

Approximate thickness of maximum  
reef build-up

- > 250 metres
- 225 - 250 metres
- < 225 metres

Northern terminus  
of

• Ft.  
McMurray

Canadian Shield

Peace River Arch

# **Dolomite Recrystallization Along the Devonian Rimbey-Meadowbrook Reef Trend, Western Canada Sedimentary Basin, Alberta, Canada**

**Sergey Kuflevskiy**

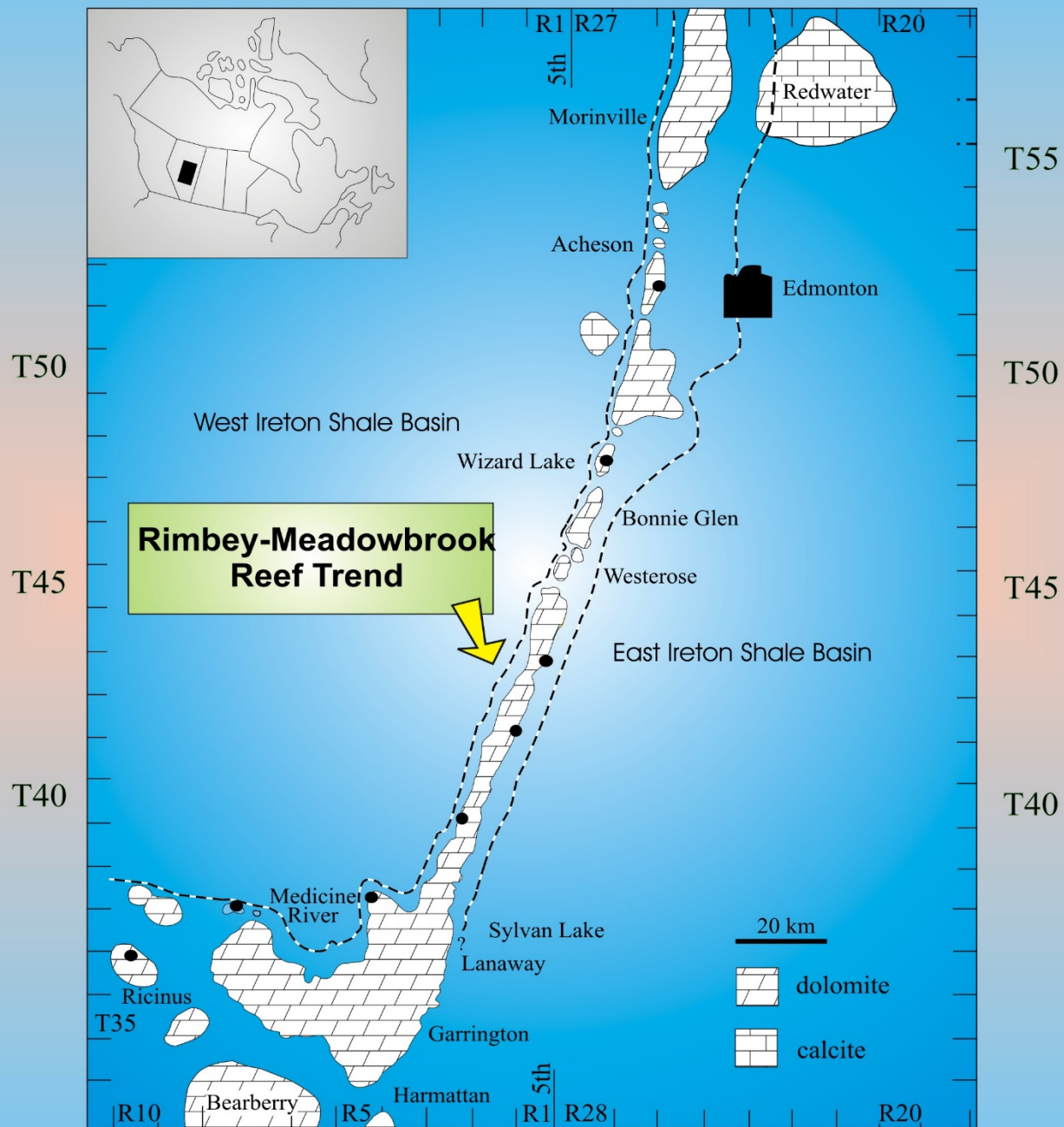
