Parsing the structurally-controlled fluid migration history of the Moab Fault, UT with carbonate clumped isotope thermometry

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KEY POINTS

- Clumped isotopes reveal multiple episodes of cementation on the Moab Fault.

- Cementation was controlled by different structures at different stages of deformation.

- Early cataclasis preconditions rock for fracturing during shallow burial.

How do faults control fluid flow?

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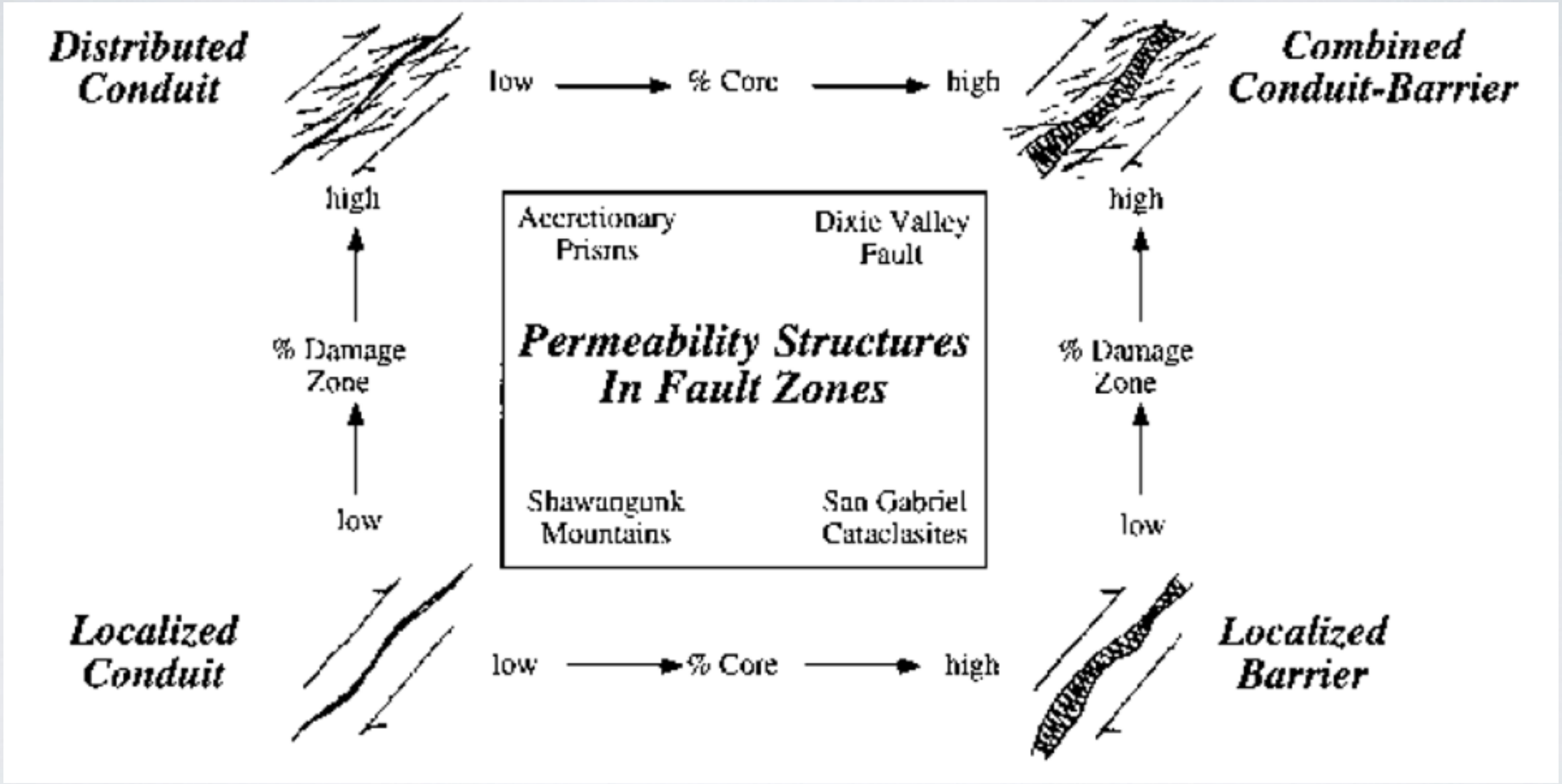
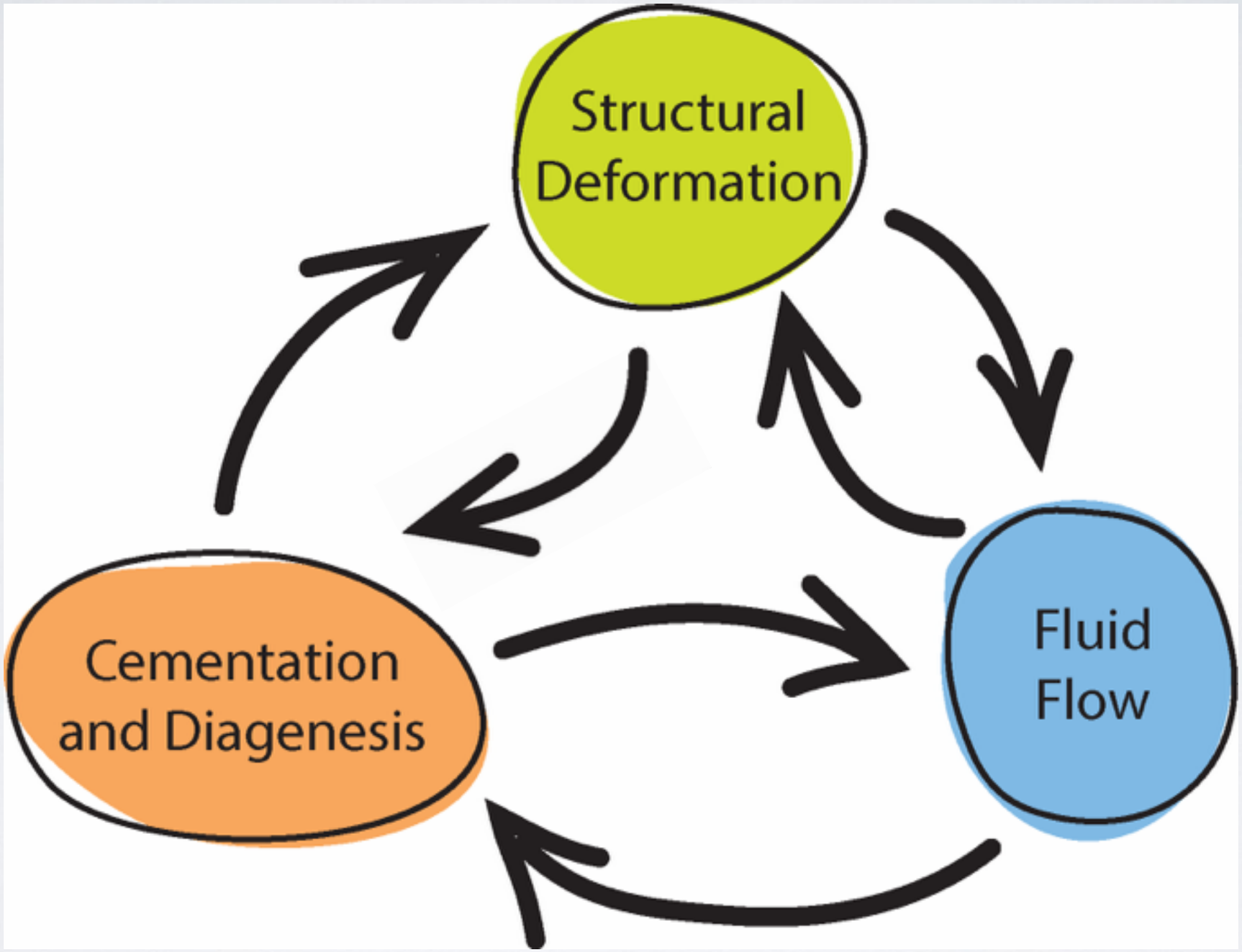


Caine et al. 1996

STRUCTURAL DIAGENESIS



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Clumped isotopes provide a new window: **Temperature**

CEMENTS RECORD PAST FLUID FLOW

Carbonate C and O stable isotope geochemistry

Method:	**Measurement:**			**Proxy for:**
	Abundance *of rare isotopes*			
• $\delta^{13}C$	16	**13**	16	- C source
• $\delta^{18}O$	**18**	12	16	- O source, Temperature

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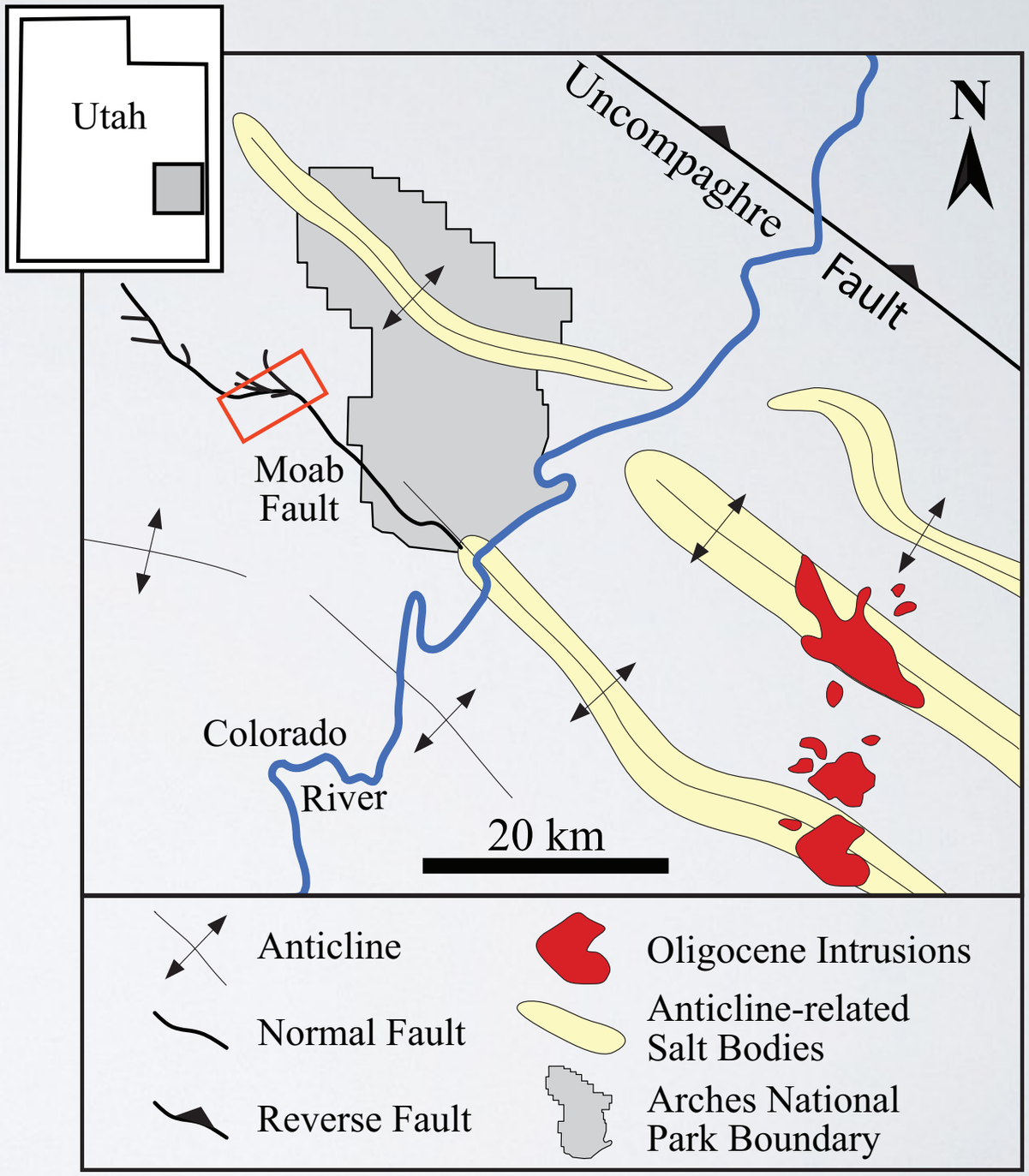
	Arrangement *of rare isotopes*	
• Δ_{47}	**18** **13** 16	**Temperature alone**

THE PARADOX BASIN AND MOAB FAULT

- Paleozoic to Mesozoic foreland basin.
- Internal deformation controlled by ductile salt.
- Moab Fault initiates by Triassic; main slip event 50-60 m.y.a.



