



**GEOLOGICAL SURVEY OF CANADA  
COMMISSION GÉOLOGIQUE DU CANADA**

**Open File 3545**

**MAYHEM IN THE MANNVILLE: STRATIGRAPHIC COMPLEXITY  
IN SOUTHERN ALBERTA AND SASKATCHEWAN - RESOLVED**

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Although every effort has been made to ensure accuracy, this Open File Report has not been edited for conformity with Geological Survey of Canada standards.

## **Mayhem in the Mannville: Stratigraphic Complexity in Southern Alberta and Saskatchewan — Resolved**

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### **Abstract**

The results of a GSC-industry, collaborative, regional mapping project of the Lower Cretaceous Mannville Group in southern Saskatchewan and Alberta (Twp. 1 - 20, Rge. 13 - 30W3 and Twp. 1 - 10, Rge. 1 - 13W4 ) are presented. The geological history is one of multiple erosion events, creating a complexly-evolving landscape where accommodation space was generally low. We present a series of maps, cross sections and analogs to illustrate the following sequence of events.

The lowermost Cretaceous sediment (Hauterivian to Barremian) is the predominantly braided fluvial sandstones of the Sunburst/S2, deposited as a continuous, unconfined sheet directly overlying the basal Cretaceous unconformity. The top of the Sunburst/S2 is a deeply-weathered paleosol which represents several million years of non-deposition and corresponds to a lull in tectonic activity in the Rocky Mountains.

Renewed Cordilleran tectonic activity resulted in deep incision in the eastern foreland basin, characterized by multiple episodes of incision and slow sediment supply. The result is deep incised valleys cut into pre-existing Cretaceous and older sediments. The Sunburst/S2 was preserved as erosional remnants forming valley interfluves. The valleys are up to 75 m deep, 30 km wide and hundreds of kilometres long.

Where the incised valleys cut into Mississippian carbonates, the lowermost sediments are called the Detrital, the deposits of a landscape consisting of carbonate scarps, debris-flow deposits, talus cones, and karst features.

As relative sea level started to rise and create limited accommodation space, sediments of the Basal Quartz/McCloud were deposited on the valley floors. These quartzose reservoir sandstones were deposited as valley-confined sandy-braided rivers in Alberta, and sluggish meandering rivers in southern Saskatchewan. Brackish to lacustrine, fine-grained sediments of the Bantry/Ostracod Member were deposited within and overlapped onto margins of the

valleys. Debris flow and colluvium deposits within Bantry/Ostracod zone indicate considerable local relief, associated with nearby interfluves.

The Glauconite Member represents a complex of different facies types resulting from multiple changes in relative sea level. Shorelines and deeply incised estuarine channel deposits have been identified, opening up new exploration opportunities in Saskatchewan.

In the predominantly lithic Upper Mannville, accommodation space and sediment supply increased, changing the fluvial style to predominantly meandering with associated fine-grained floodplain deposits.

To complement the regional approach of this study, a detailed case example of the Manyberries area will be presented.

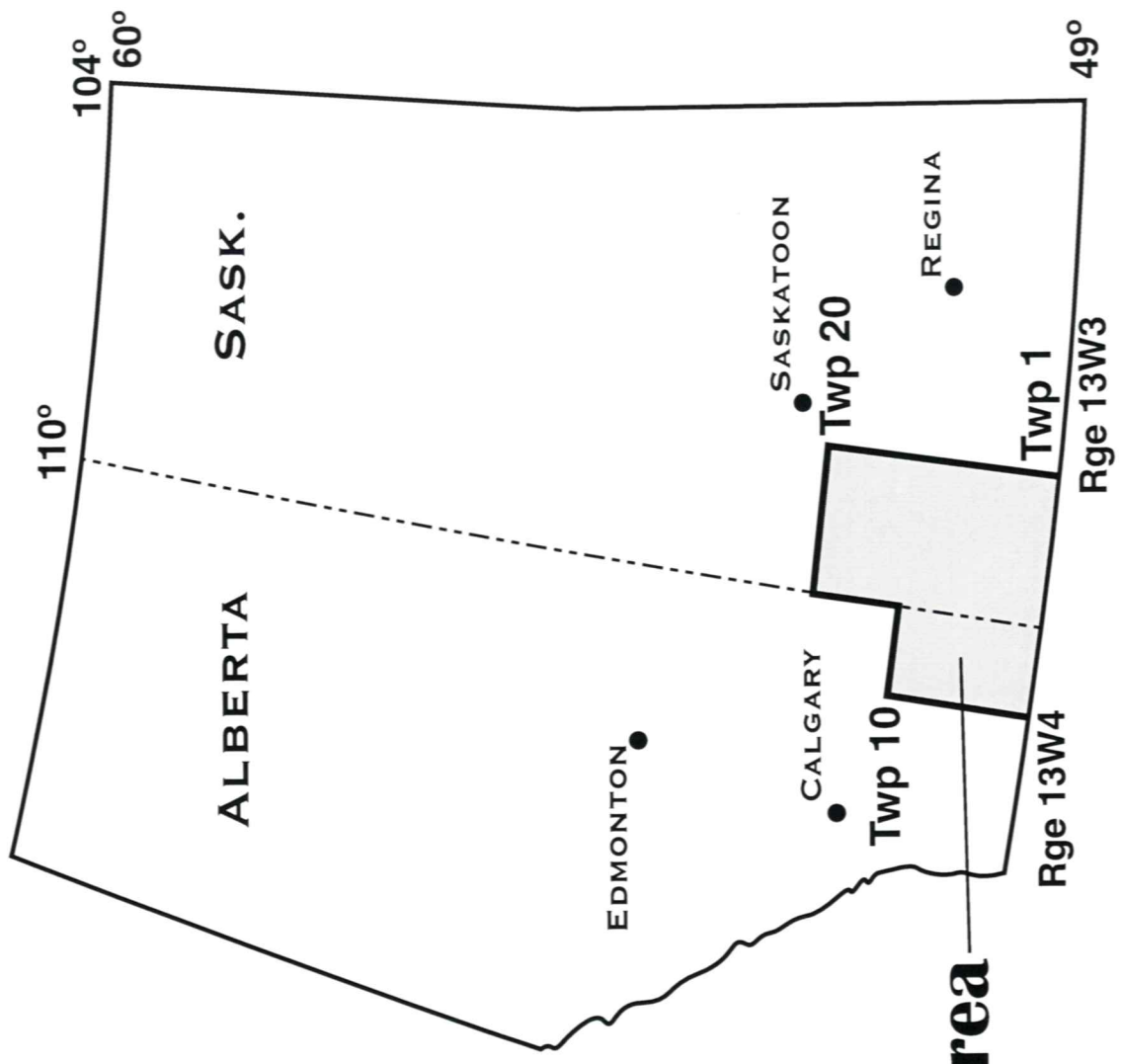
What follows are hard-copy graphics of a talk presented to the Canadian Society of Petroleum Geologists on Tuesday, October 28, 1997, in Calgary. This open file report is seen as supplemental data dissemination to the oral presentation.

# **Mayhem in the Mannville: Stratigraphic Complexity in Southern Alberta and Saskatchewan - Resolved**

**Dale A. Leckie  
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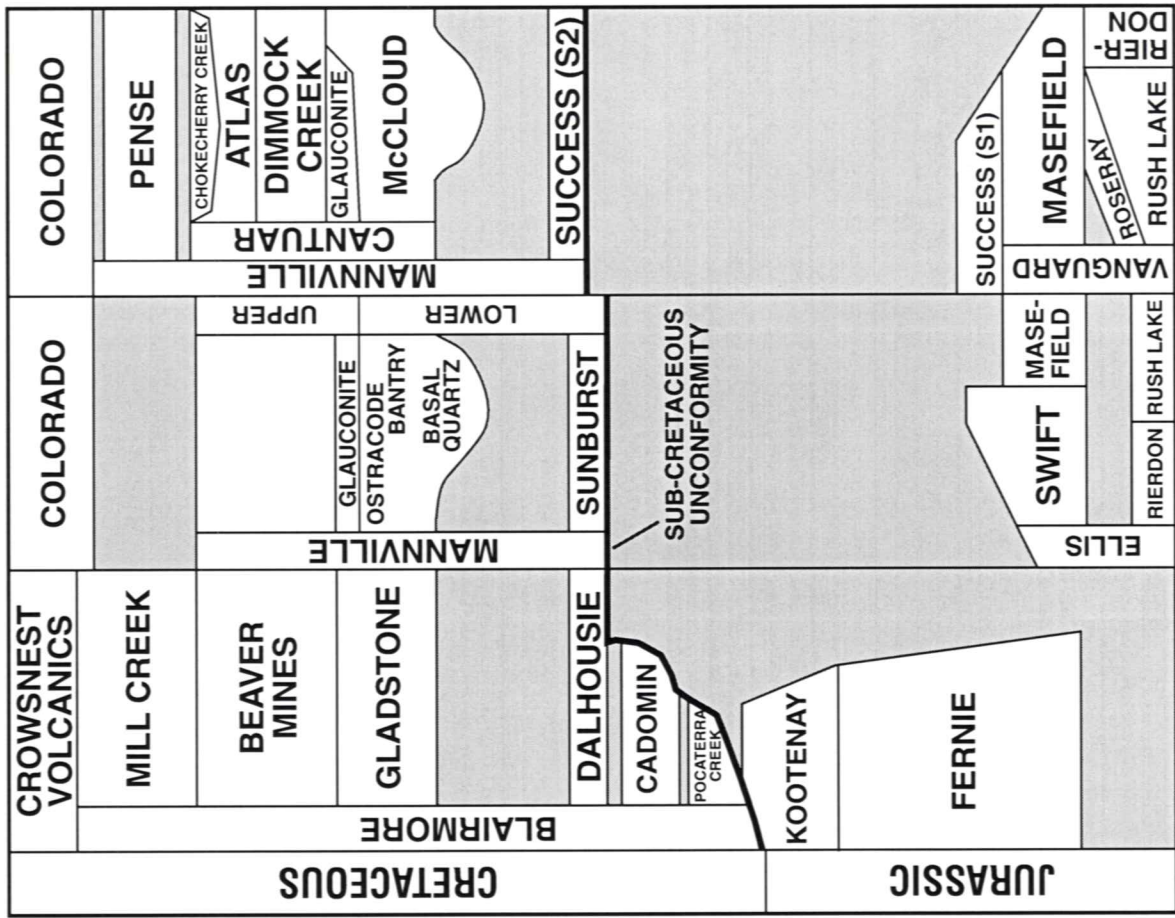


A subsidiary of Canadian Occidental Petroleum Ltd.

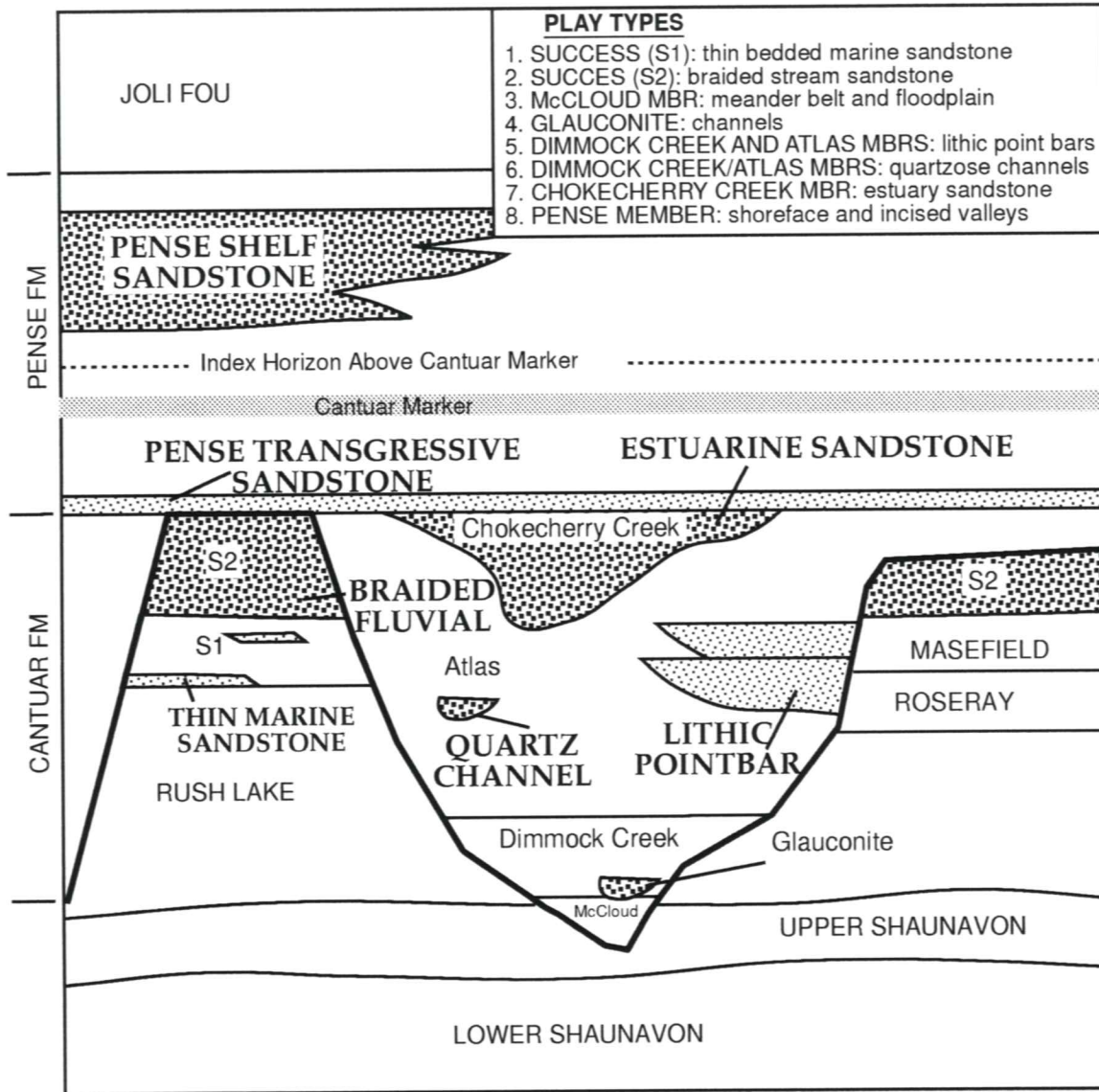


**Study Area**

**ROCKY MOUNTAIN SOUTHERN SOUTHWEST  
FOOTHILLS ALBERTA SASKATCHEWAN**



# MANNVILLE PLAY TYPES



# **Data Base**

**272 Cores**

**1040 Well logs**

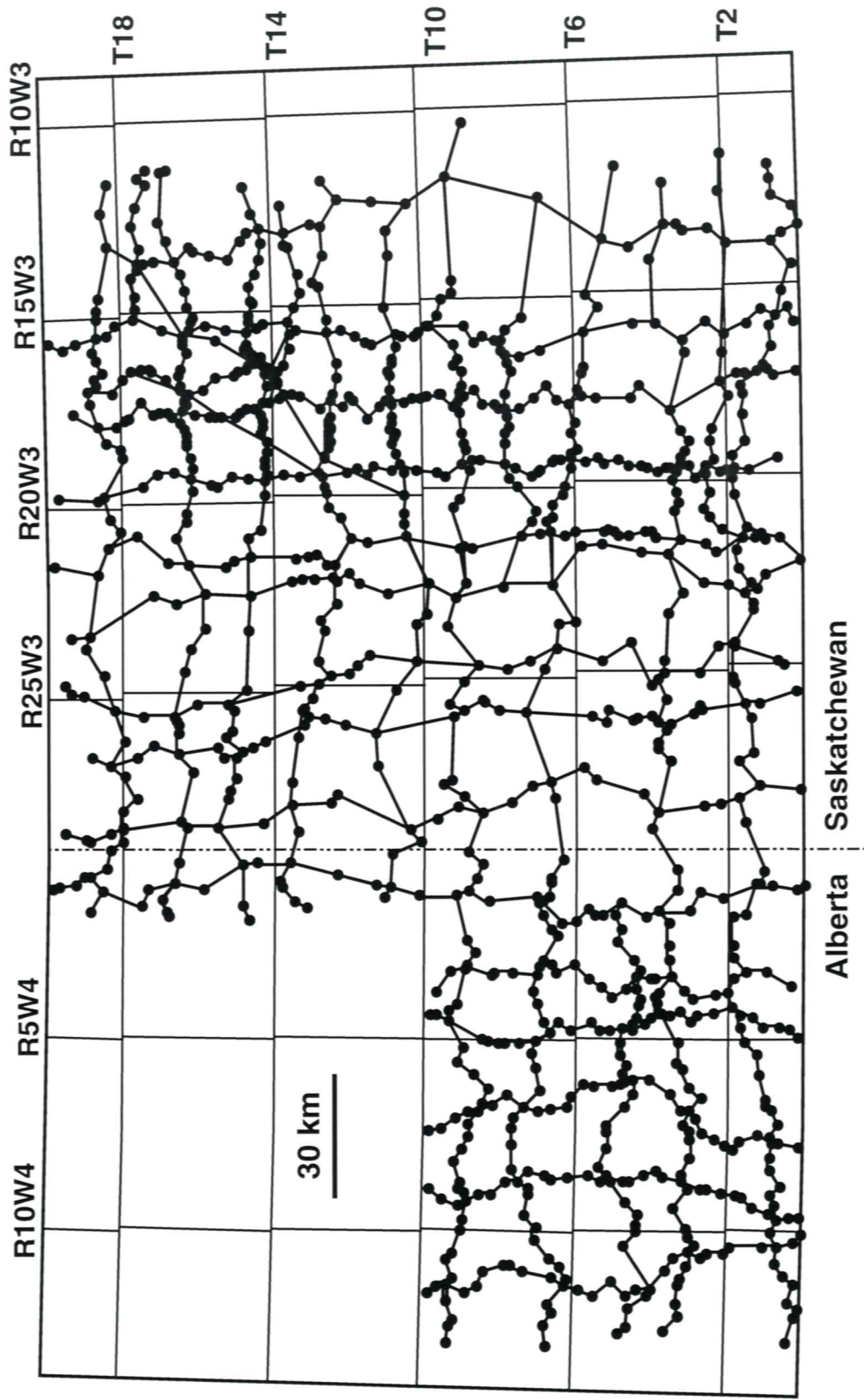
**141 CanStrat logs**

**136 Drill cuttings**

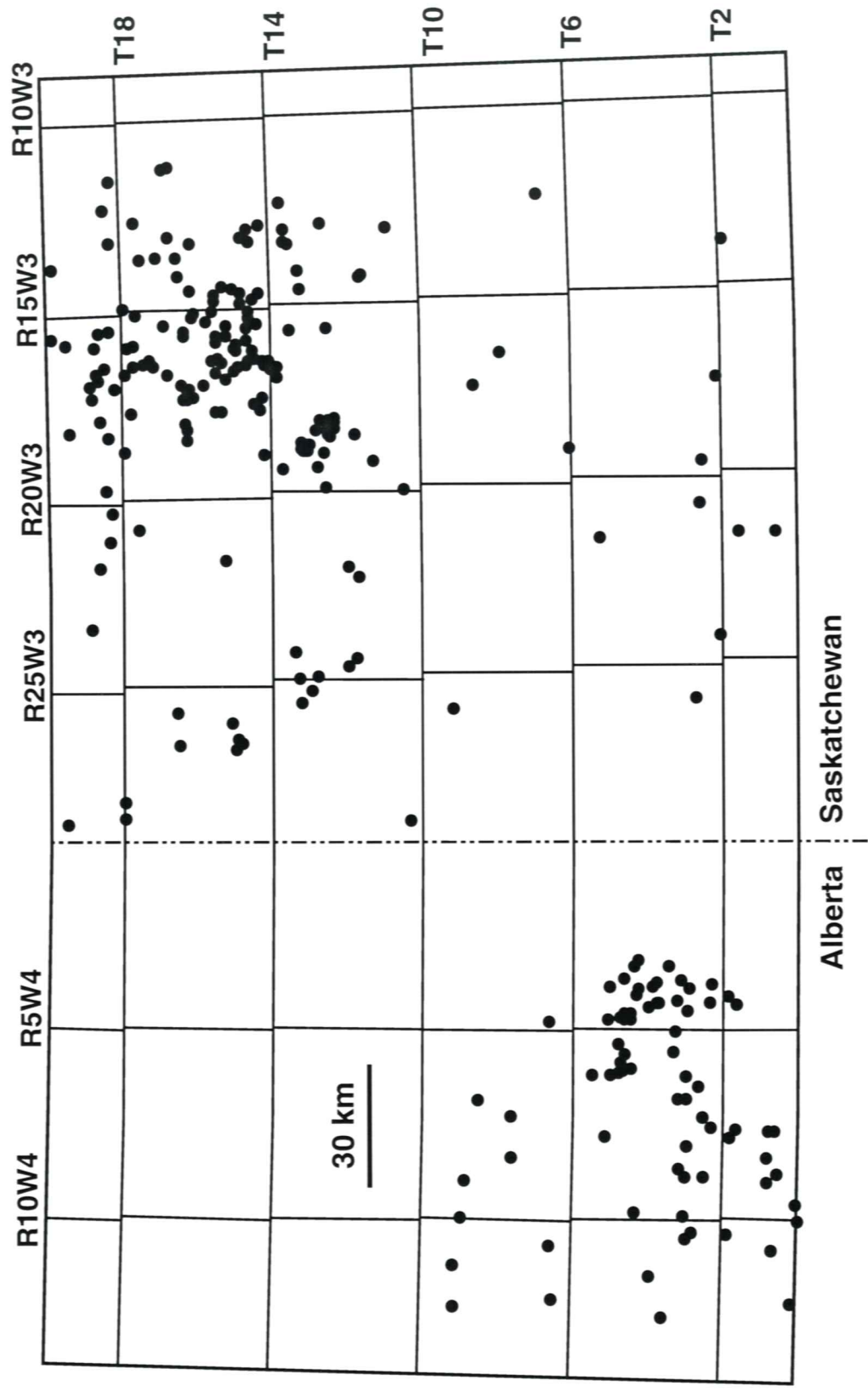
**28 Regional cross-sections**



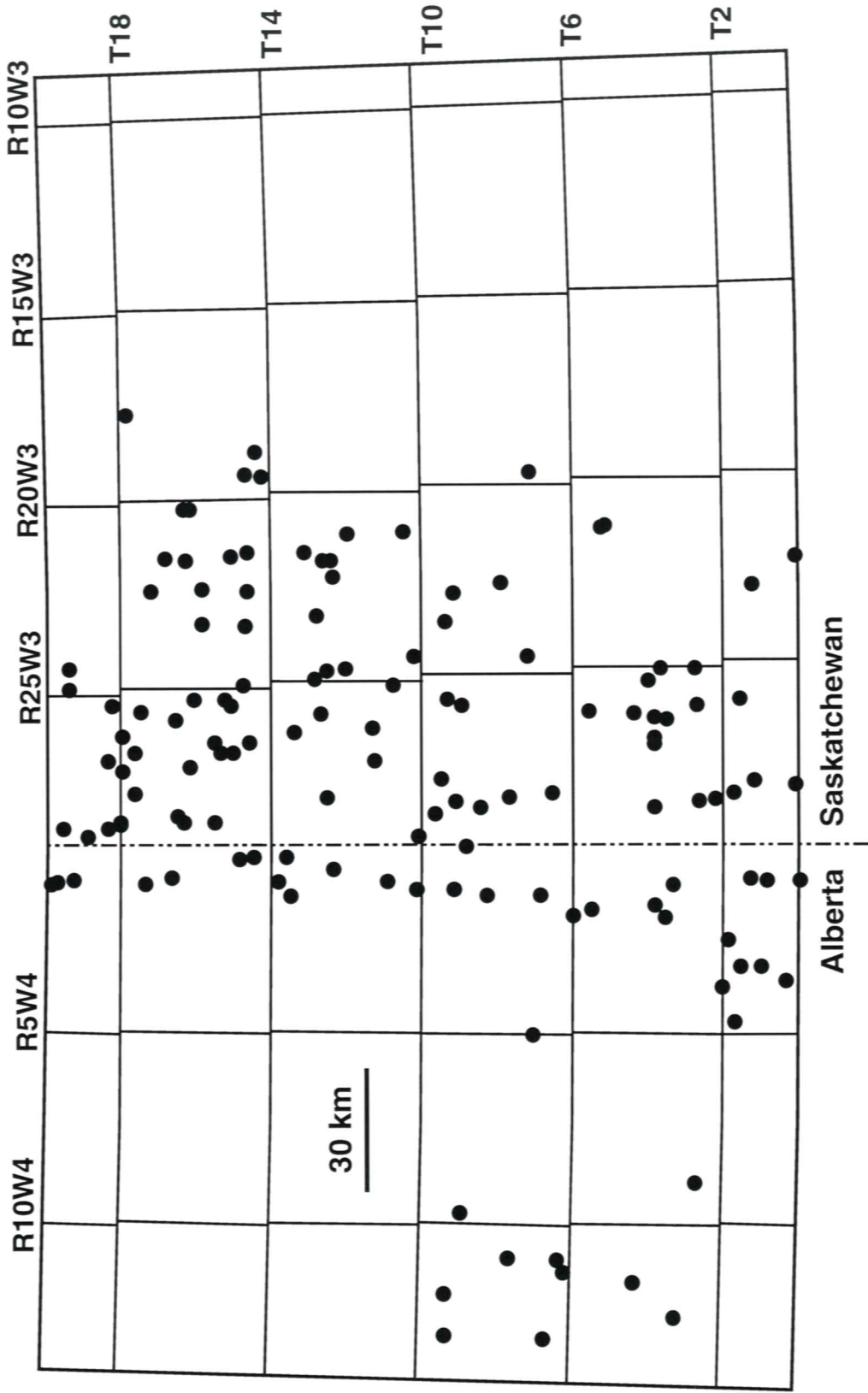
# Mannville Cross-section Grid < 1040 logs 28 sections