**Hans G. Machel**

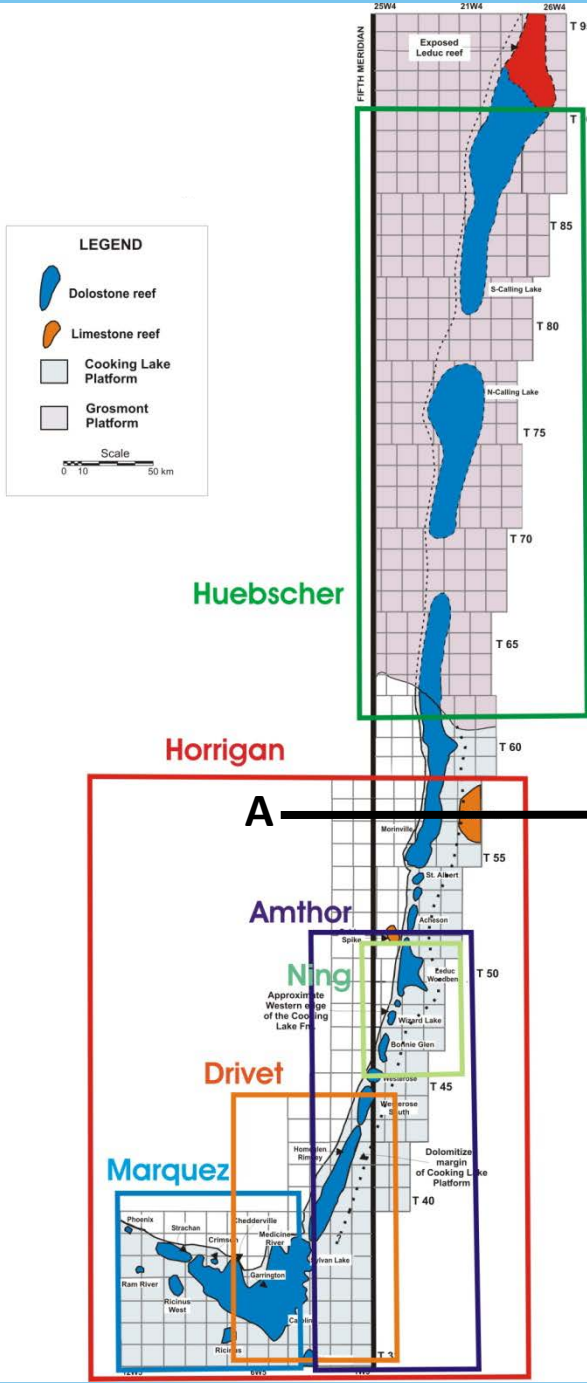
**Nick Harris**



**University of Alberta**

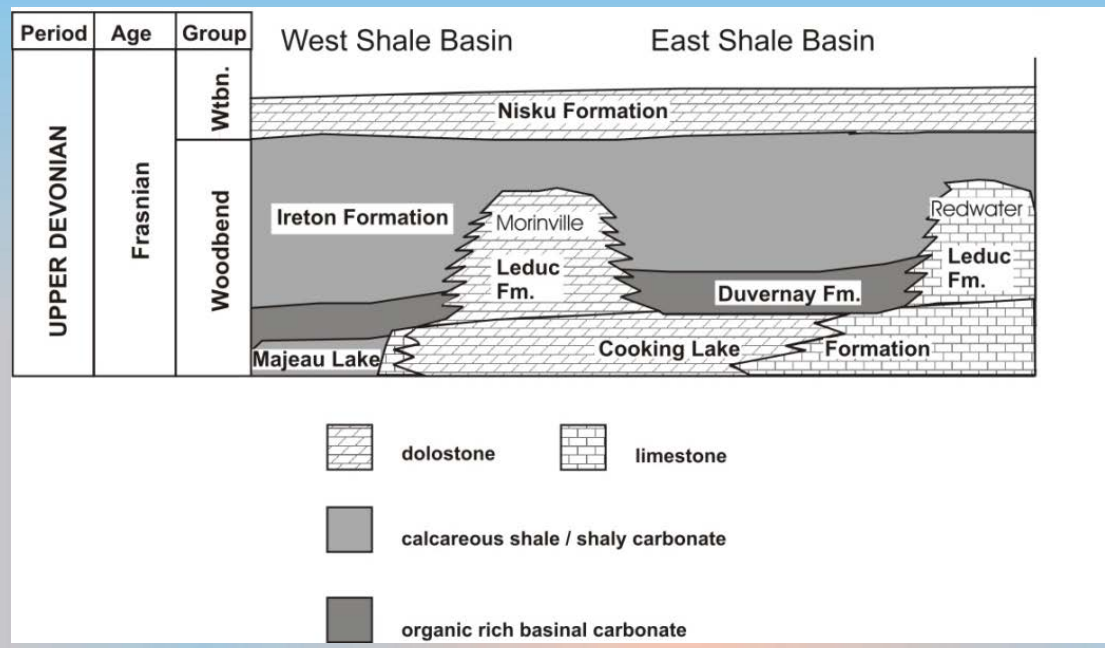
0 50 100 kilometres  
50 miles





A

B



- ~ 600 km long
- depths: ~ 200 m NNE T95 ~6000 m SSW T33
- series of reefs (blue) on top of platform margin
- thicknesses ranging from ~ 150m to 300m



