

PS Geology and Resource Assessment of the Grand Rapids, Southern Cold Lake, Alberta, Canada*

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Abstract

The mission of the Energy Resources Conservation Board (ERCB) is to ensure that the discovery, development and delivery of Alberta's resources takes place in a fair, equitable manner and in the public's best interest. One mandate of the ERCB is: "to provide for the appraisal of Alberta's oil sands resources". Oil sands is the general term used to refer to crude bitumen and the rocks and sediments that contain it. Oil sands deposits occur within several stratigraphic intervals over wide areas, with each deposit consisting of one or more zones.

Three geographic areas, together with the oil sands deposits they contain, have been designated as Oil Sands Areas (OSAs) by the ERCB. These OSAs occupy an area of approximately 140,000 square kilometers (54,000 square miles) and are denoted as Athabasca, Cold Lake and Peace River. The Cold Lake OSA has been the focus of a recent regional geological study to update the bitumen resource of the Upper and Lower Grand Rapids Bitumen Deposits. The Grand Rapids Formation consists of Lower Cretaceous (Albian) sands and shales that were deposited as a series of regional coarsening upward sequences (middle shoreface to near shore marine) with incised channels containing estuarine sediments. It is conformably overlain by the Colorado Group and conformably overlies the Clearwater Formation within the study area. In this study the Grand Rapids has been differentiated into the following stratigraphic units: Rex Sand, General Petroleum (GP) Member, Sparky Sand, Waseca Member, McLaren Member and Colony Sand.

The last resource estimate, published in 1996, for the Upper and Lower Grand Rapids oil sands deposits combined is 17,304,106 m³ and was based on a 3% mass bitumen cut-off. For the recent study, crude bitumen pay was determined for each stratigraphic zone and the bitumen deposit volume was determined on a cumulative basis at a 6% mass bitumen cut-off.

The poster presents the results of the study and includes new regional cross sections, isopach/structure maps and new volumetrics.

References

Cant, D.J. and B. Abrahamson, 1997, Regional stratigraphy, sedimentology and petroleum geology of the Grand Rapids Formation, Mannville Group, northeastern Alberta: Canadian Petroleum Geology Bulletin, v. 45/2, p. 141-154.

McPhee, D. and M.J. Ranger, 1998, The geological challenge for development of heavy crude and oil sands of Western Canada: UNITAR International Conference on Heavy Crude and Tar Sands Proceedings, v. 7, p. 189.

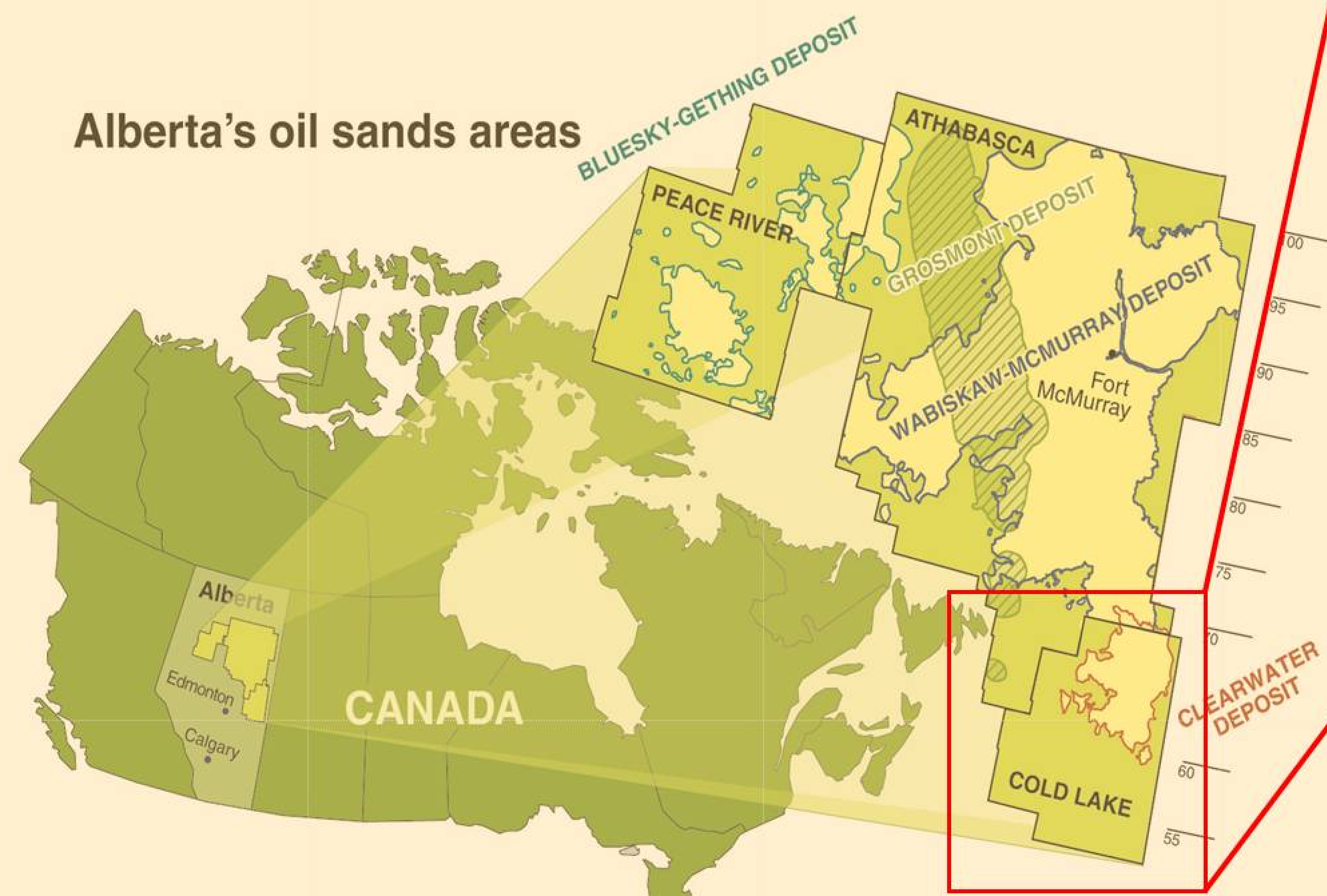
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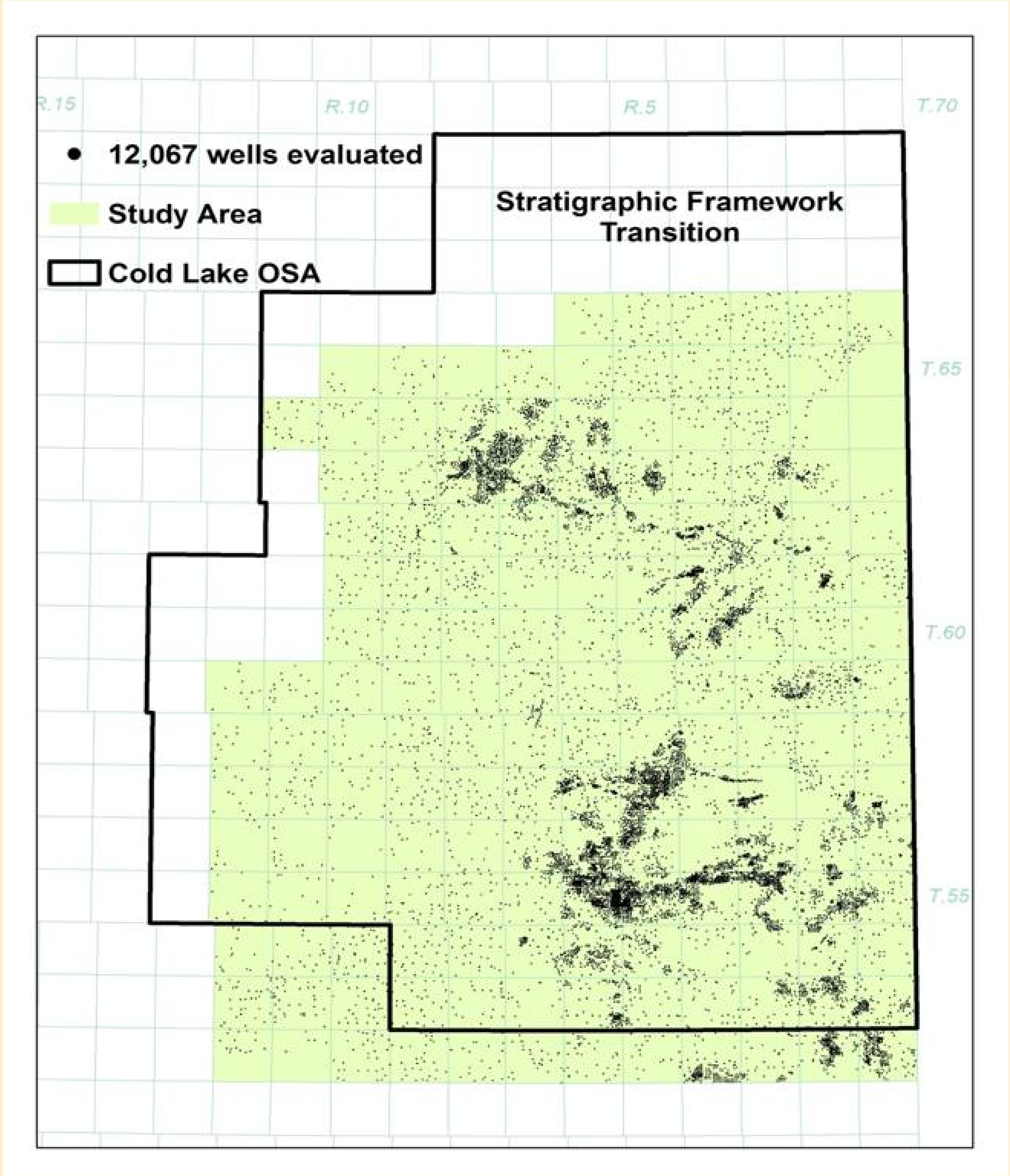
Energy Resources Conservation Board, Calgary, Alberta, Canada



