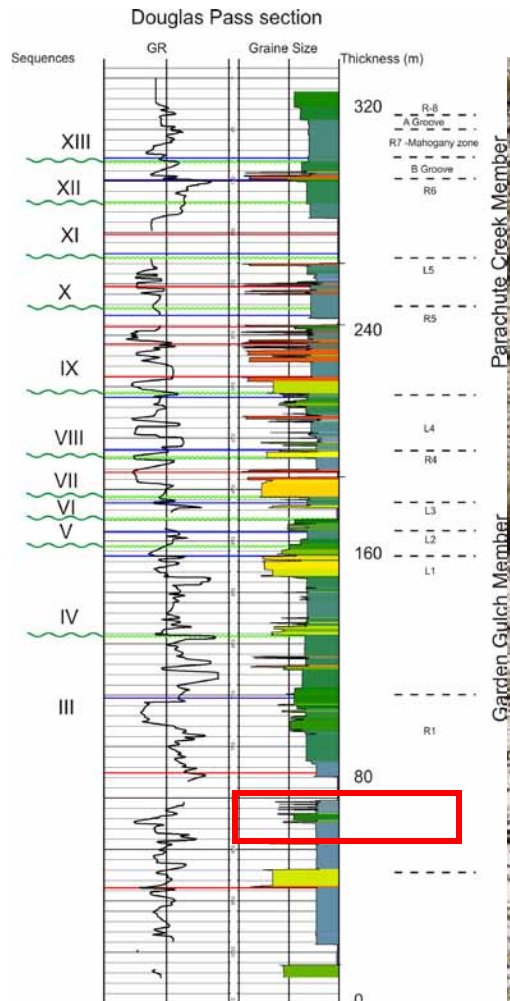


Mahogany zone

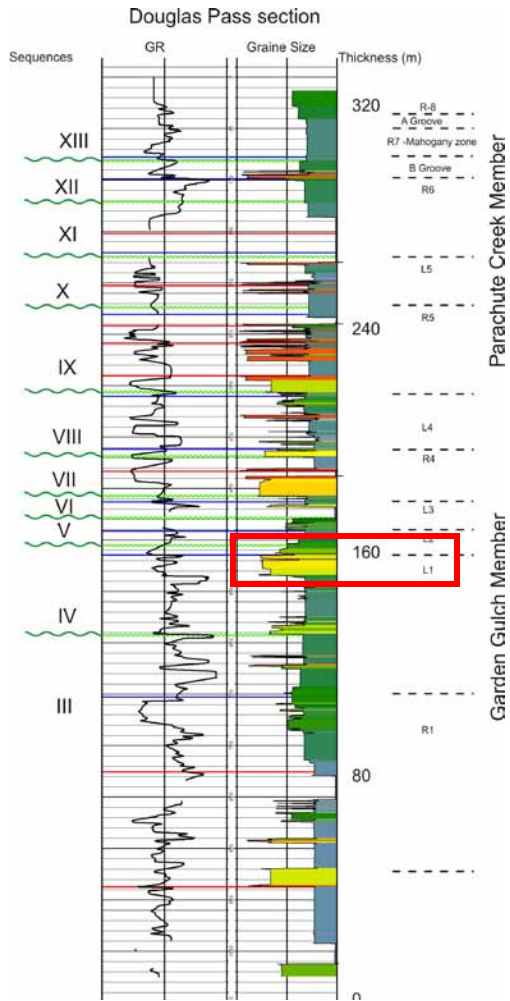
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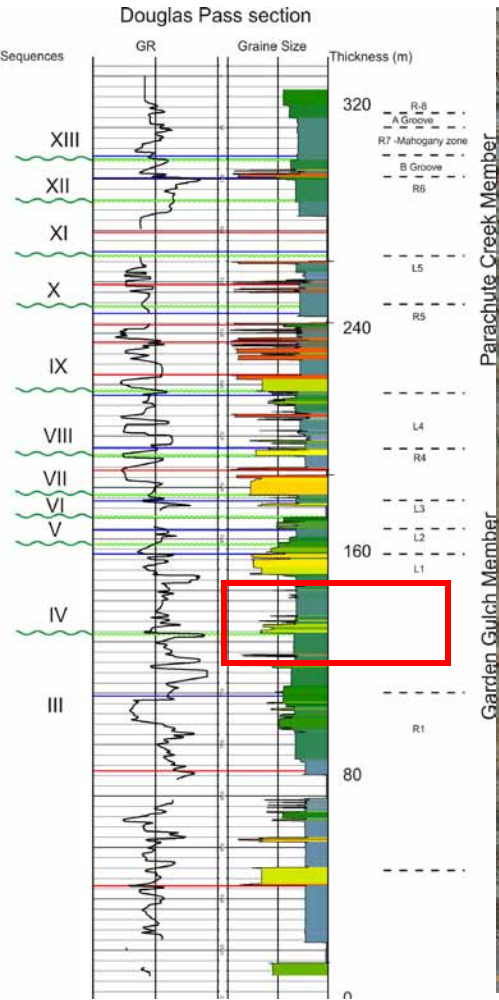
Douglas Pass: Bedded Oil Shale & Ostracodes (Upper R-1 Zone)



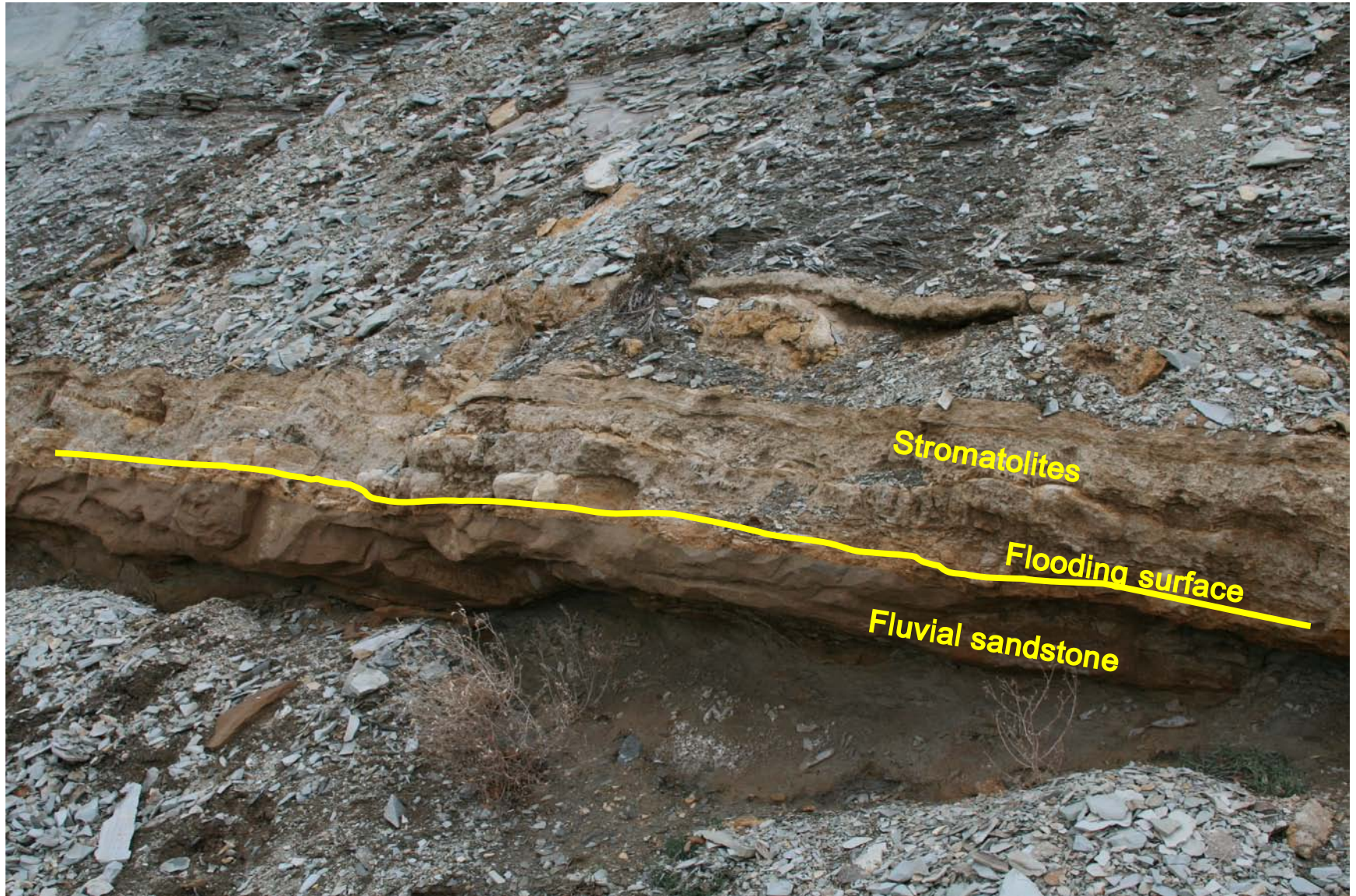
Douglas Pass: Fluvial SS During L-1 Time