## ***SIGNIFICANT RECRYSTALLIZATION***

Any TEXTURAL CHANGE,

STRUCTURAL CHANGE, OR

COMPOSITIONAL CHANGE

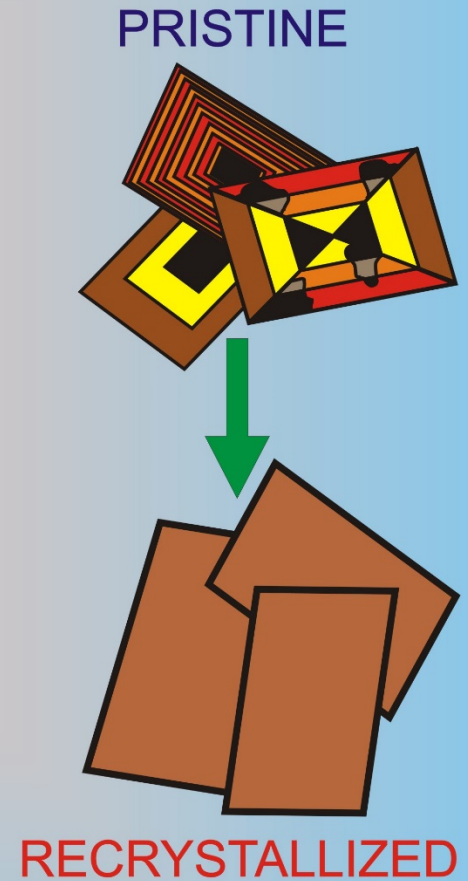
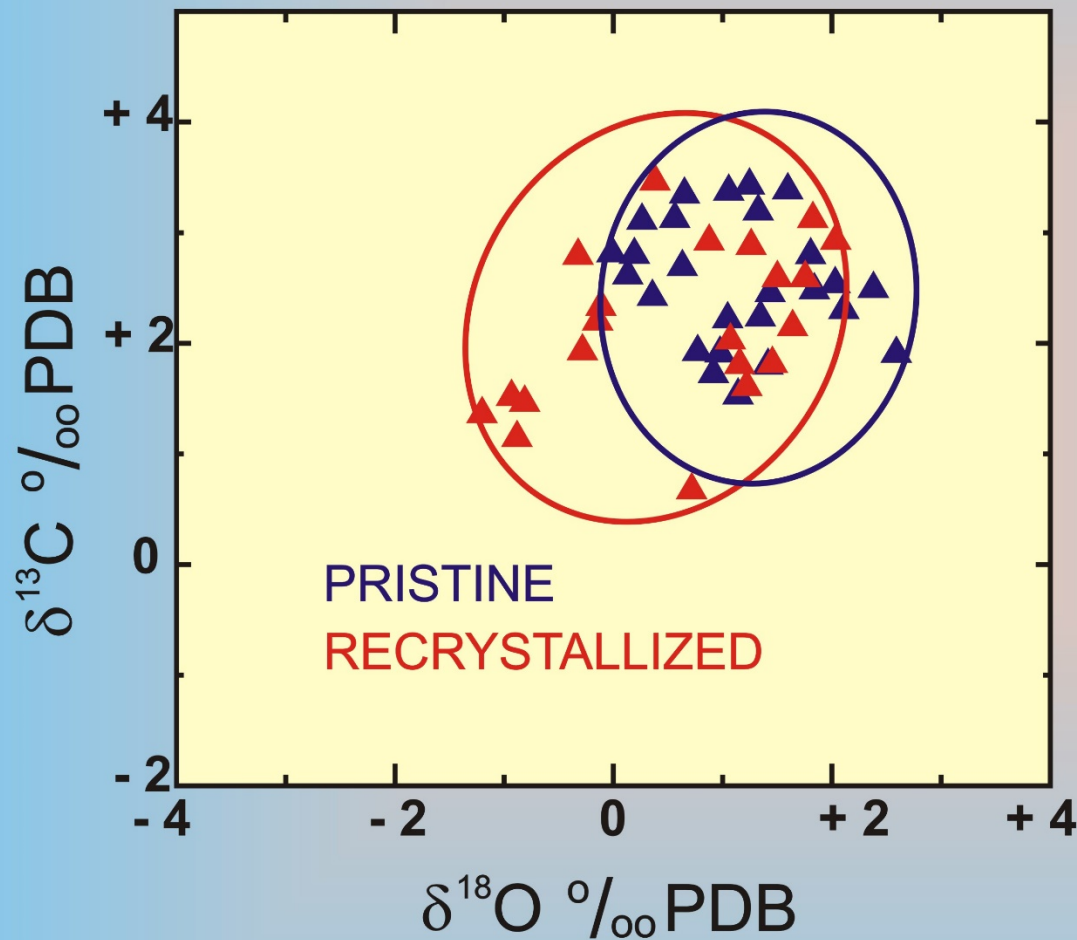
via recrystallization that results in a variation  
**larger** than the original range.

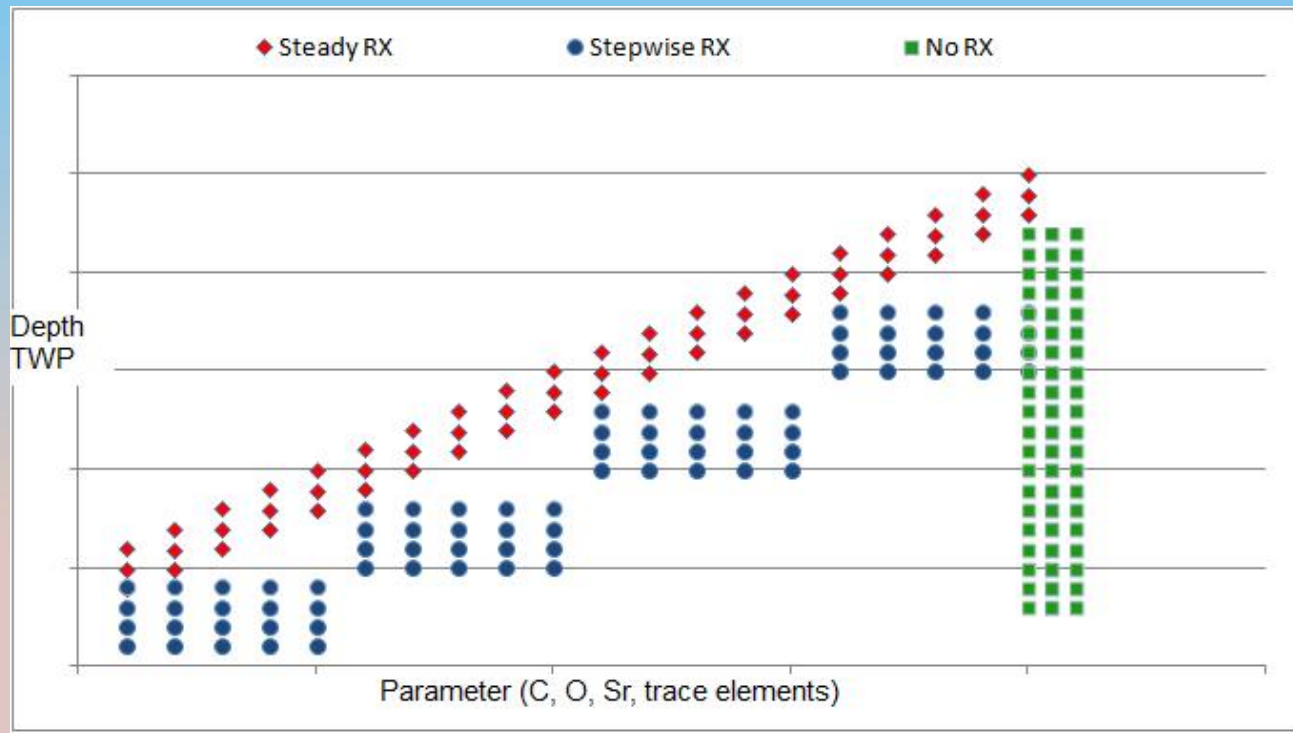
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## ***INSIGNIFICANT RECRYSTALLIZATION***

**smaller ....**

## ***SIGNIFICANT RECRYSTALLIZATION***





### ***FOUR THEORETICAL ALTERNATIVES:***

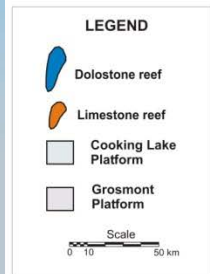
1) **no visible signs of recrystallization**

2) **steady recrystallization**

3) **stepwise recrystallization**

‘quantum theory of dolomite stabilization’ (Land 1992)