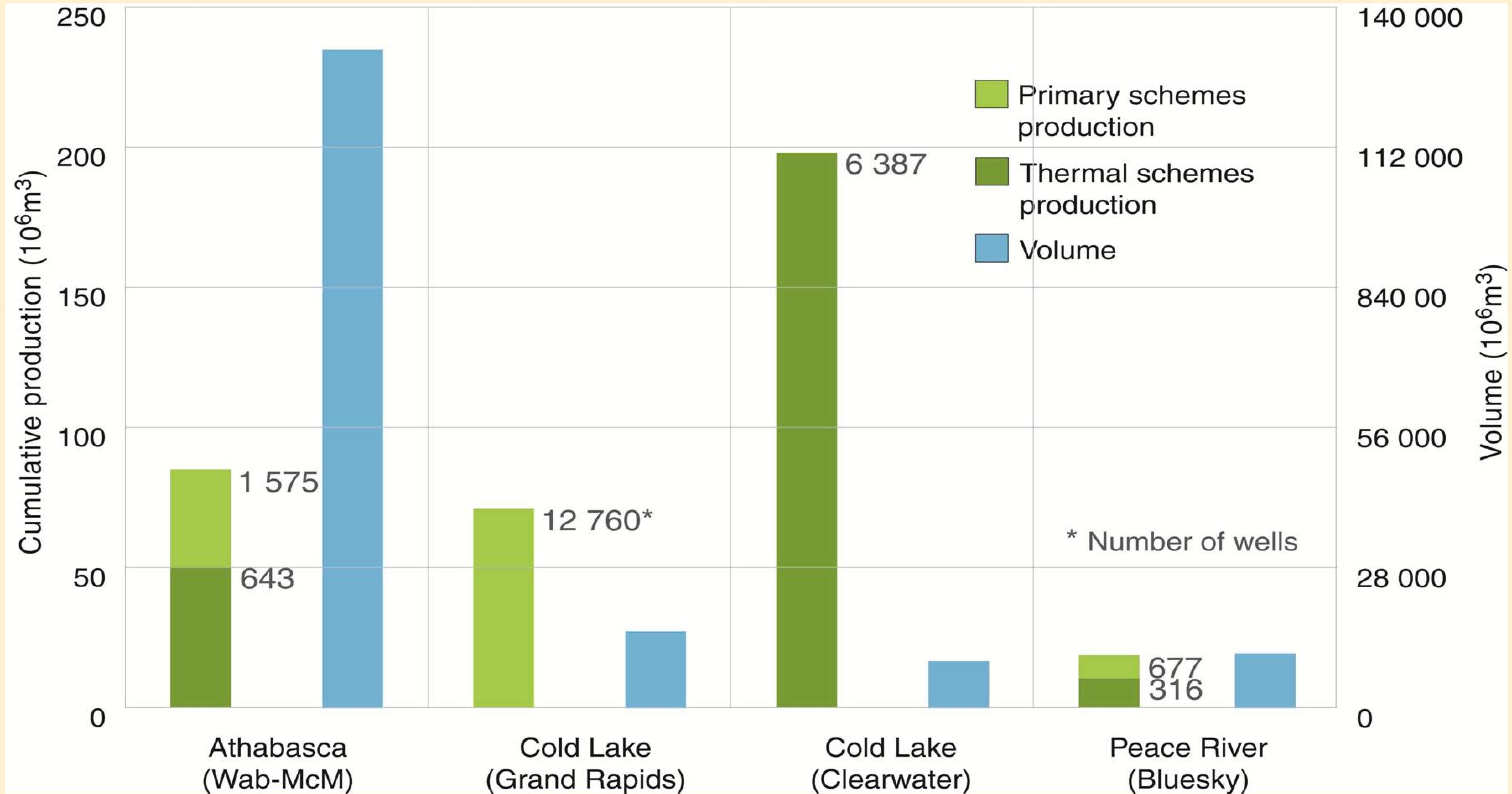
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OSA with detailed Cold Lake study area



Three geographic areas, together with the oil sands deposits they contain, have been designated as Oil Sands Areas (OSAs) by the ERCBC. These OSAs occupy an area of approximately 140 000 square kilometres (54 000 square miles) and are denoted as Athabasca, Cold Lake and Peace River. The Cold Lake OSA has been the focus of a recent regional geological study to update the bitumen resource of the Upper and Lower Grand Rapids Bitumen Deposits.



Wells listed are classified for production. It should be noted that there are several wells that have been abandoned, suspended and some wells that never produced even though they are classified as production wells.