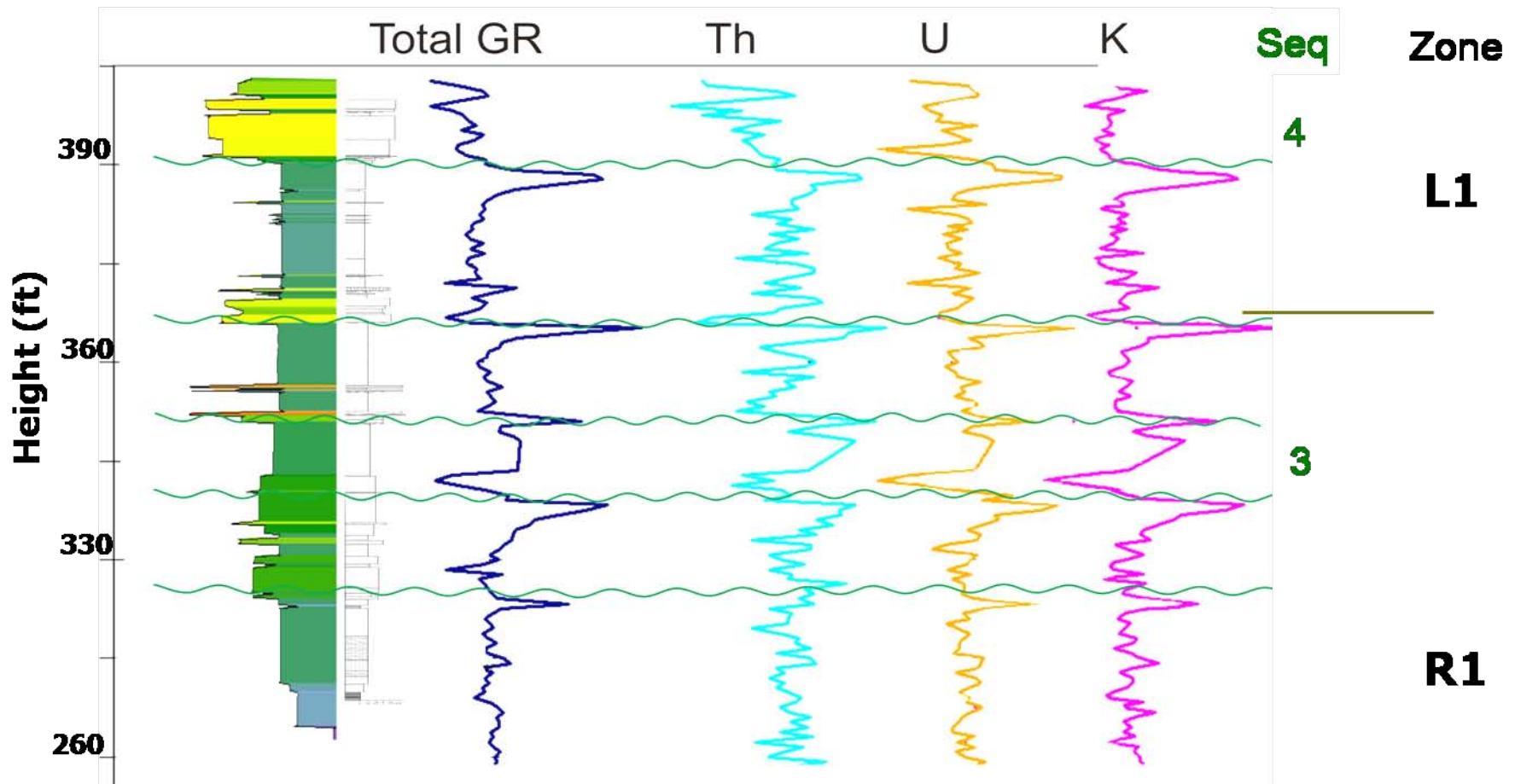
Douglas Pass: Sequences 3 and 4 (R1/L1)



Douglas Pass: Flooding Surface



Douglas Pass: Outcrop Spectral GR (Seq 3–4)

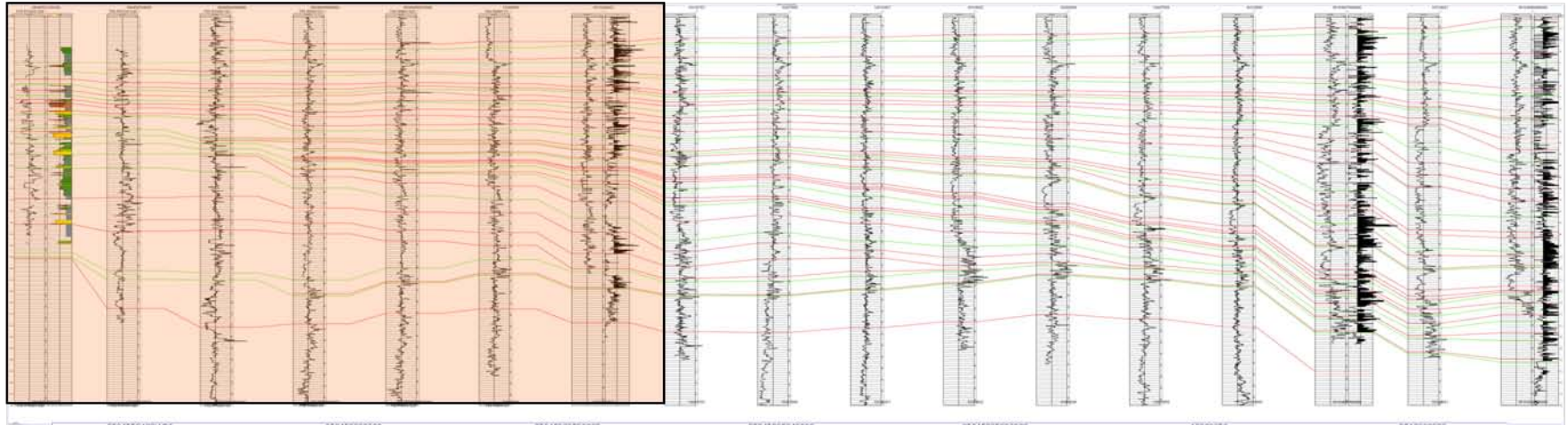


- High GR responses lie stratigraphically below erosional surfaces
- Increase in GR response caused by increased water influx to lake (highstands), associated with radioactive mineral deposition