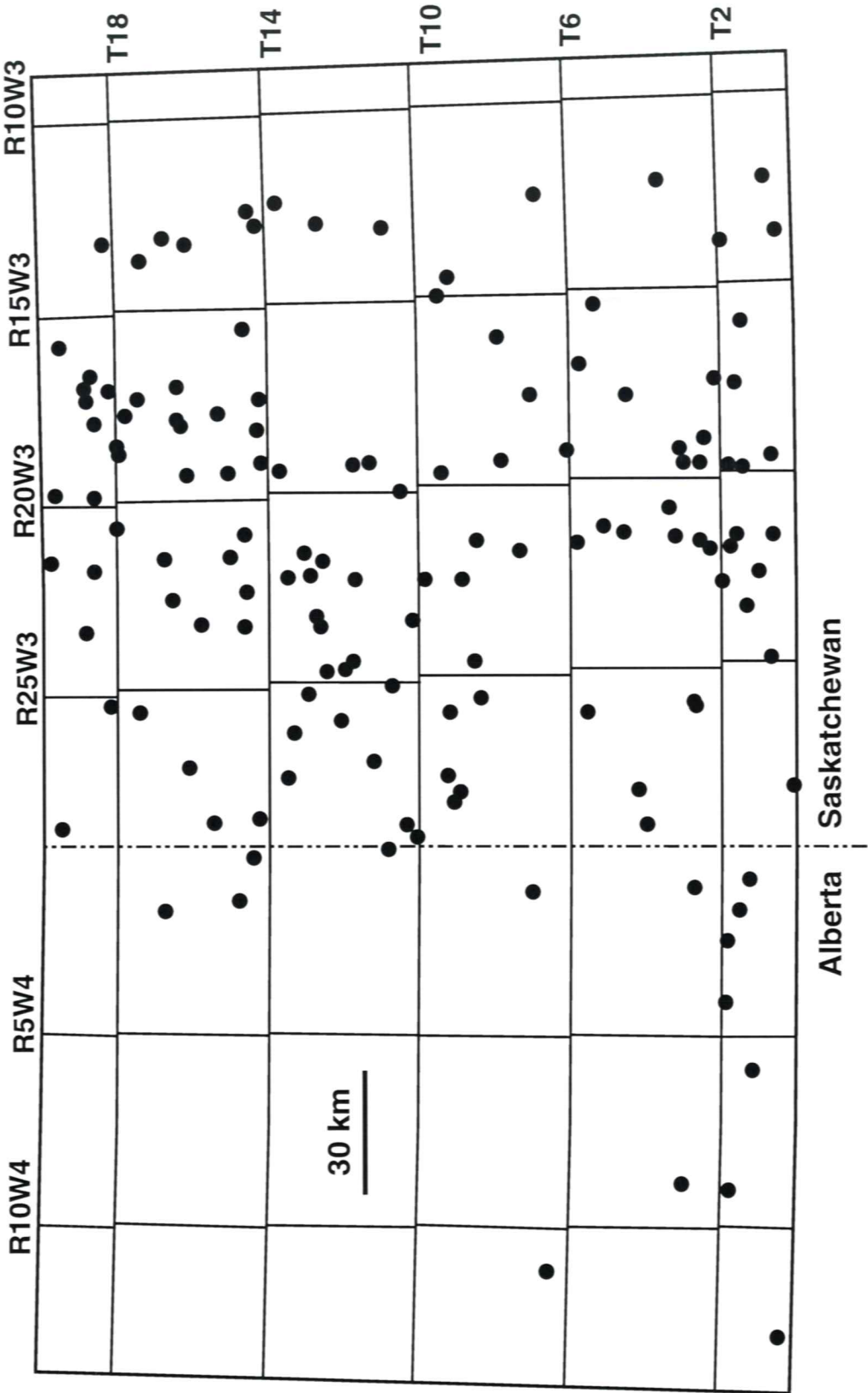
# Mannville Core 272 cores



# Mannville Drill Cuttings - 136 cuttings

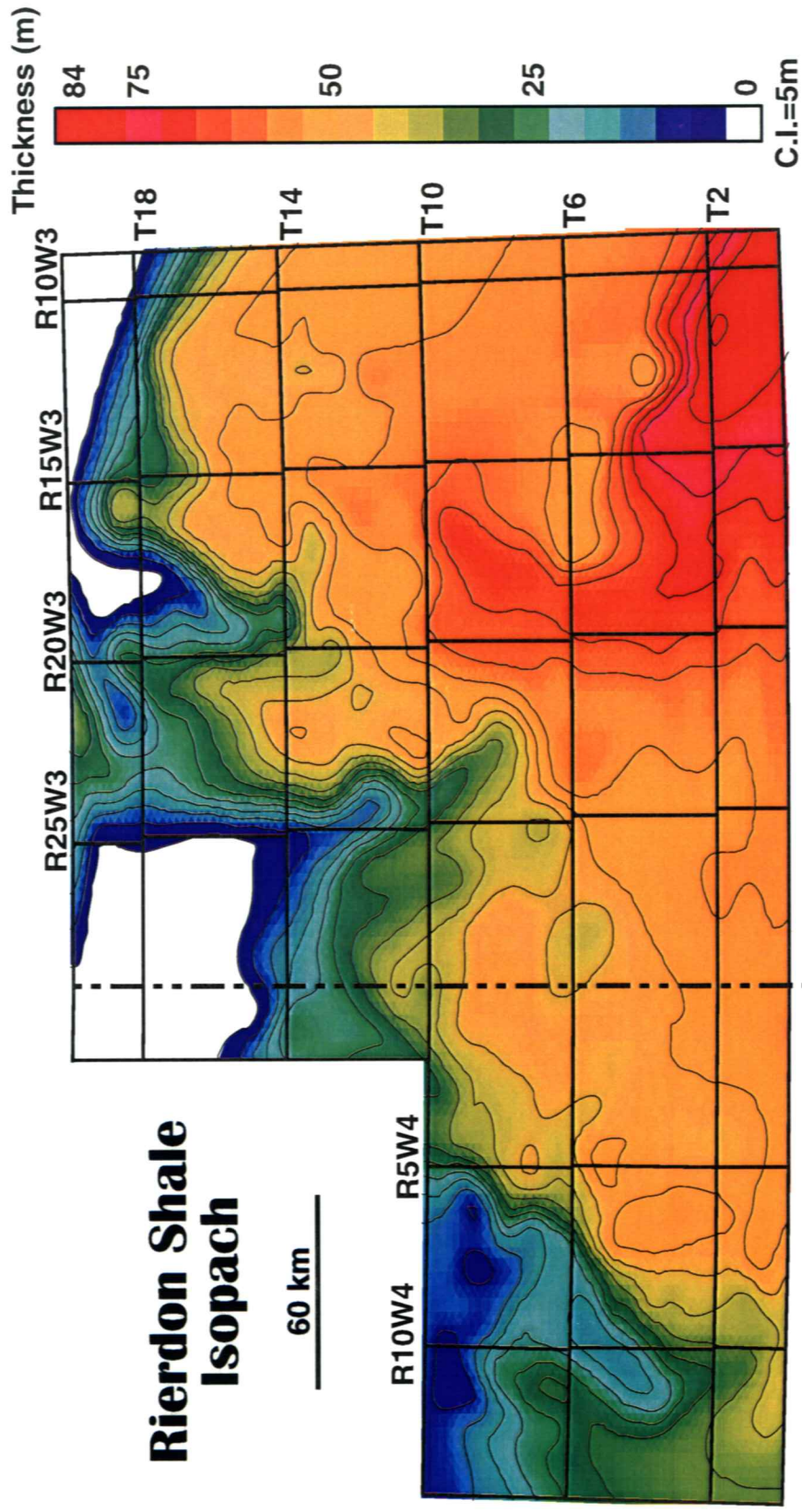


# Mannville CanStrat Logs - 141 logs



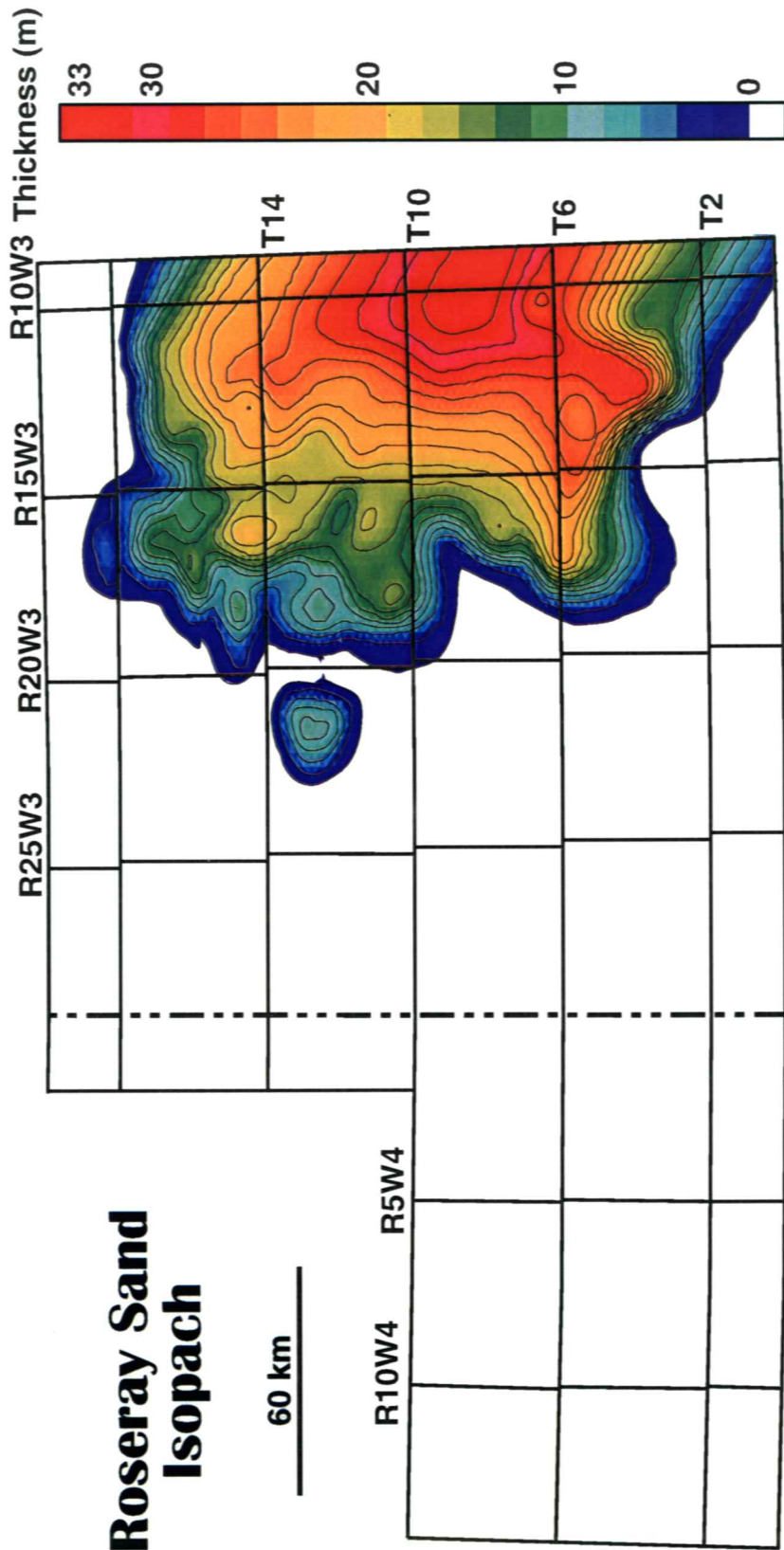
# Rierdon Shale Isopach

60 km



# Roseray Sand Isopach

60 km

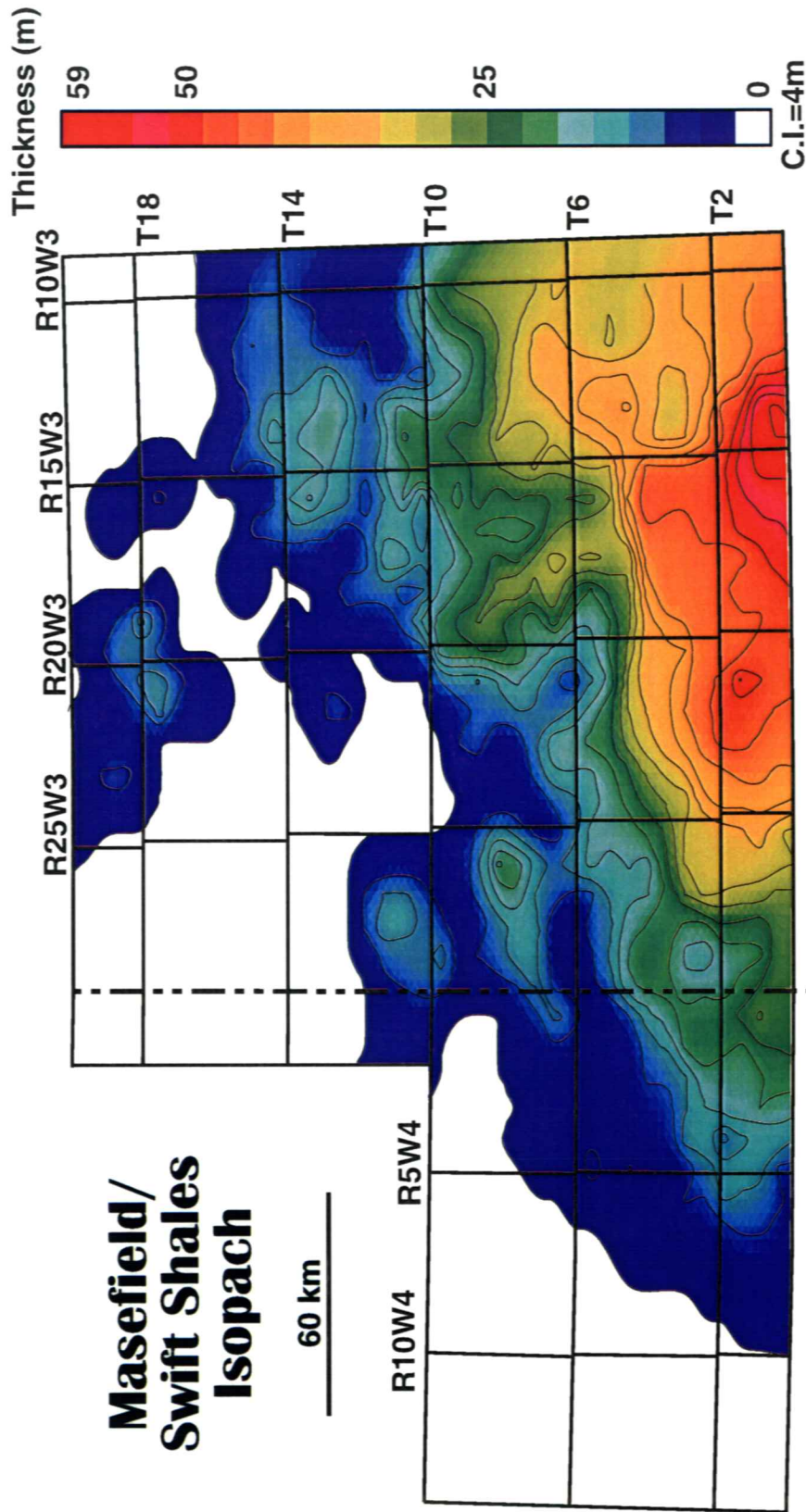


C.I.=2m

Alberta | Saskatchewan

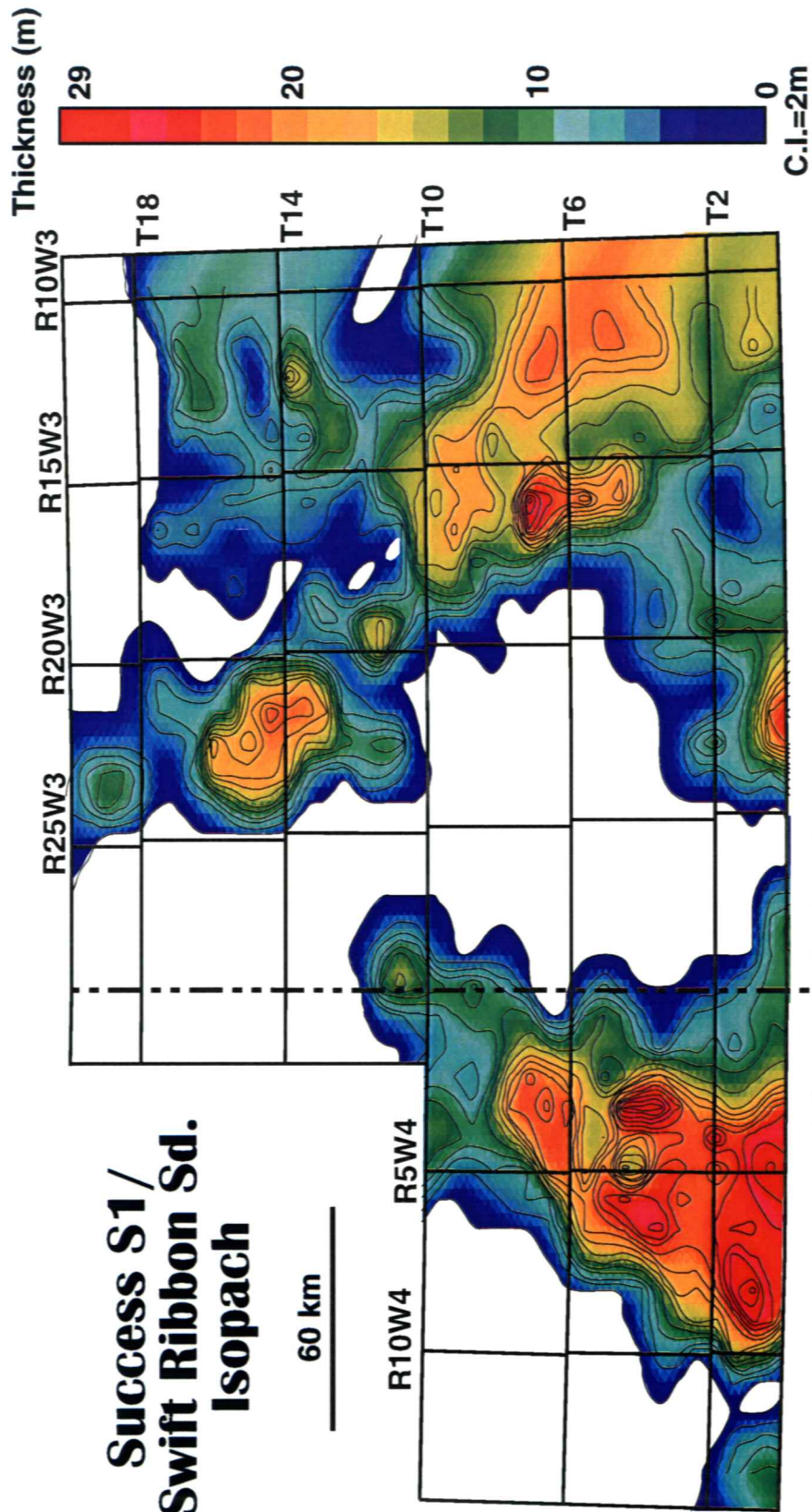
# Masefield/ Swift Shales Isopach

60 km



# Success S1/ Swift Ribbon Sd. Isopach

60 km

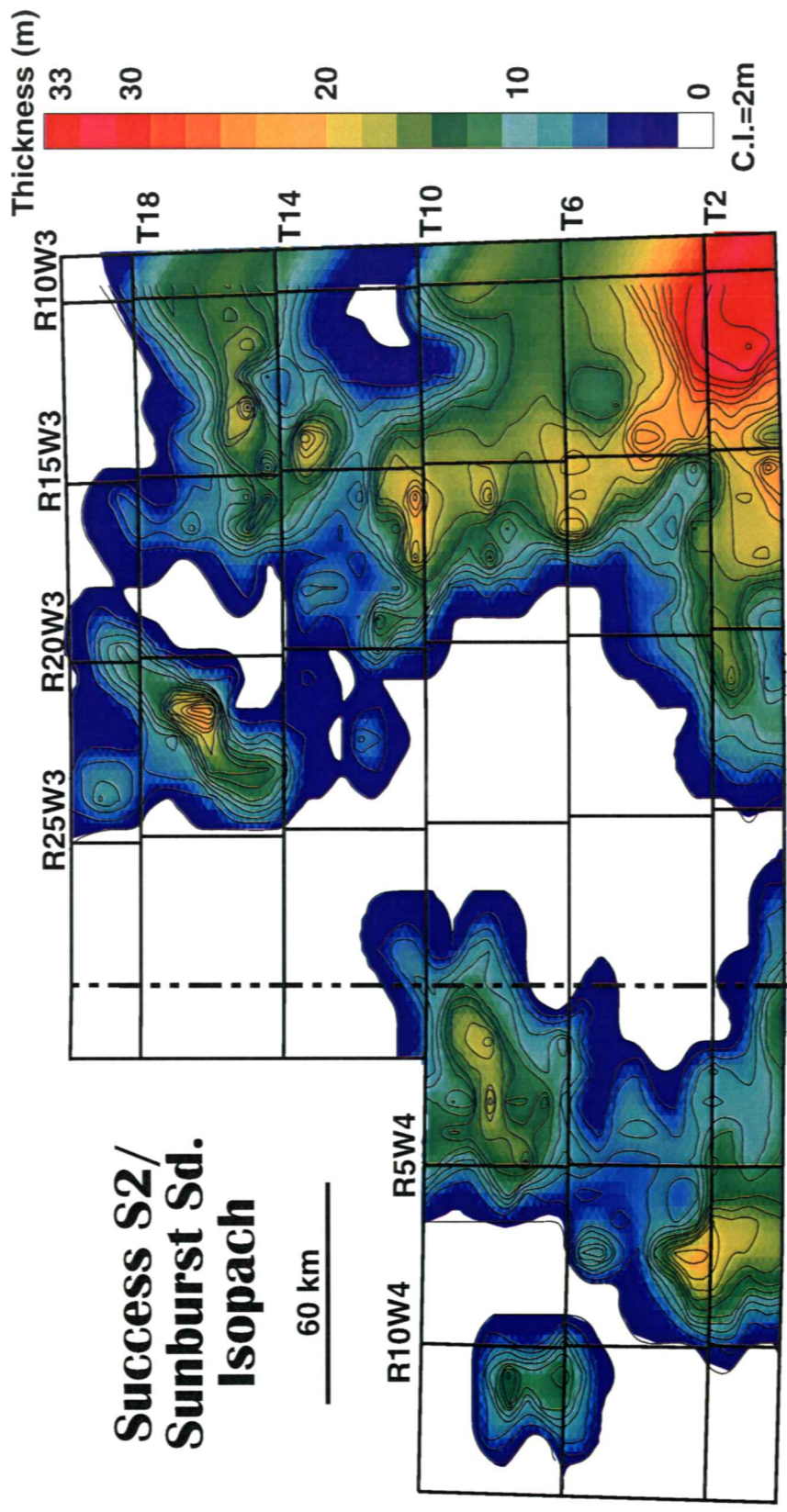