Hodson et al., 2016 (after Foxford et al., 1996)

COURTHOUSE JUNCTION

Image: Google Earth

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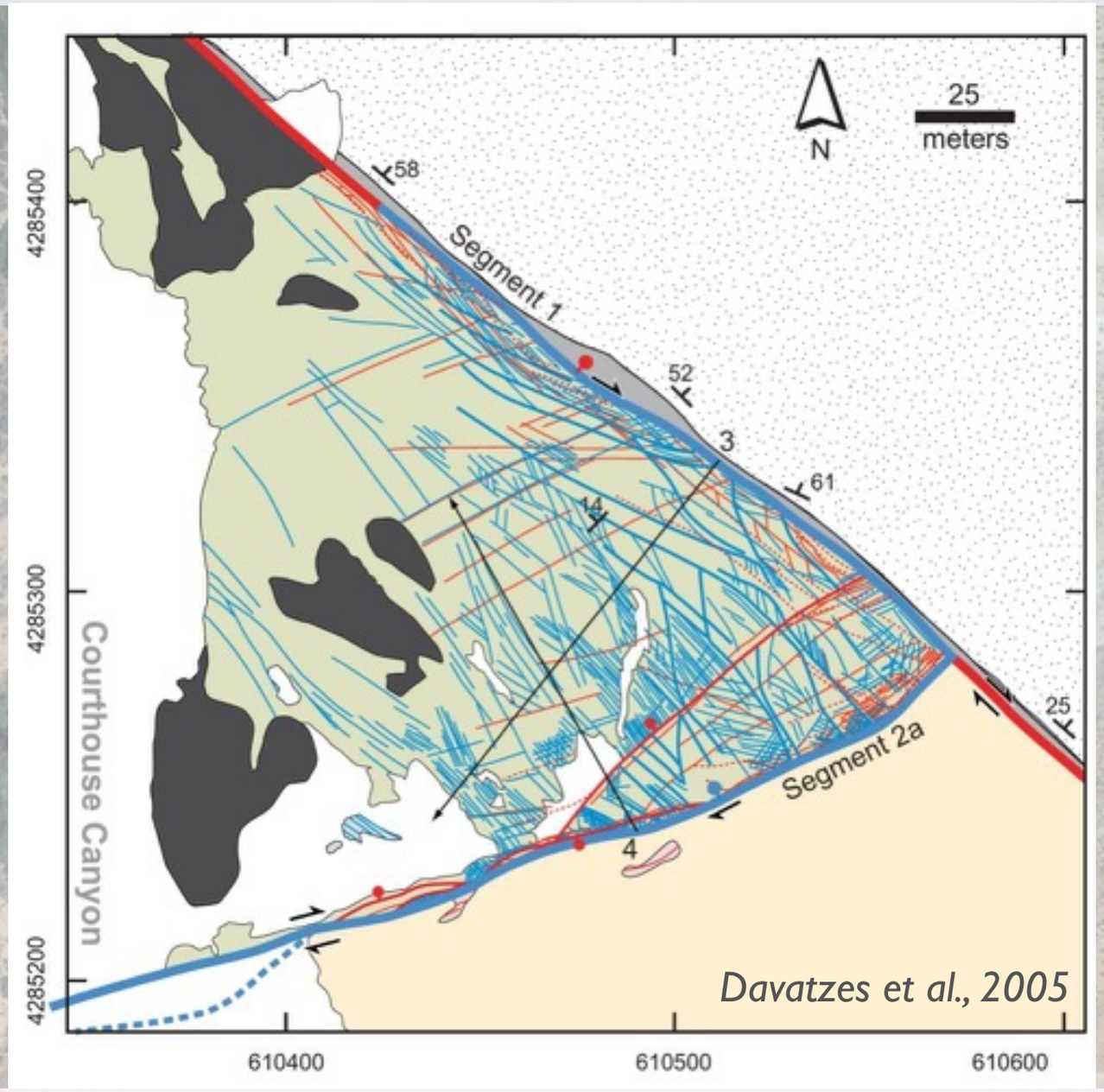

Davatzes et al., 2005

3 PHASES OF DEFORMATION

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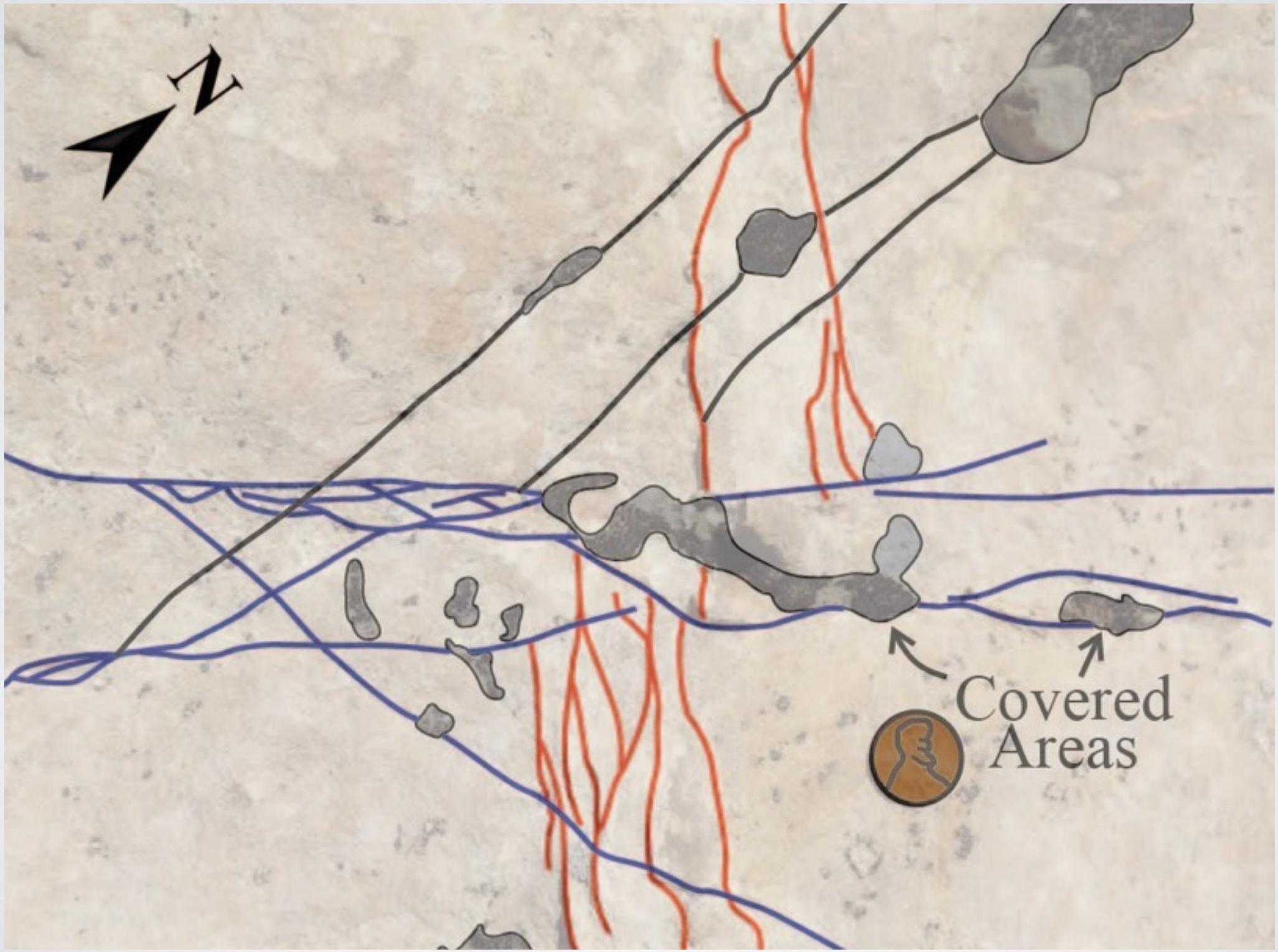

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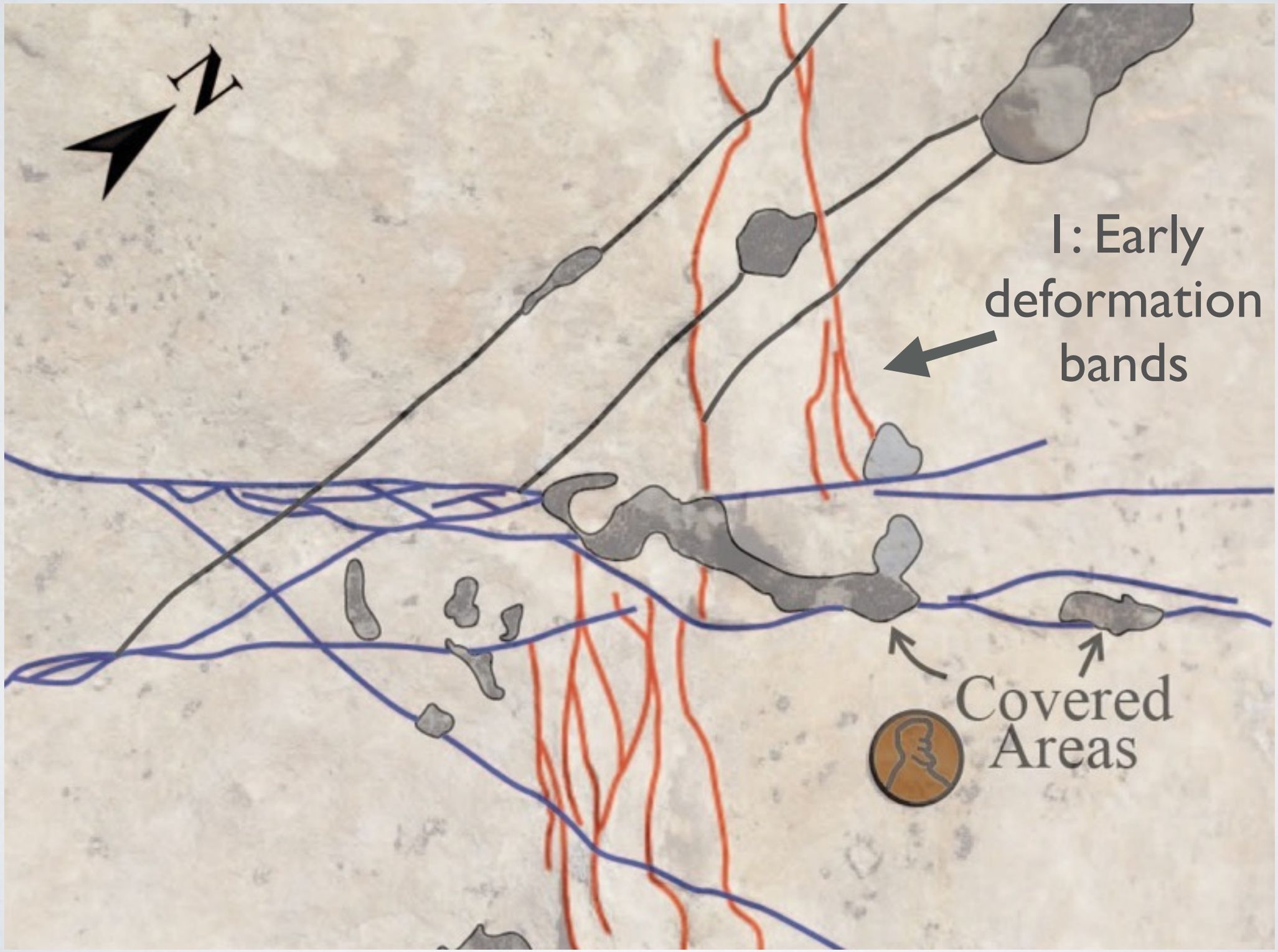