GEOLOGY

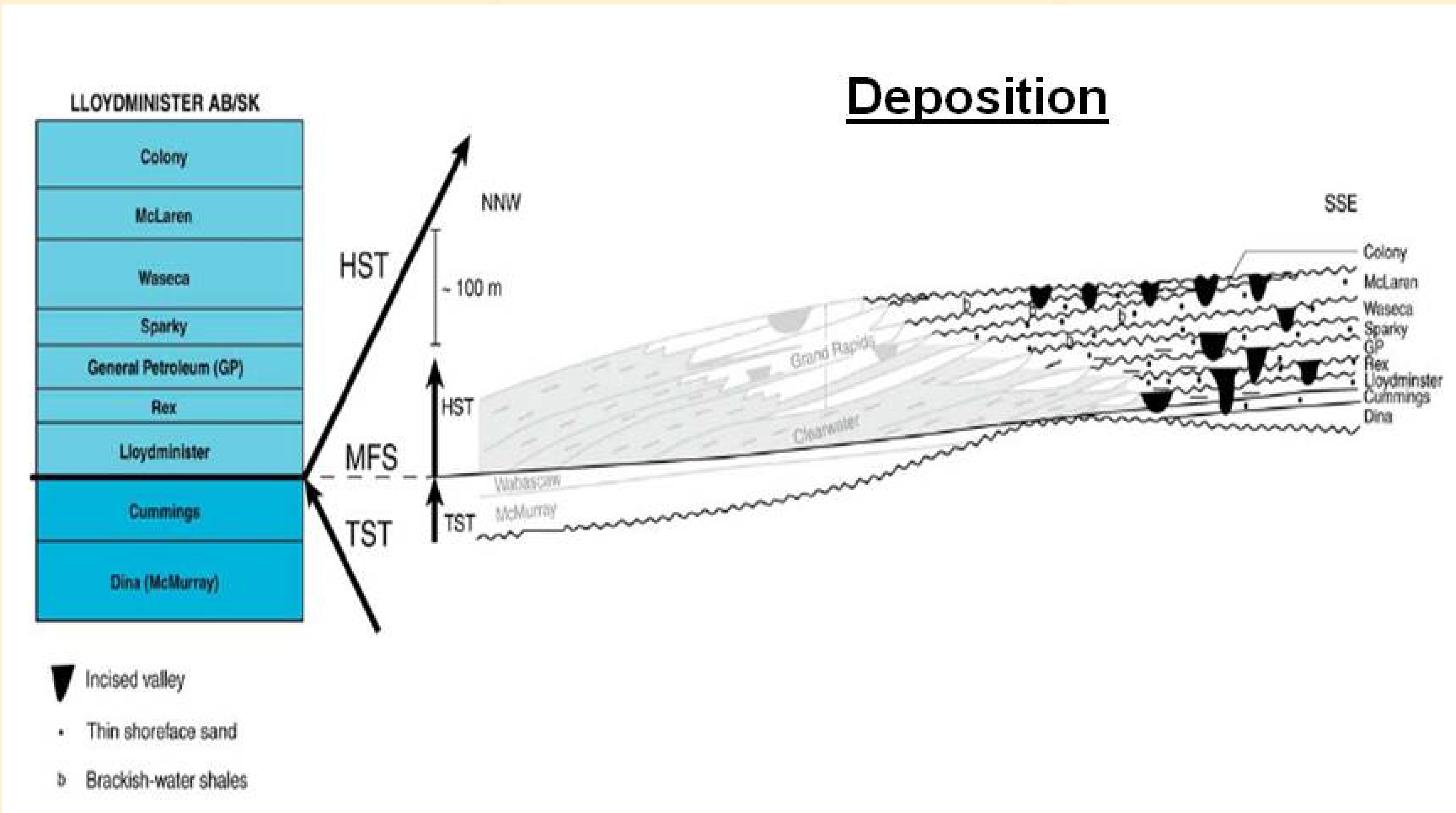
Mannville Stratigraphy

| GROUP | | NORTHEAST ALBERTA | | | NORTHERN COLD LAKE | | LLOYDMINISTER AB/SK | | AGE | | |
|-----------|-------|-------------------|--------|--|--------------------|------------------------|---------------------|--|--------|------------------|---|
| MANNVILLE | UPPER | Grand Rapids Fm. | A | | Upper Grand Rapids | Colony | | | Albian | Lower Cretaceous | |
| | | | B | | | McLaren | | | | | |
| | | | C | | | Waseca | | | | | |
| | | Clearwater Fm. | A | | Lower Grand Rapids | Sparky | | | | | |
| | | | B | | | General Petroleum (GP) | | | | | |
| | | | C | | | Rex | | | | | |
| | | Wabiskaw | A | | Clearwater | A | Cummings | | | | |
| | | | B | | | | | | | | |
| | | | C | | | | | | | | |
| | LOWER | McMurray Fm. | UPPER | | McMurray | B | Dina | | Aptian | | |
| | | | MIDDLE | | | | | | | | |
| | | | LOWER | | | | | | | | |
| | | McMurray Fm. | UPPER | | McMurray | C | Dina | | | | ? |
| | | | MIDDLE | | | | | | | | |
| | | | LOWER | | | | | | | | |

The Grand Rapids Formation consists of Lower Cretaceous (Albian) sands and shales that were deposited as a series of regional coarsening upward sequences (middle shoreface to near shore marine) with incised channels containing estuarine sediments. It is conformably overlain by the Colorado Group and conformably overlies the Clearwater Formation within the study area. In this study the Grand Rapids has been differentiated into the following stratigraphic units: Rex Sand, General Petroleum (GP) Member, Sparky Sand, Waseca Member, McLaren Member and Colony Sand.

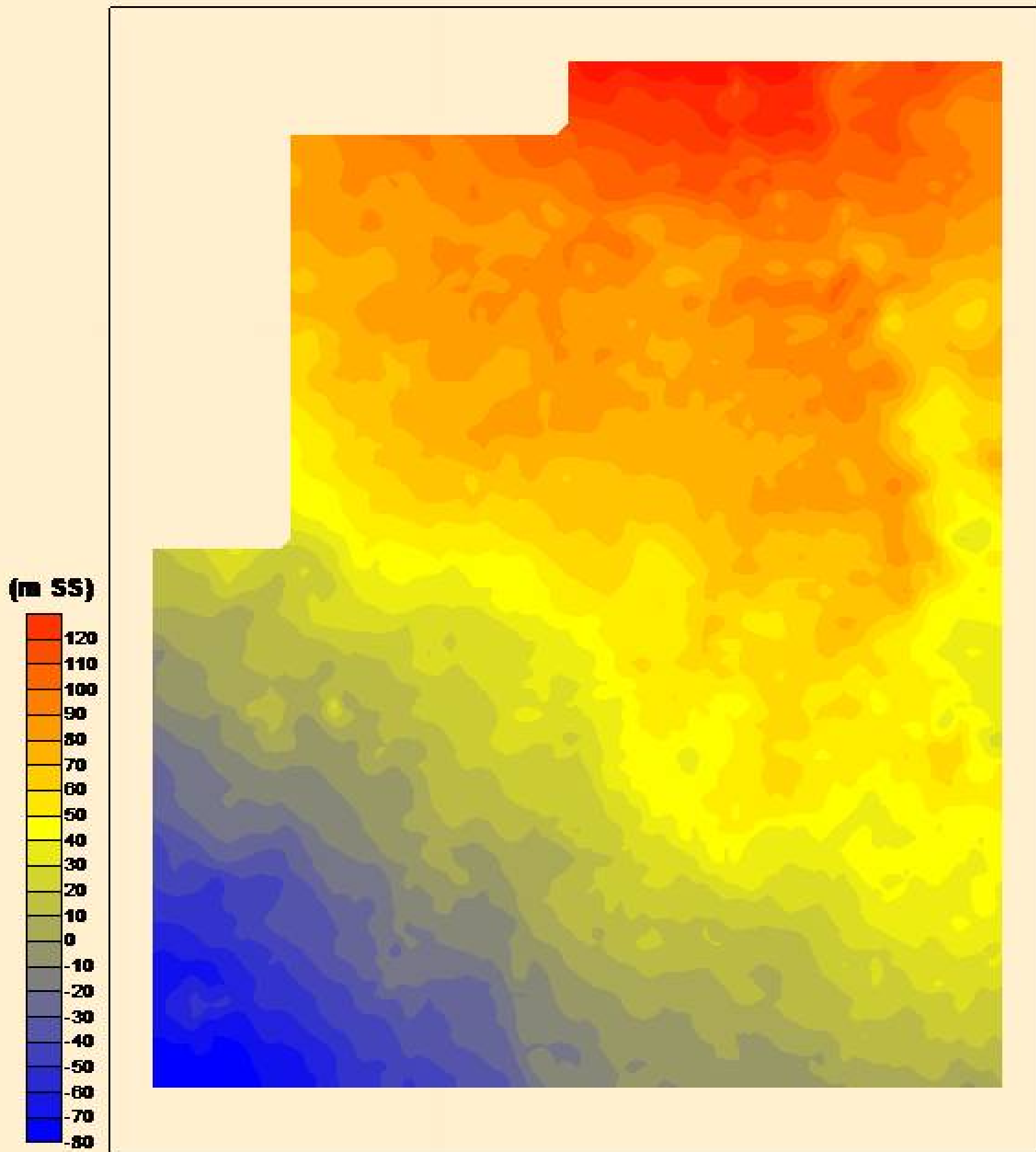
Mannville Stratigraphy (modified from McPhee and Ranger, 1998)

Deposition is controlled by relative sea level (S.L.). Deposition follows structure at lower Mannville time. Maximum transgression is reached by the end of Wabiskaw-McMurray time. This maximum flooding surface is a conformable surface between the Lloyd and Cummings. Within the Grand Rapids each ‘stratal’ unit is unconformity bound. Regression is terminated by the unconformity and the transgression at the end of the Mannville time.