4) **OTHER (combination 1-2-3 ?, something else?)**



Huebscher

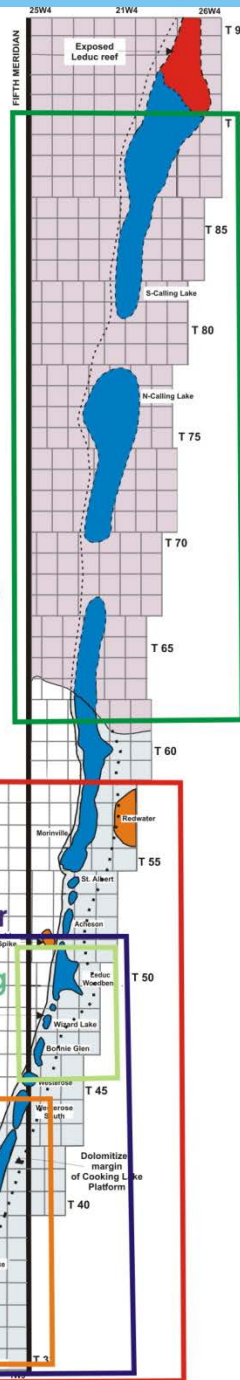
Horrigan

Amthor

Ning

Drivet

Marquez



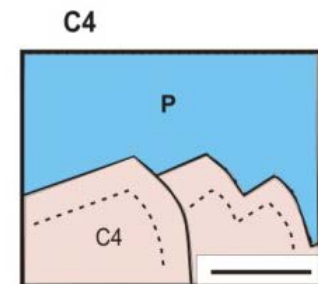
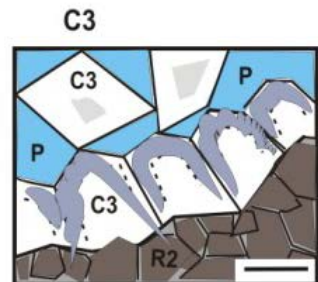
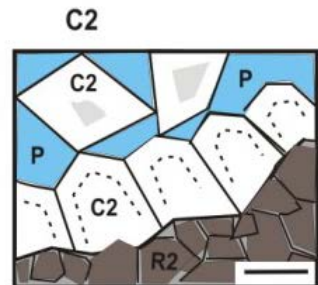
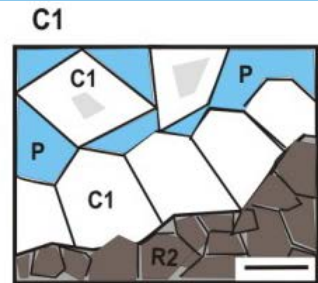
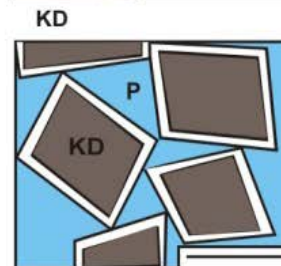
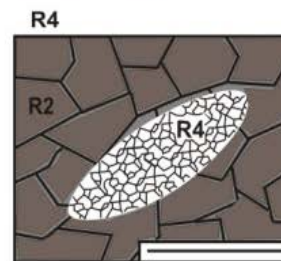
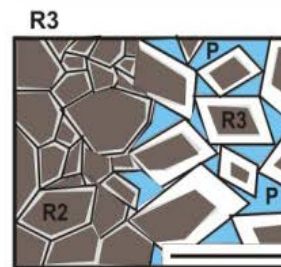
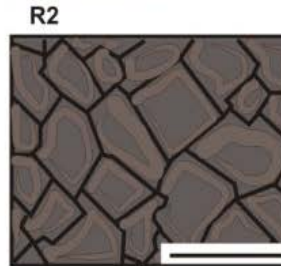
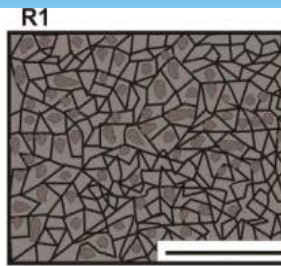
## ***METHODS:***

- average 6 samples per township
- petrography (350 thin sections)
- CL microscopy and spectroscopy
- XRD
- stable isotopes
- $^{87}\text{Sr}/^{86}\text{Sr}$
- major and trace elements
- image analysis
- multivariate statistical analysis

# ***DOLOMITE TYPES IN THE STUDY AREA:***

\* best choice  
for identifying  
recrystallization:

most abundant  
types along the  
entire  
reef trend





**R1**

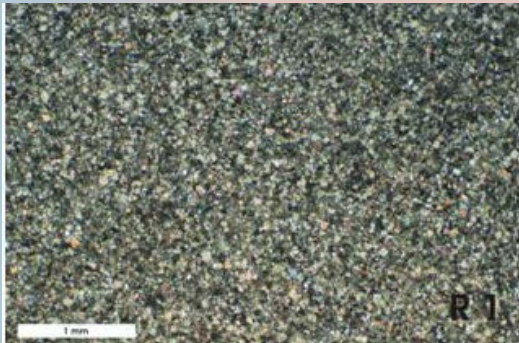


*Fine-crystalline grey matrix dolomite (R1):*

- fine crystalline
- planar-subhedral to non-planar
- dense mosaic
- dull orange-red luminescence

*Medium- to coarse-crystalline grey matrix dolomite (R2):*

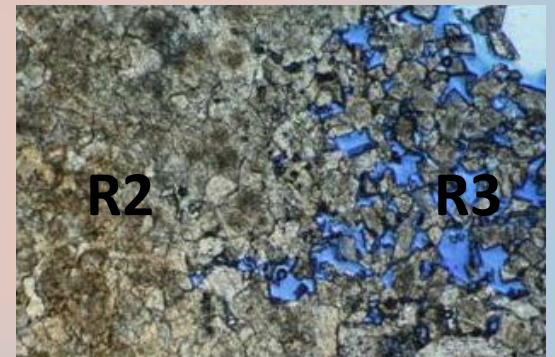
- micro-medium to micro-coarse crystalline
- planar-subhedral to non-planar
- dense mosaic
- grey to beige
- dull orange-red luminescence (sometimes blotchy)