Alberta | Saskatchewan



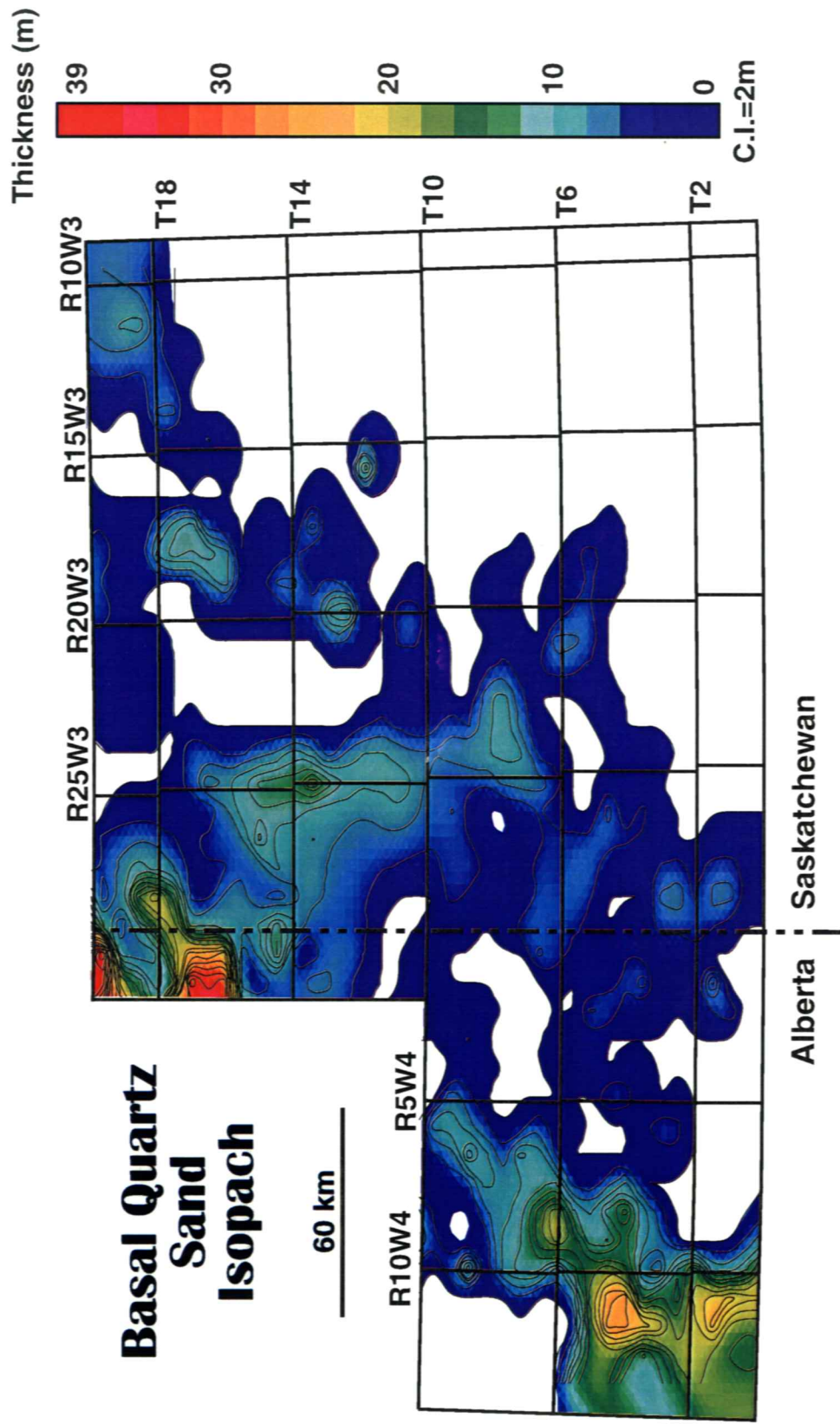
# Success S2/ Sunburst Sd. Isopach

60 km



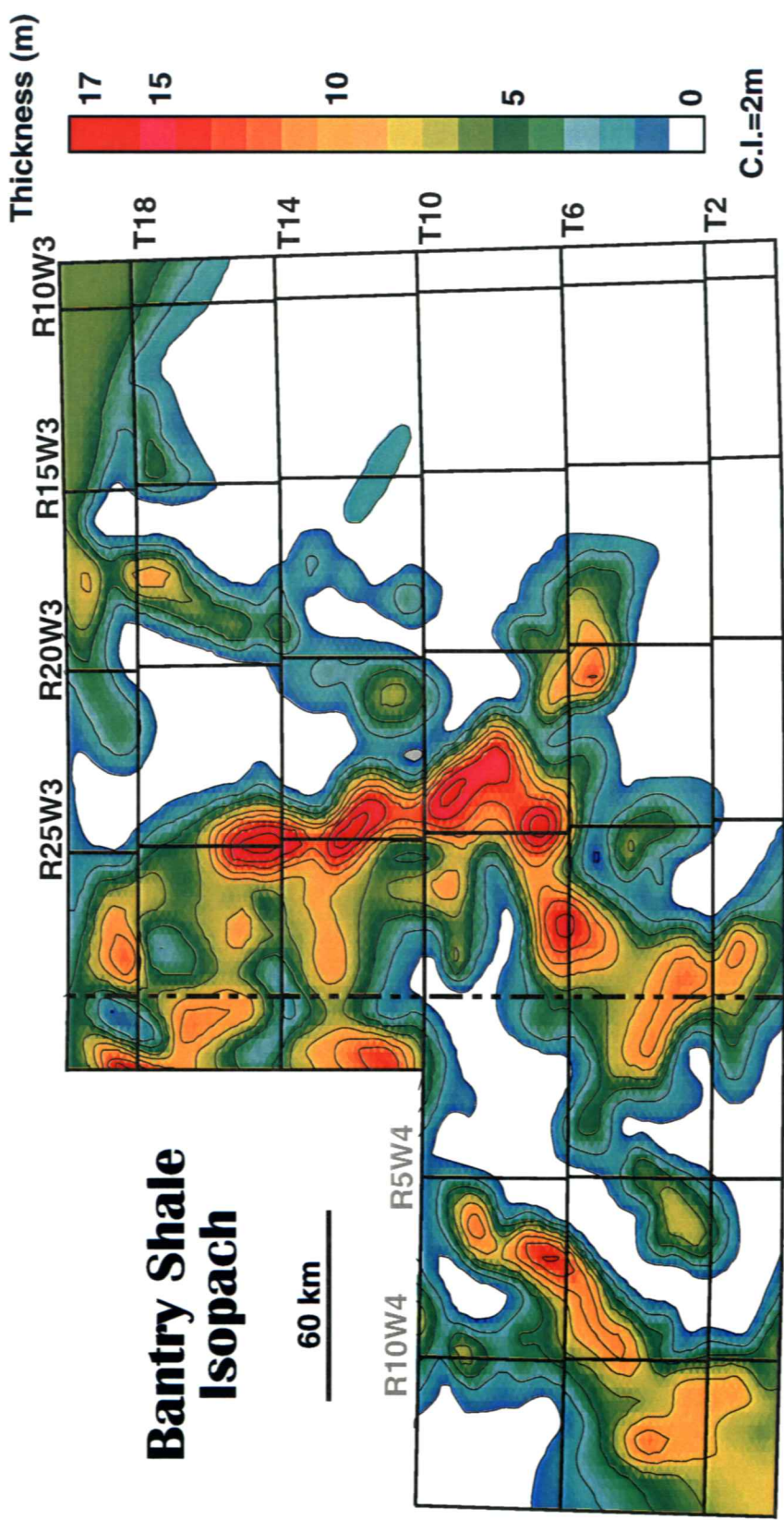
# Basal Quartz Sand Isopach

60 km



# Bantry Shale Isopach

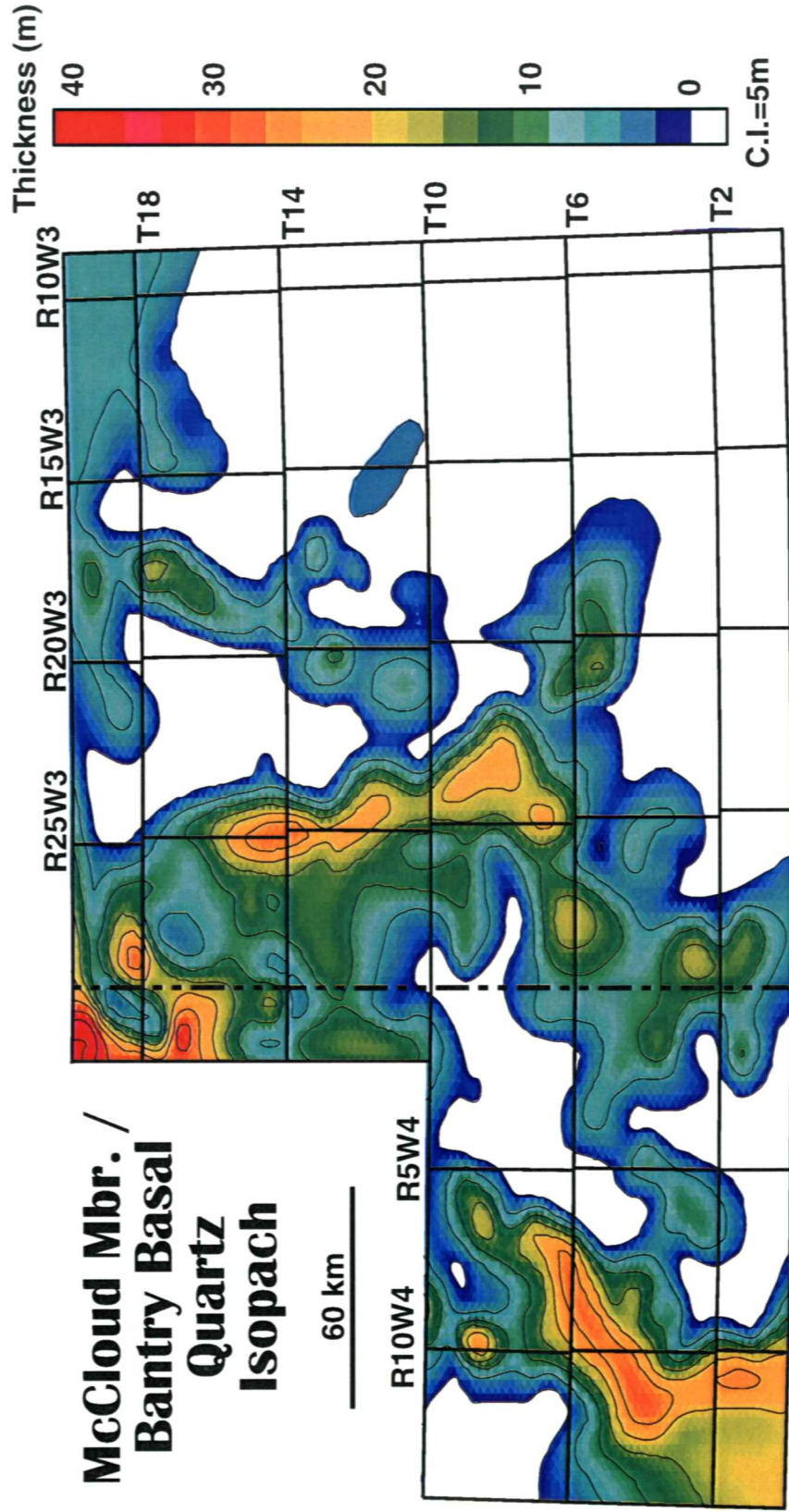
60 km



Alberta | Saskatchewan

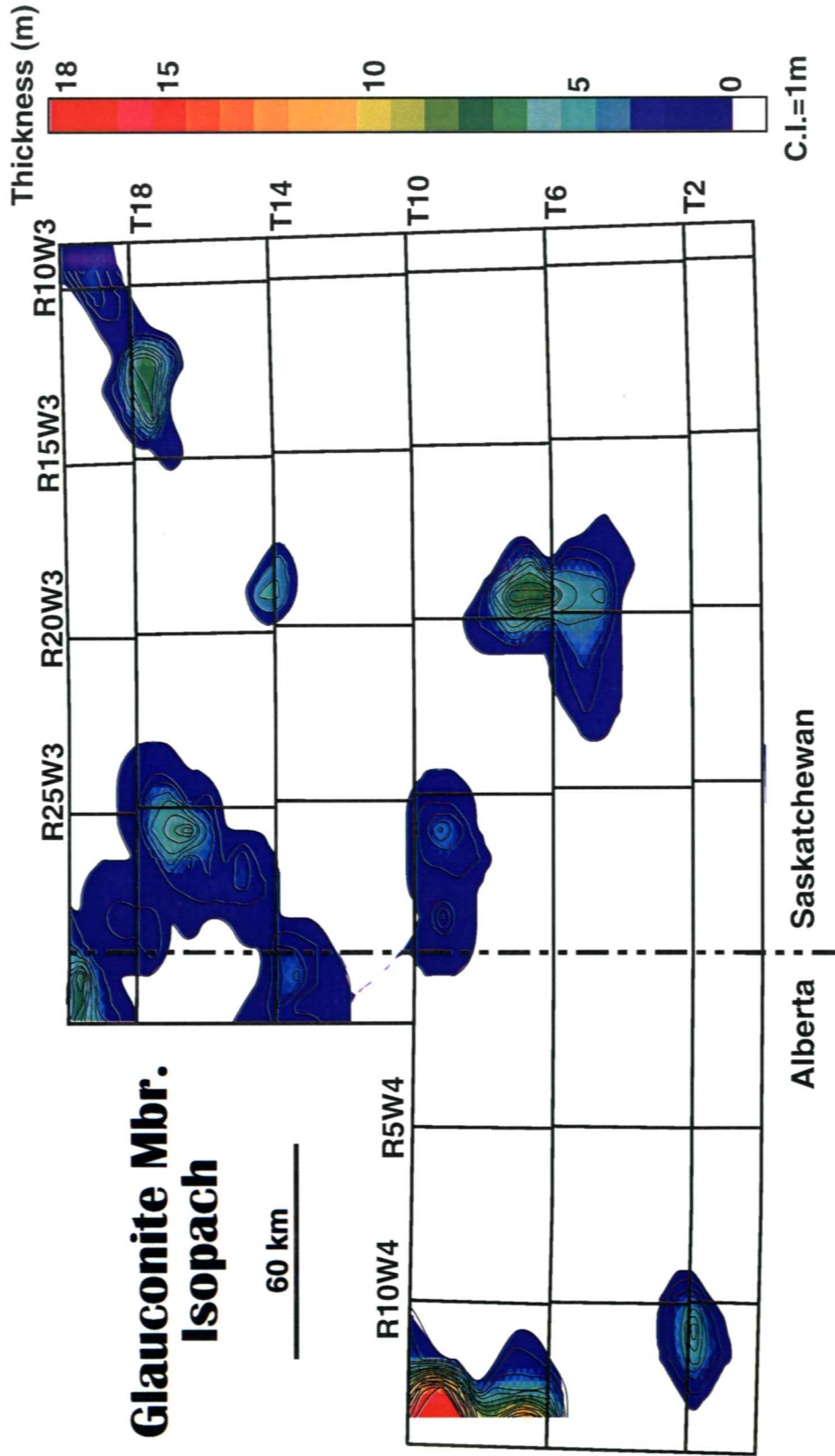
# McCloud Mbr. / Bantry Basal Quartz Isopach

60 km



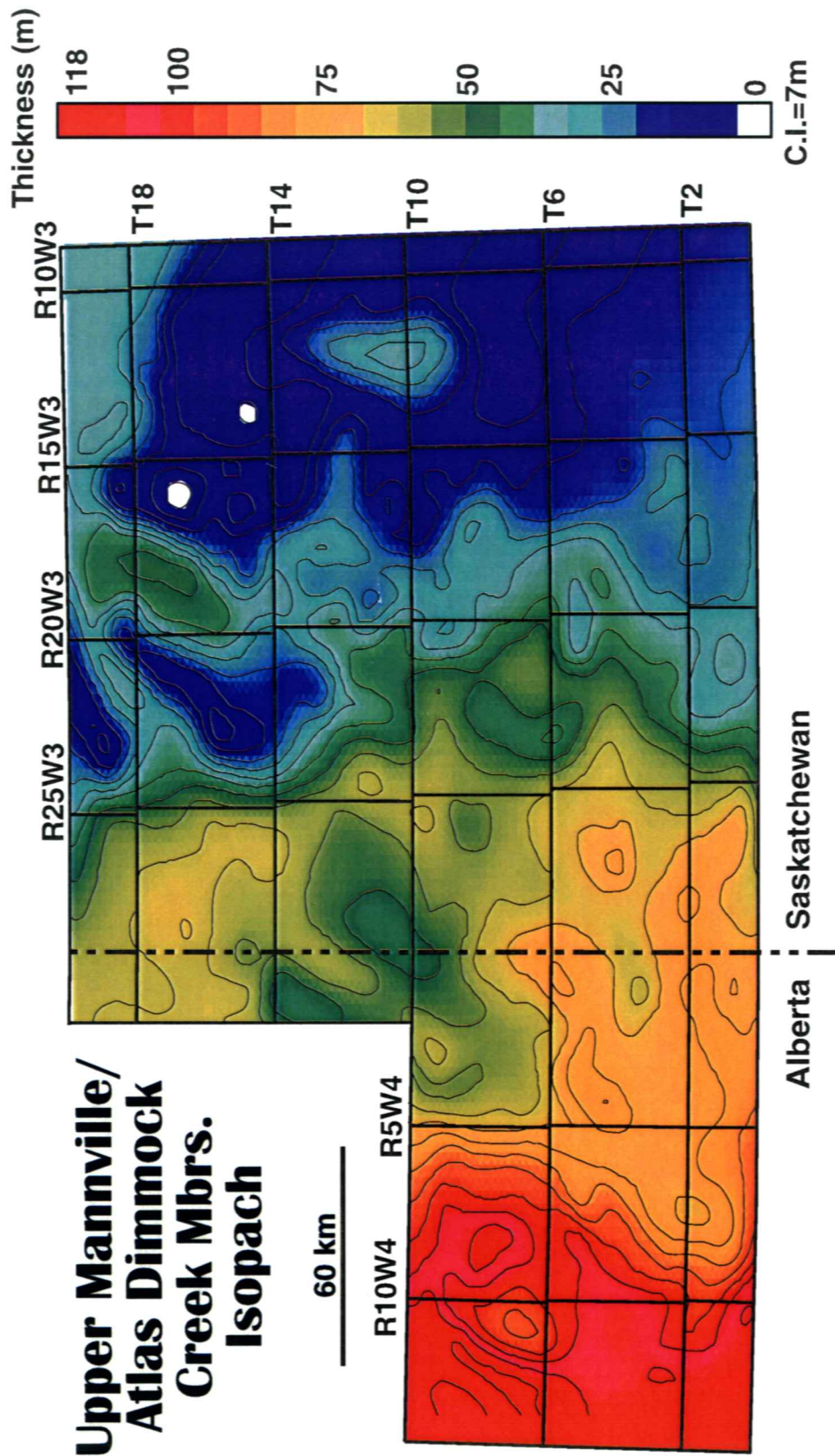
# Glauconite Mbr. Isopach

60 km



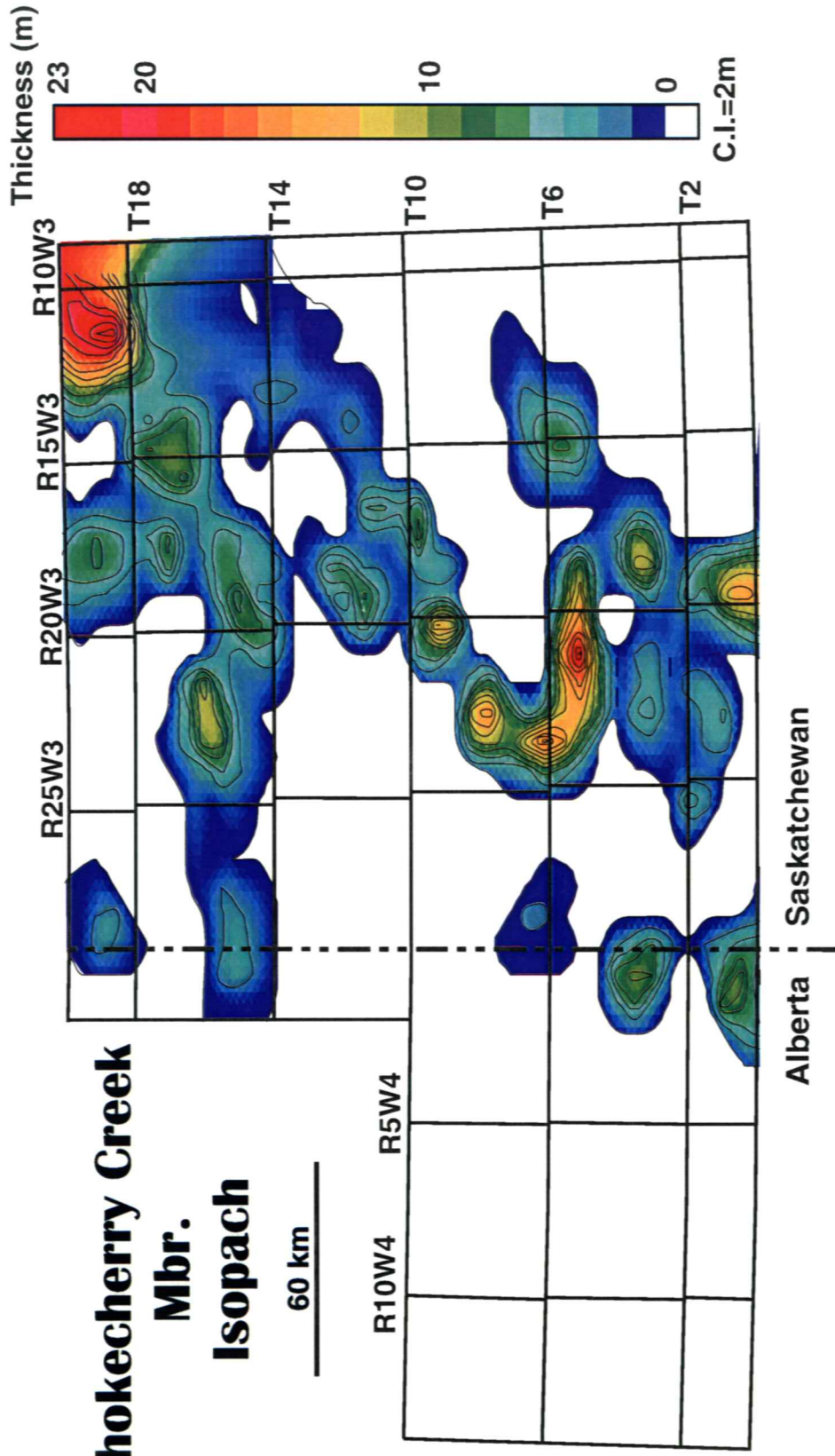
# Upper Mannville/ Atlas Dimmock Creek Mbrs. Isopach