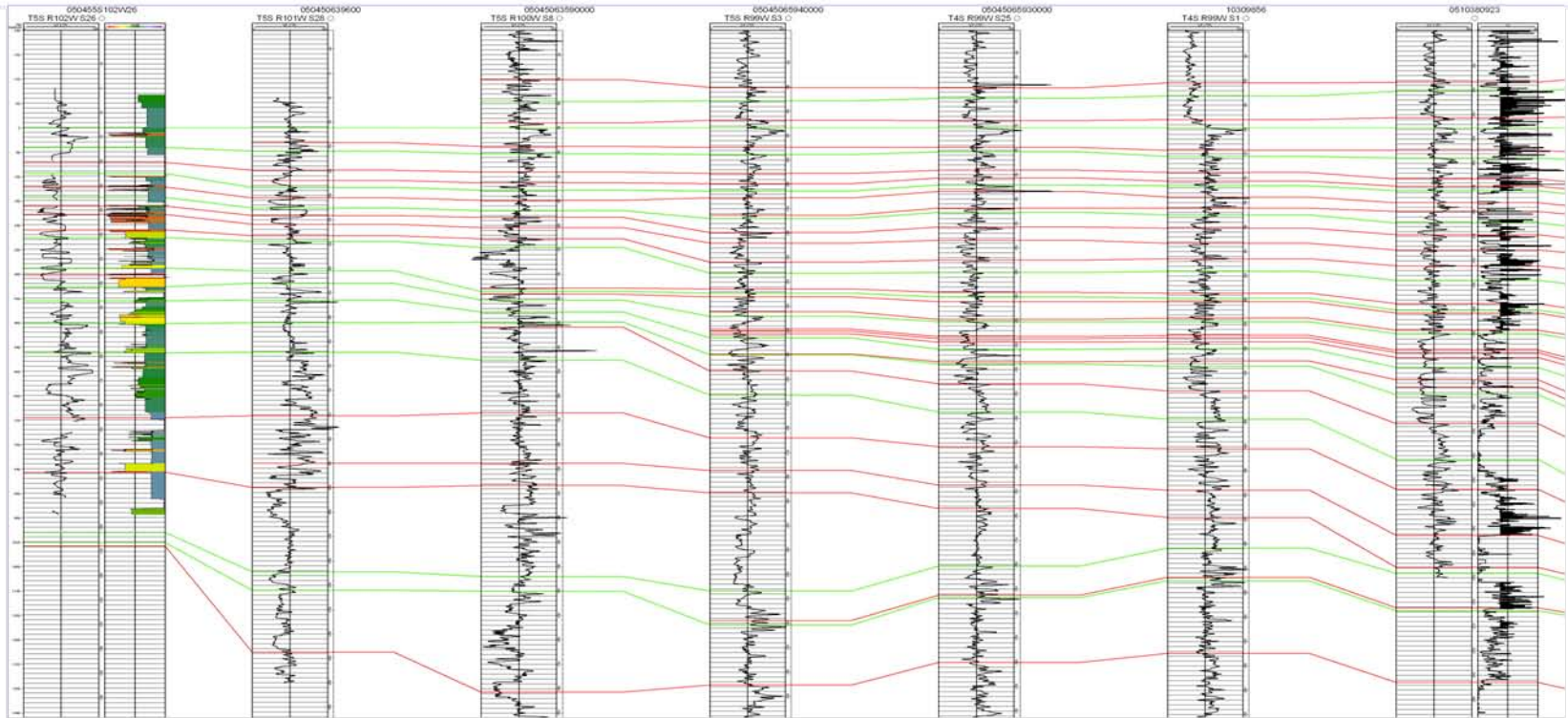
Stratigraphic Section

Douglas Pass to North Piceance Creek

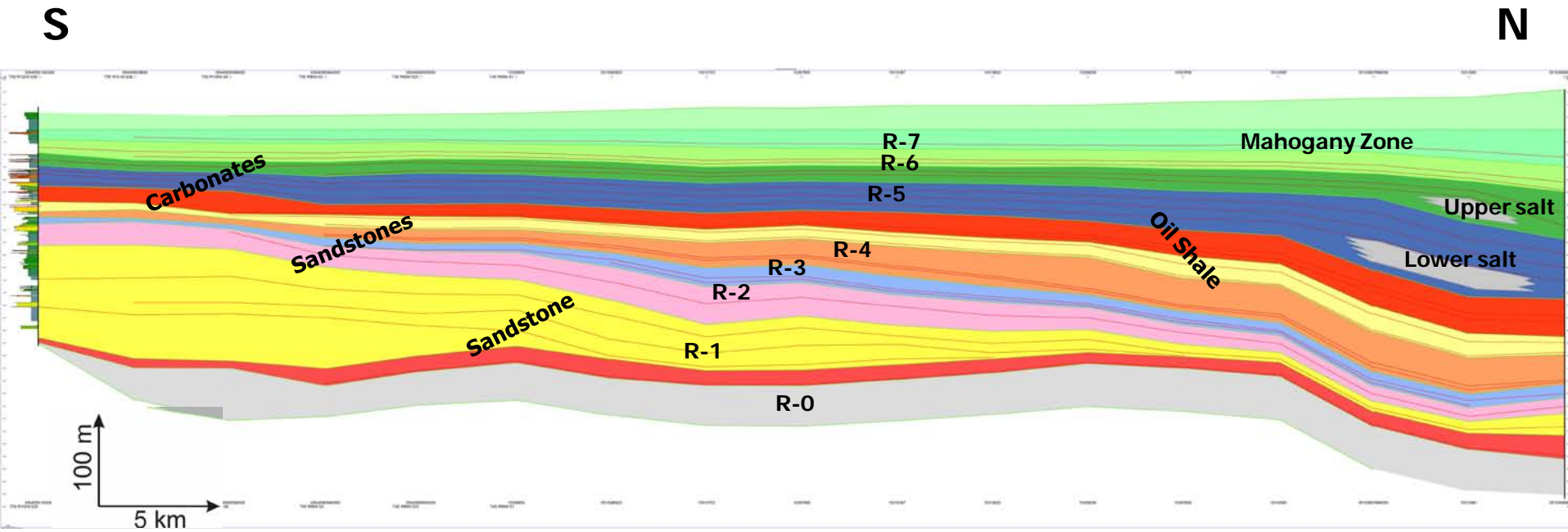