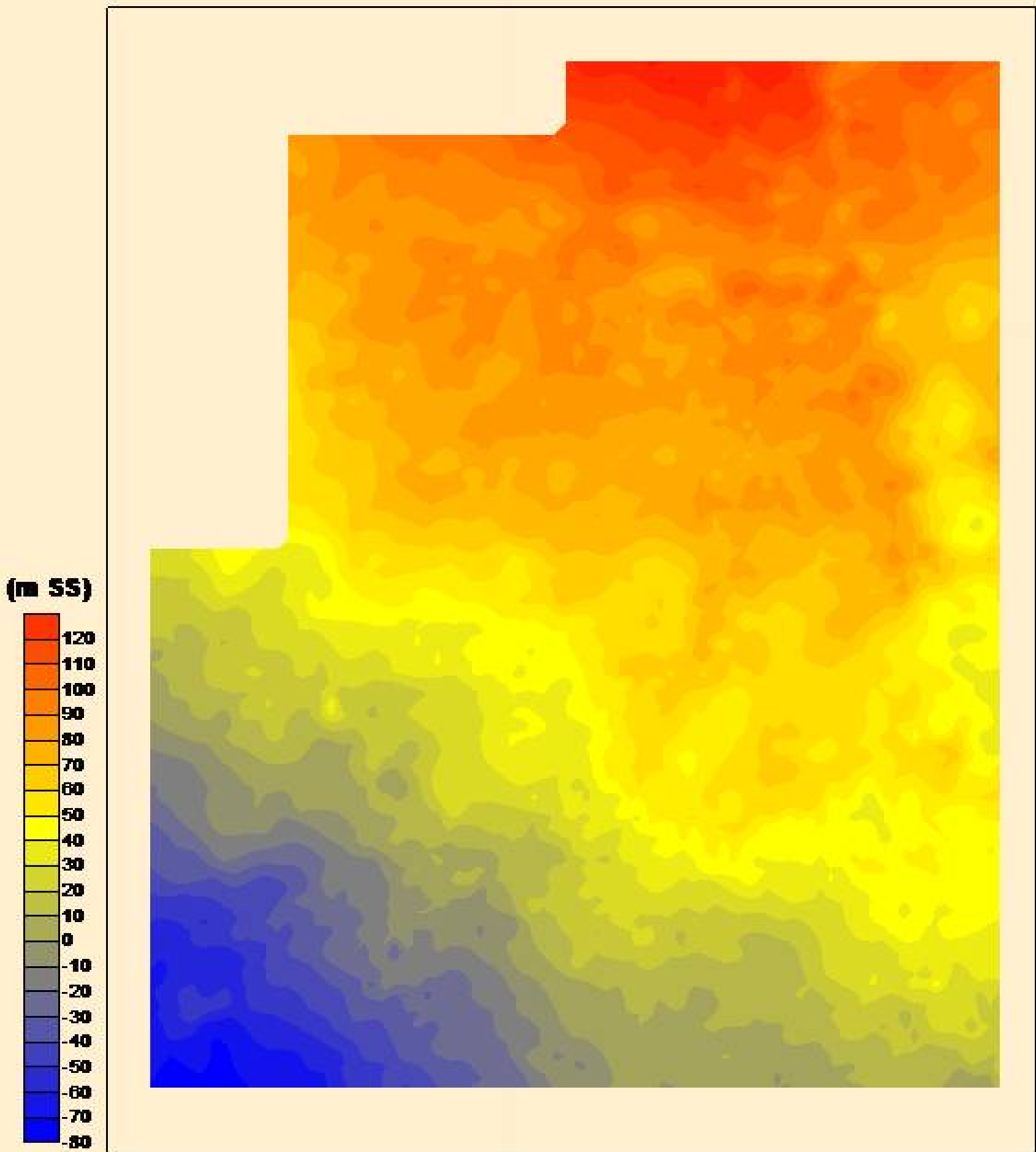


Grand Rapids Depositional Schematic (modified from Cant and Abrahamson, 1997)