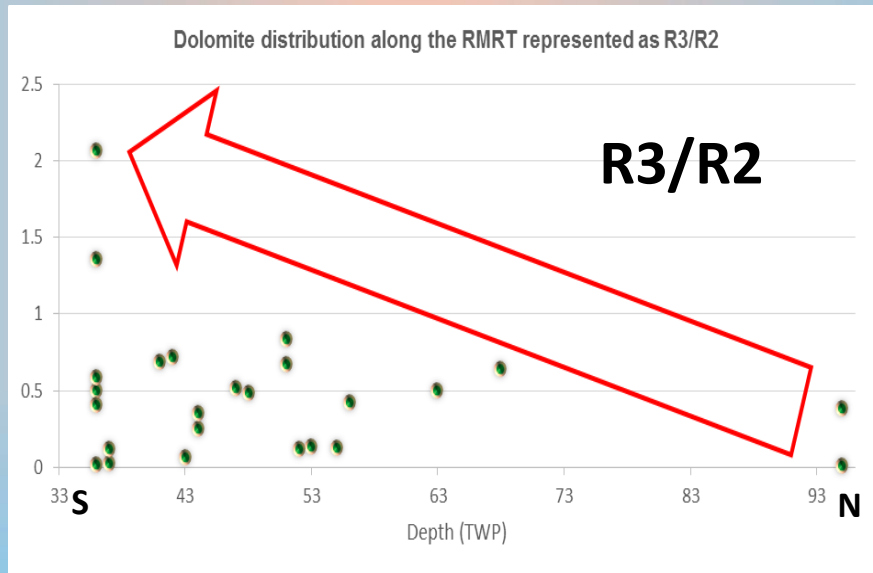
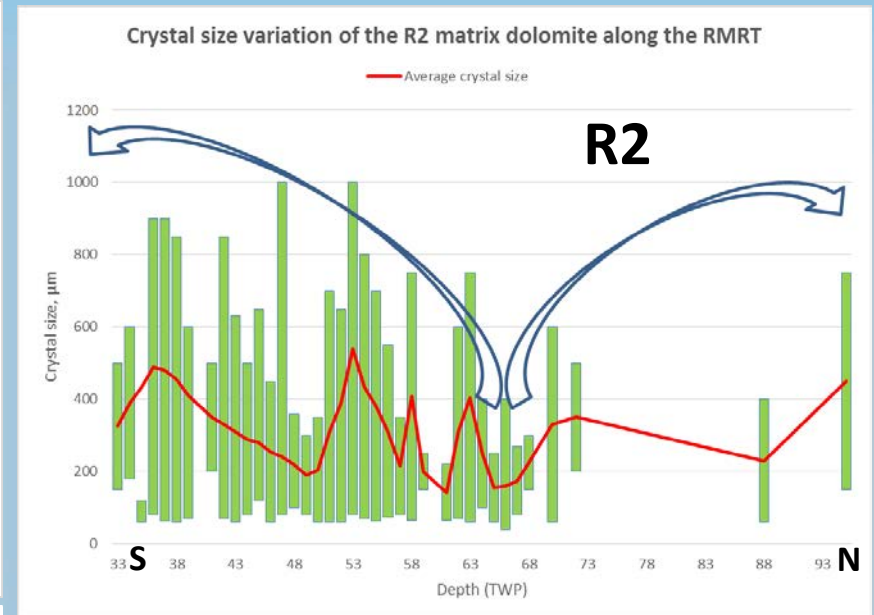
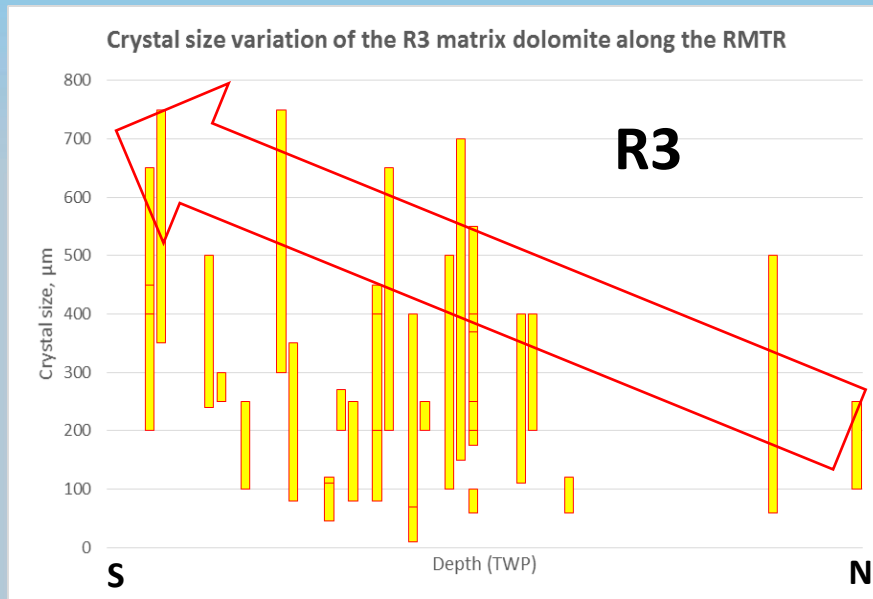
*Brown porous matrix dolomite (R3):*

- medium to coarse crystalline
- planar-euhedral to planar-subhedral
- porous mosaic
- clear to brown
- blotchy orange-red luminescence