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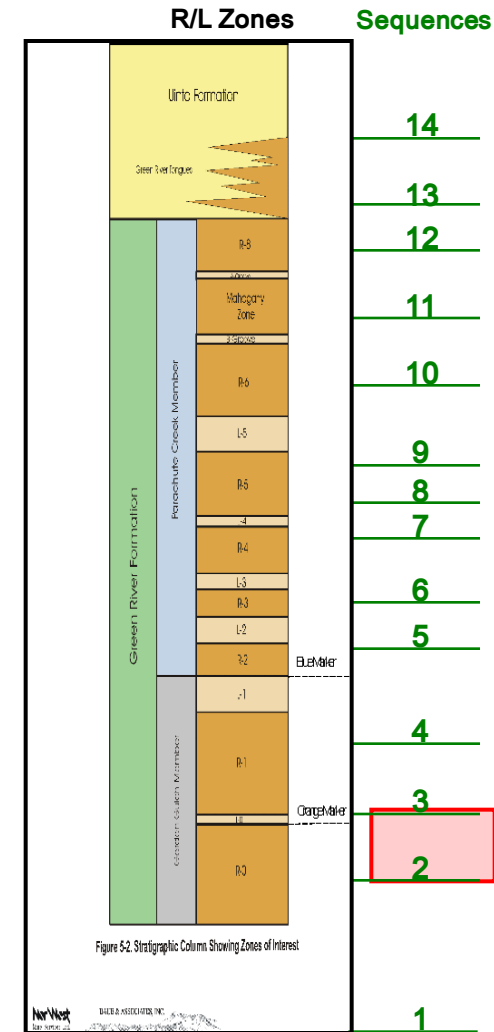
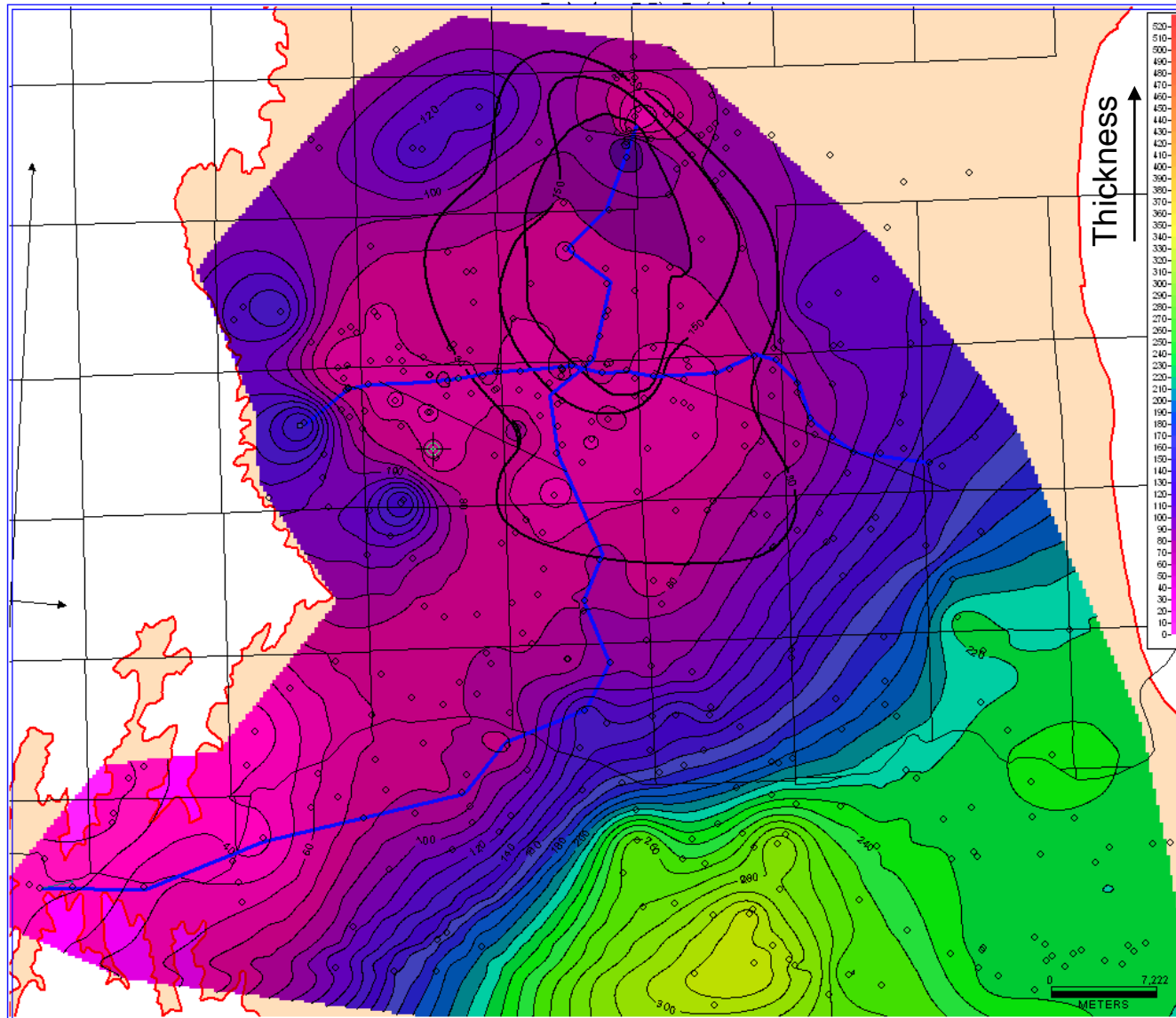