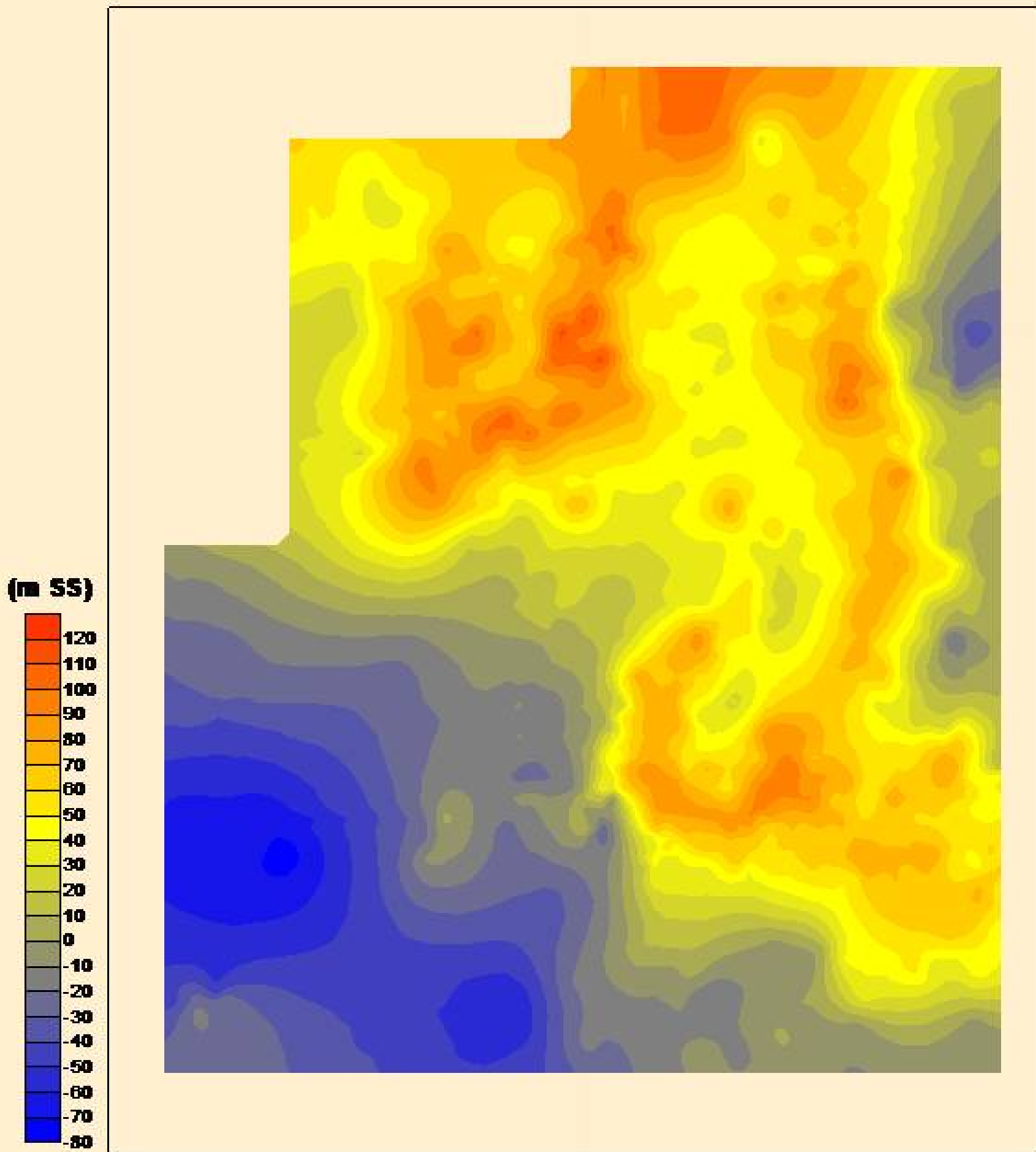
Colony Structure



Sparky Structure

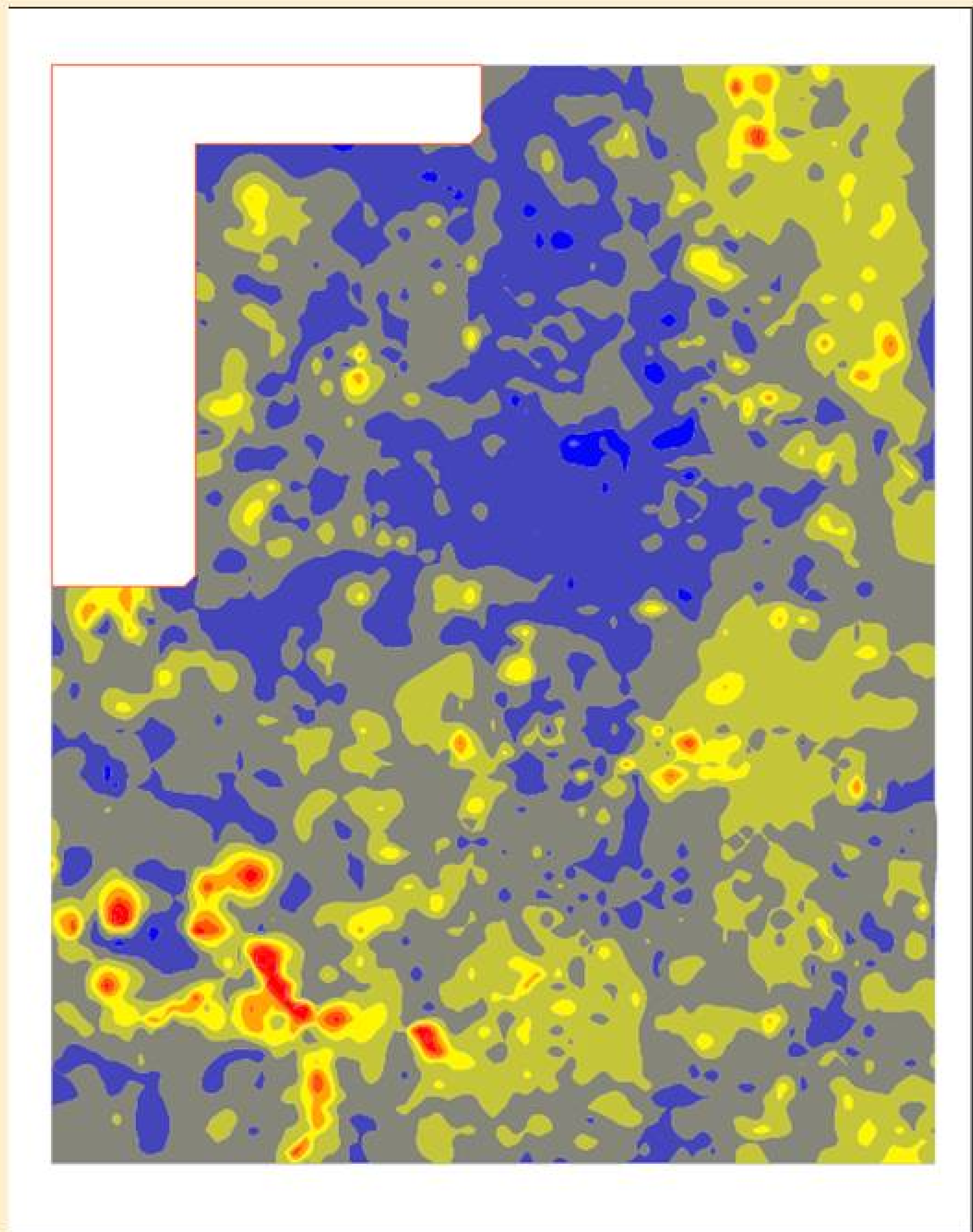


Paleozoic Structure

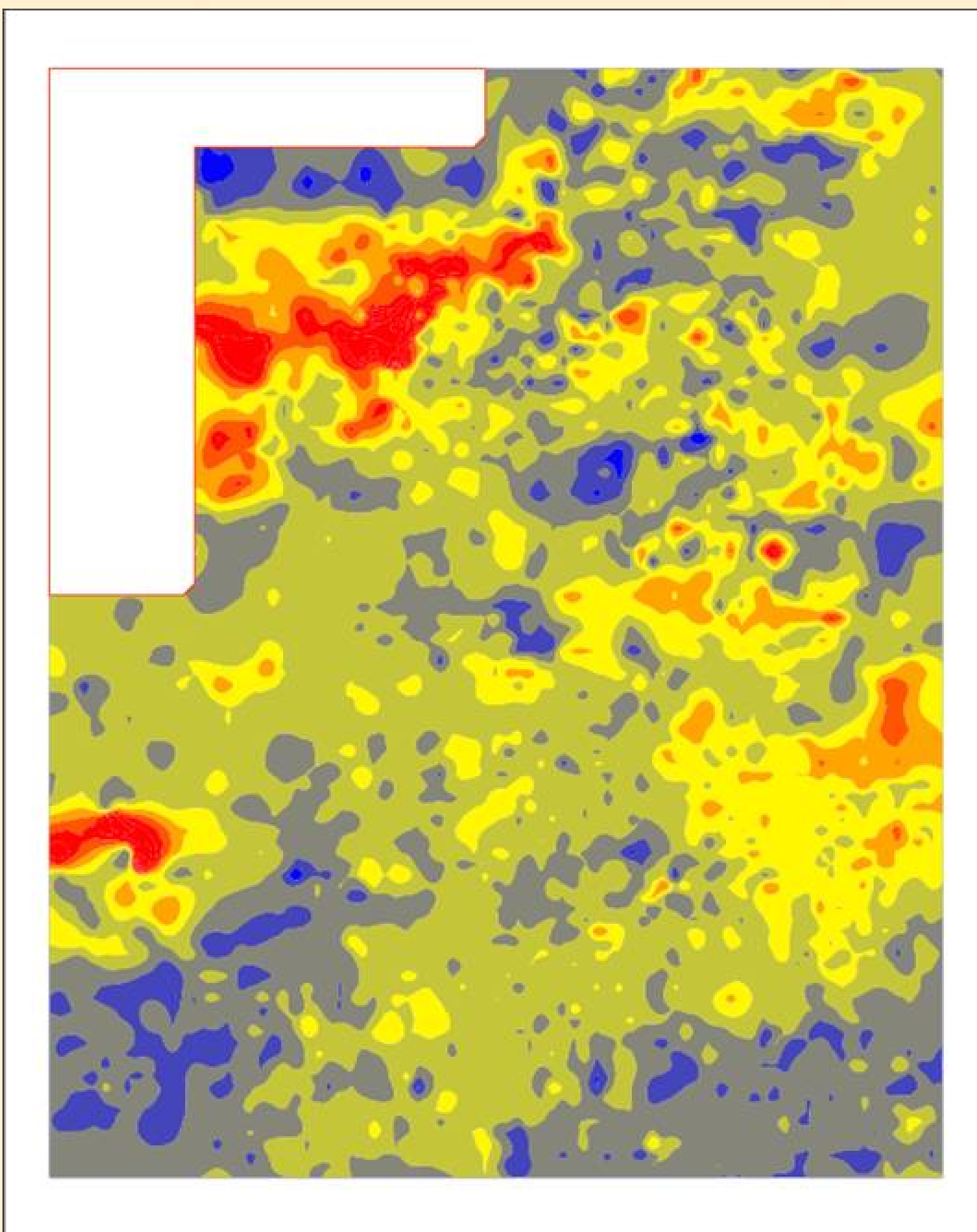


Colony and Sparky Structure maps representing Upper and Lower Grand Rapids respectively. Structural dip is to the SSW. Structure follows the highs as determined by the Paleozoic and infill during McMurray time.

Colony Isopach
(0-42 m (3m contour interval))



General Petroleum Isopach
(0-42 m (3 m contour interval))