**R2 + R3**



# IMAGE ANALYSIS

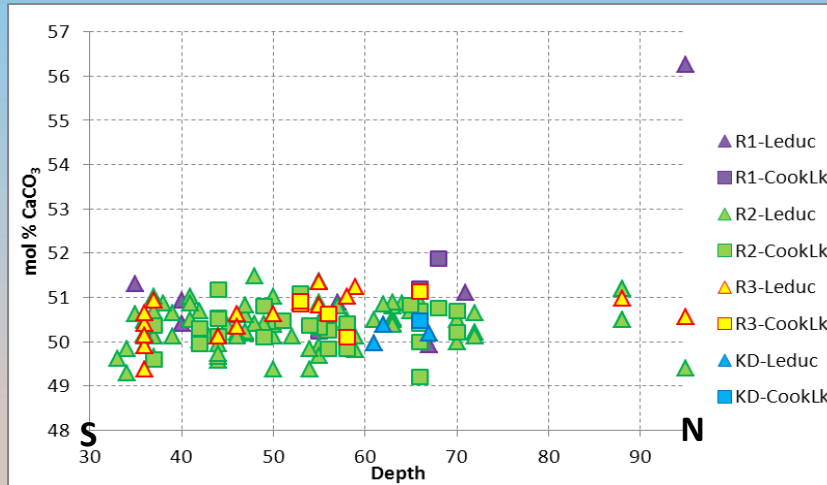


**Previous studies:**  
Textural differences precursor-controlled for R2, but not for R1 and R3 ?

**This study:**  
Fabric- preserving R1  
pervasively recrystallized  
to fabric-destructive R2

R2 locally recrystallized to R3  
through Ostwald-ripening

# DOLOMITE STOICHIOMETRY

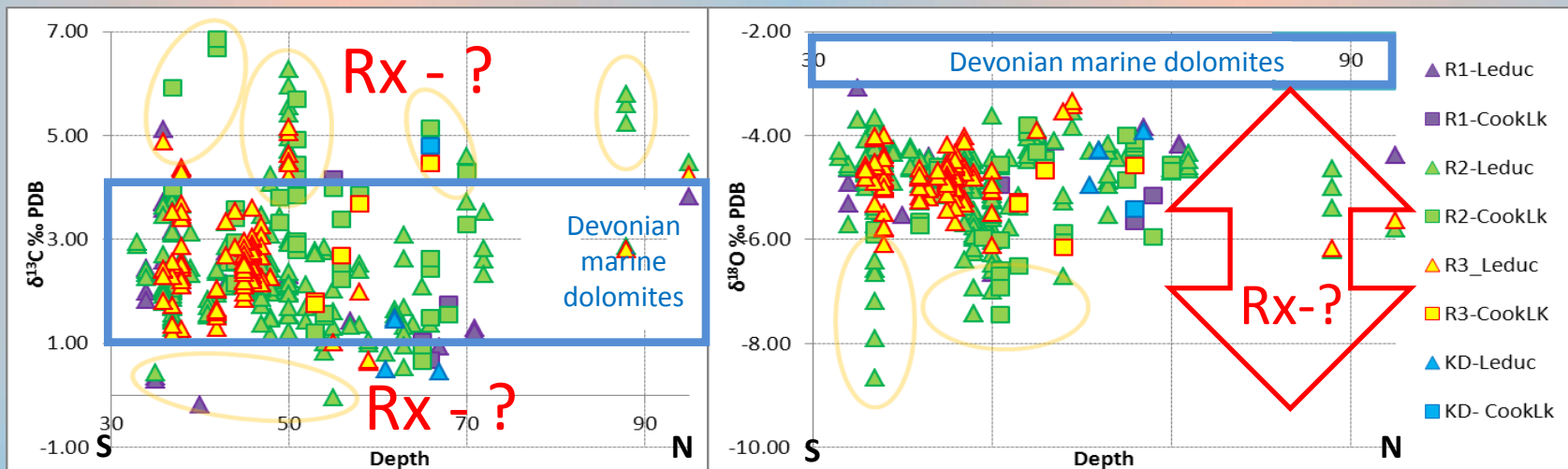


Nearly ideal  
stoichiometric  
composition



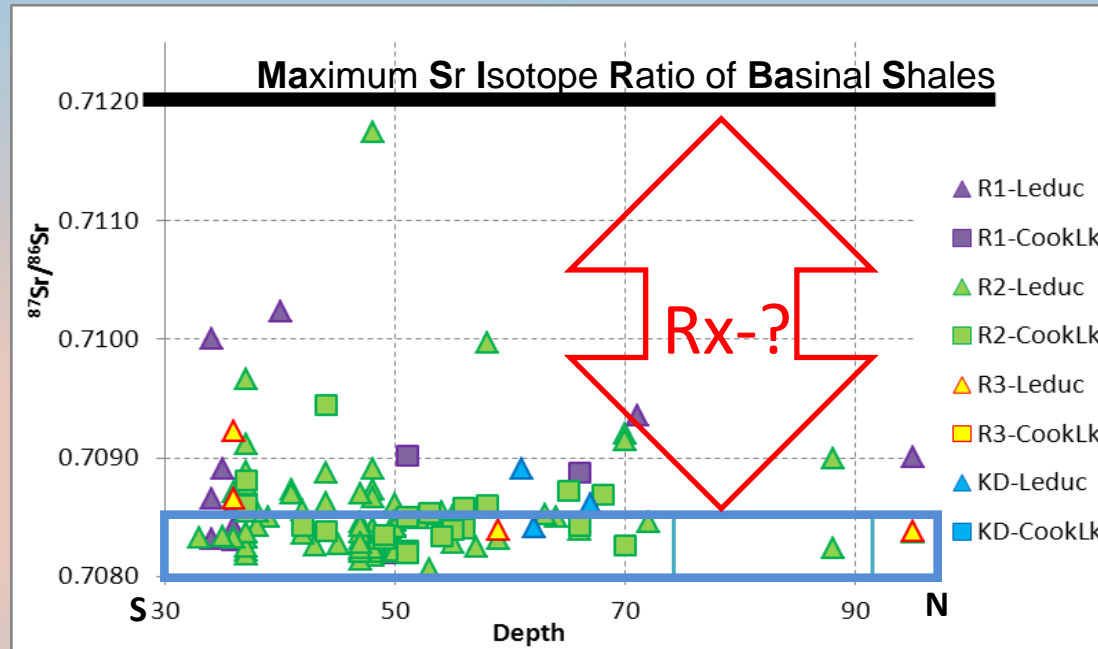
Progressive  
recrystallization

## STABLE ISOTOPE RESULTS



- Carbon derived from sea-water dominated fluids
- Depleted  $\delta^{18}\text{O}$  values due to later interaction with lighter  $\delta^{18}\text{O}$  fluids