Sequence Section: Douglas Pass–Basin Center

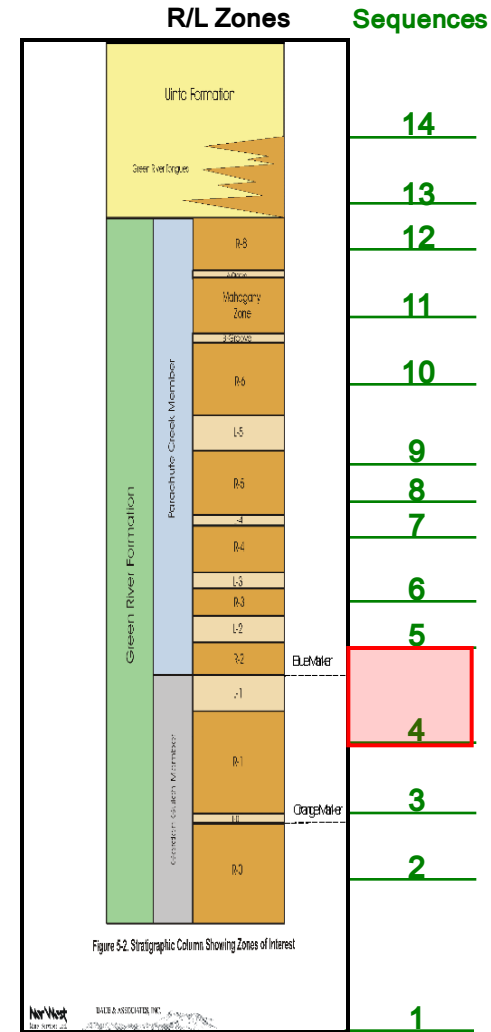
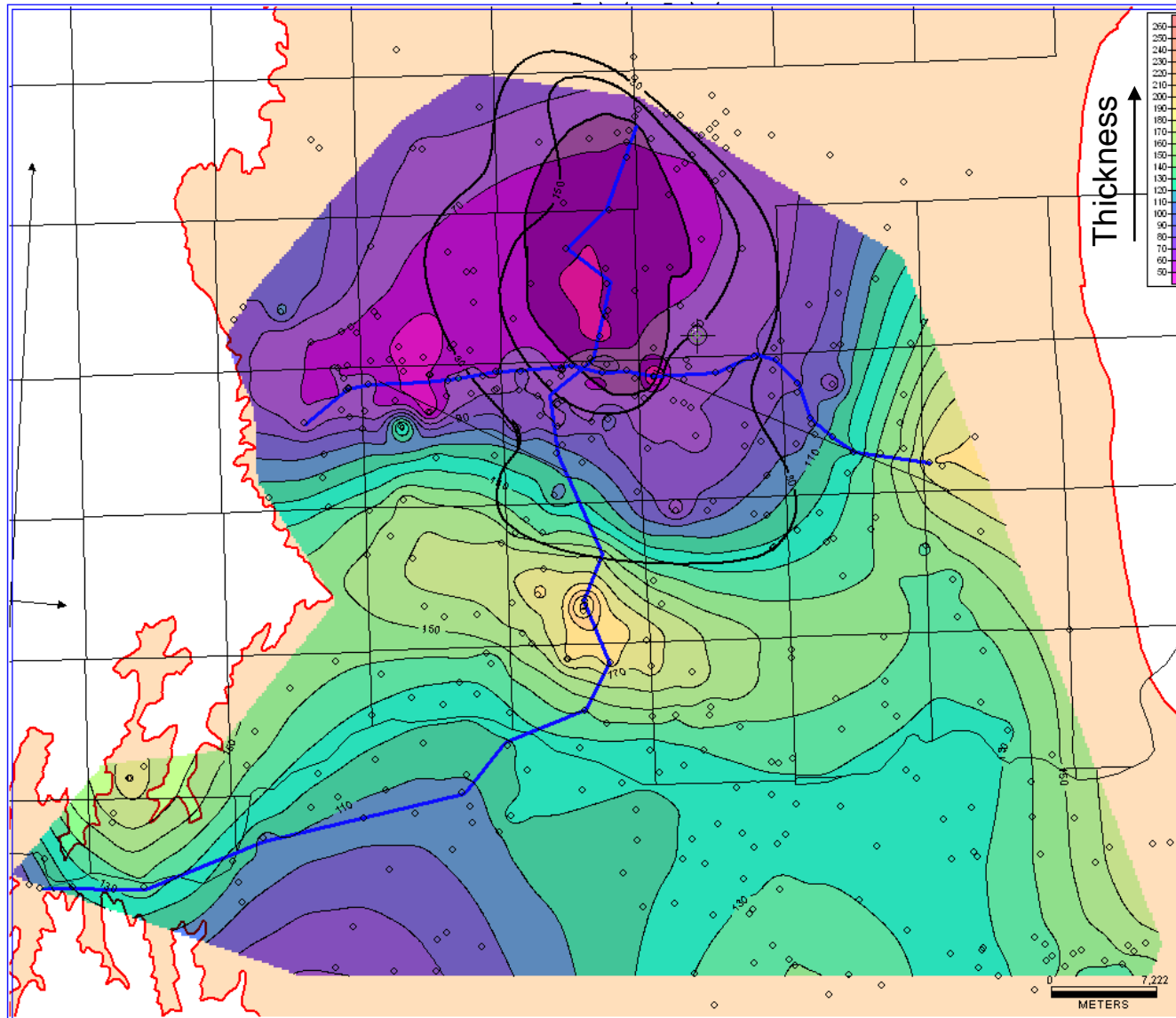


Colors represent sequences

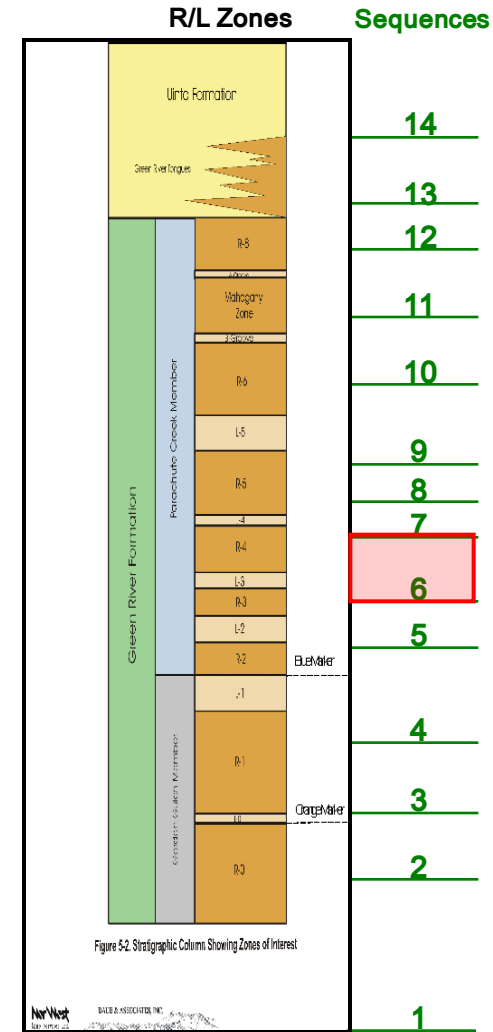
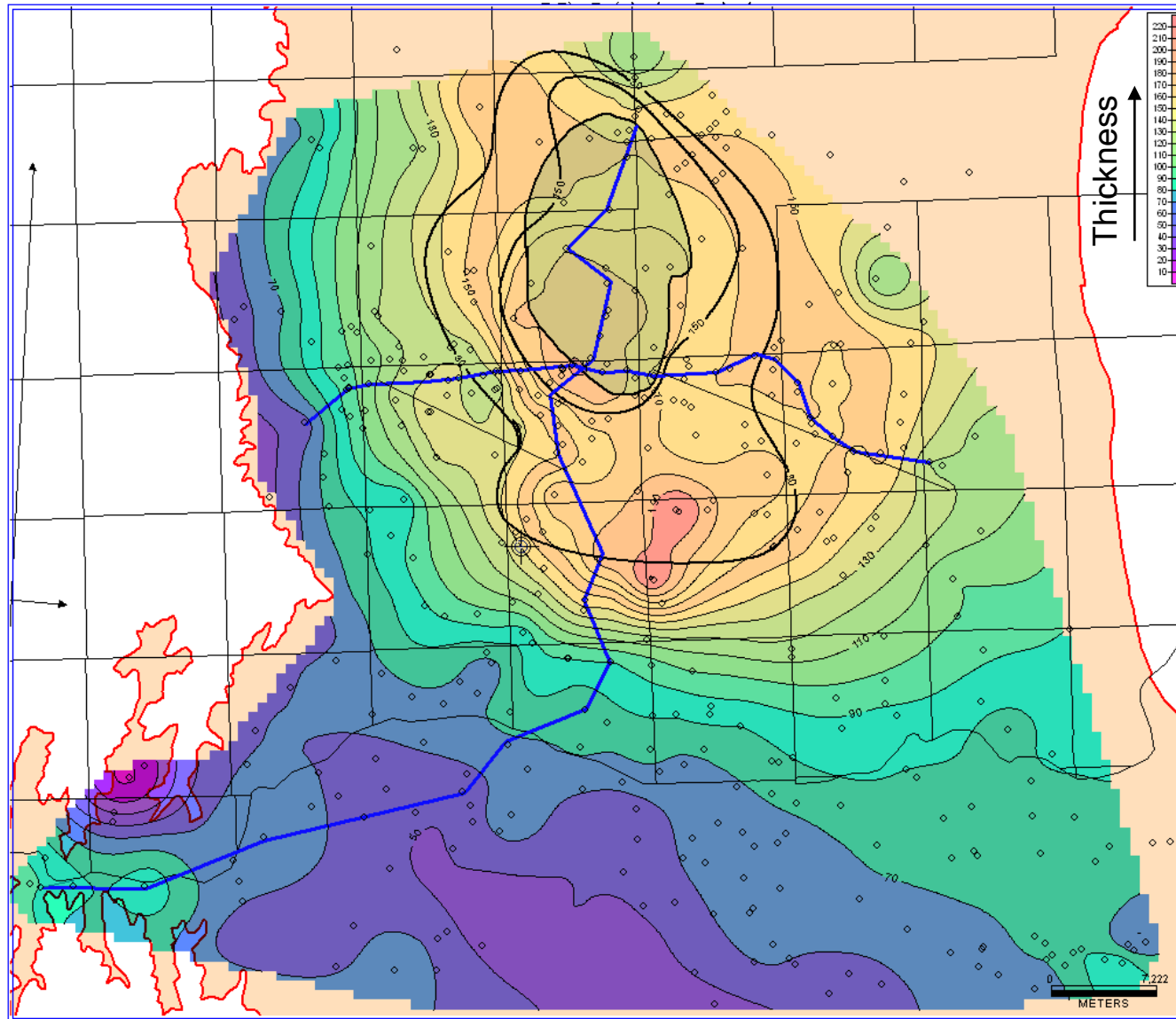
Sequence 2 Isopach (lower R-1 Zone)