60 km



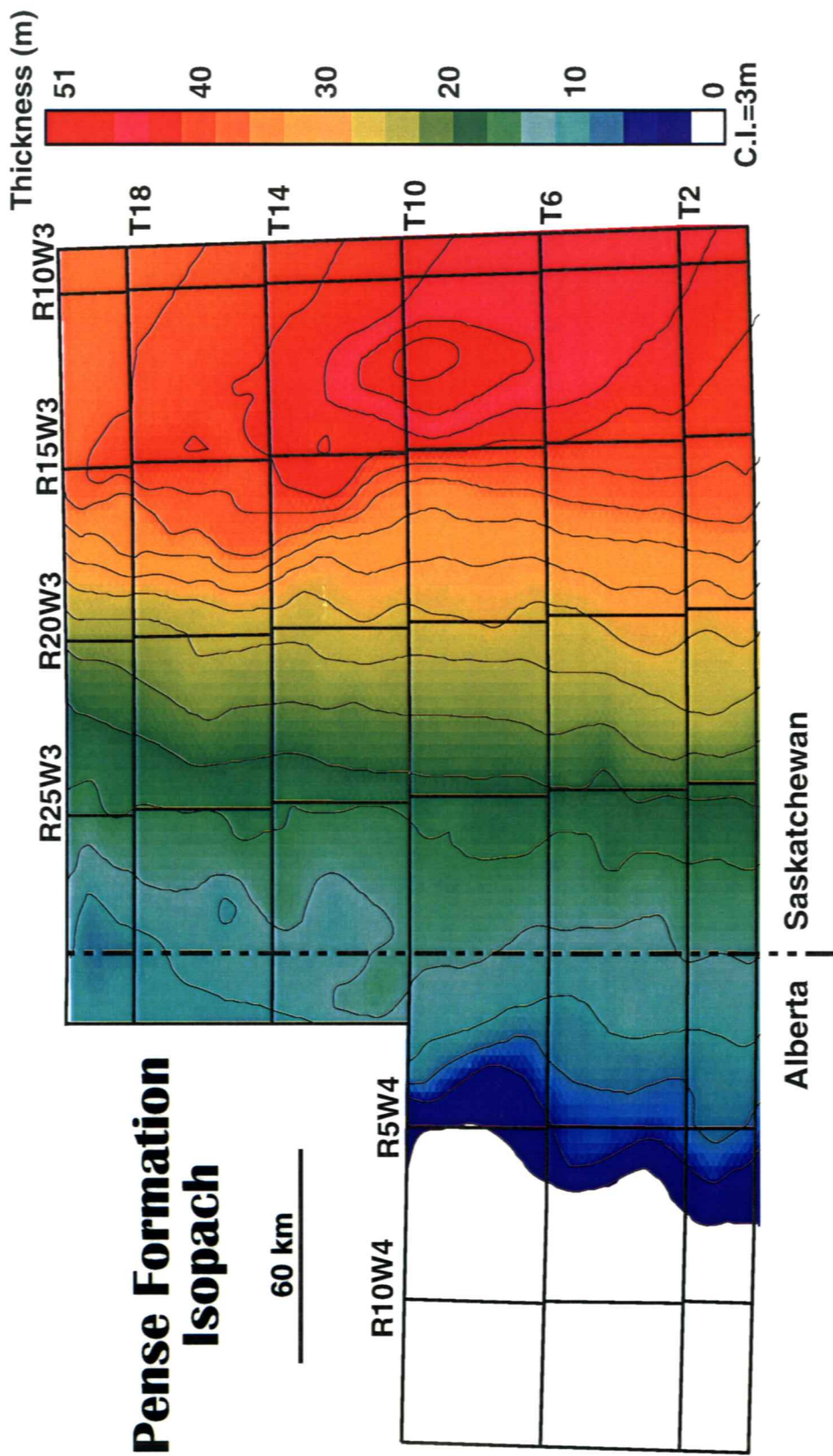
# Chokecherry Creek Mbr. Isopach

60 km



# Pense Formation Isopach

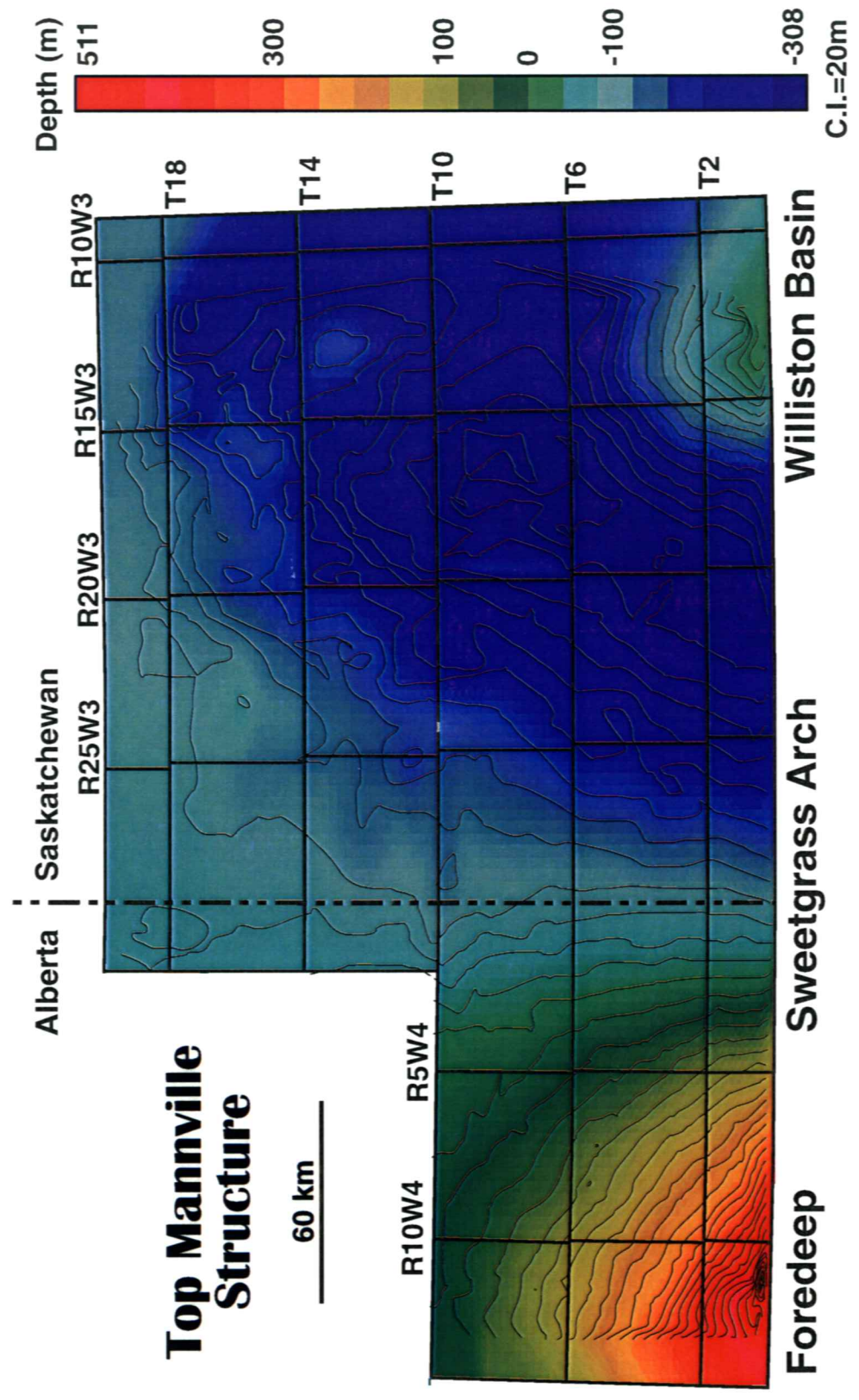
60 km





# Top Mannville Structure

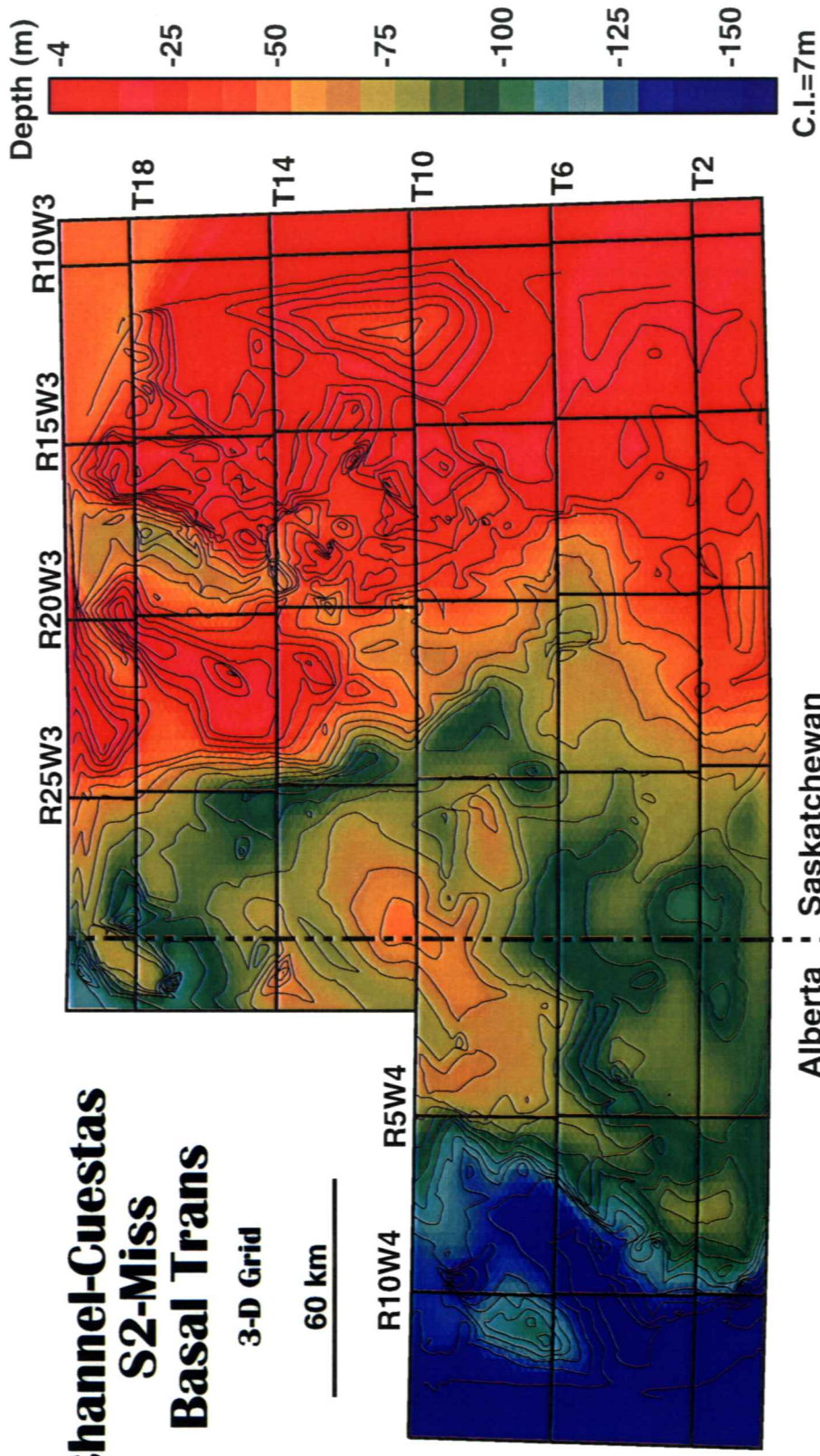
60 km



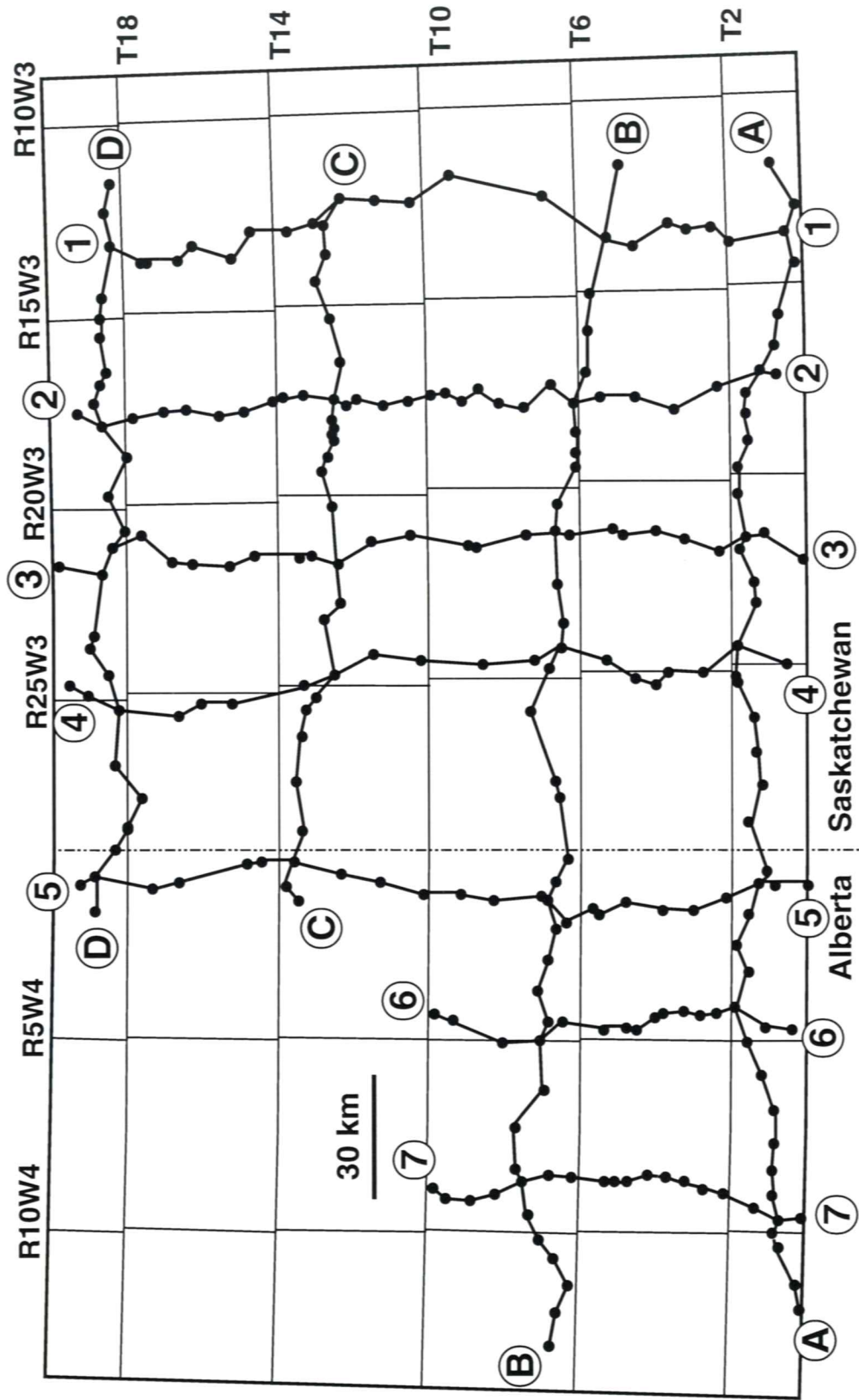
# Channel-Cuestas S2-Miss Basal Trans

3-D Grid

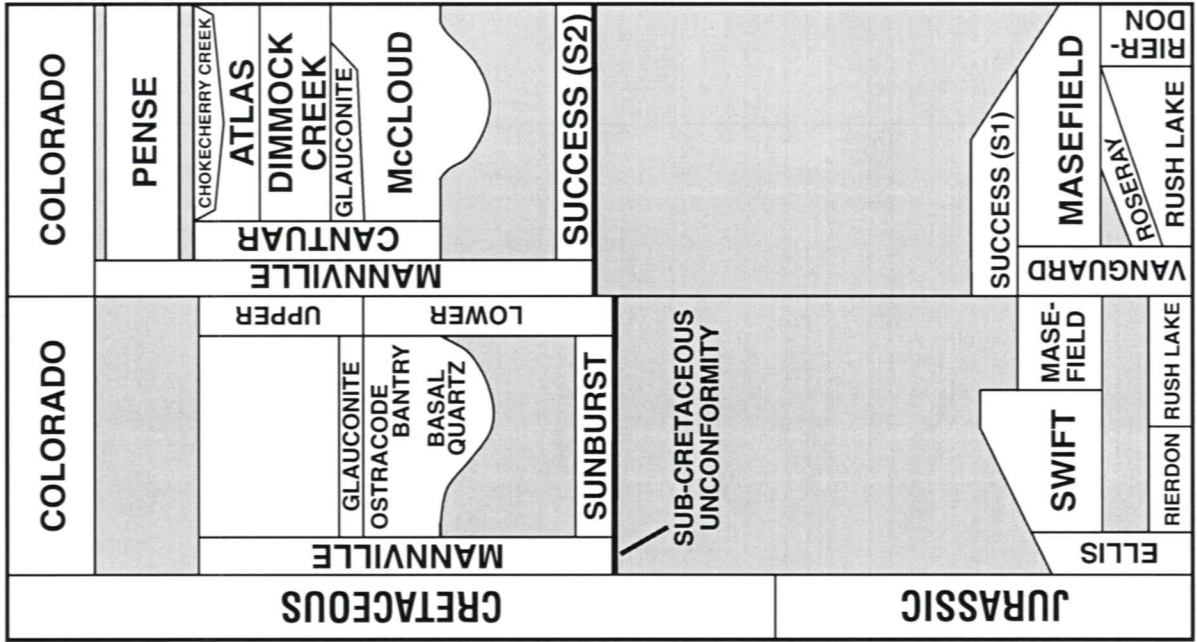
60 km



# Summary Cross-section Grid

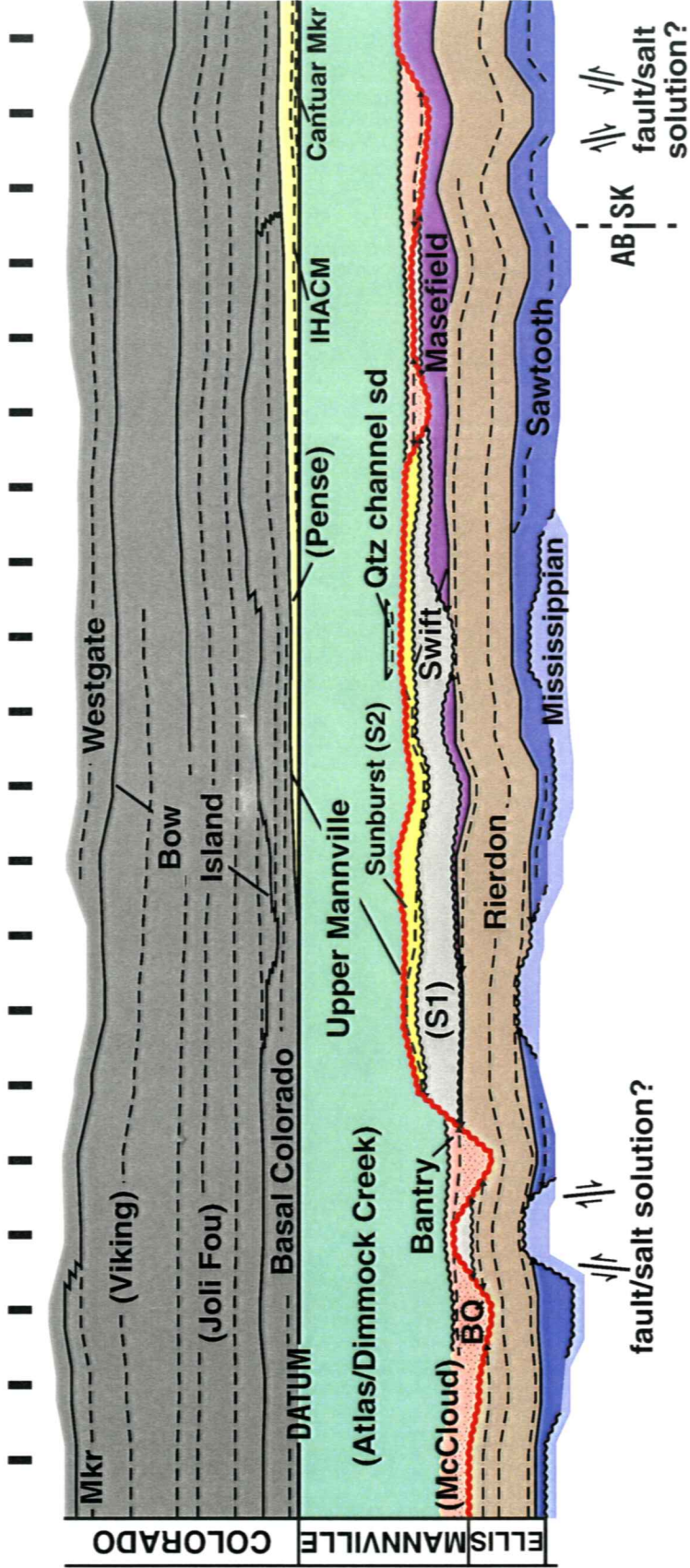


**SOUTHERN ALBERTA**      **SOUTHWEST SASKATCHEWAN**



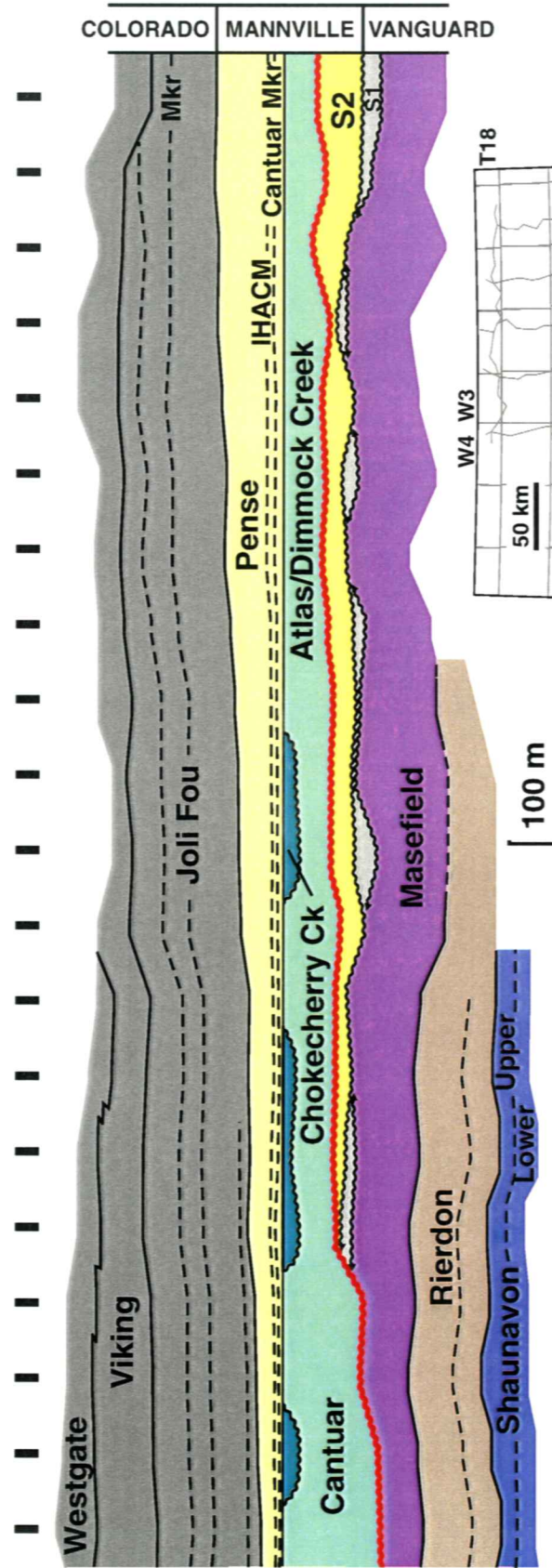
# MANNVILLE COMPILATION A

West  
1-13W4

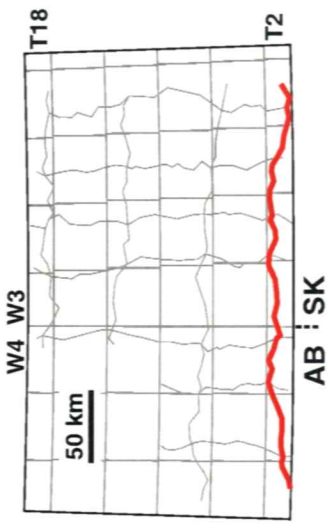


# MANNVILLE COMPILATION A

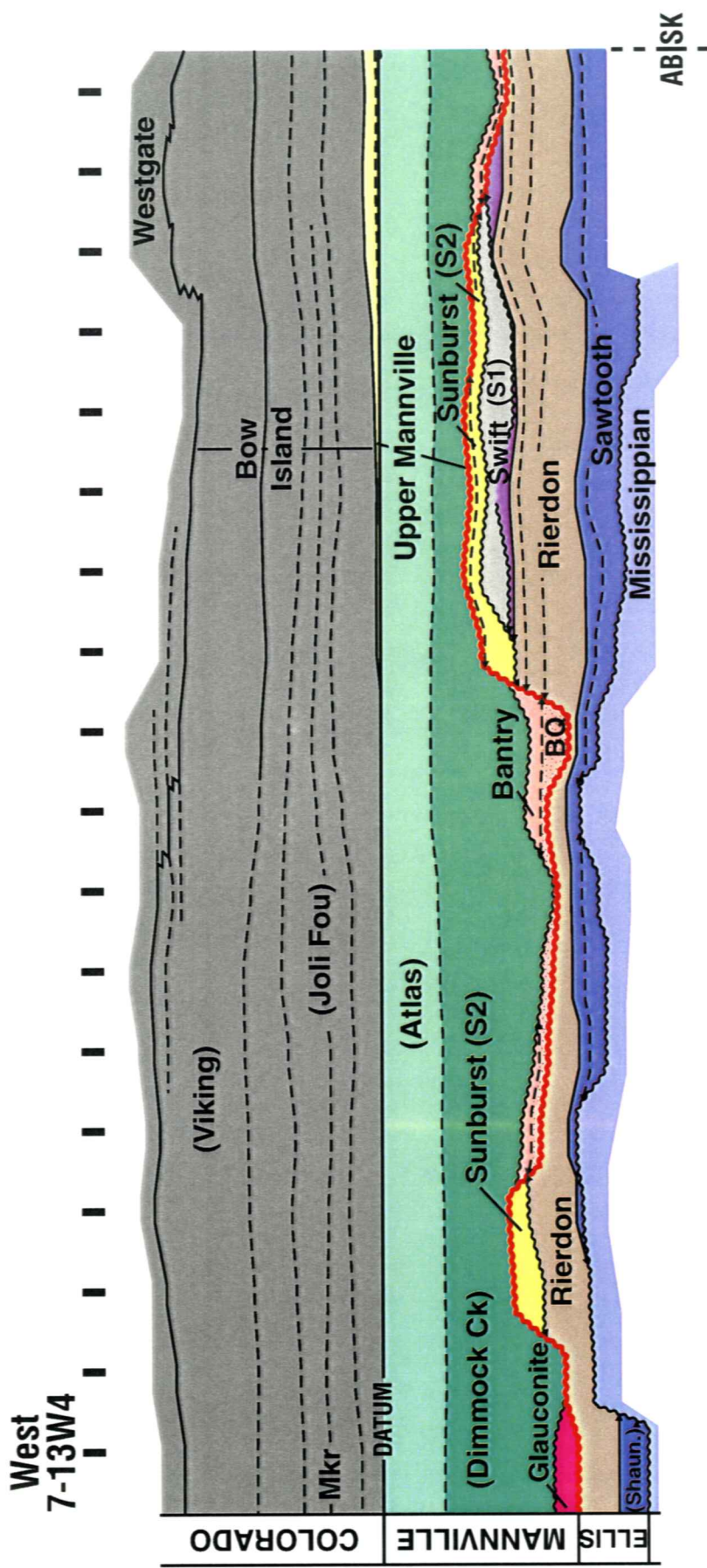
East  
1-12W3



COLORADO    MANNVILLE    VANGUARD

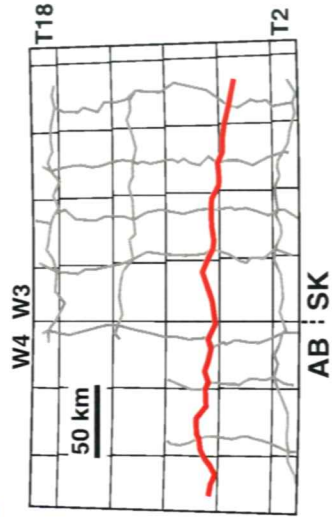
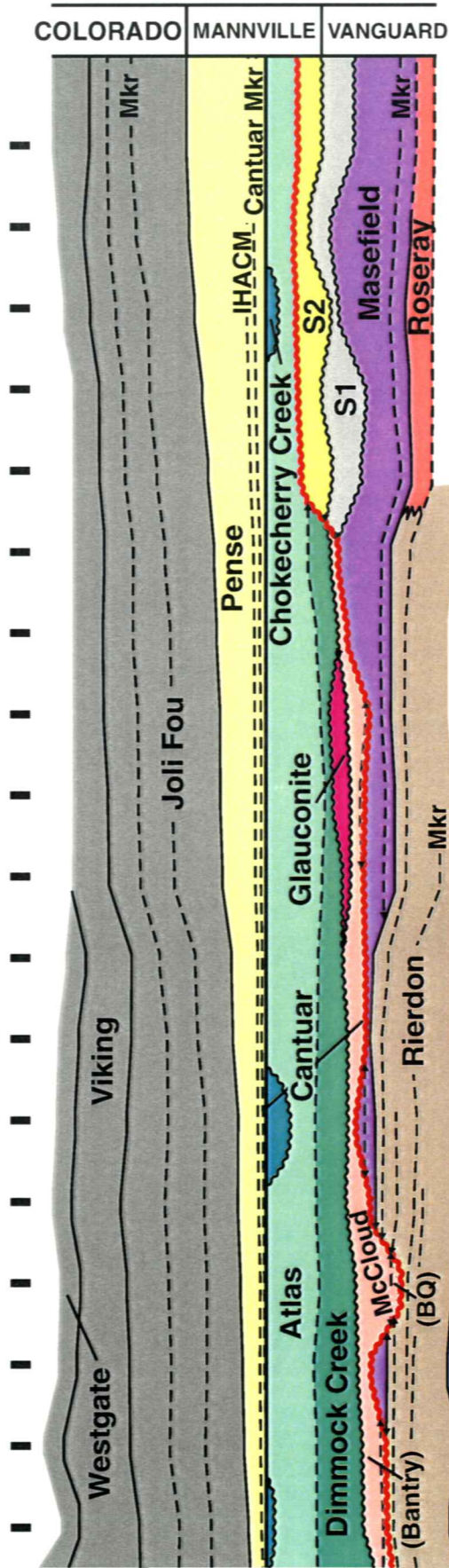