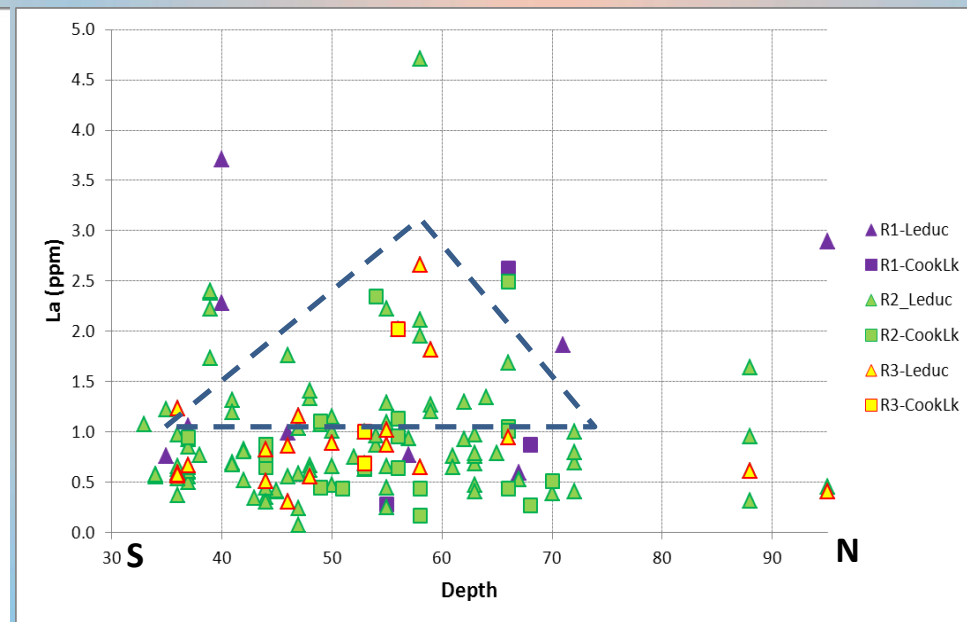
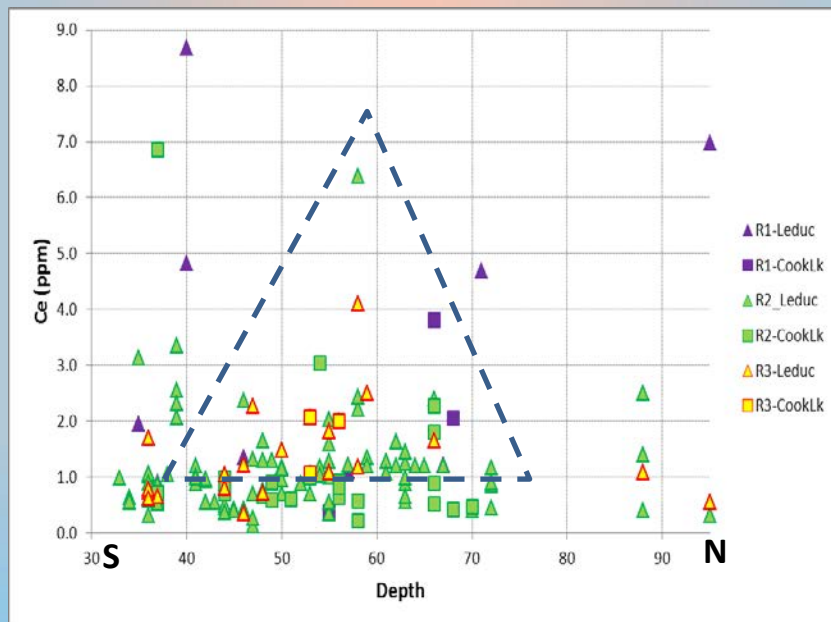
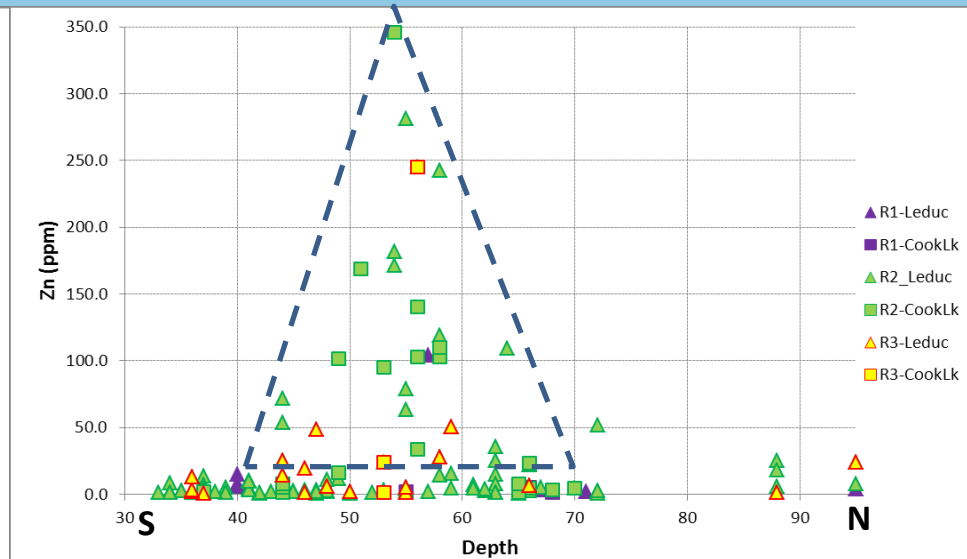
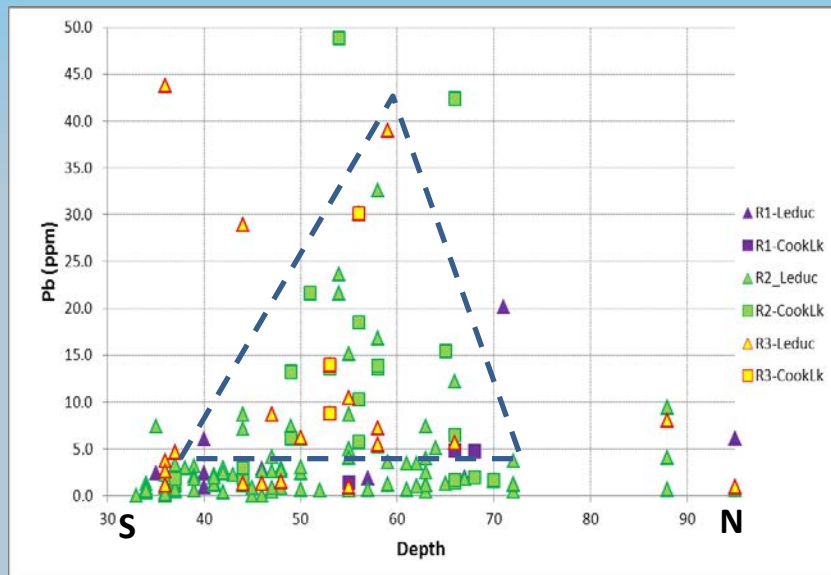
## RADIOGENIC (Sr) ISOTOPES