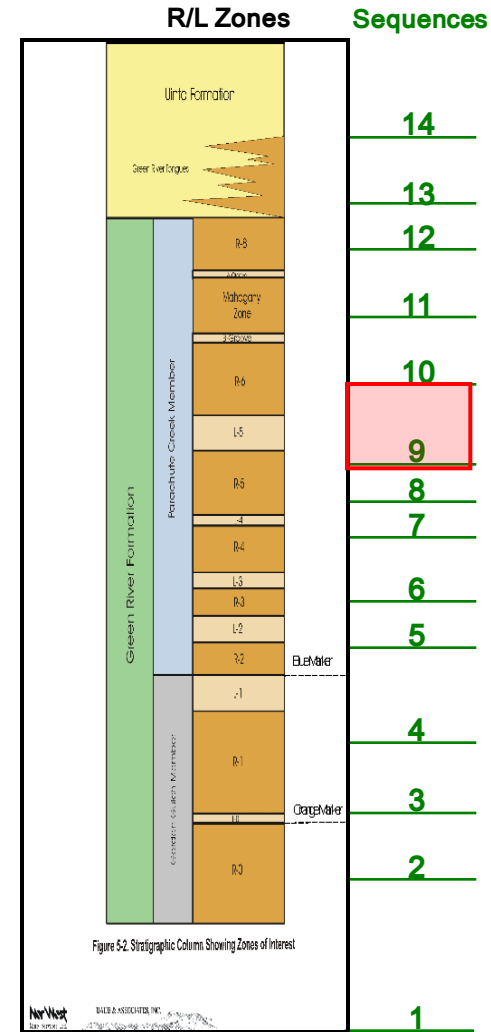
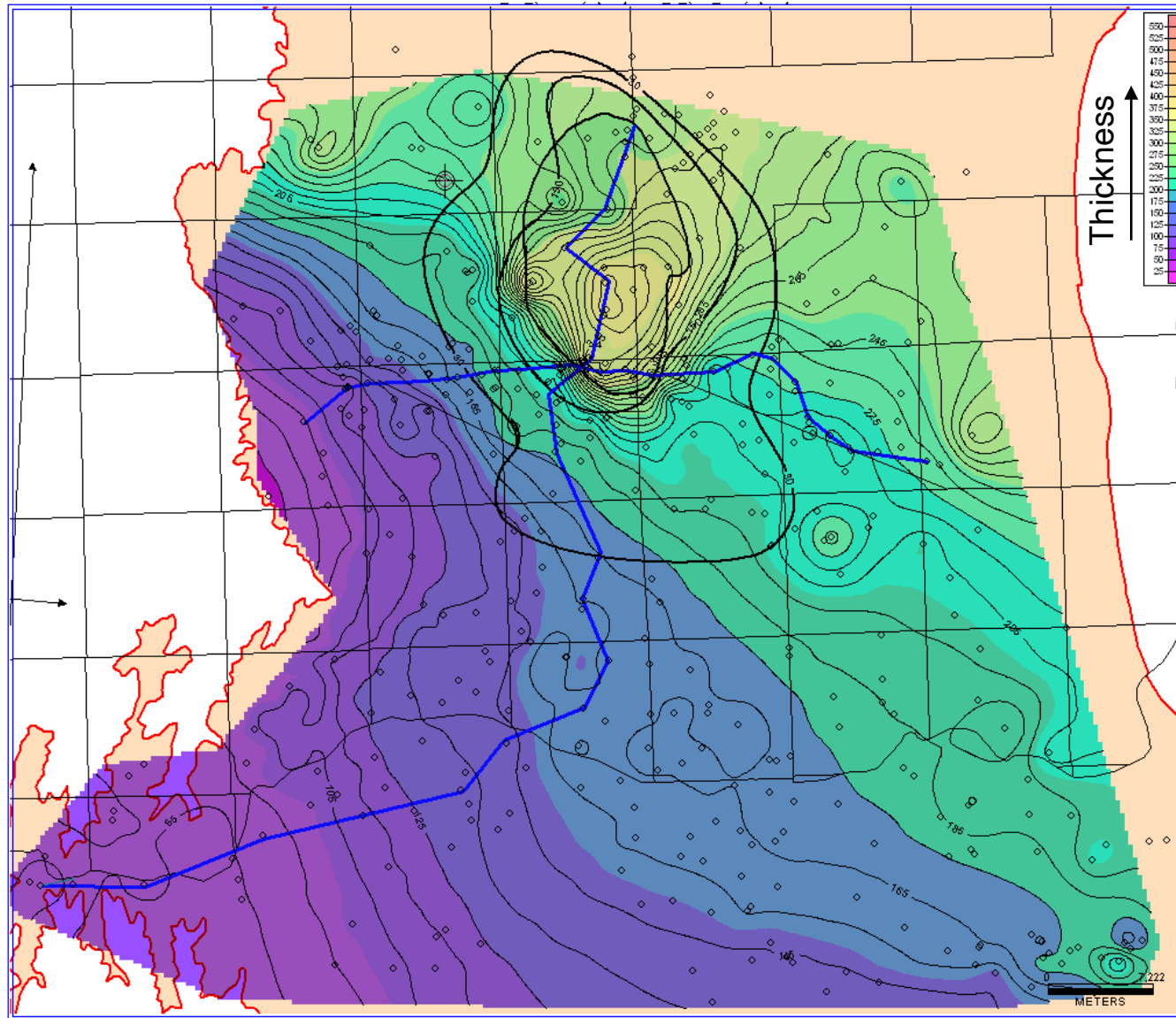
Sequence 4 Isopach (L-1 & lower R-2 Zones)