# MANNVILLE COMPILATION B



# MANNVILLE COMPILATION B

East  
5-12W3

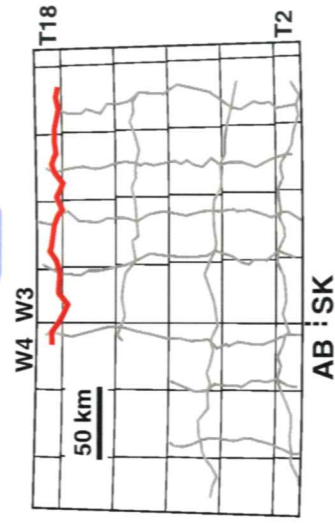
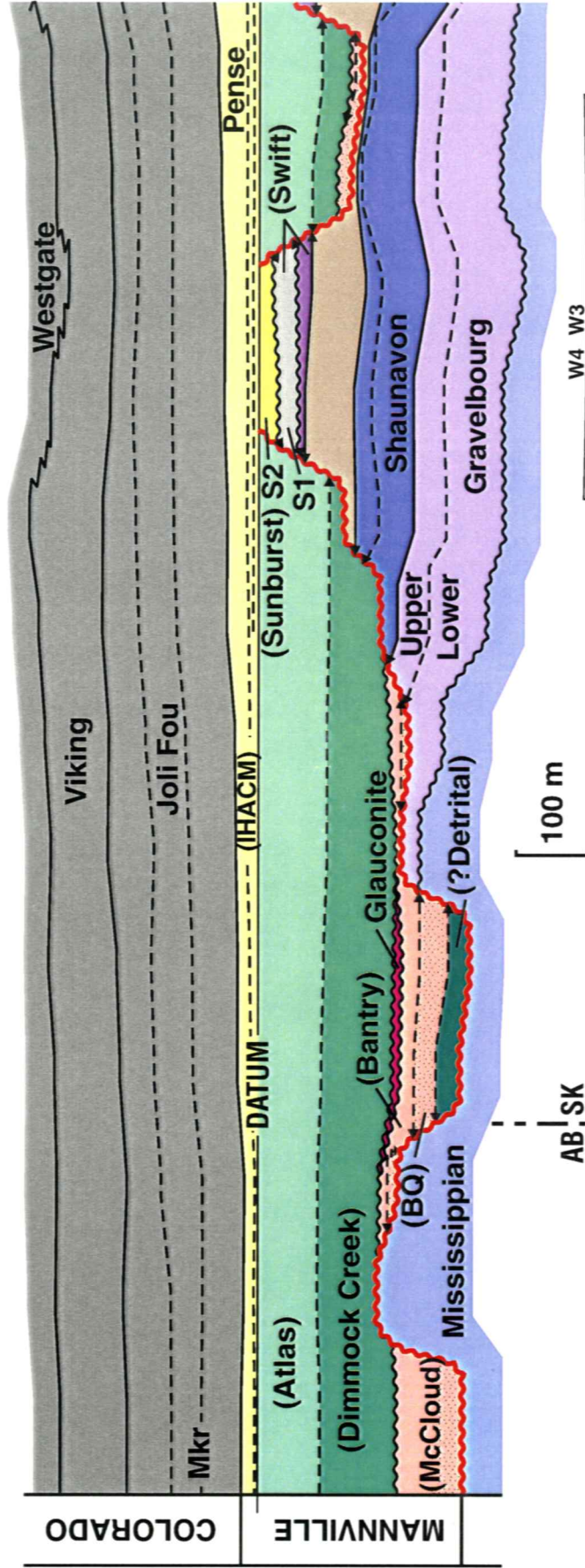


AB | SK [ 100 m



# MANNVILLE COMPILATION D

West  
19-2W4



AB:SK

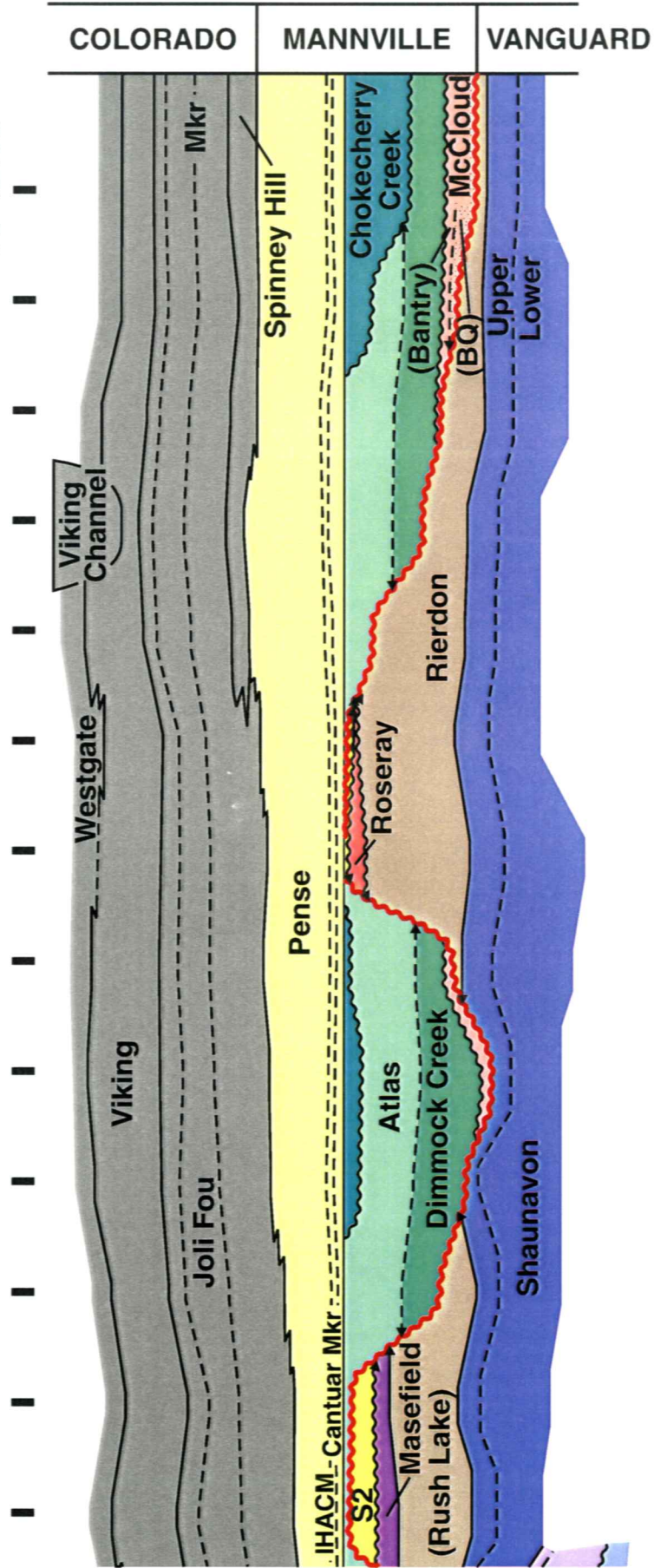
100 m

COLORADO

MANNVILLE

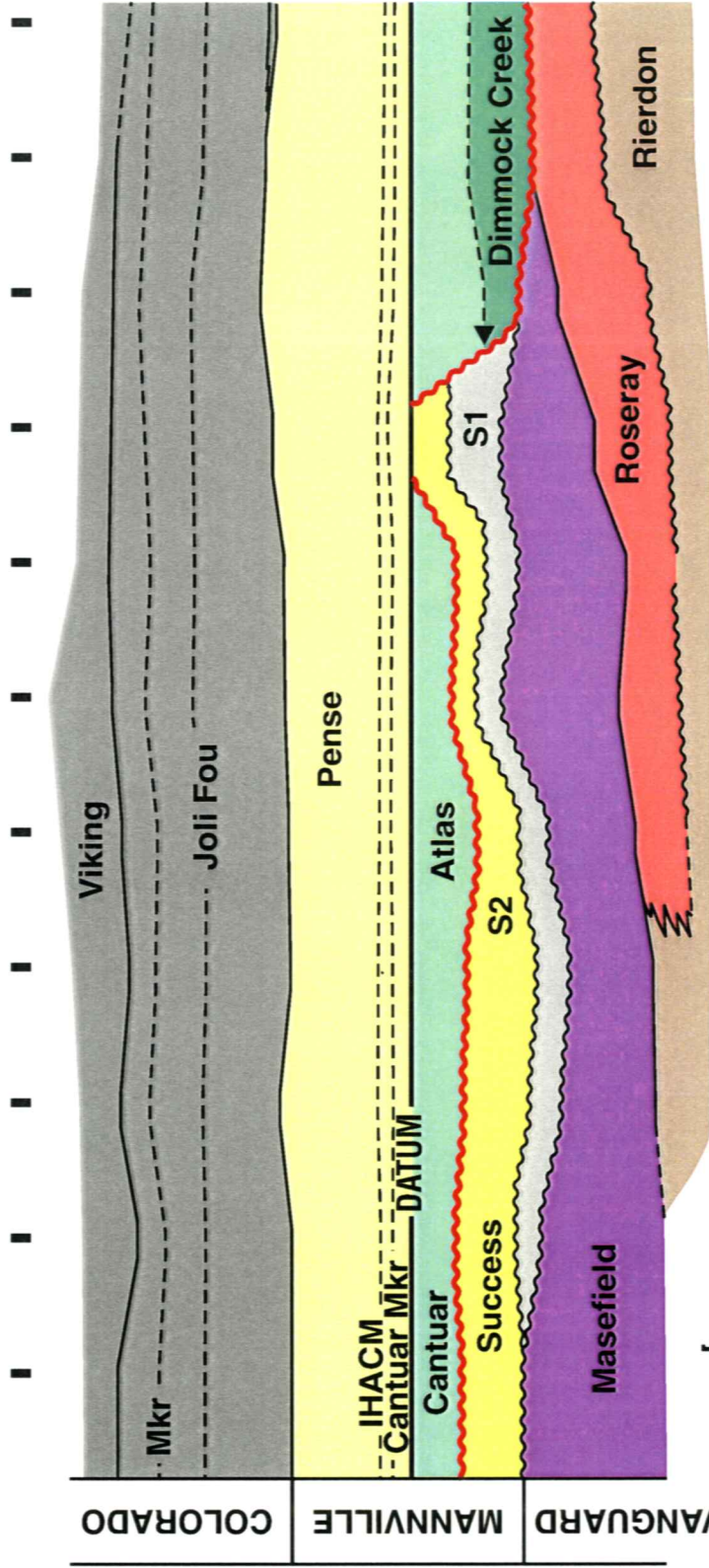
# MANNVILLE COMPILATION D

East  
19-12W3



# MANNVILLE COMPILATION 1

South  
1-14W3

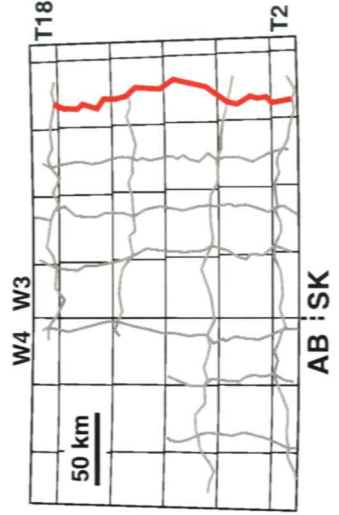


COLORADO

MANNVILLE

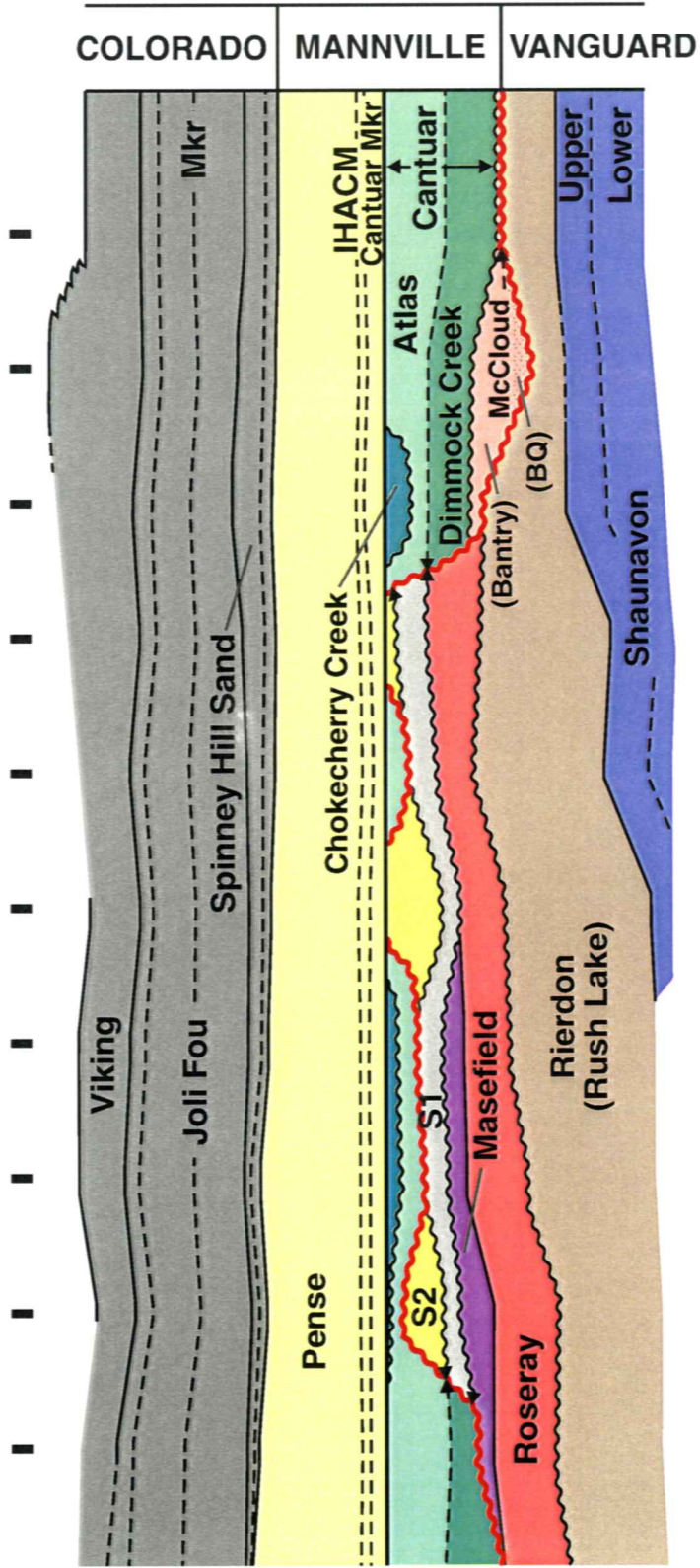
VANGUARD

100 m



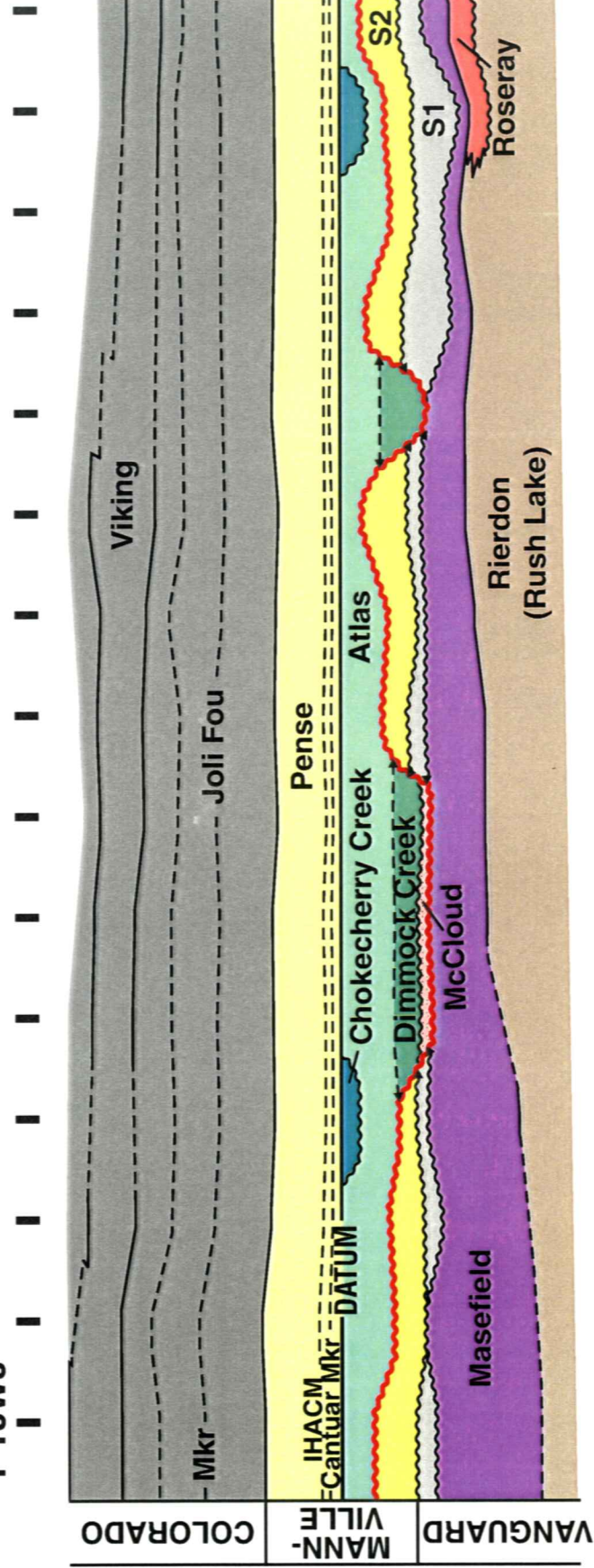
# MANNVILLE COMPILATION 1

North  
19-14W3



# MANNVILLE COMPILATION 2

South  
1-18W3

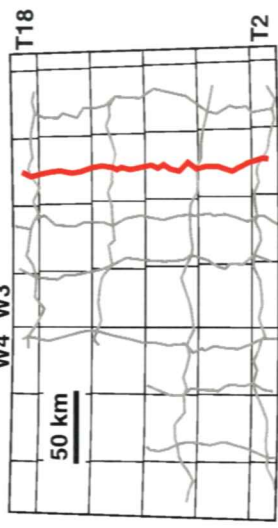
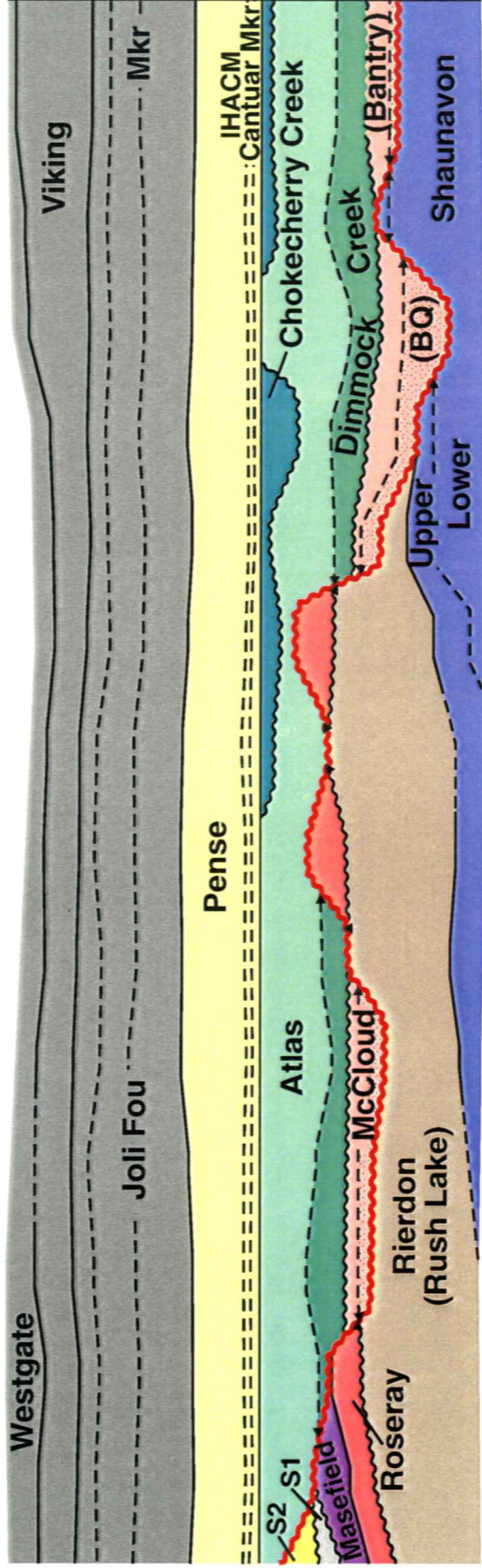