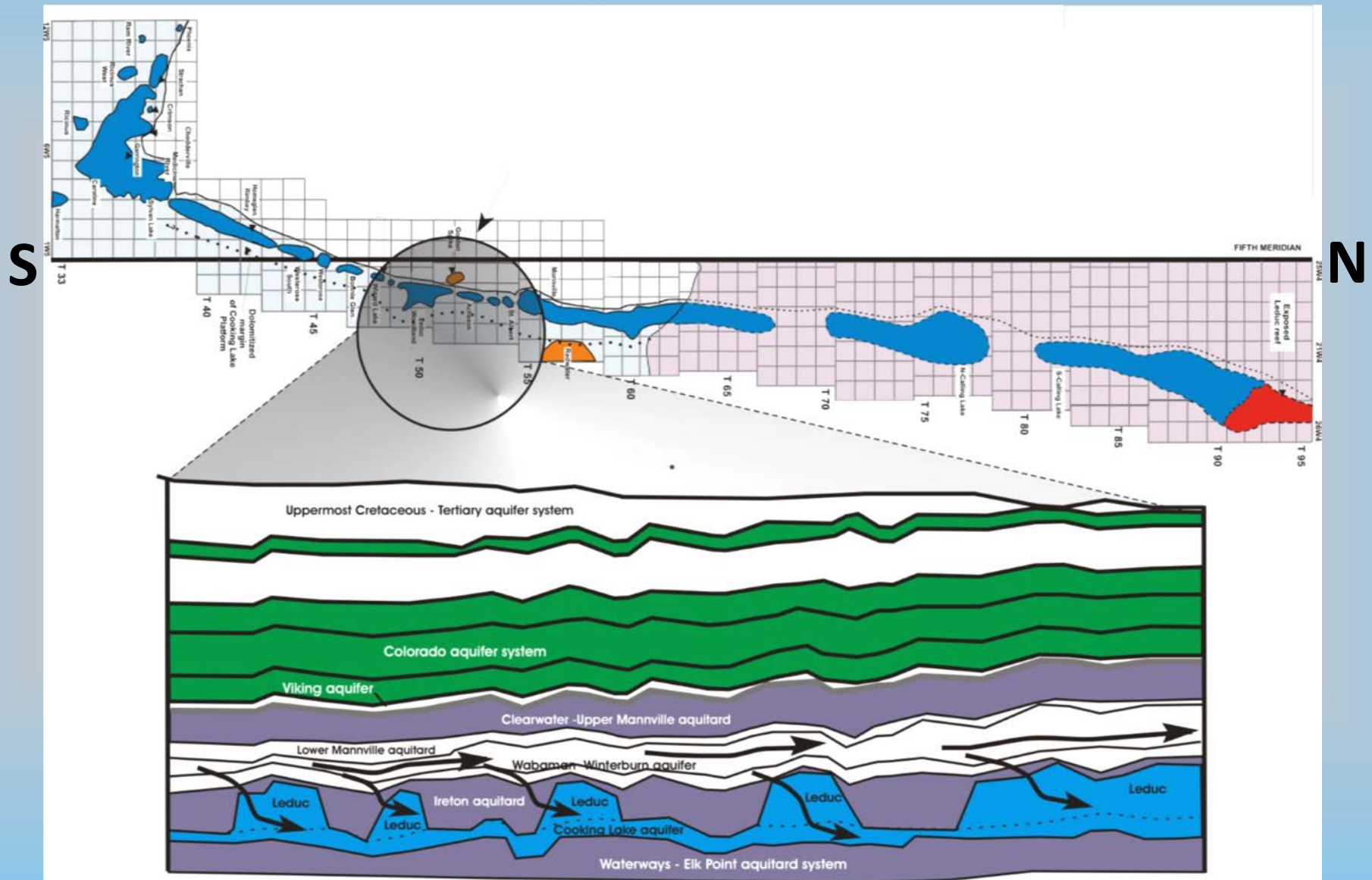
- Elevated strontium ratios due to interaction with siliciclastic rocks and clay minerals along the flow path.



# ELEMENTAL COMPOSITIONS



# Original flow of formation waters joined by the cross-formation fluid through local breaching of the Ireton aquitard



# CONCLUSIONS

- Matrix dolomites have undergone a 'significant' recrystallization
- R1 is the 'least-altered' dolomite phase. Dolomitizing fluids - marine waters. Early recrystallization likely occurred during Late Devonian to Early Carboniferous.
- R2 and R3 dolomites formed by further alteration of R1 at deeper burial and/or by warmer fluids (up to 105 °C).
- Mixing of meteoric waters of the Lower Mannville and dense brines of the Cooking Lake aquifer significantly affected area located north from township 44 causing depletion of  $\delta^{18}\text{O}$  values and enrichment in  $\delta^{13}\text{C}$ ,  $^{87}\text{Sr}/^{86}\text{Sr}$ , trace elements and REE compositions ?
- No signs of stepwise recrystallization proposed by Land (1992)
- Mode of recrystallization along reef trend