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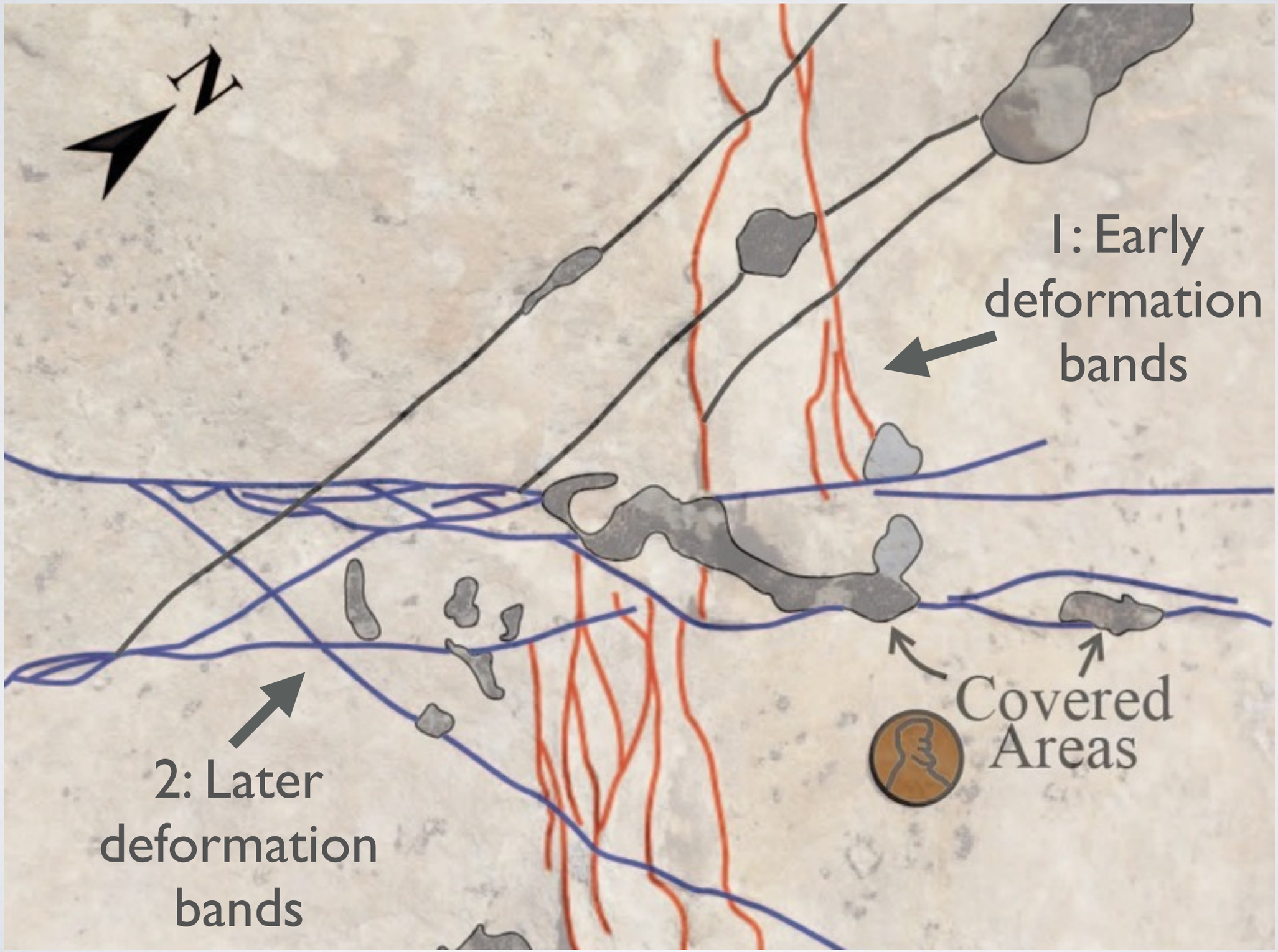

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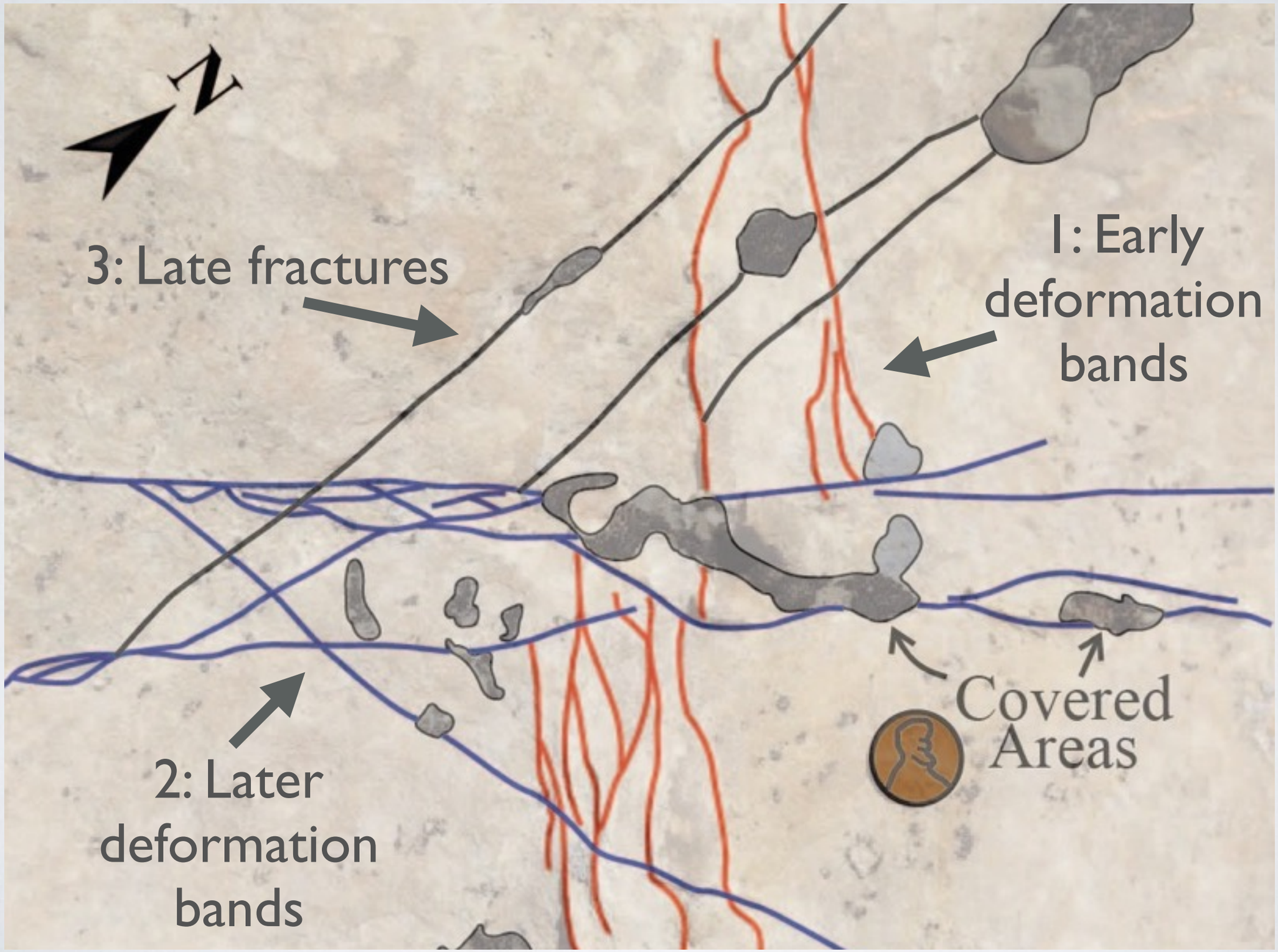
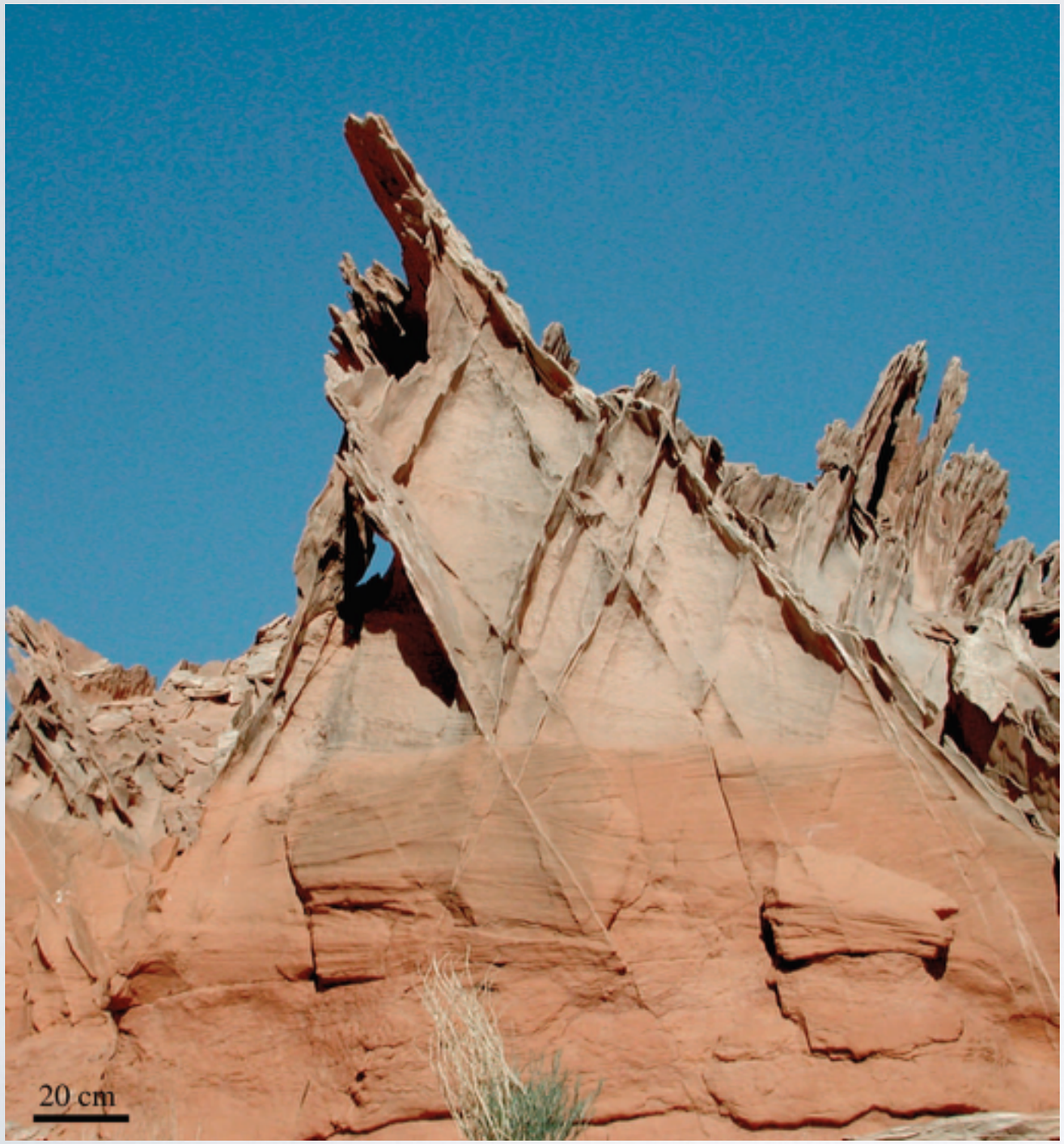
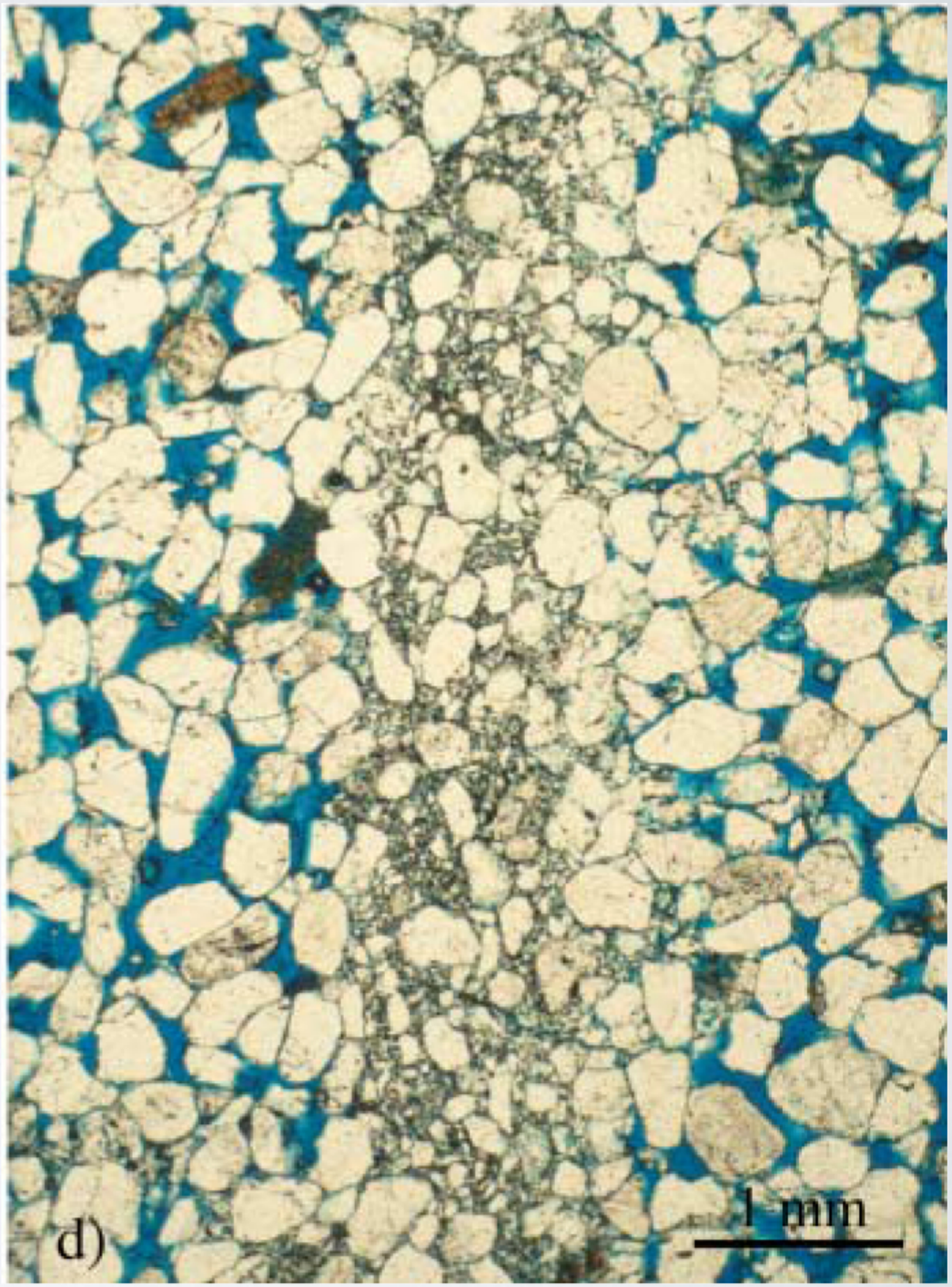