# MANNVILLE COMPILATION 2

North  
20-18W3



COLORADO MANNVILLE VAN-GUARD

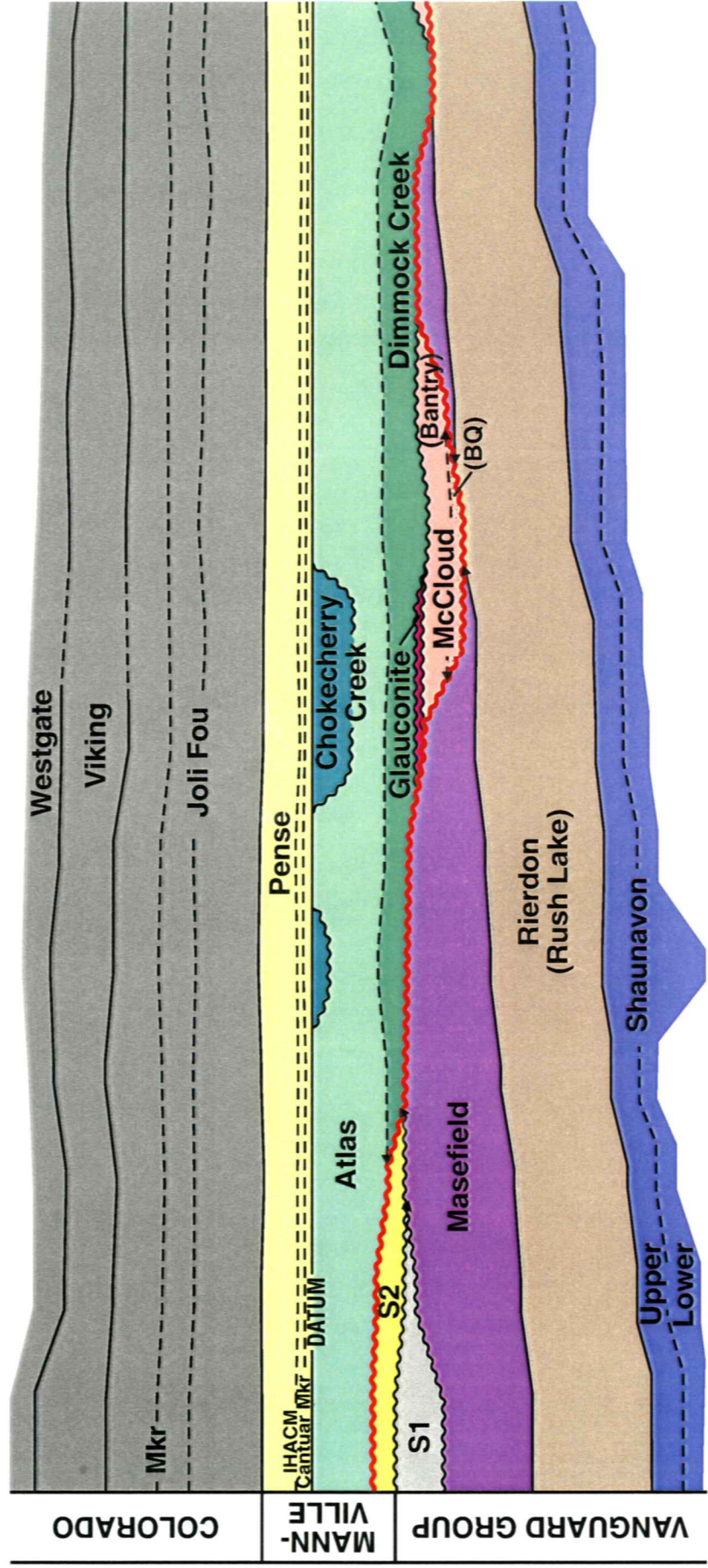


[ 100 m

AB : SK

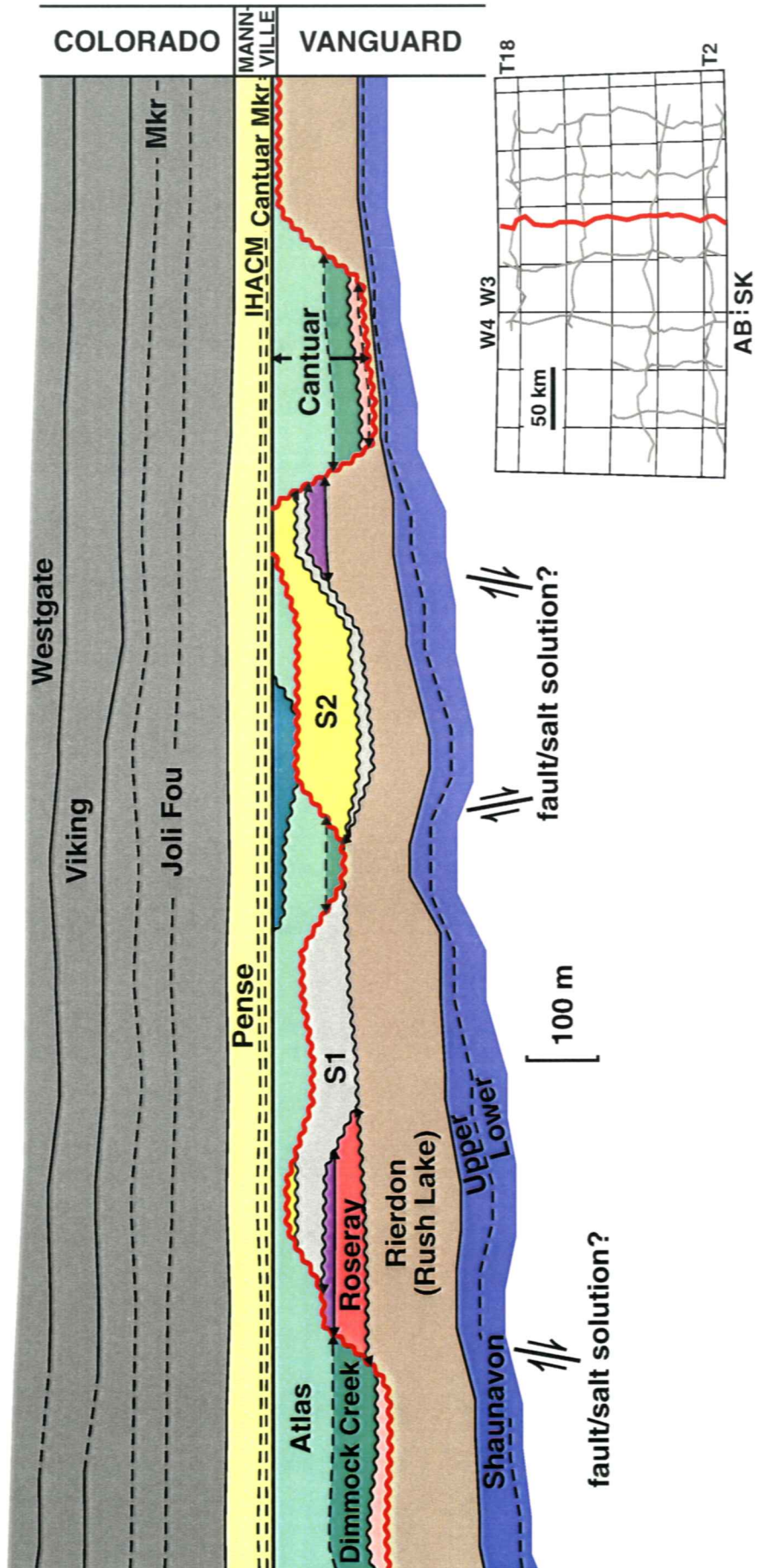
# MANNVILLE COMPILATION 3

South  
1-23W3



# MANNVILLE COMPILATION 3

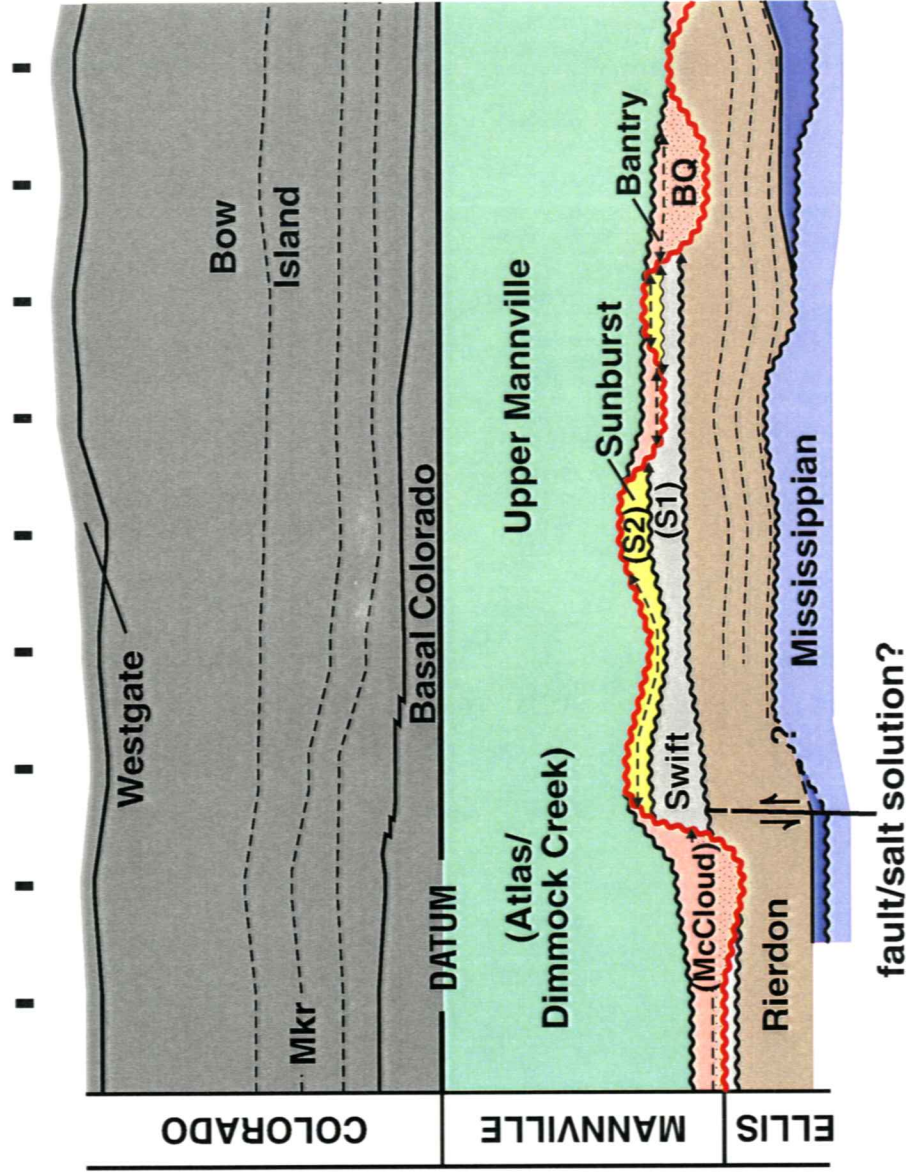
North  
20-22W3





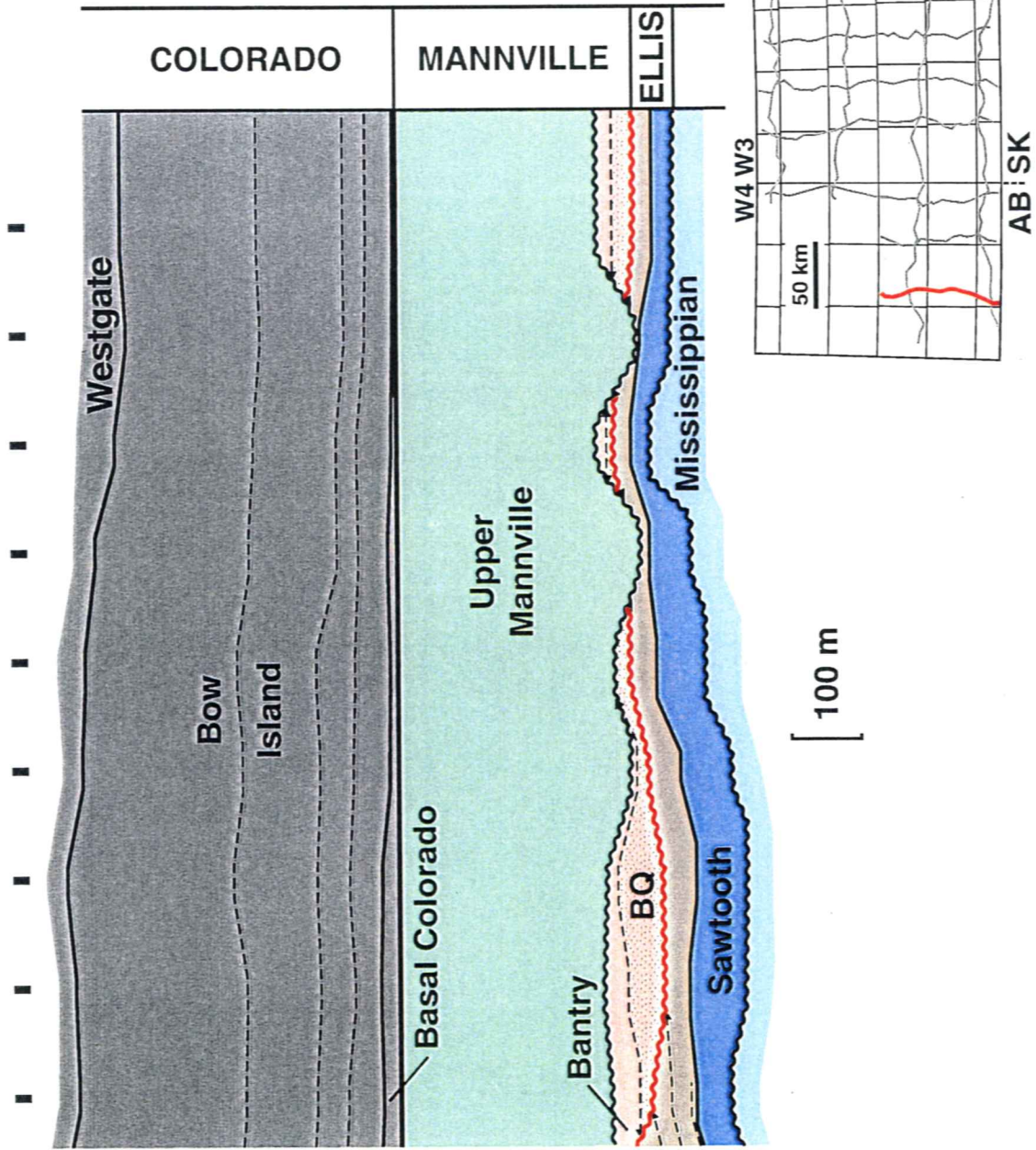
# MANNVILLE COMPILATION 7

South  
1-10W4



# MANNVILLE COMPILATION 7

North  
10-9W4



**A story of unconformities  
and their complexities...**

# **What about...**

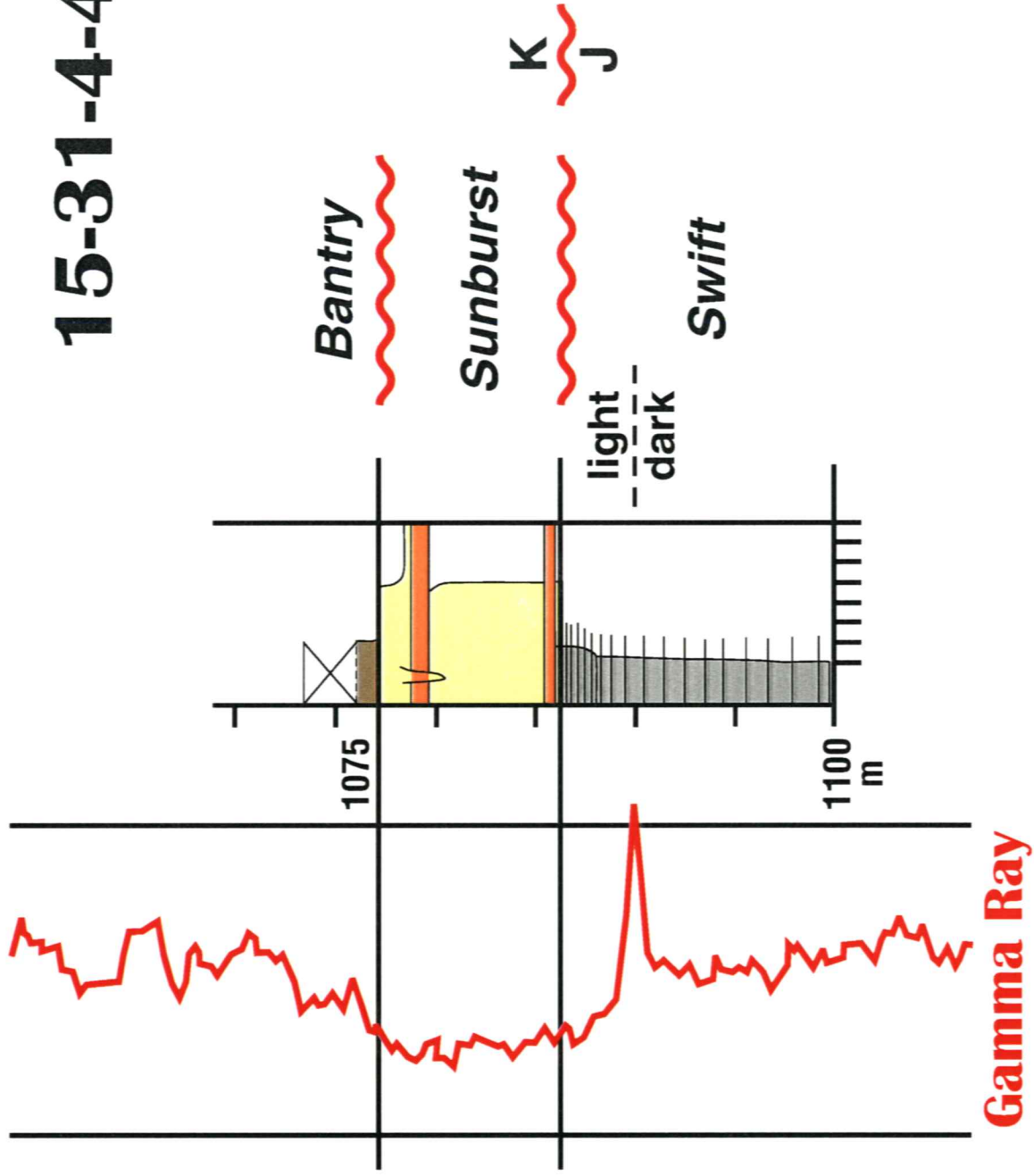
- ◆ **light Swift vs. dark Swift**
- ◆ **an unconformity?**

**... No!**

# **Characteristics**

- ◆ **radioactive spike**
- ◆ **facies above and below are similar**
- ◆ **porous paleo-aquifer above**
- ◆ **impermeable paleo-aquitard below**

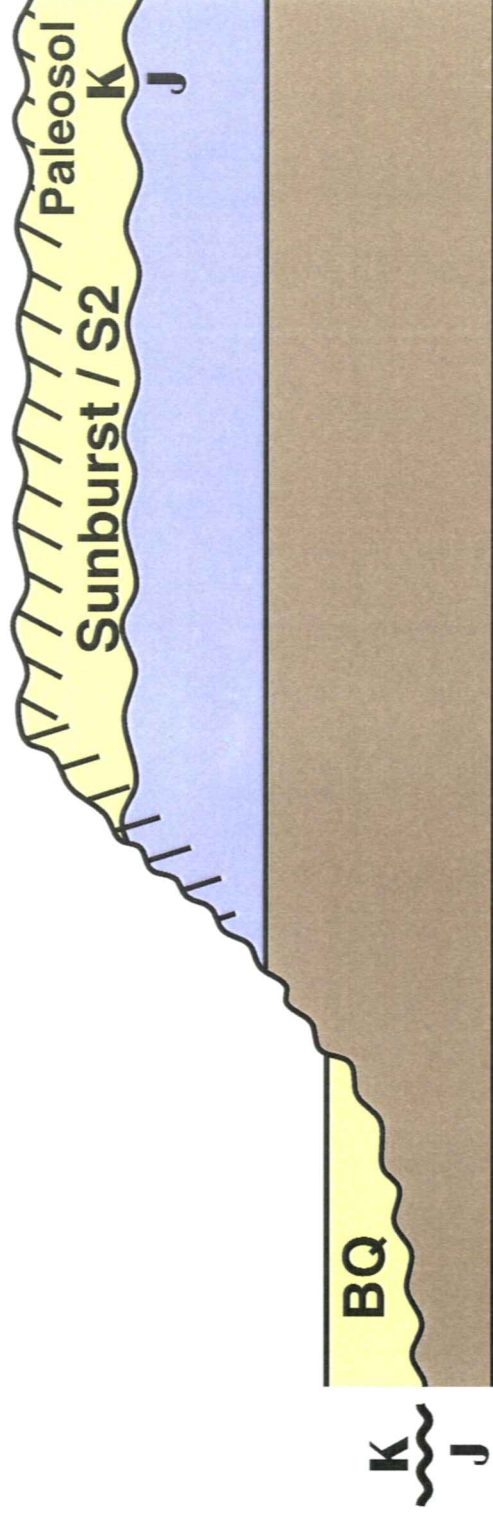
# 15-31-4-4W4



# **Sub-Cretaceous unconformity**

- ◆ **below Sunburst / S2**
- ◆ **below Basal Quartz**

# Base of Cretaceous

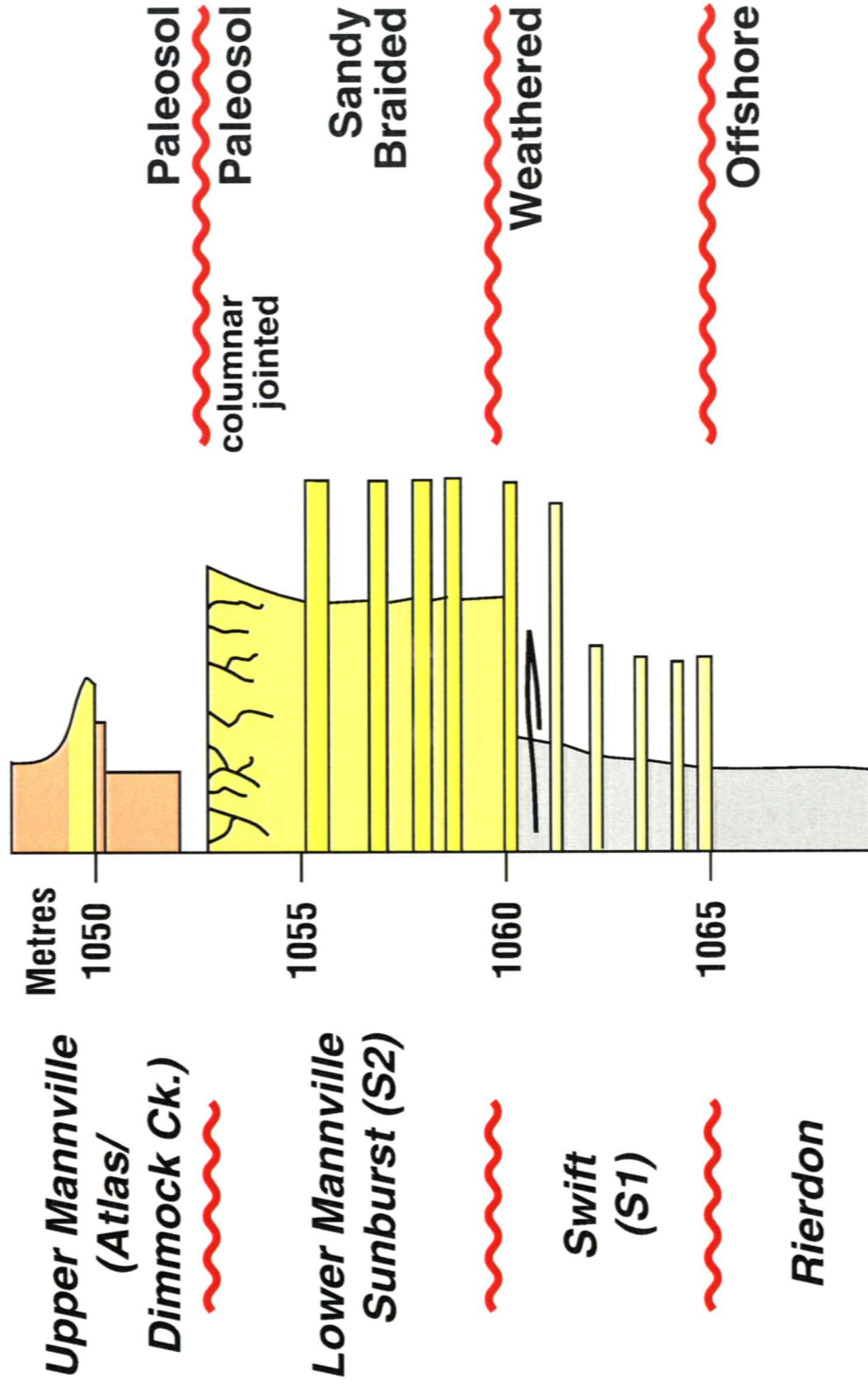




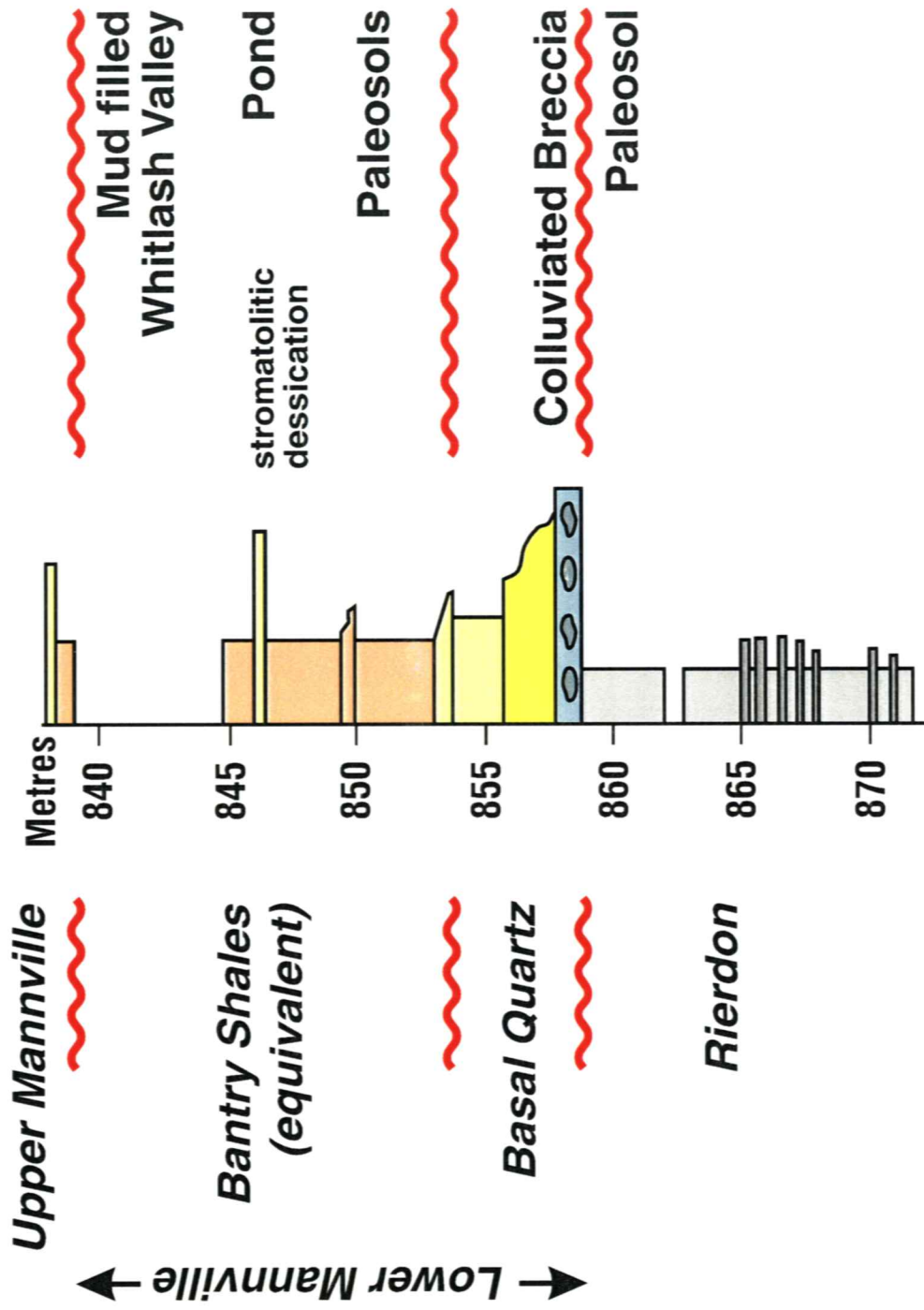
# **Unconformities**

- ◆ **weathering surface at top of Sunburst / S2**
  - **10-15 million years?**
- ◆ **incision event - cutting major valleys into older landscape**
  - **not a lot of time**
  - **created major relief**