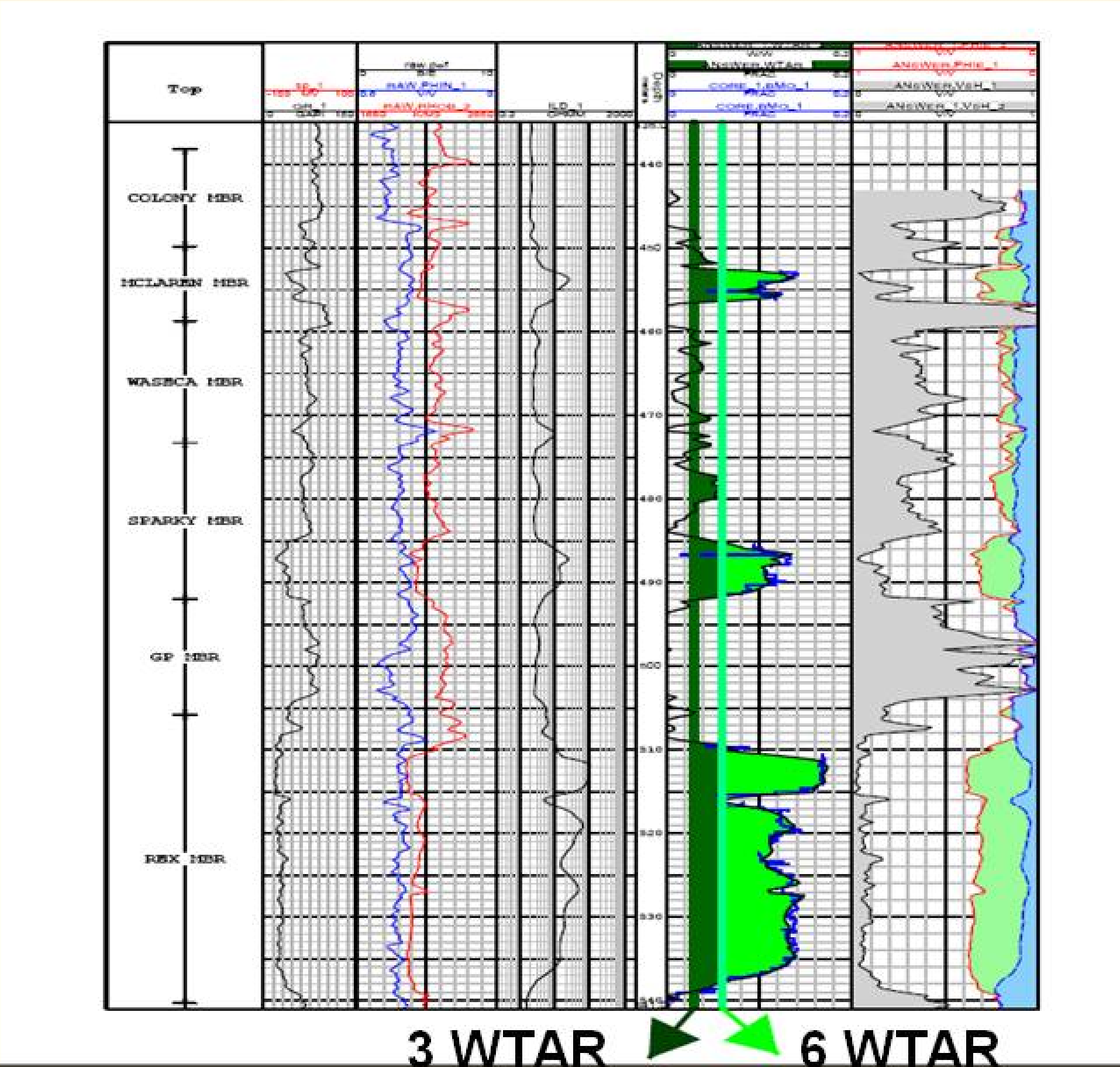
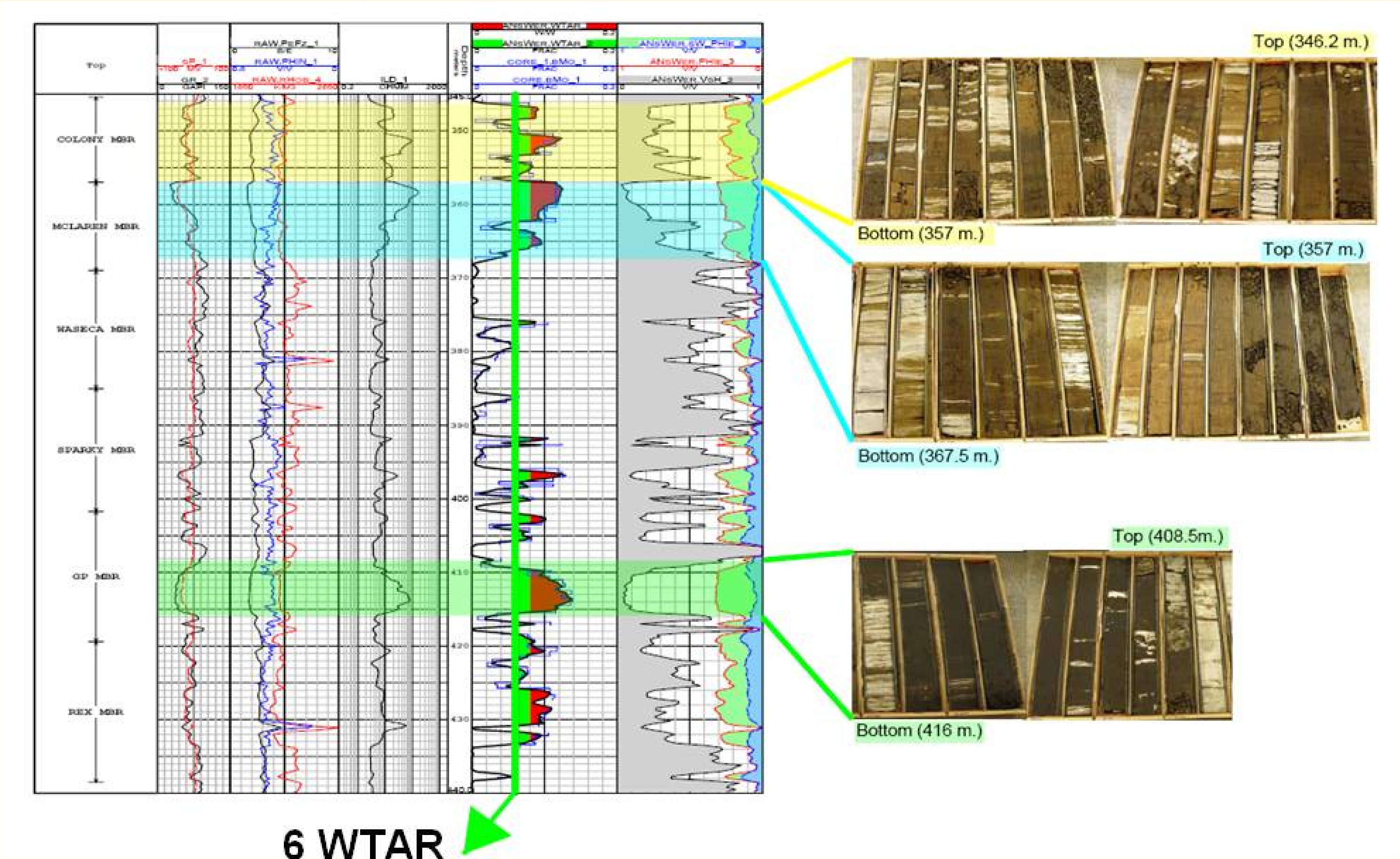


Both Colony (Upper Grand Rapids) and General Petroleum (Lower Grand Rapids) illustrate a relative uniform thickness of the sand. Exceptions are channeling to the SW in the Colony and possible estuarine fill to the NW in the G.P.