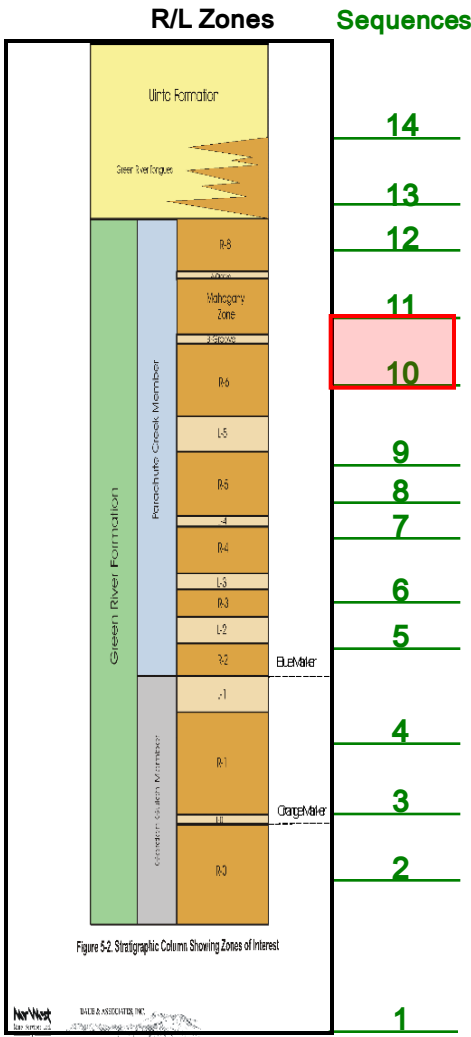
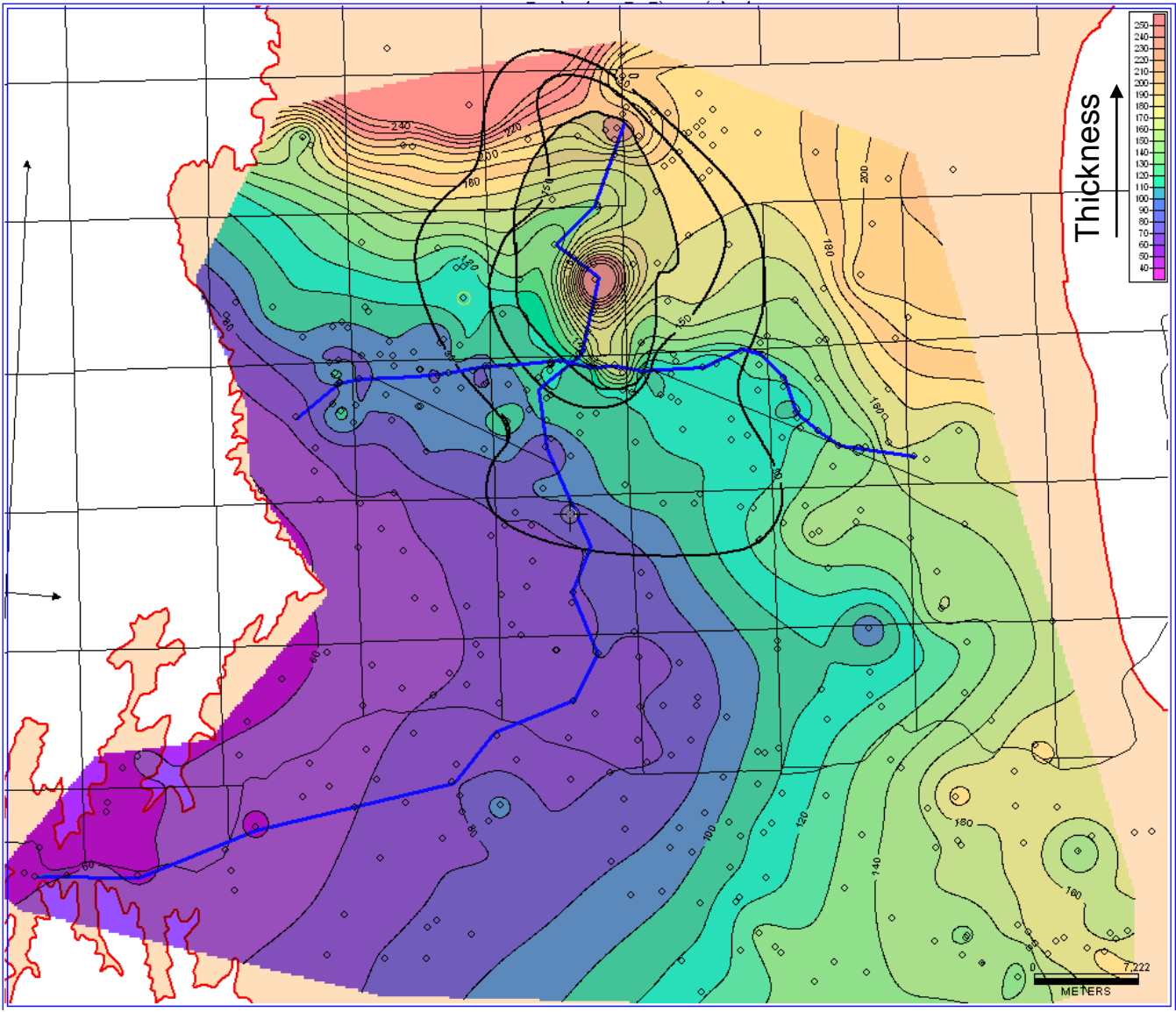
Sequence 6 Isopach (R-3 Zone)