# 6-28-5-5W4



# 14-21-4-13W4

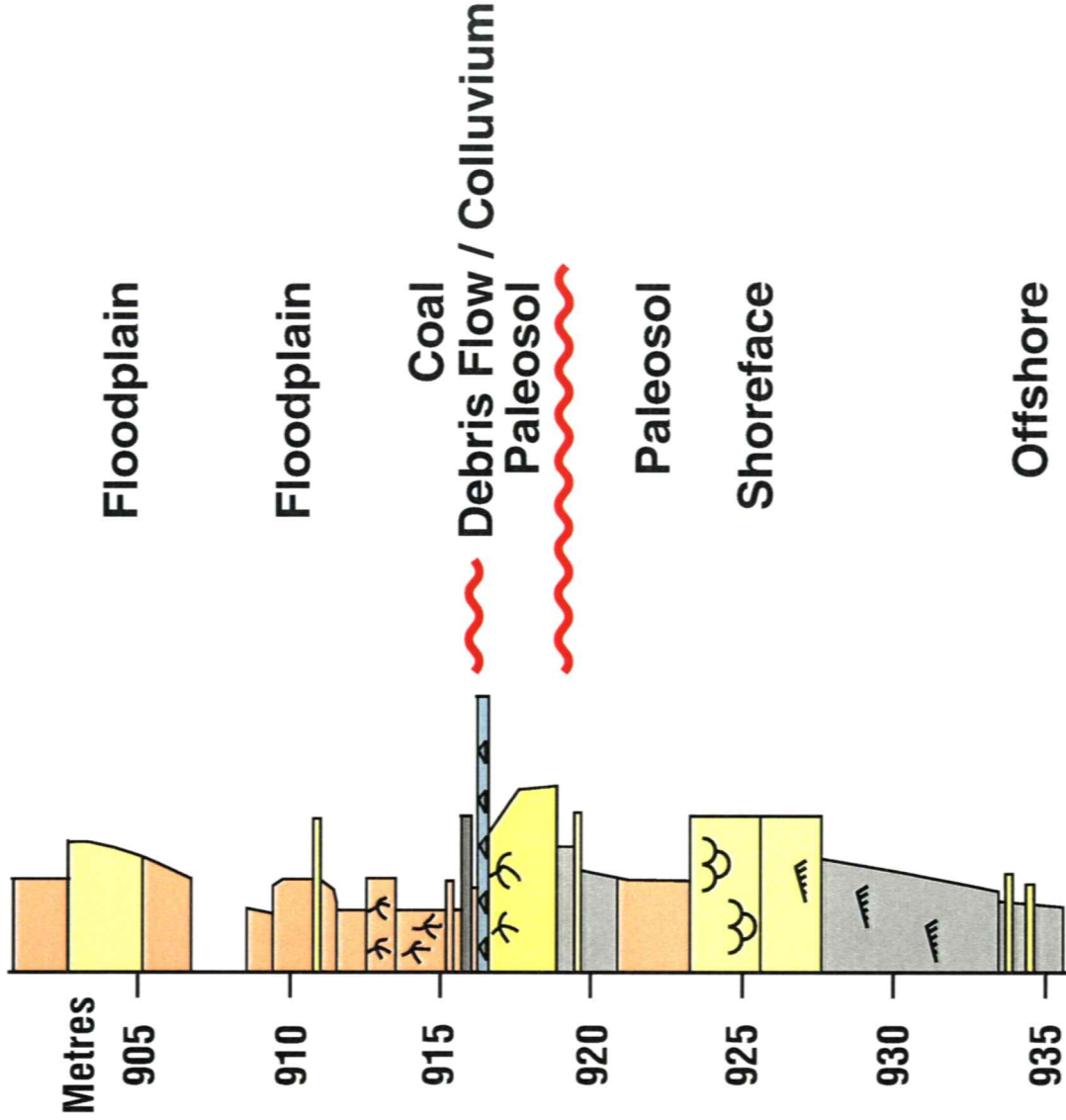


# **Basal Quartz**

- ◆ **initial infilling of the valley**
- ◆ **minimal accommodation space**
- ◆ **braided river in west**
- ◆ **meandering river in east**

# 6-24-5-7W4

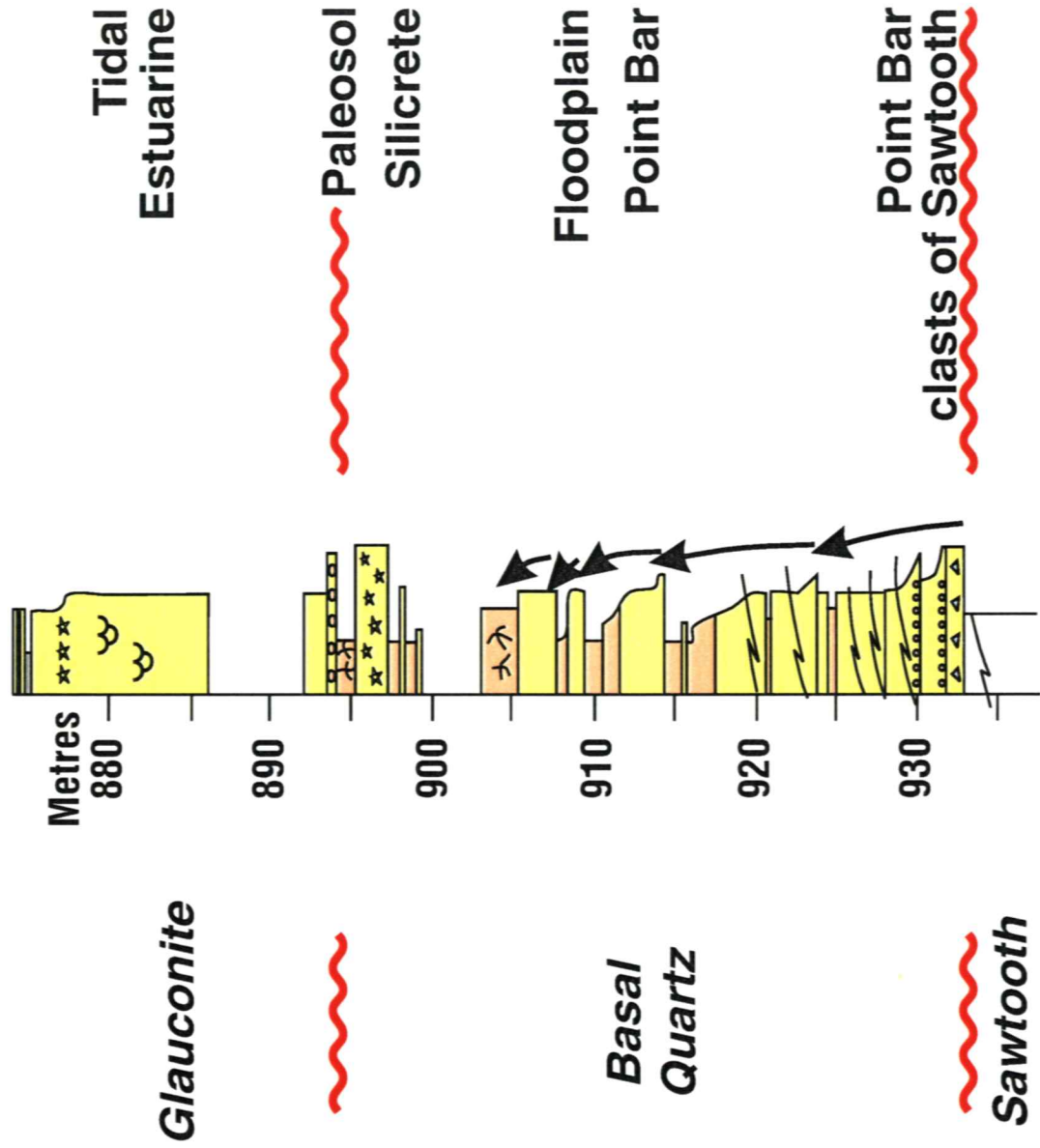
*Upper Mannville  
(Atlas/Dimmock Ck.)*



*Sunburst (S2)*

*Swift  
Ribbon  
Sds.  
(S1)*

# 15-20-11-13W4



# Valley Edge

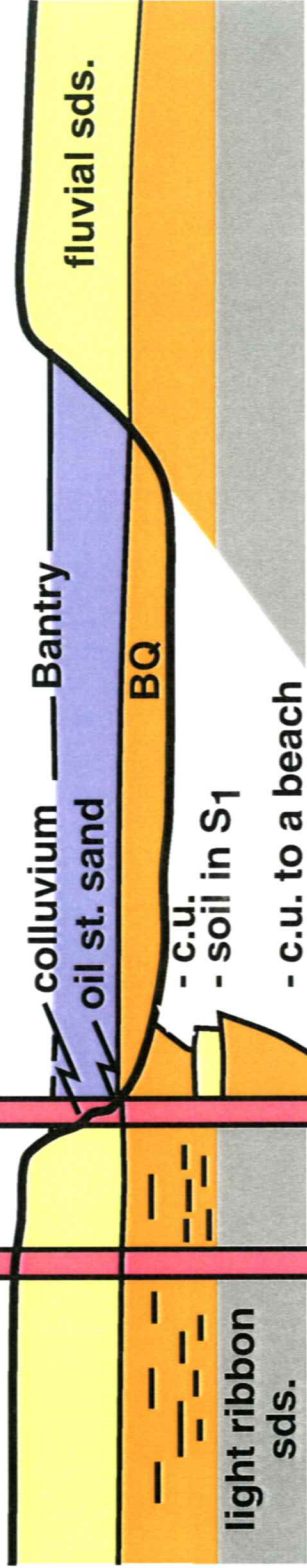
12-25-5-7W4

6-24-5-7W4

Upper Mannville

S2

S1

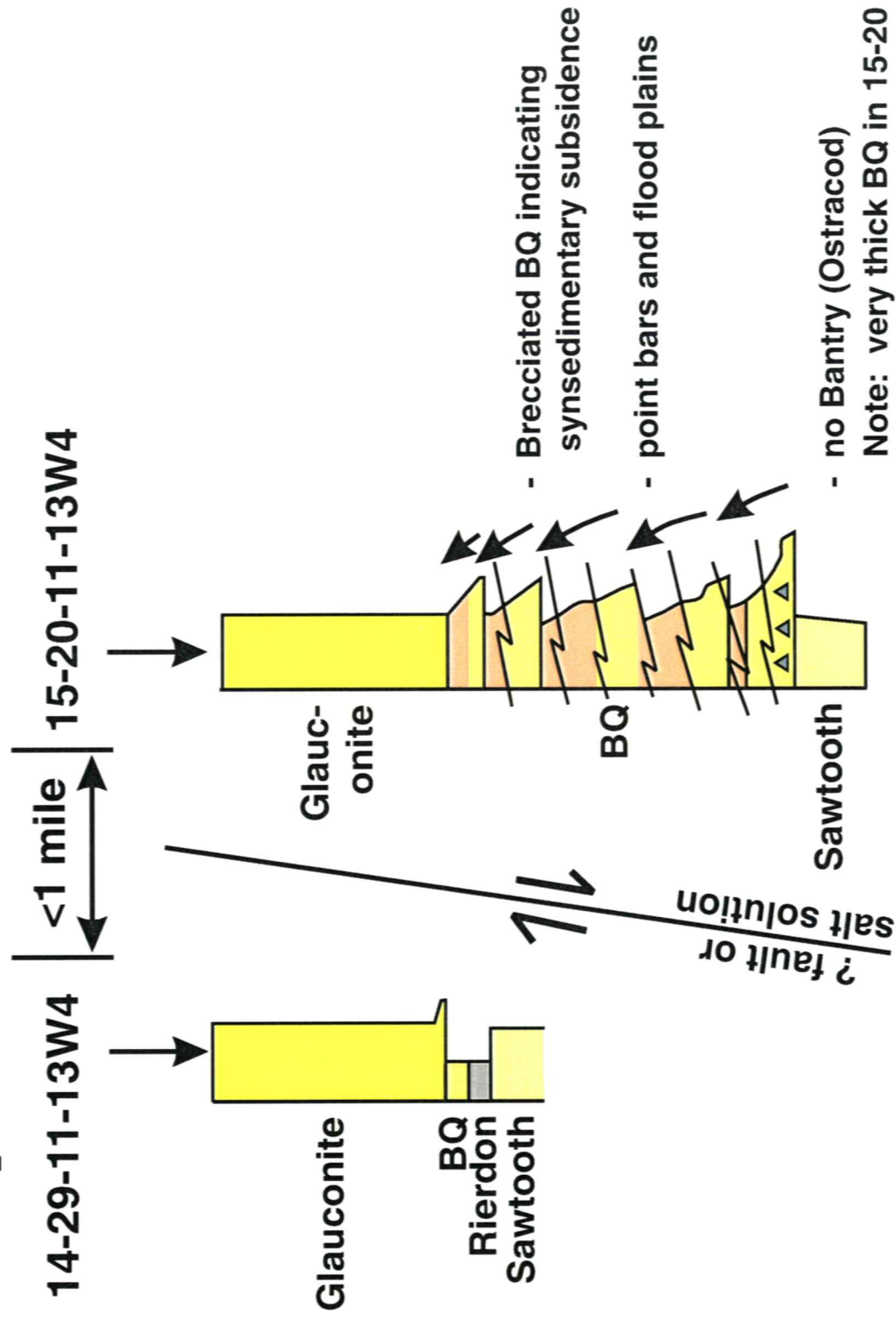


- Presence of colluvium in 6-24 indicates an S2 cuesta nearby → 12-25

Cuesta

Valley Edge

# Comparison





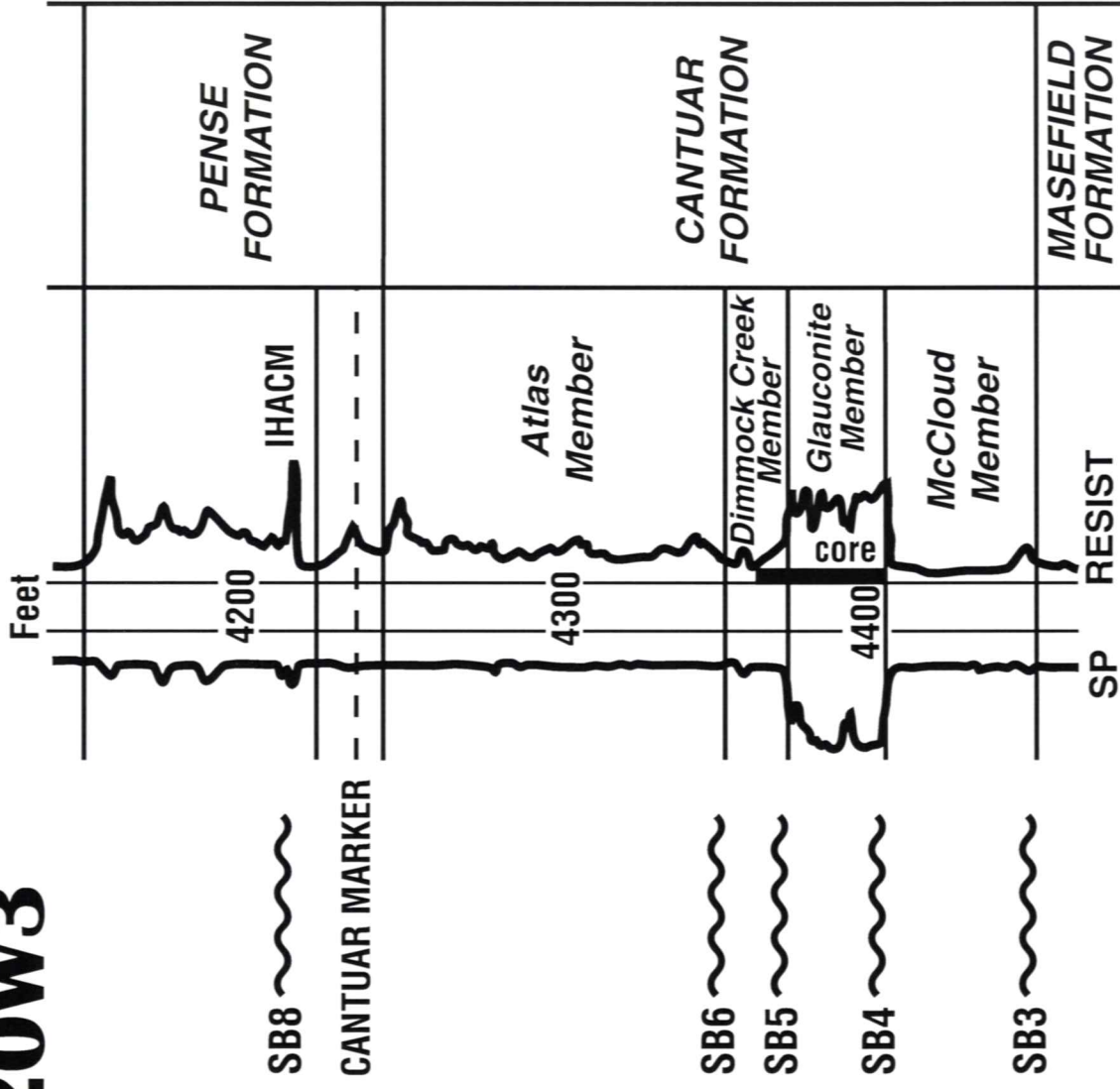
# **Glauconite channels in Saskatchewan**

# **Glauconite**

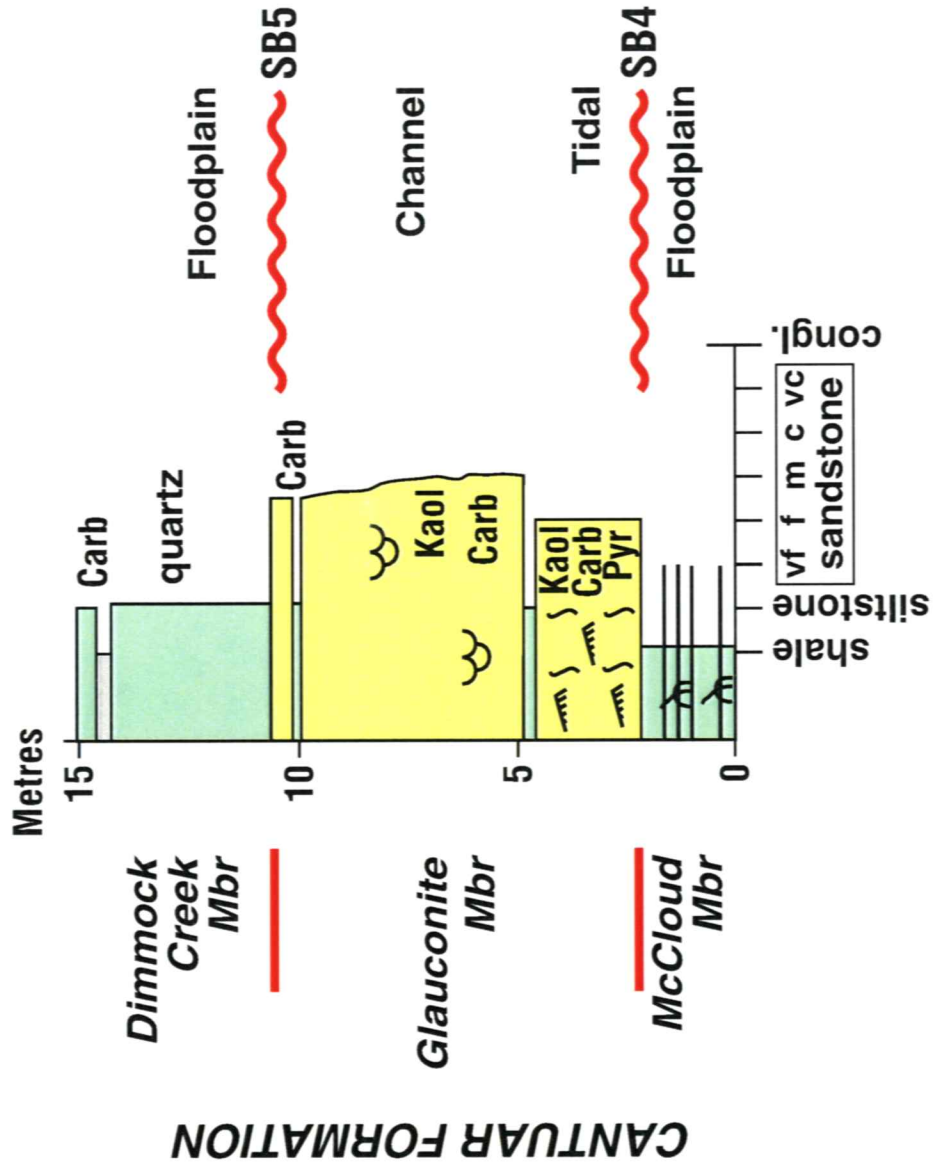
- ◆ **far more complex than most suggest**
- ◆ **not just incised valley fill**
- ◆ **multiple depositional environments**
  - **incised valleys at Countess**
  - **shorelines at Suffield**
  - **inlets**
- ◆ **multiple episodes of glauconite sedimentation**