DEFORMATION BANDS: AN EFFECTIVE BAFFLE?

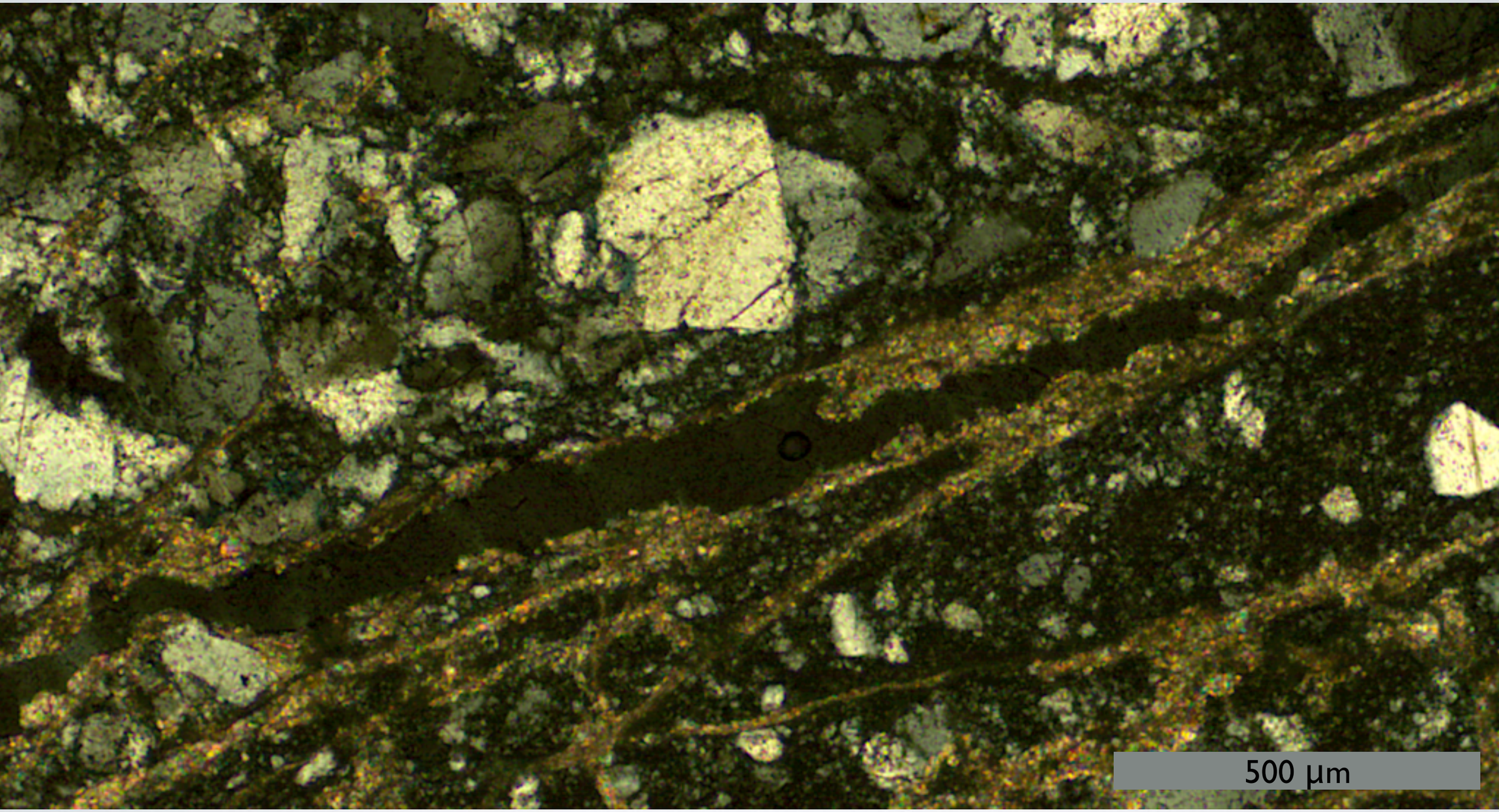


Fossen and Bale, 2007



Fossen et al. (2007)

WHAT IF THEY FRACTURE?



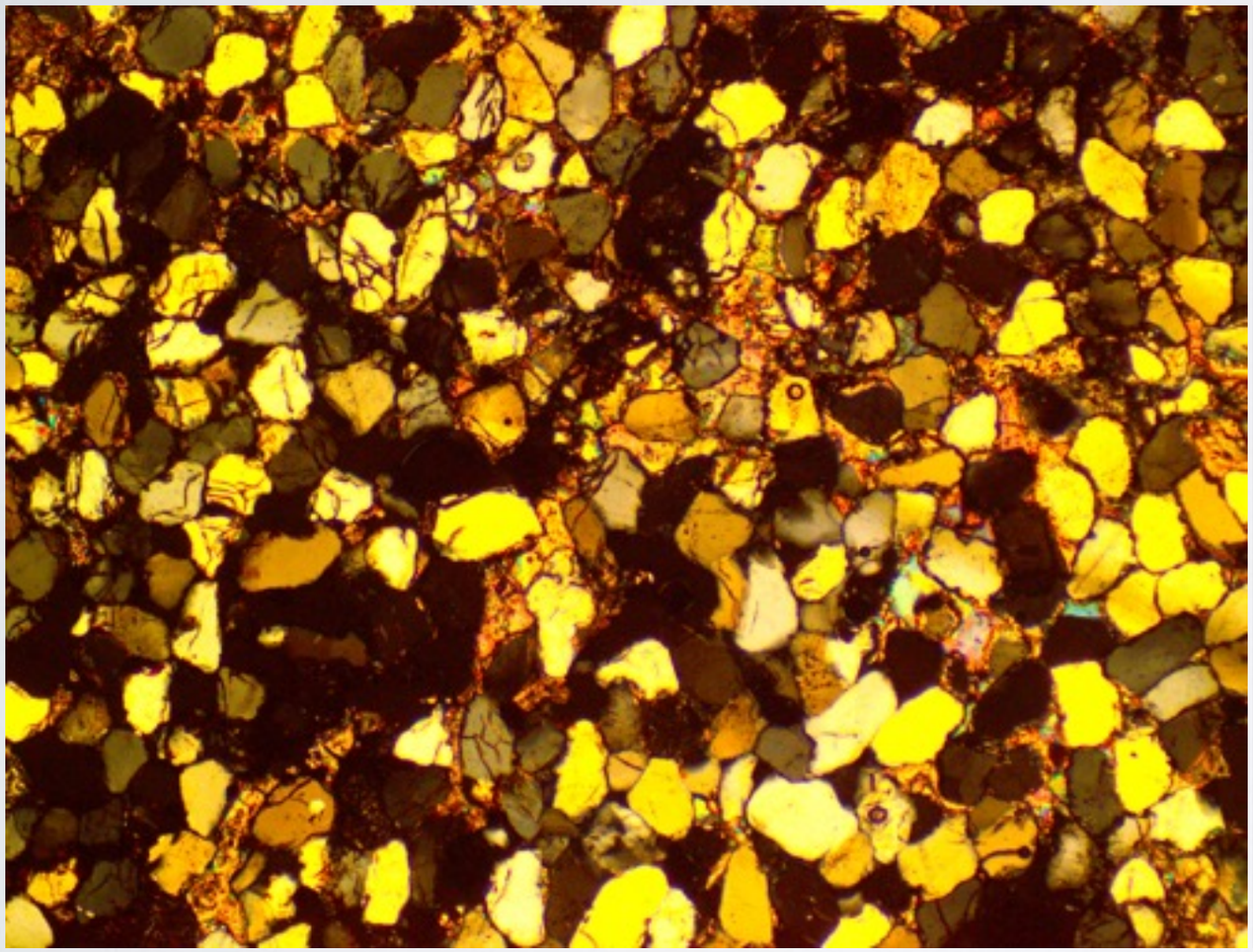
OUTSTANDING QUESTIONS:

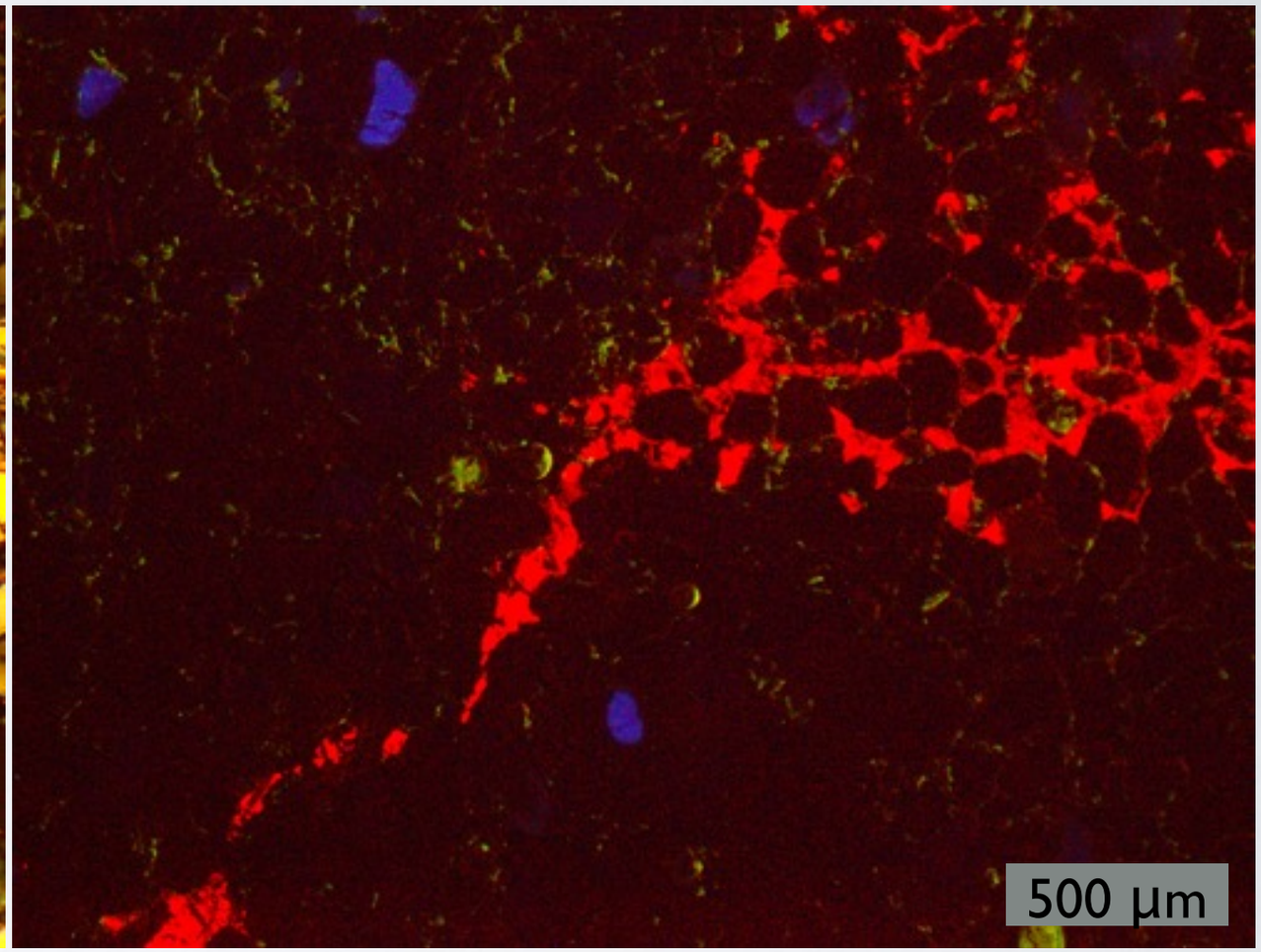
How does cementation relate to structural deformation?

What were the precipitation temperatures?

What is the relative timing of cementation?

RELATIVE AGES FROM CATHODOLUMINESCENCE





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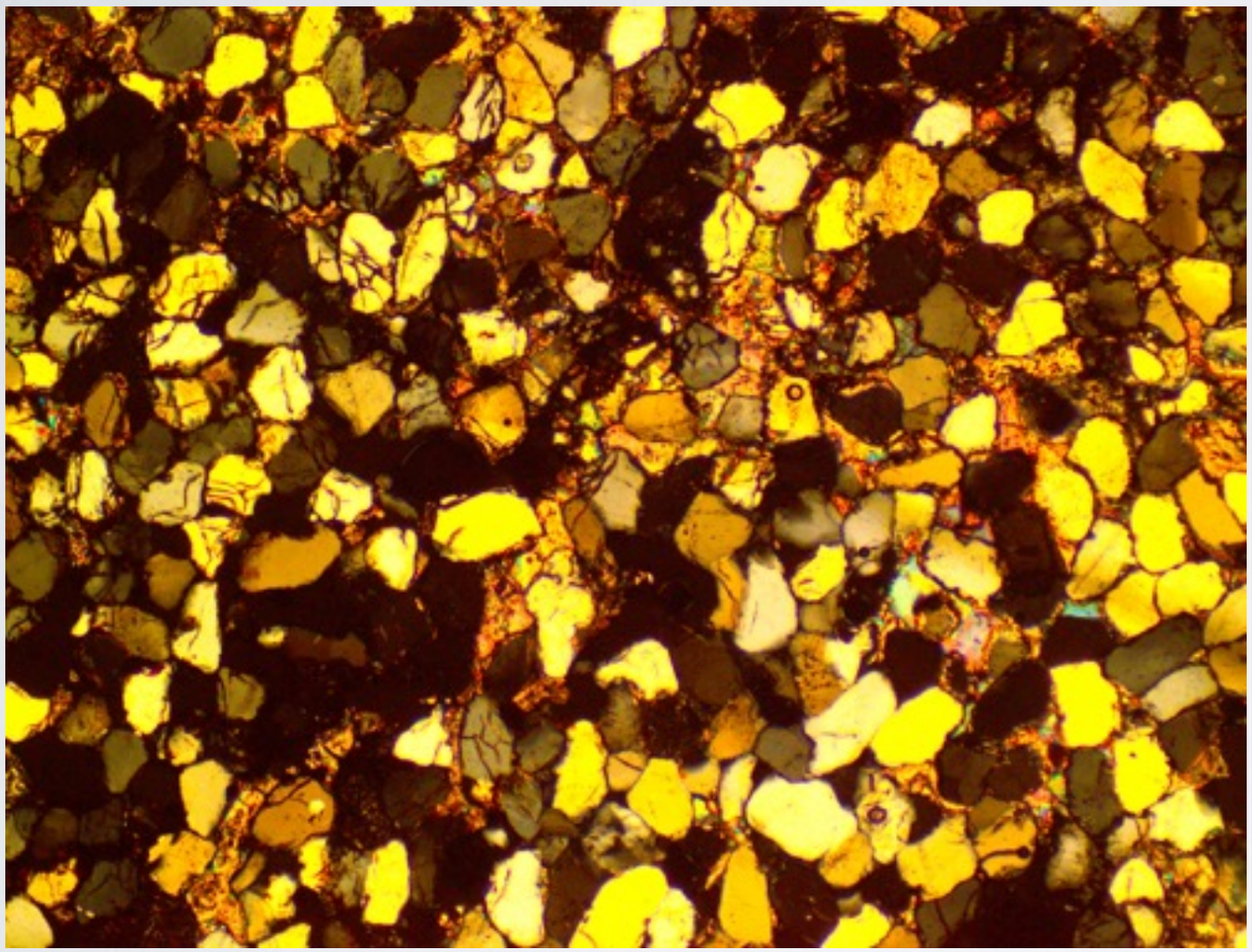