RESOURCES

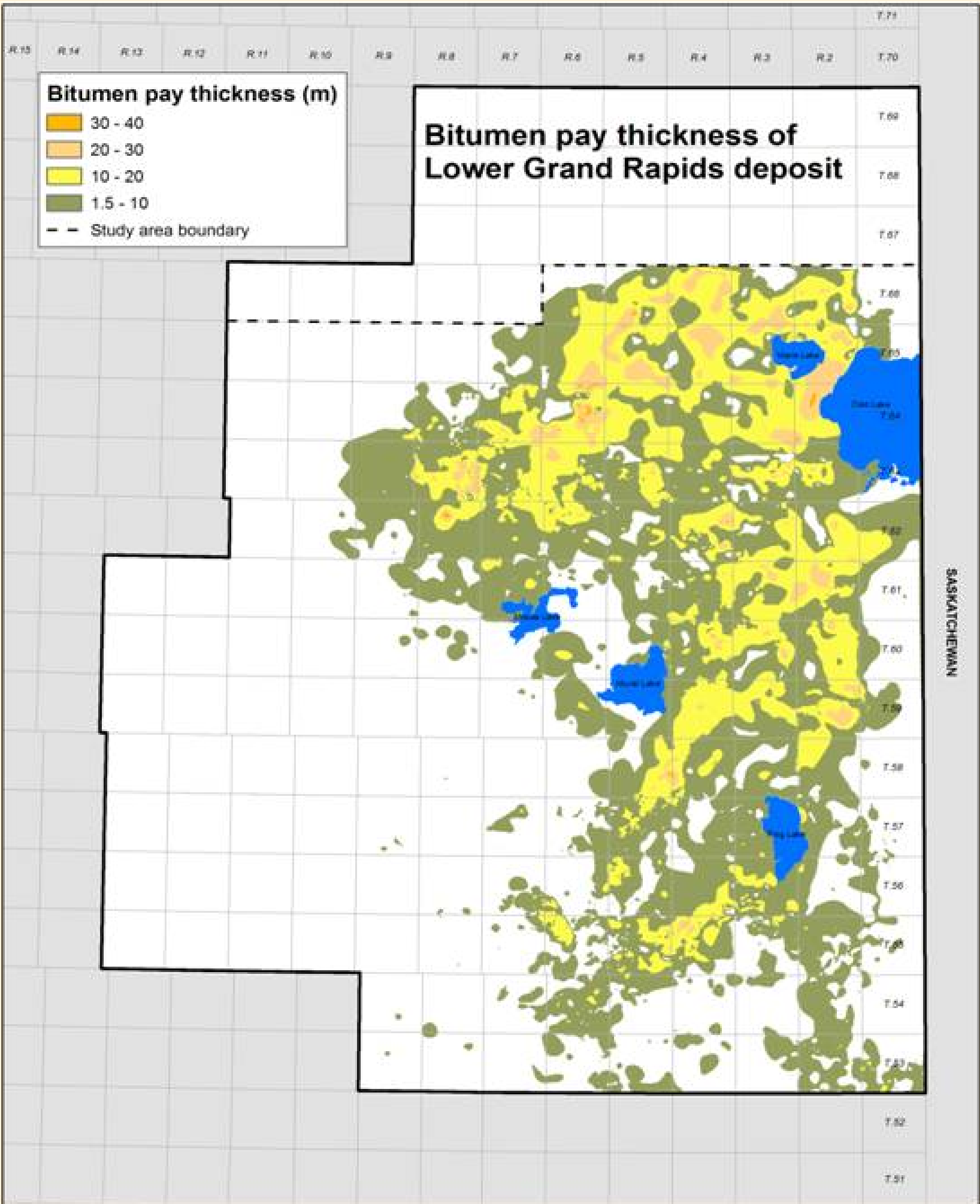
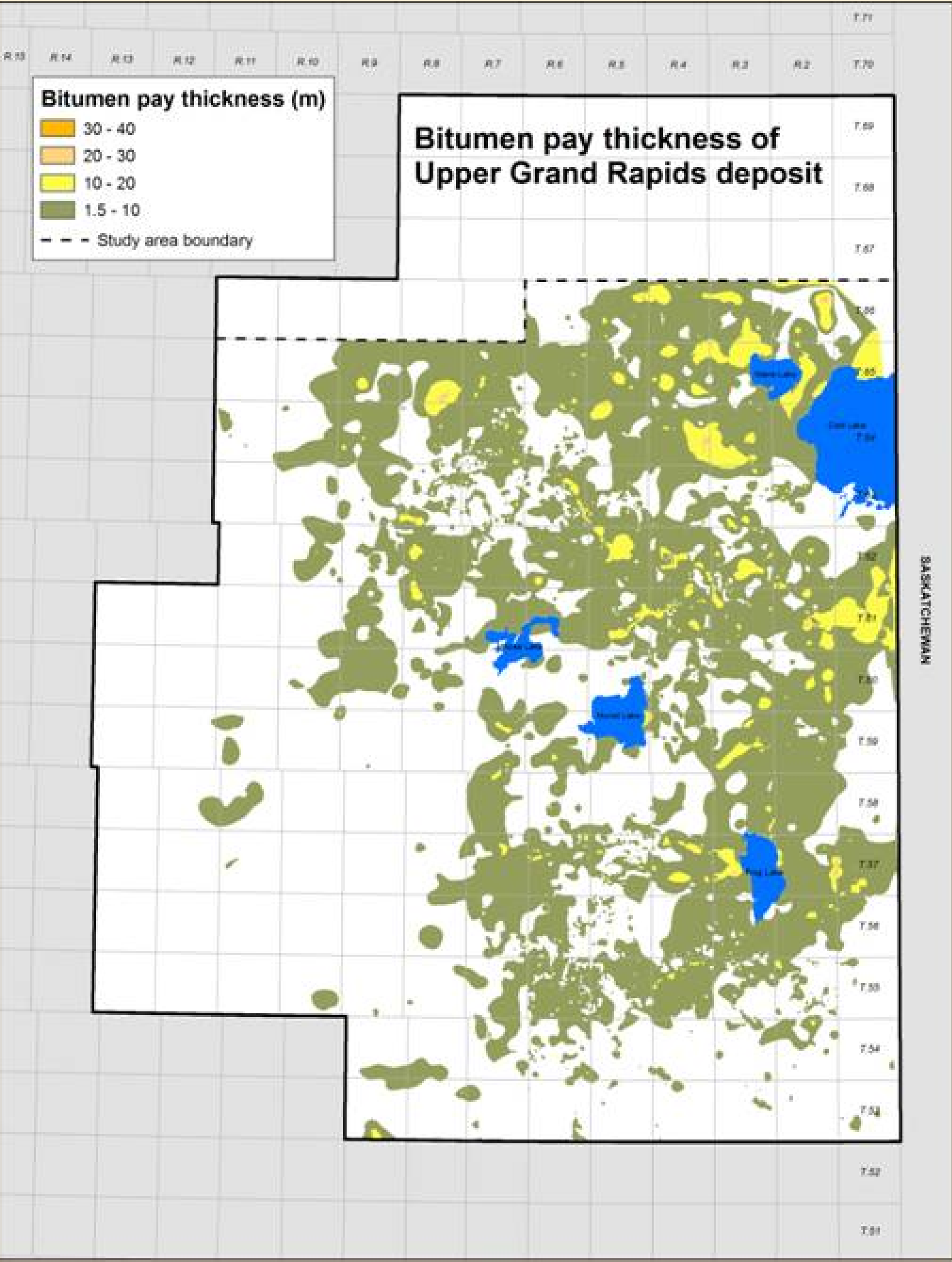
The last resource estimate, published in 1996, for the Upper and Lower Grand Rapids oil sands deposits combined was based on a 3% weight tar (WTAR) cut-off. For the recent study, crude bitumen pay was determined for each stratigraphic zone and the bitumen deposit volume was determined on a cumulative basis at a 6% weight tar (WTAR) bitumen cut-off.