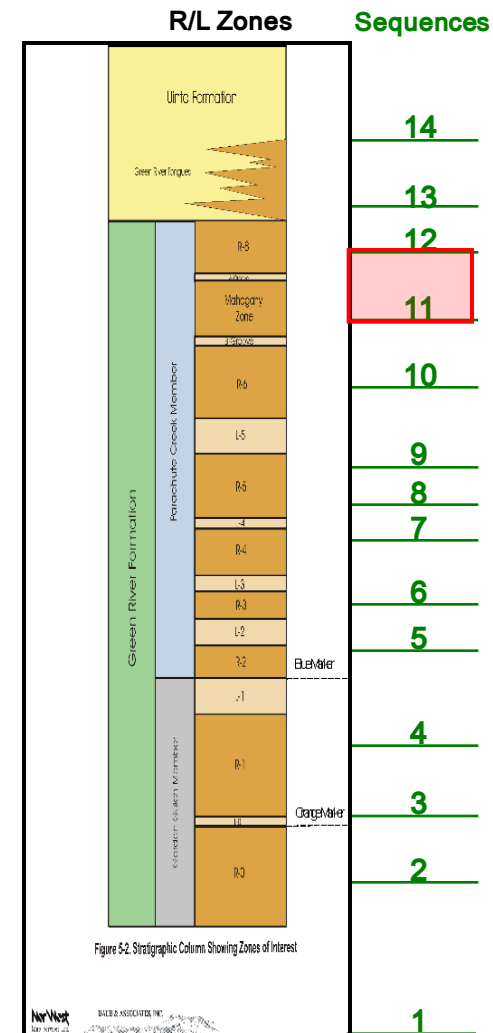
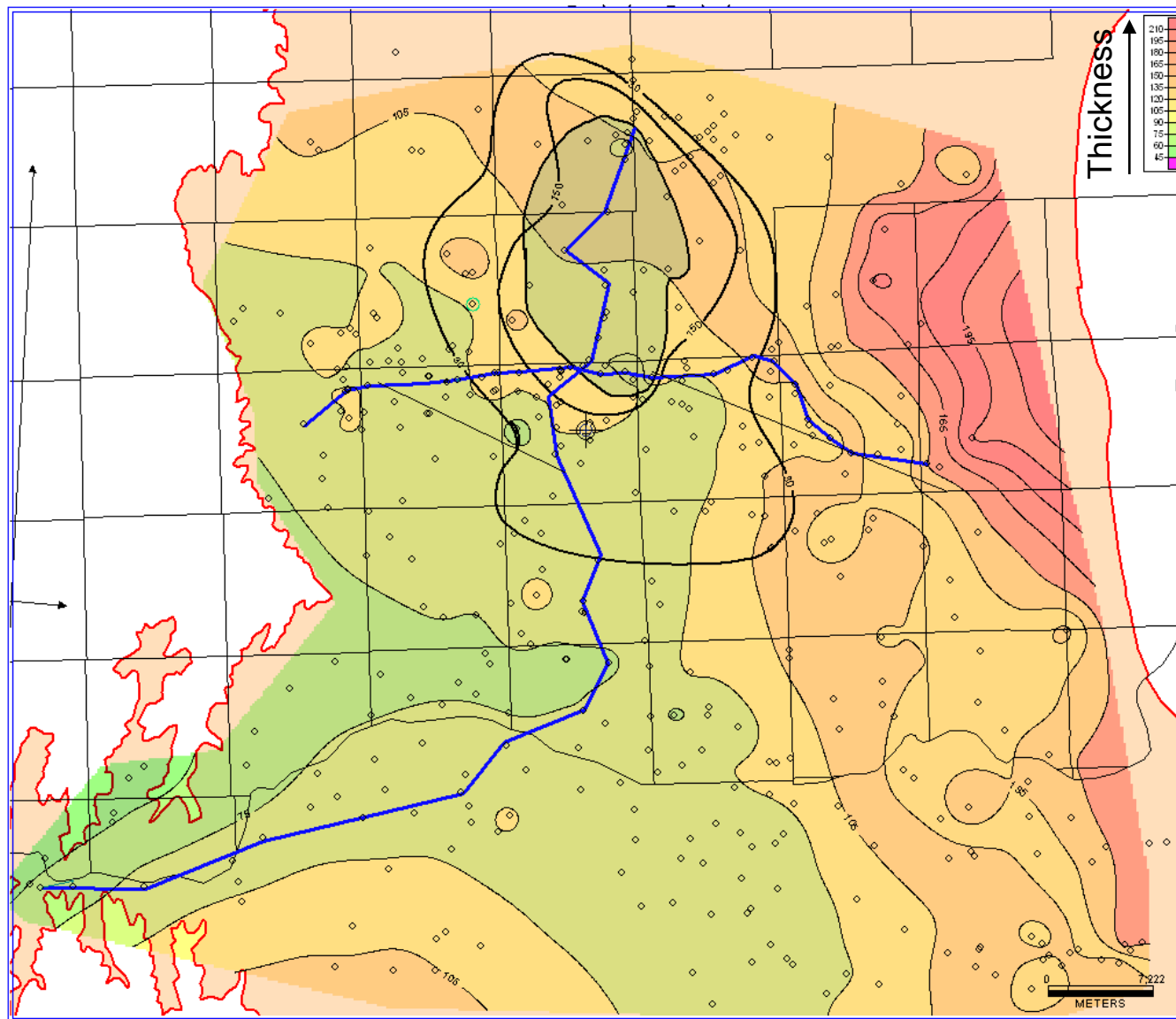
Sequence 9 Isopach (R-5 Zone)

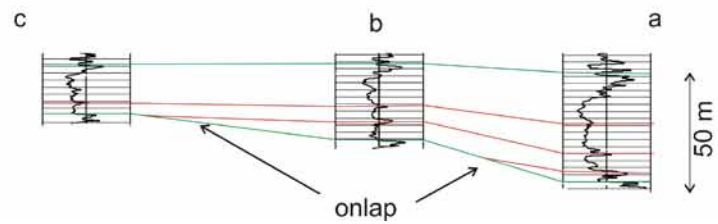
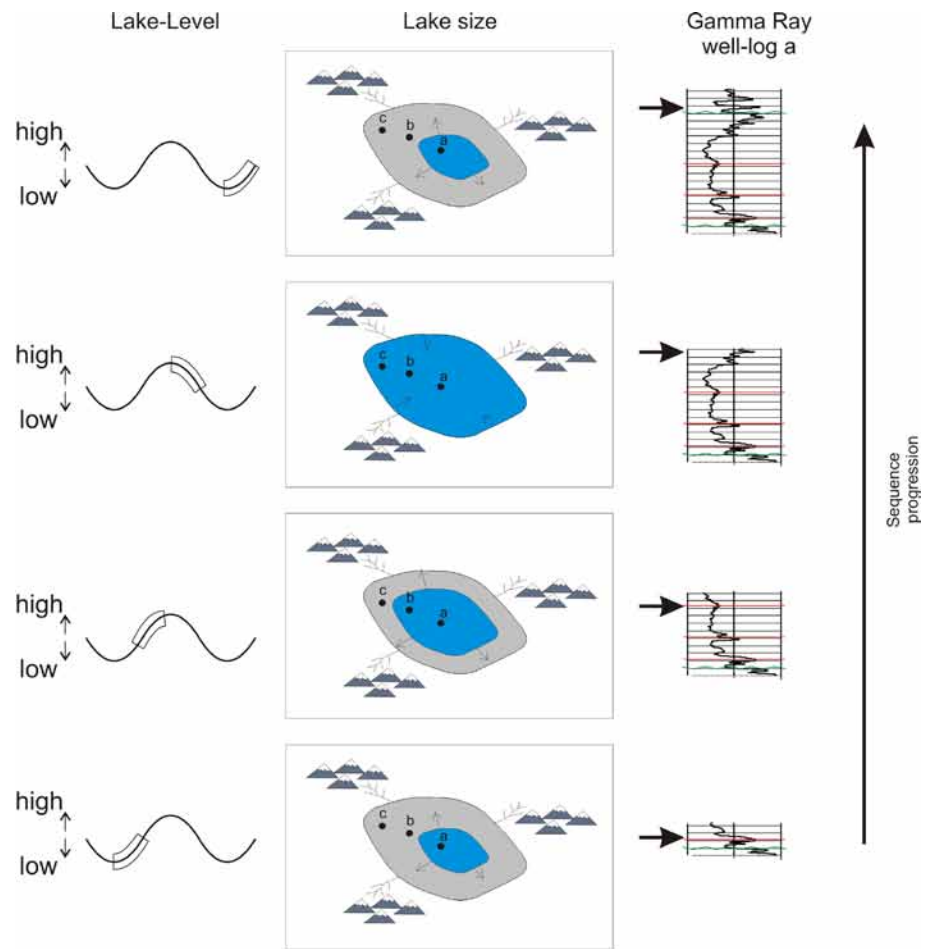


Sequence 10 Isopach (lower R-5 & L-5 Zones)



Sequence 11 Isopach (lower R-6 Zone)





Green River Relative Lake-level curve