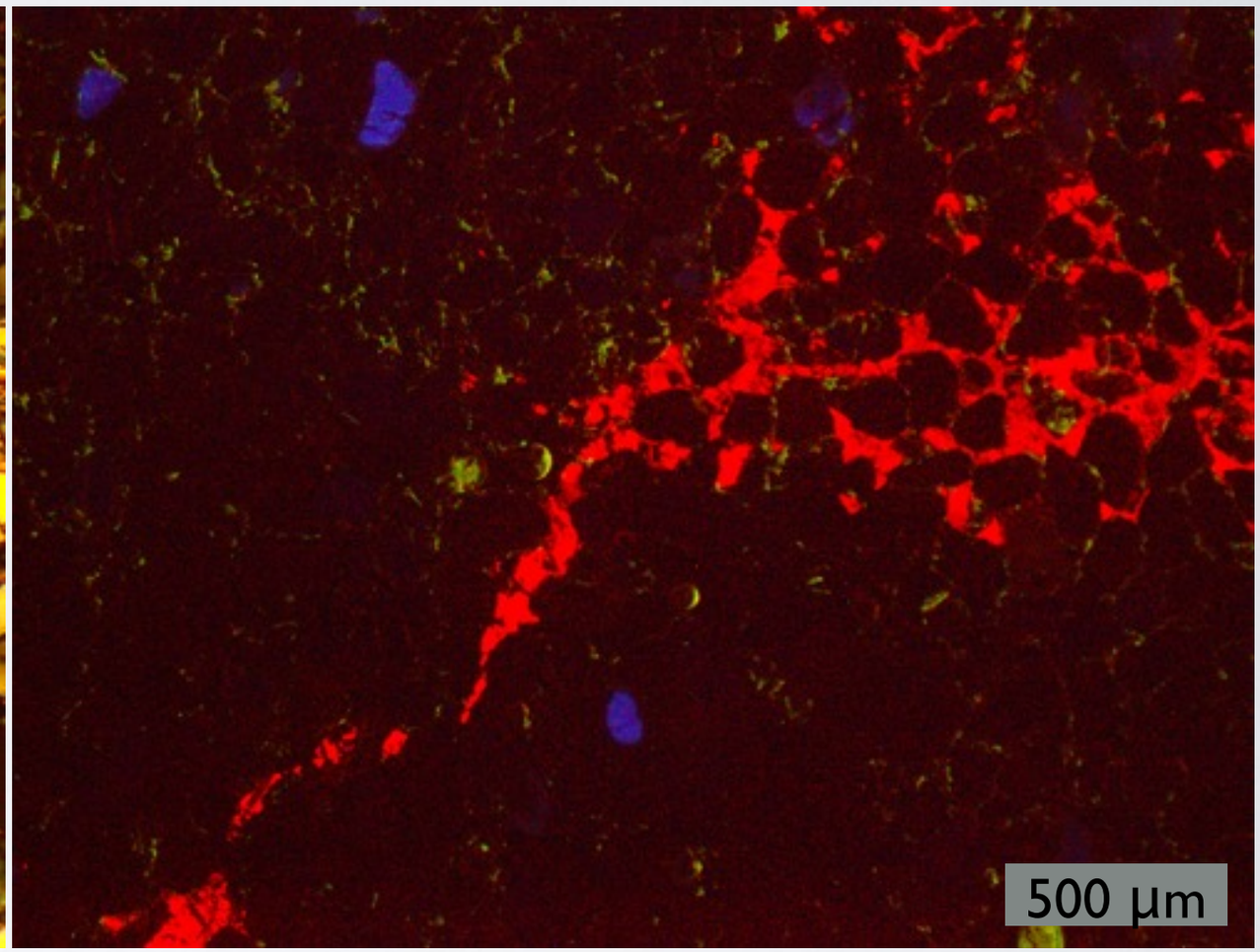

1 - Non-luminescent cement

2 - Luminescent cement

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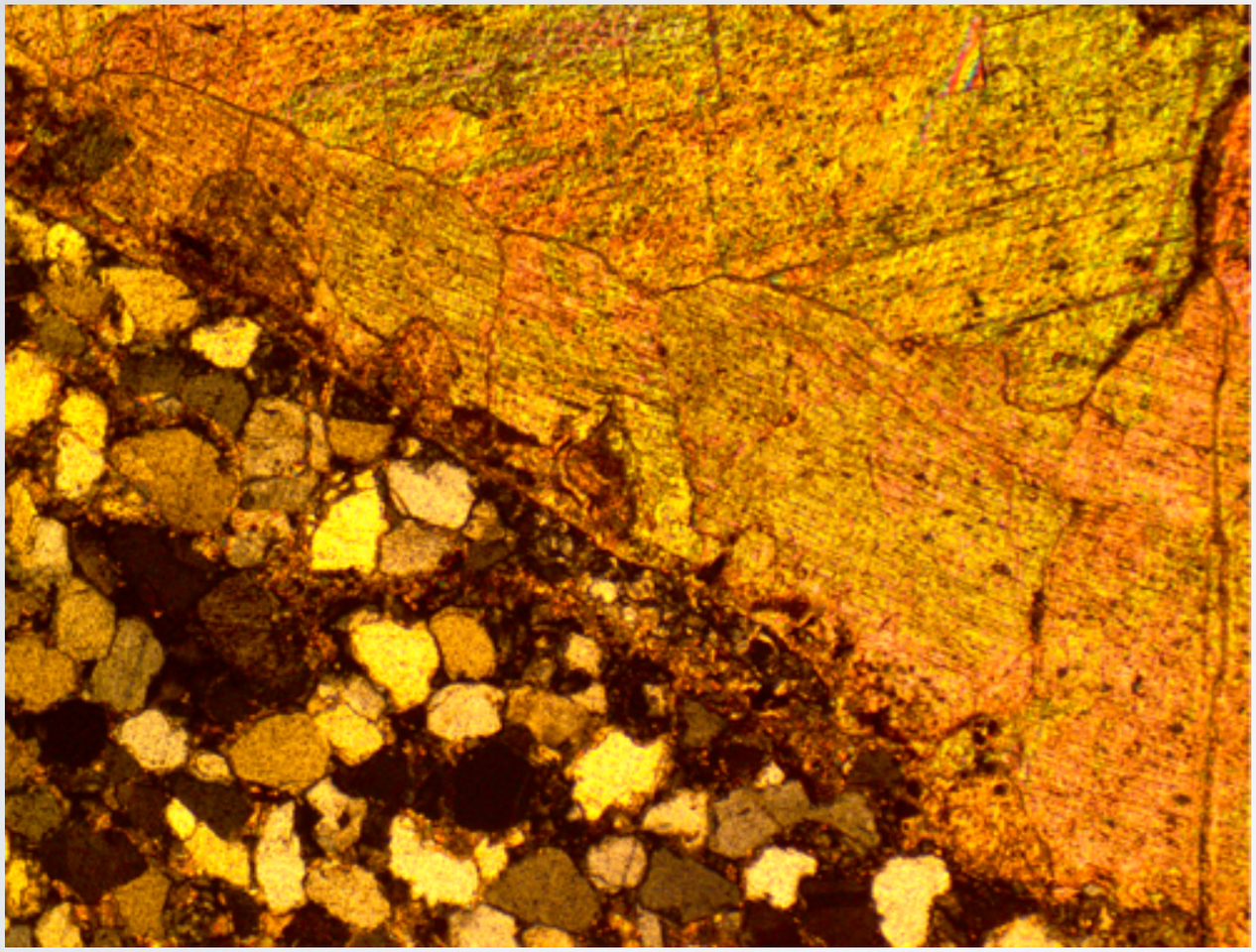

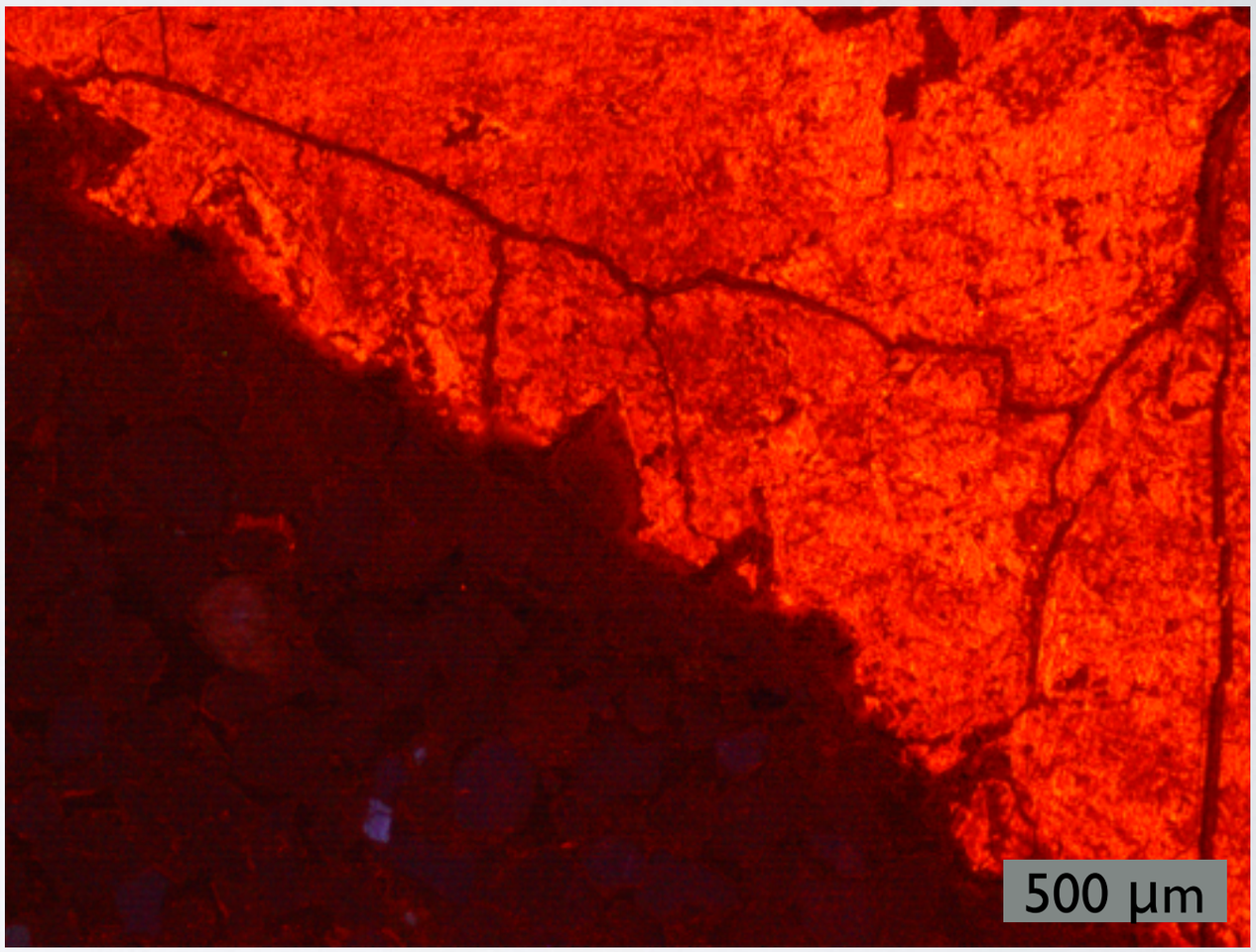

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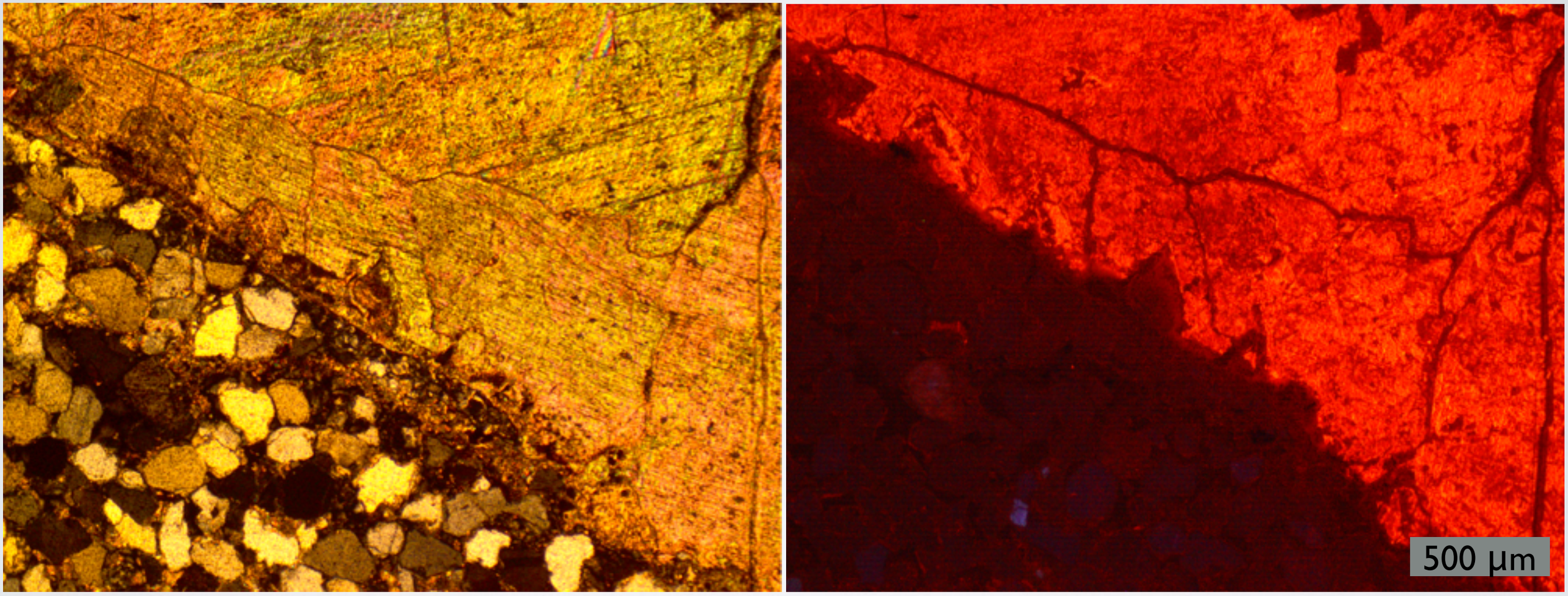

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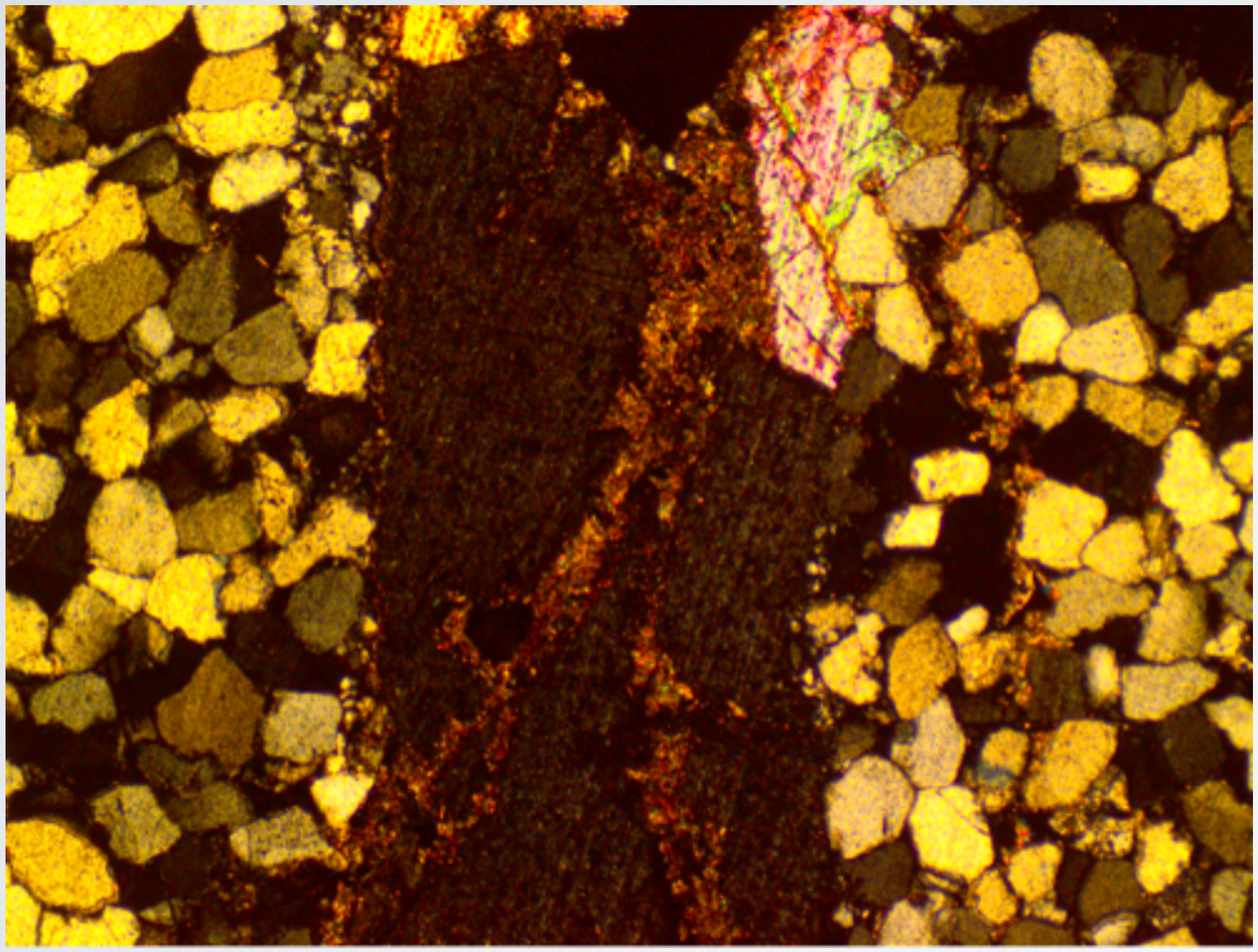