Methodology

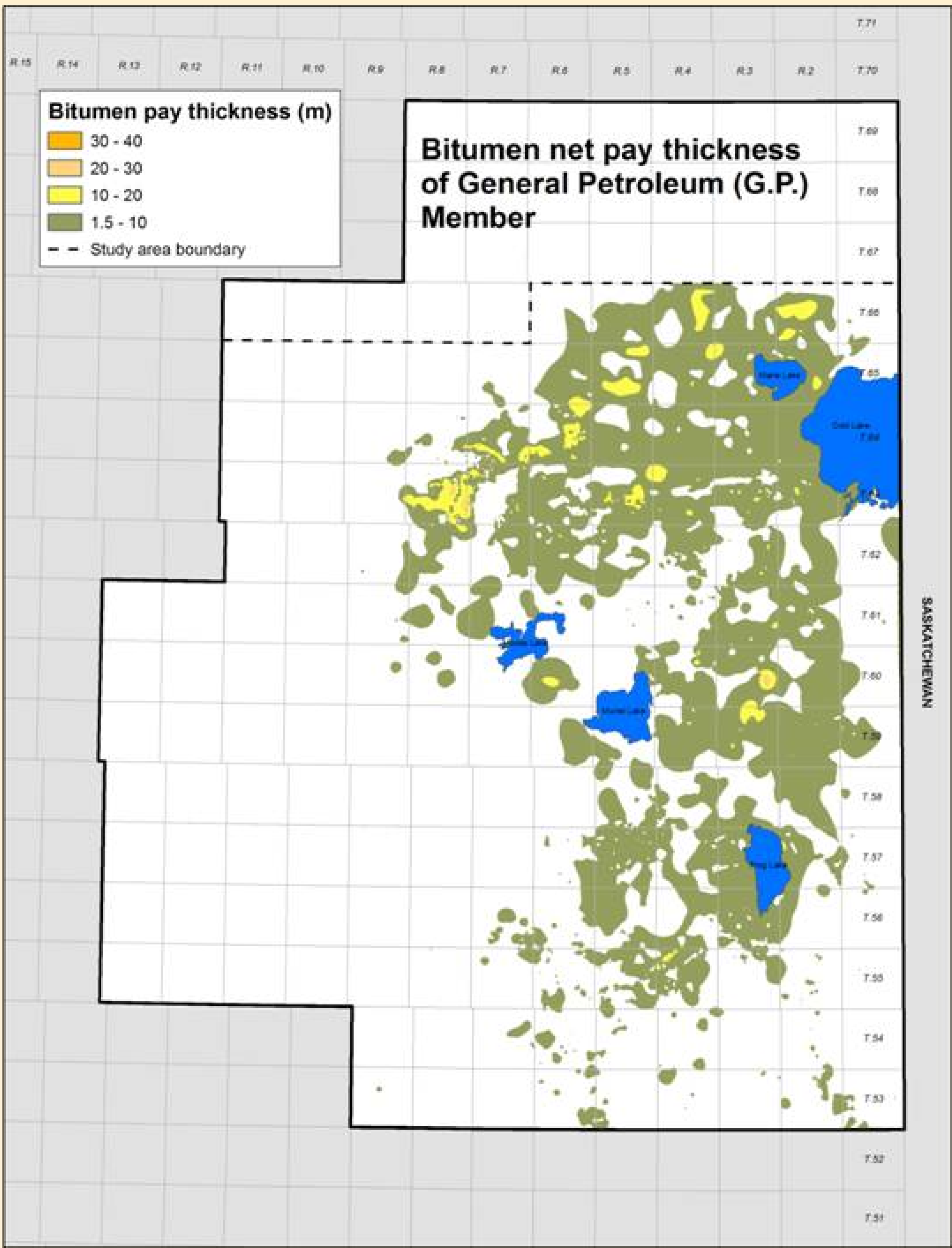
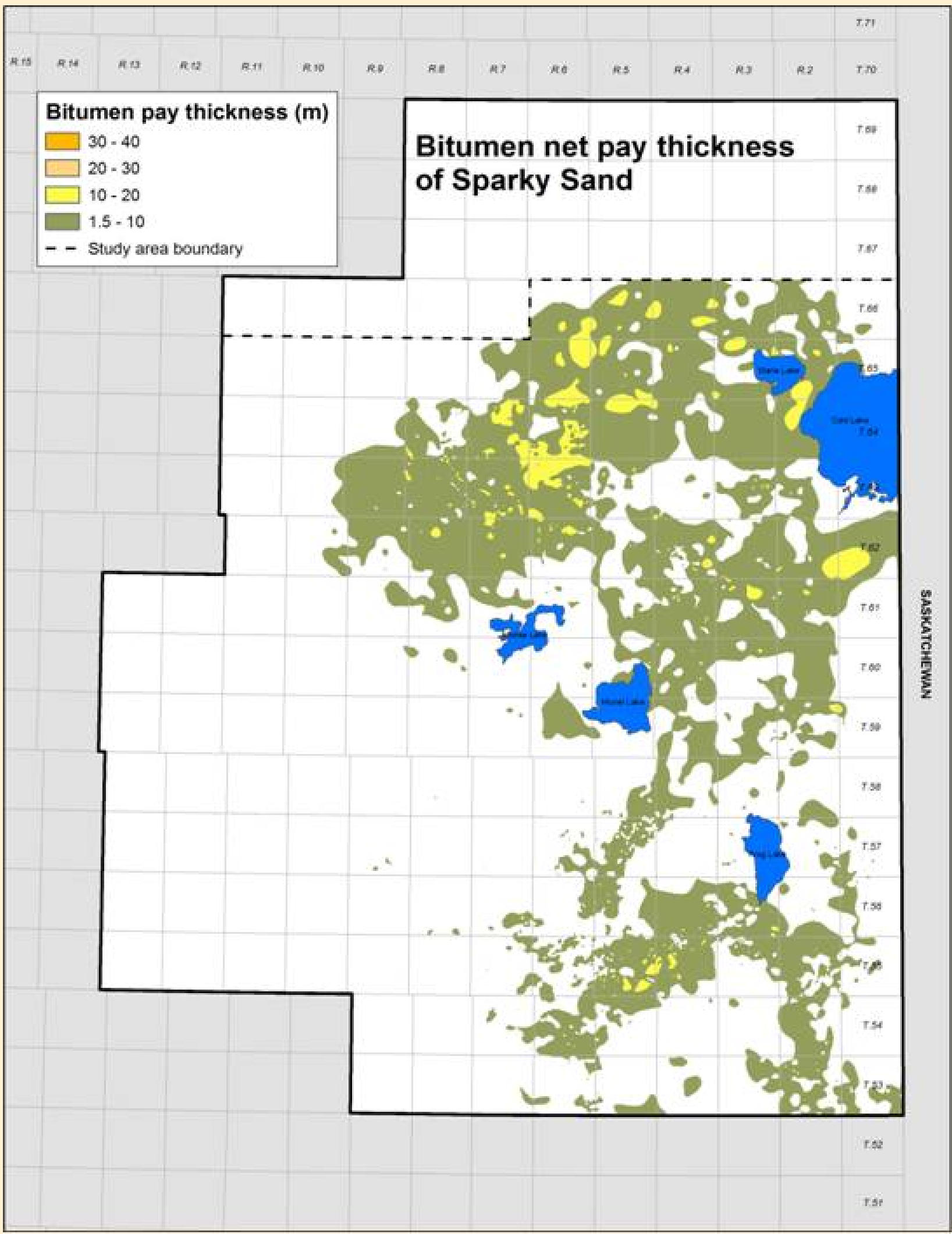
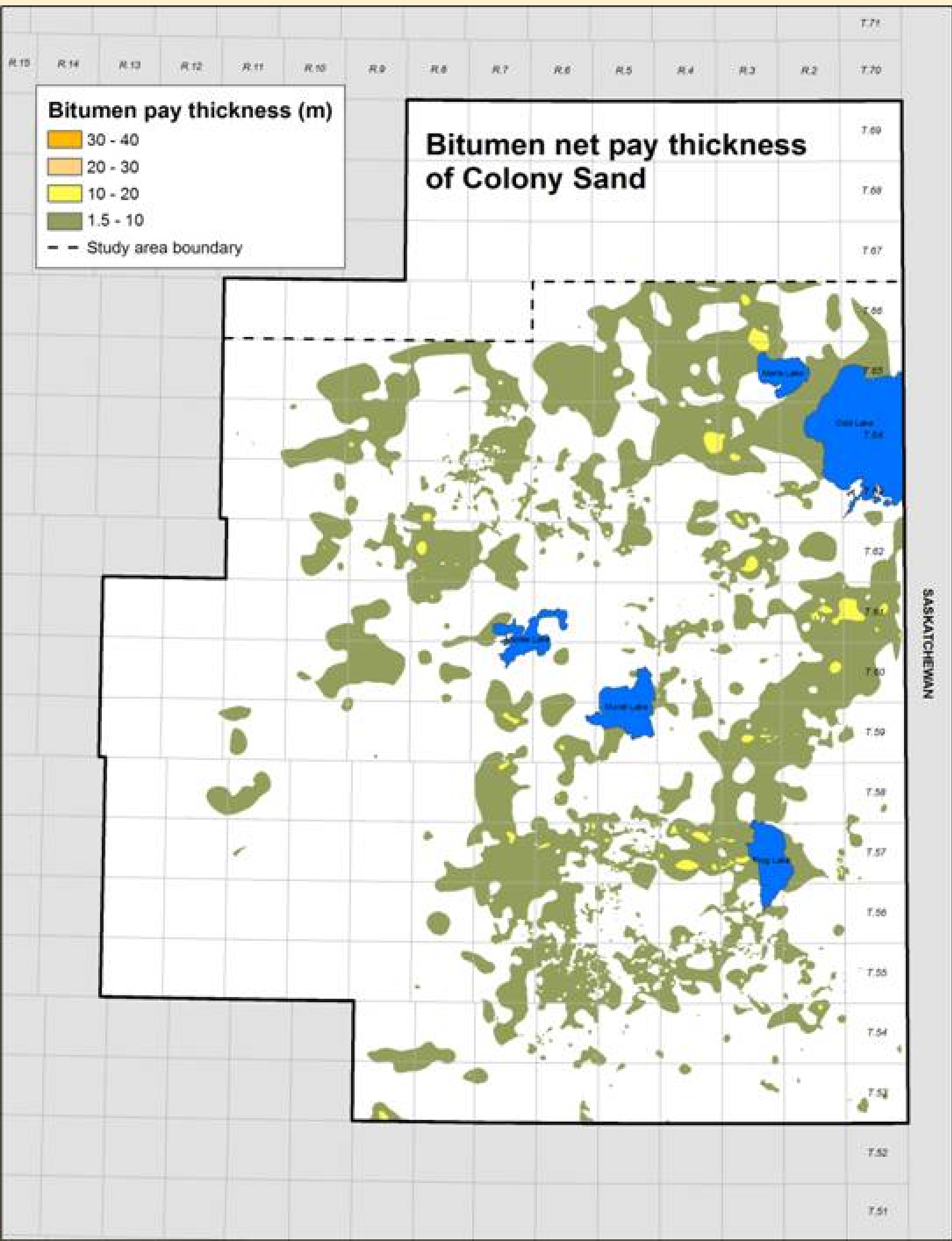


Calibration of core to the petrophysical evaluation of open-hole well logs 6-1-61-2W4. 157 petrophysical evaluations with core analysis (blue histogram) were used to determine net pay cutoffs.

Petrophysical evaluation for 03/16-13-58-5W4/00. Note the bitumen volume difference between 3 WTAR (45 m) and 6 WTAR (36 m) cutoffs.



| SOURCE | RESOURCE ESTIMATE (10 ⁶ m ³) |
|----------------------------|---|
| Previous Estimate (3 WTAR) | 17 304 |
| This Study (6 WTAR) | 15 381 |
| | Difference: -11% |



The primary resource for the Upper Grand Rapids is the Colony Sand. The Sparky Sand and General Petroleum Member account for the majority of the Lower Grand Rapids resource.