**...a story for another time**

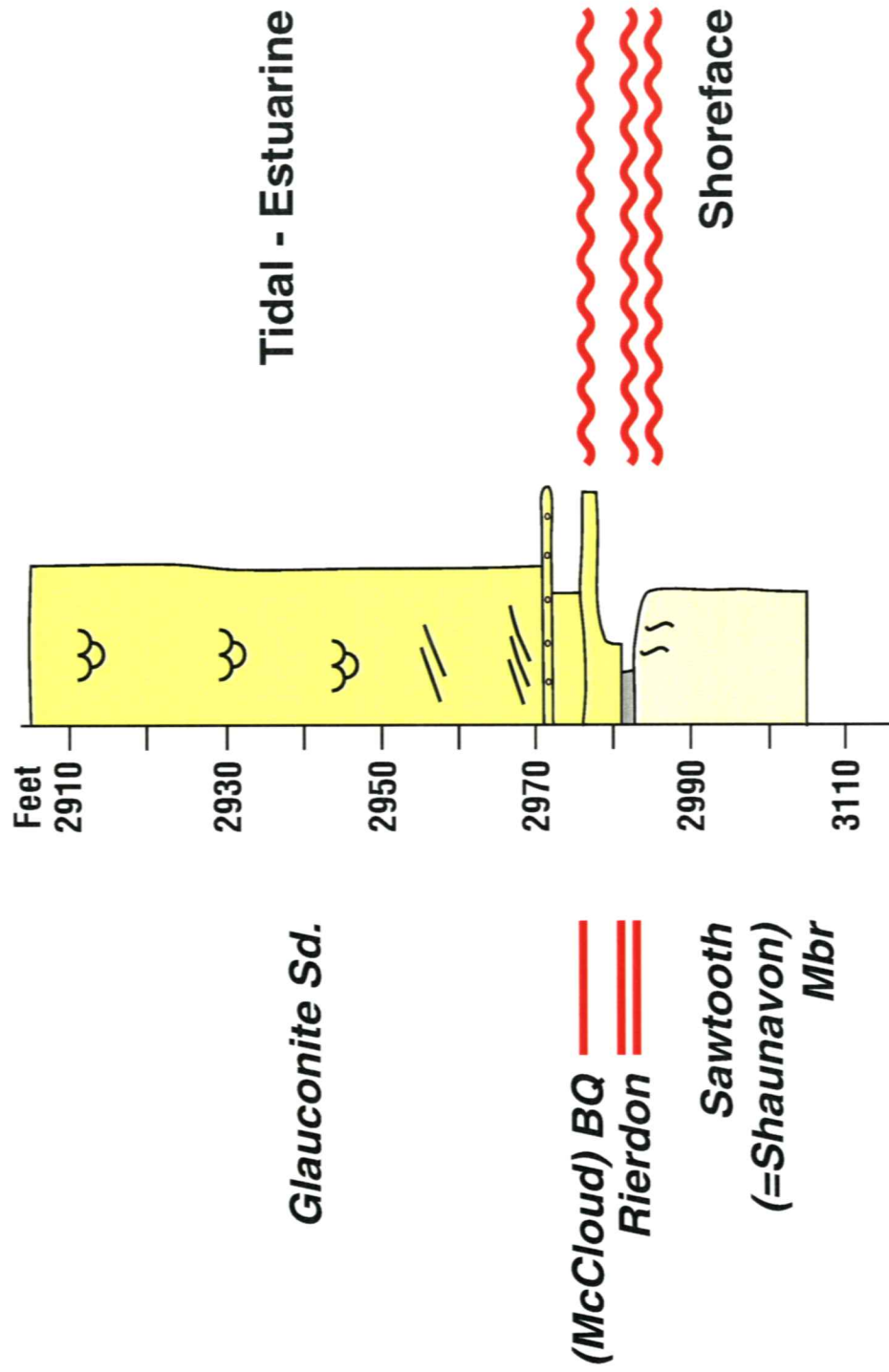
# 13-1-7-20W3



# Tidewater Dollard Creek 13-1-7-20W3 (4350 - 4400 ft)



# 14-29-11-13W4



**We now fill the valleys**

# **Upper Mannville**

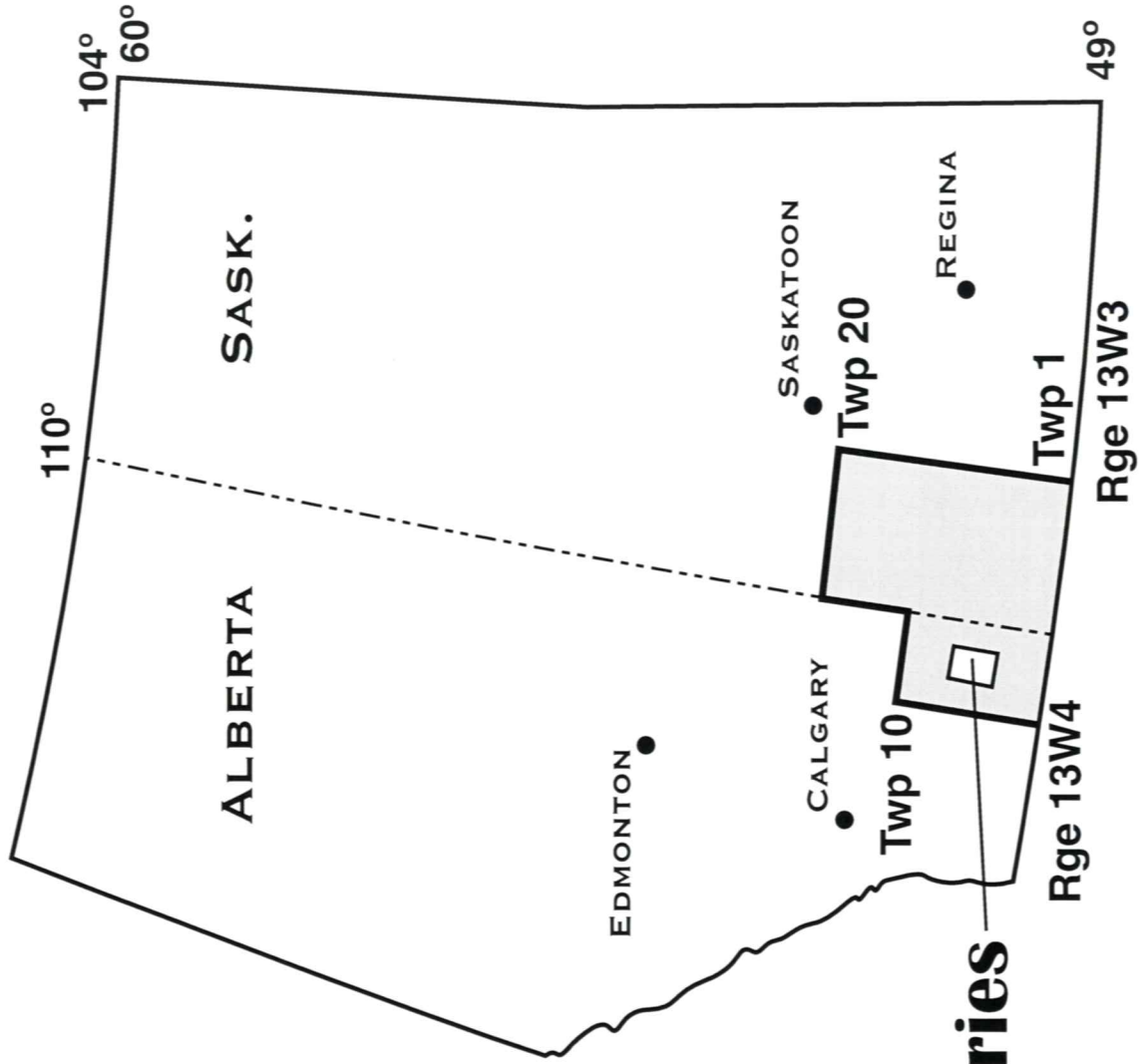
- ◆ **valleys are nearly filled**
- ◆ **overtop the valleys and flood the basin with lithics**

# **Chokecherry Creek Mbr.**

- ◆ **quartzose**
- ◆ **estuarine valley system**

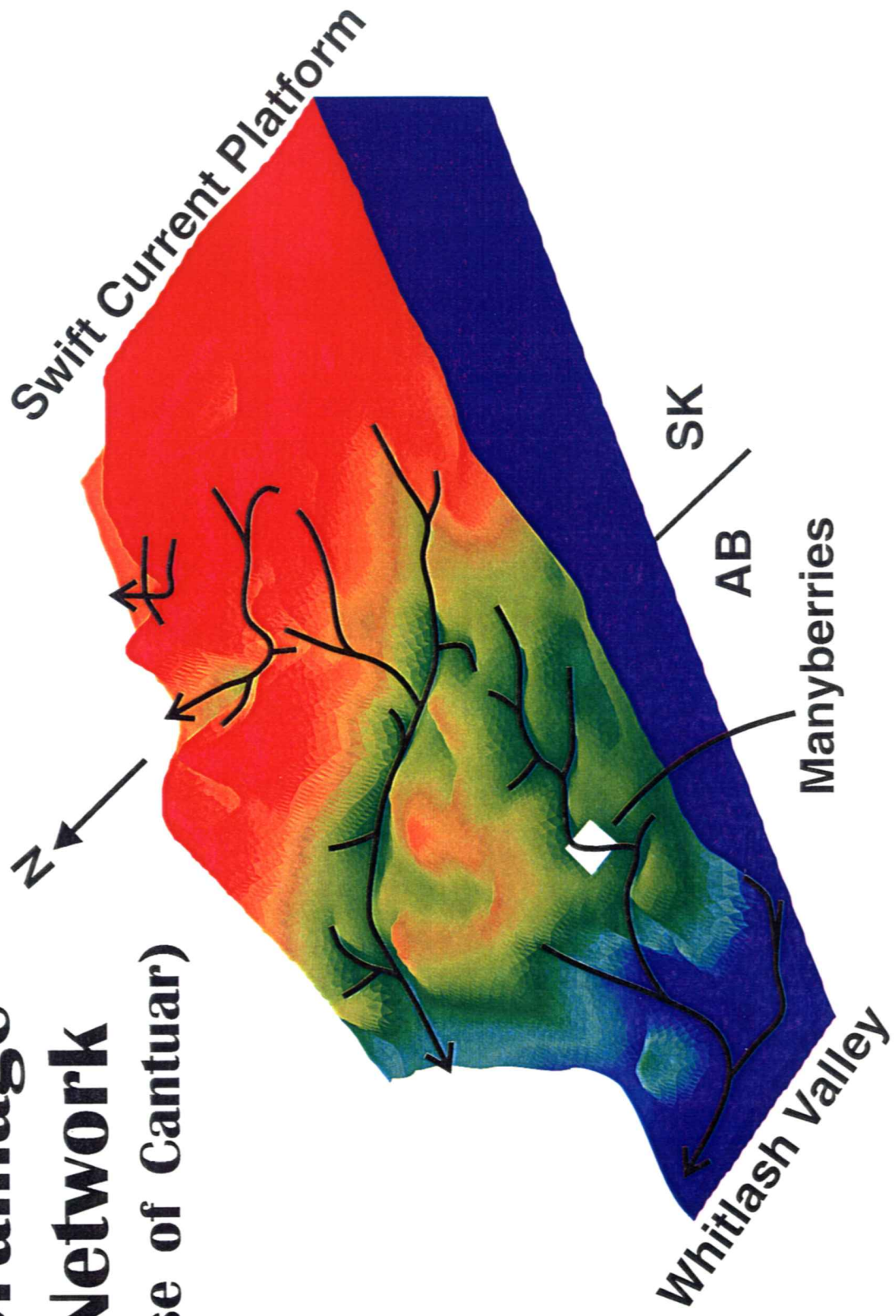


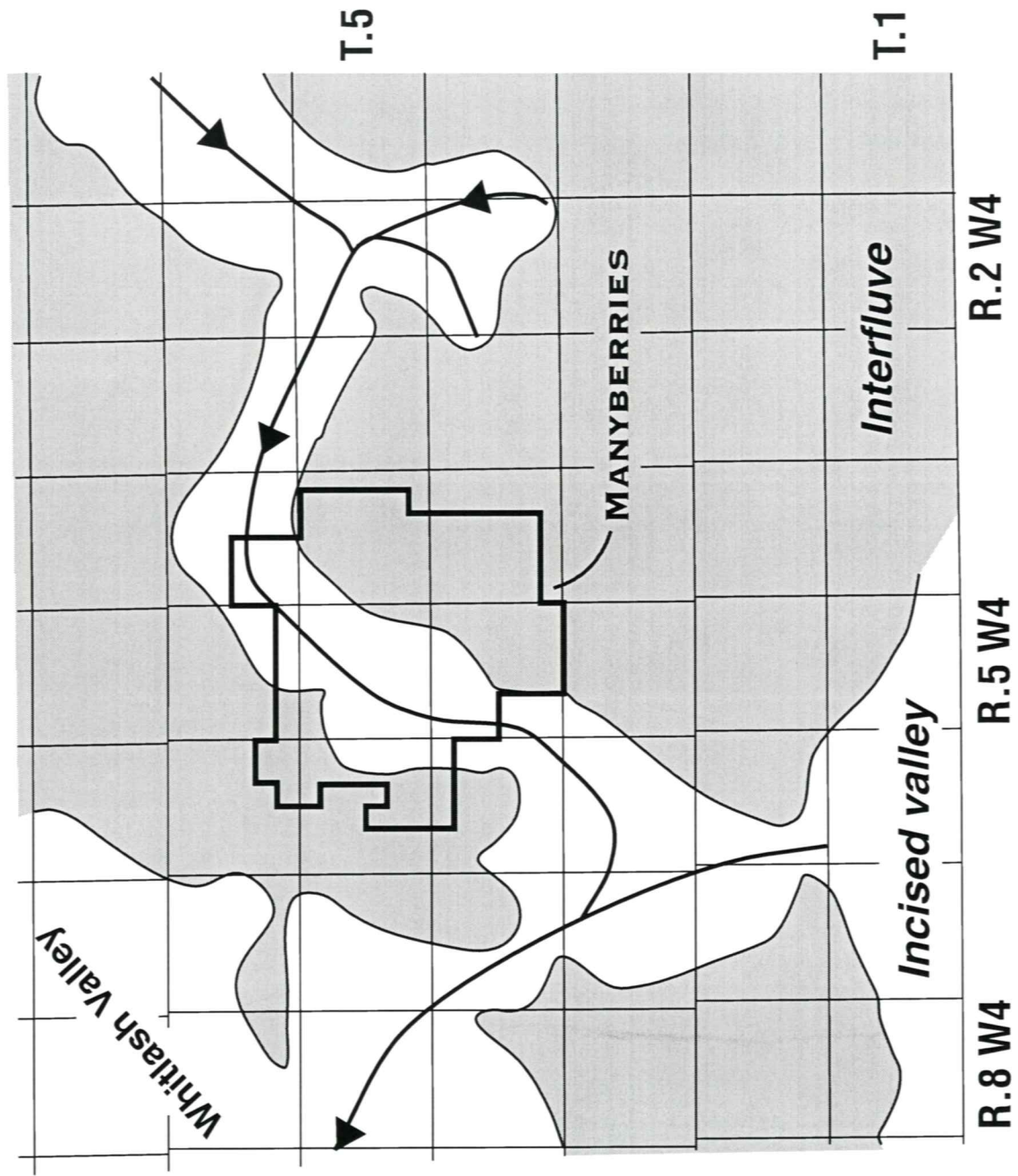
# Manyberries



# Manyberries

# Drainage Network (base of Cantuar)





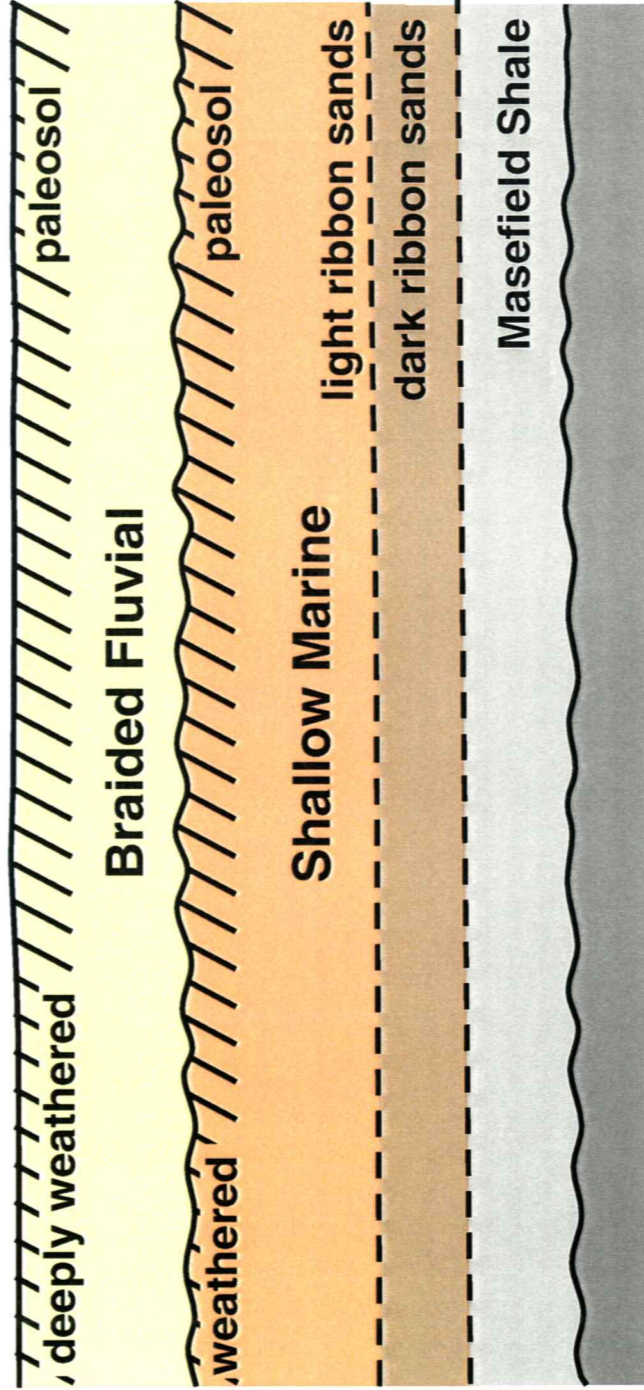
# **Oil Production**

◆ **Basal Quartz**

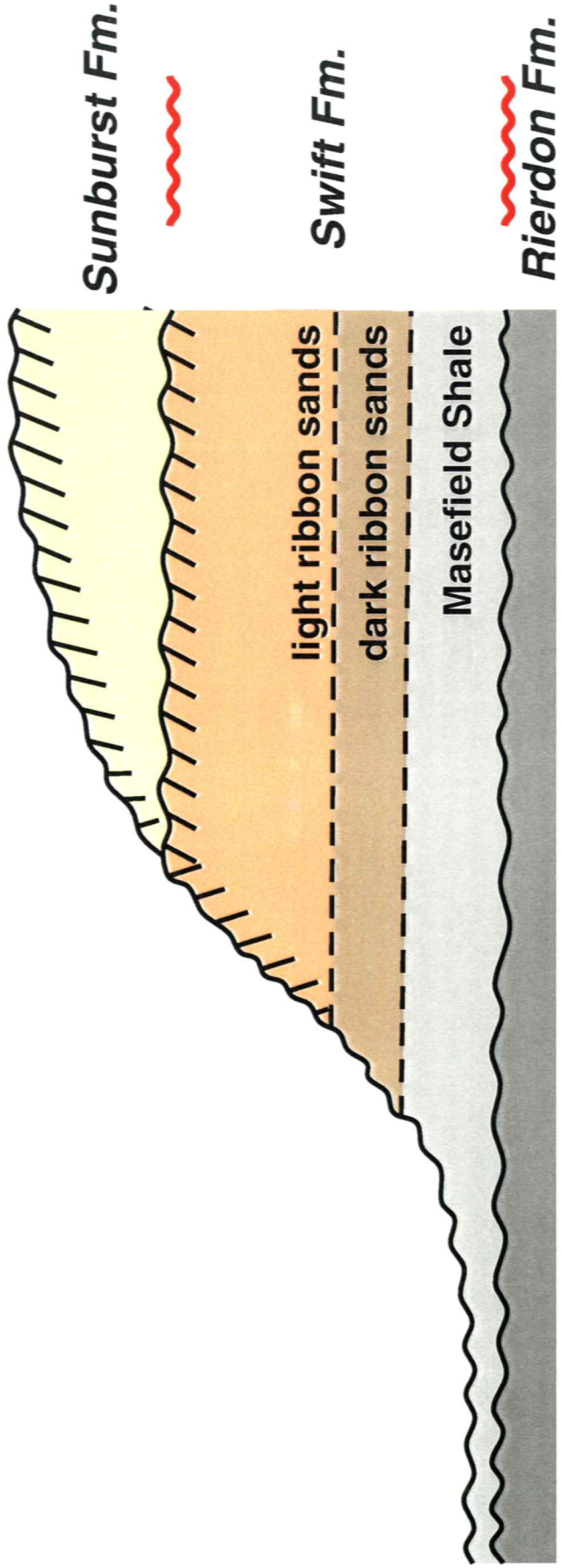
◆ **Sunburst**

◆ **Swift**

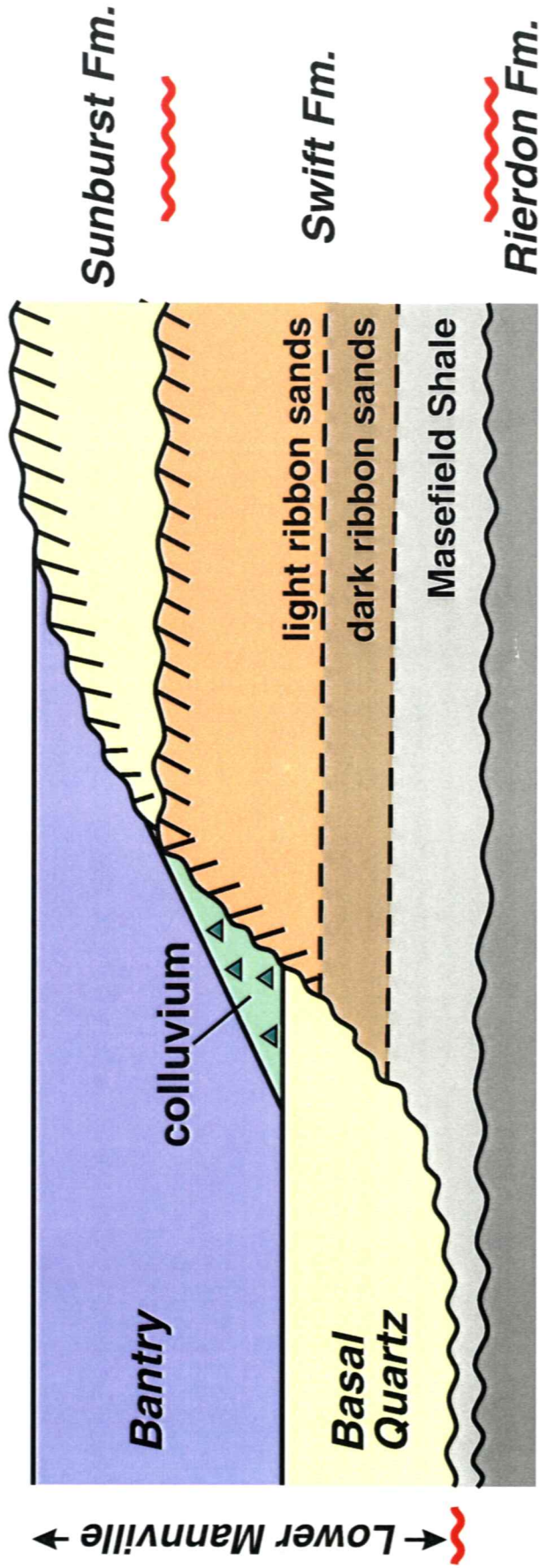
1



2

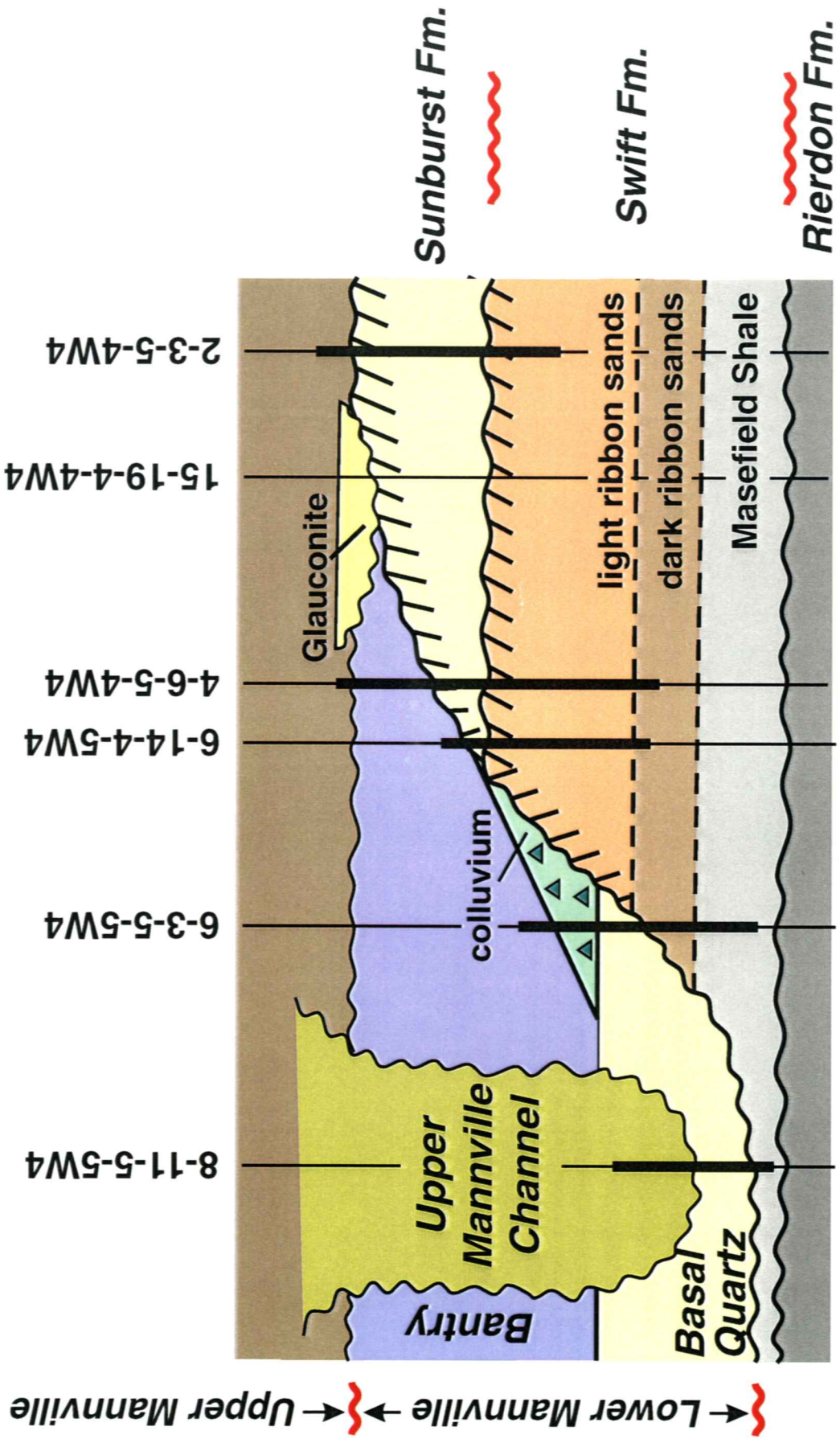


3





4



# Unconformities