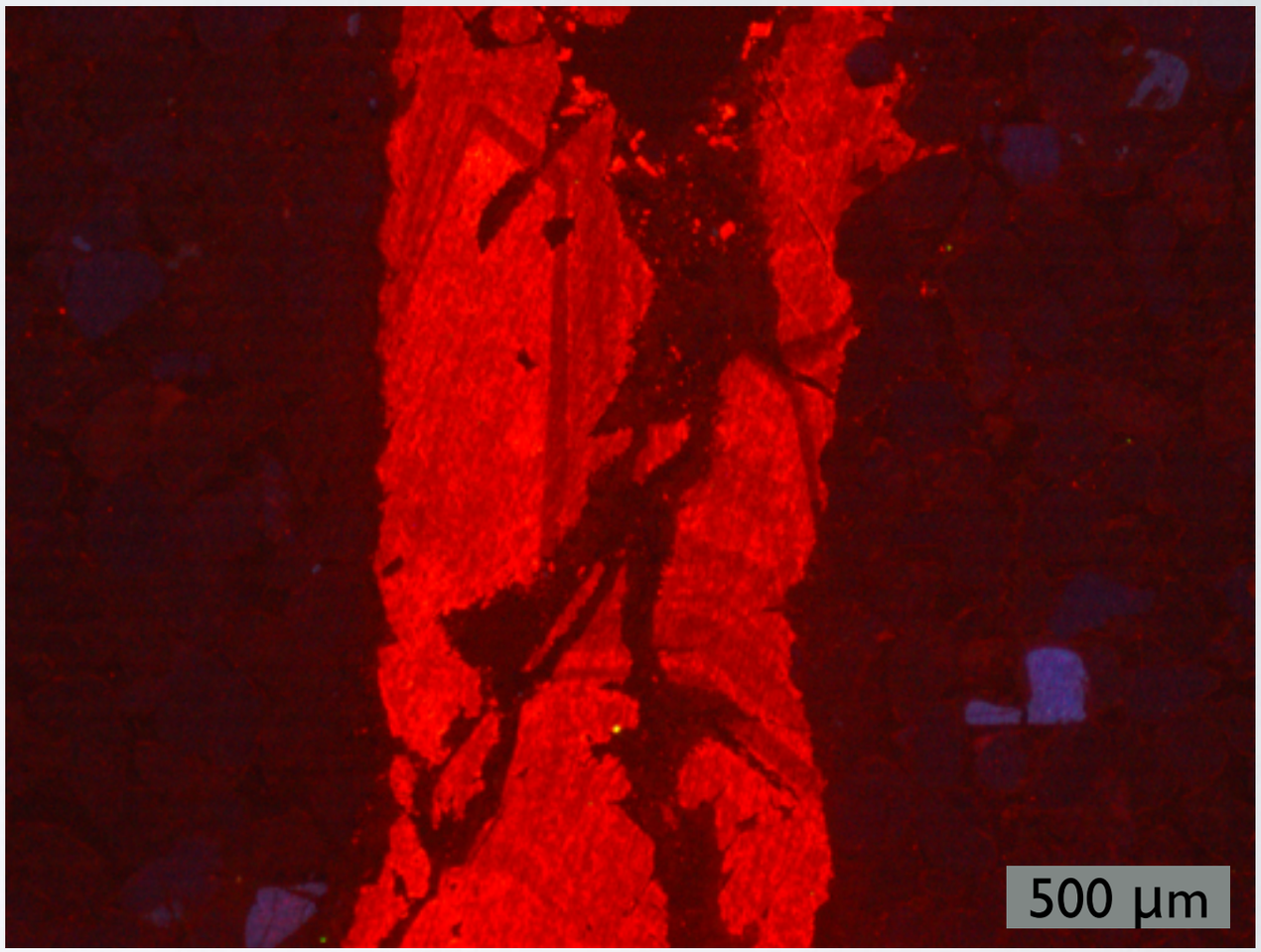

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1 - Deformation bands
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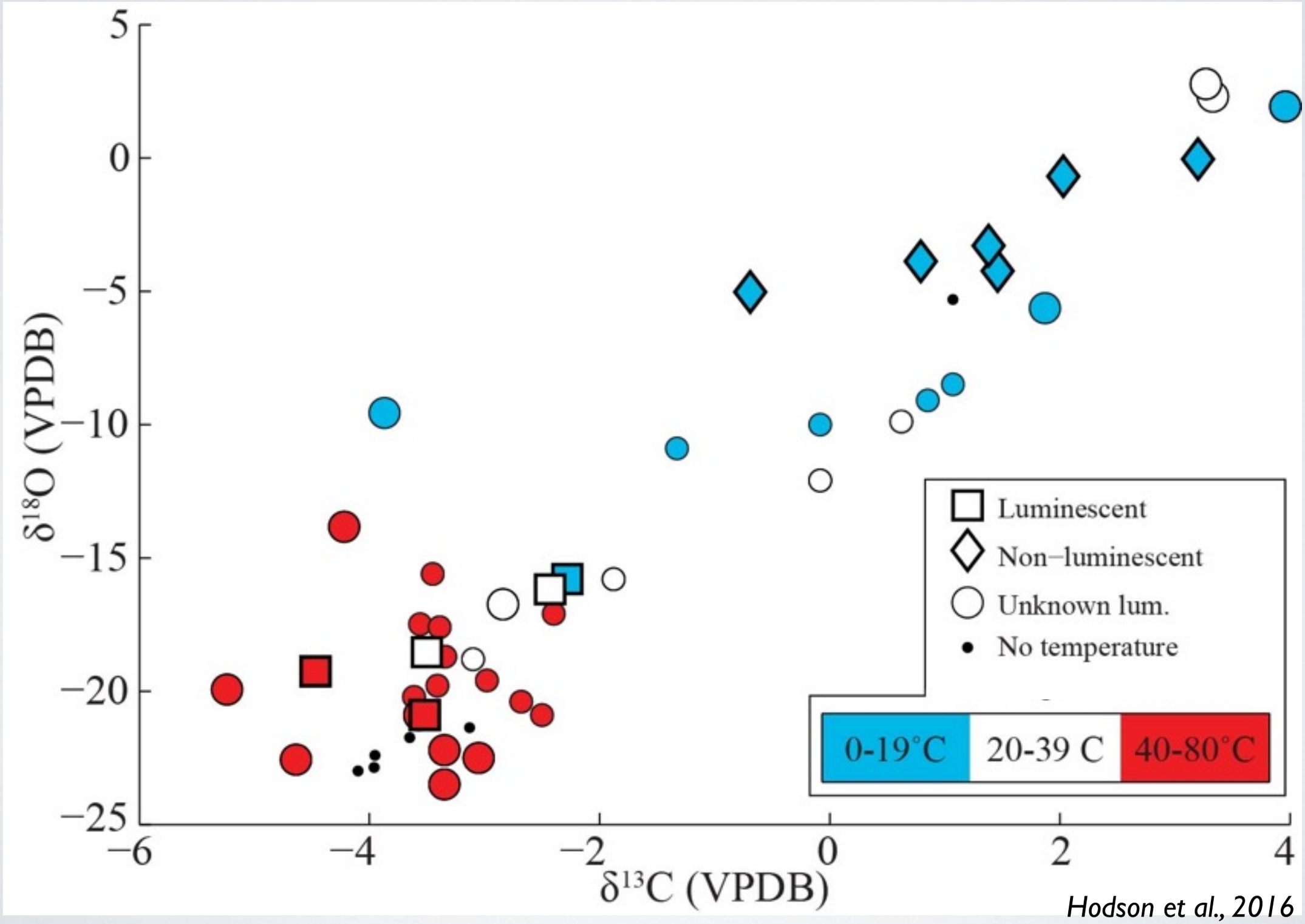
4 - Non-luminescent cement

PRECIPITATION TEMPERATURES



Hodson et al., 2016

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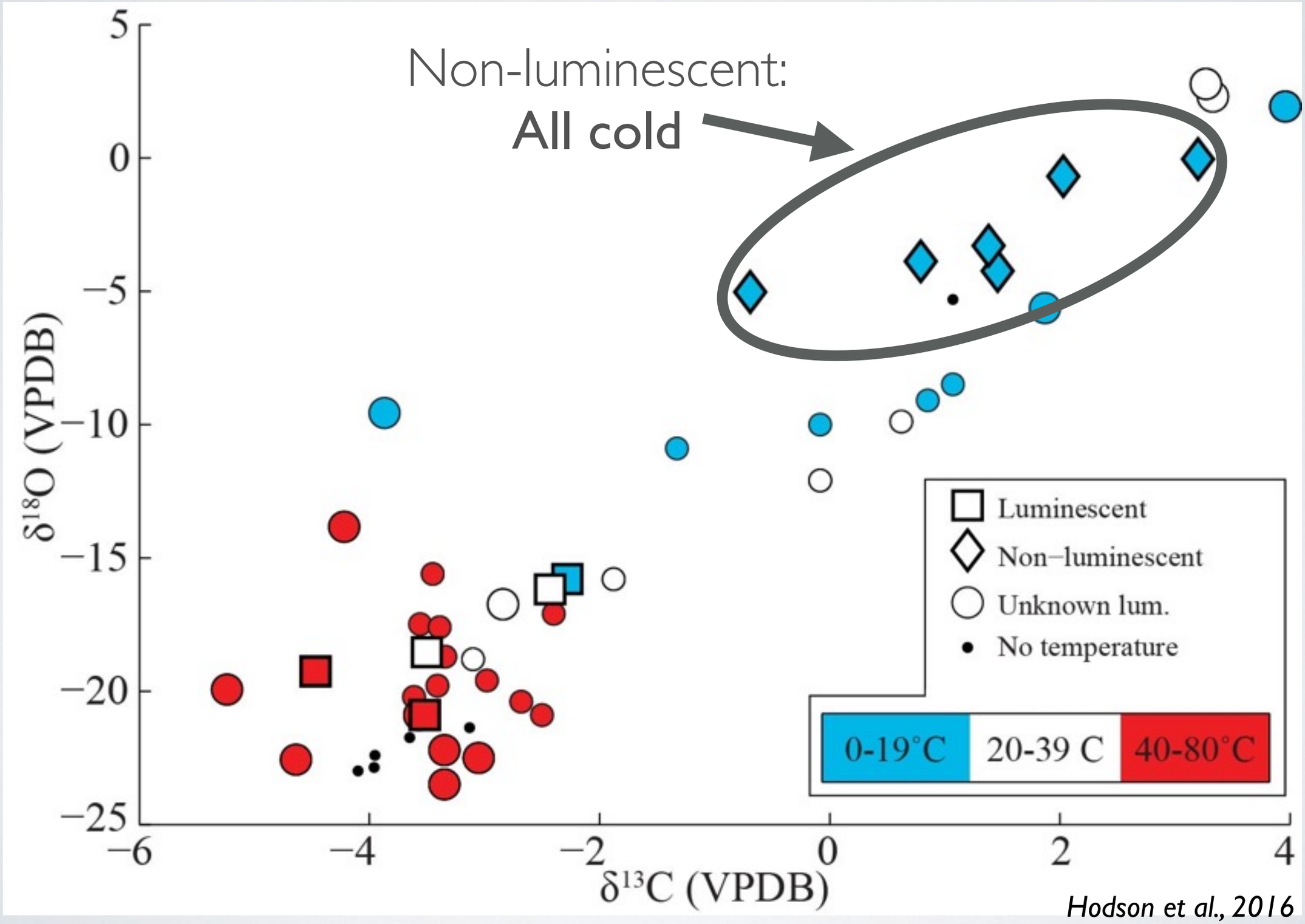

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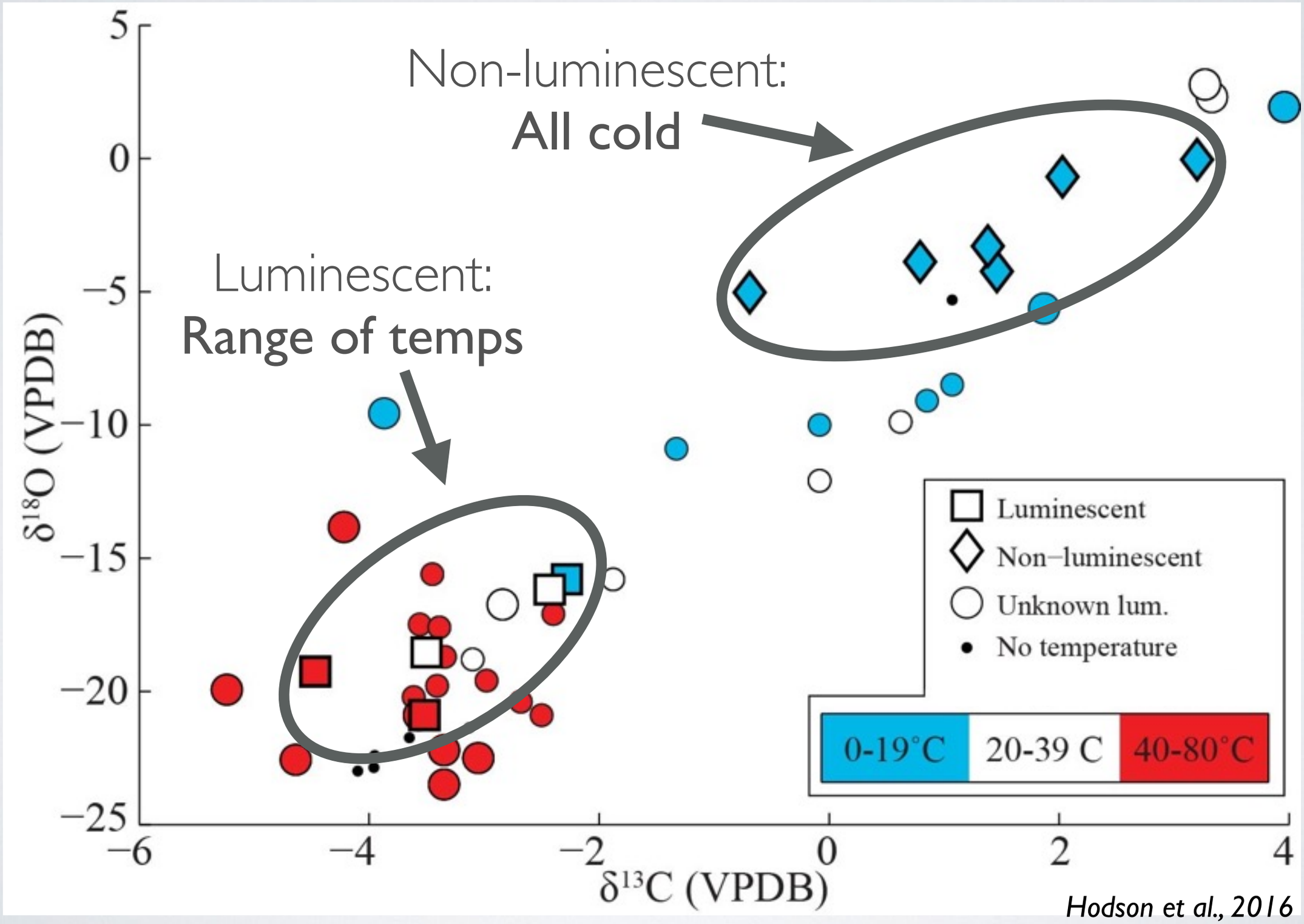

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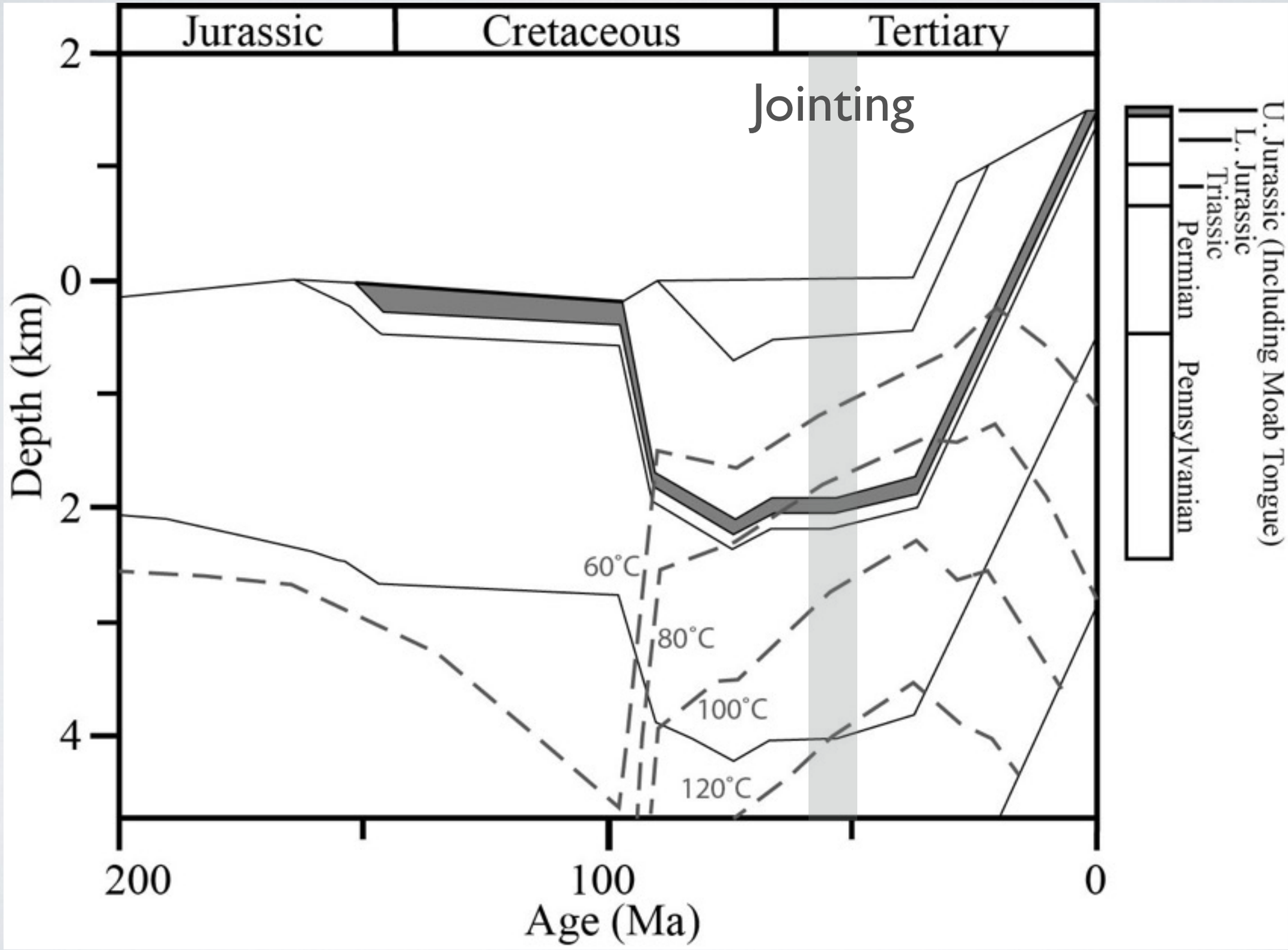
CEMENTATION HISTORY



Hodson et al., 2016, after Garden et al. 2000

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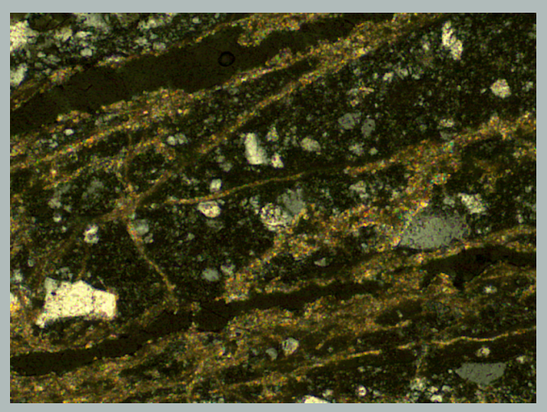

Early cements intrude DBs at shallow depths.

Hodson et al., 2016, after Garden et al. 2000

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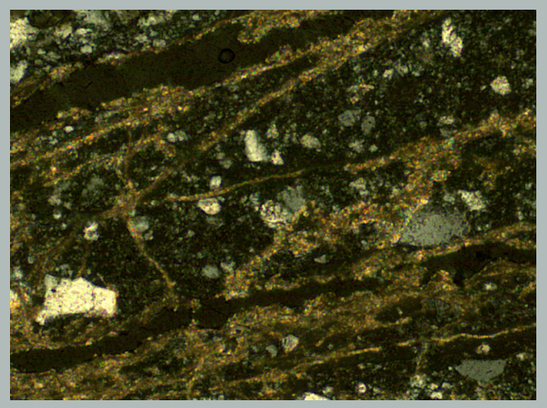

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Lum. cementation post faulting, continues during exhumation.

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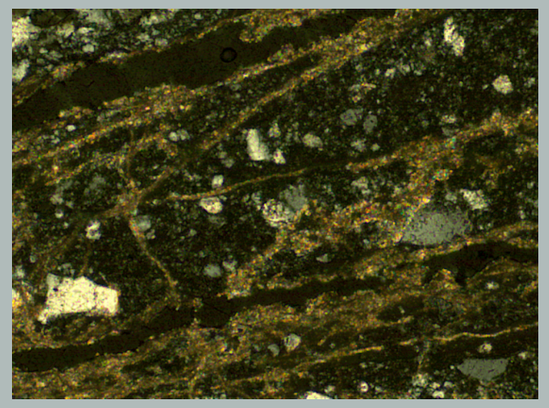

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Late cements form near surface

Hodson et al., 2016, after Garden et al. 2000

CONCLUSIONS

- Three episodes of cementation record fluid flow from burial through exhumation.
- Cements are associated with different structures and different temperatures.
- Deformation bands form and fail early in the burial history.

Questions?

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Ben Luetkemeyer
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