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I YABBA-DABBA DO!

LIMITATIONS OF PETROGRAPHIC ANALYSIS IN DETERMINING THE STONE RAW MATERIAL SOURCES

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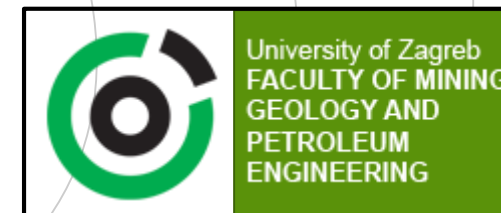


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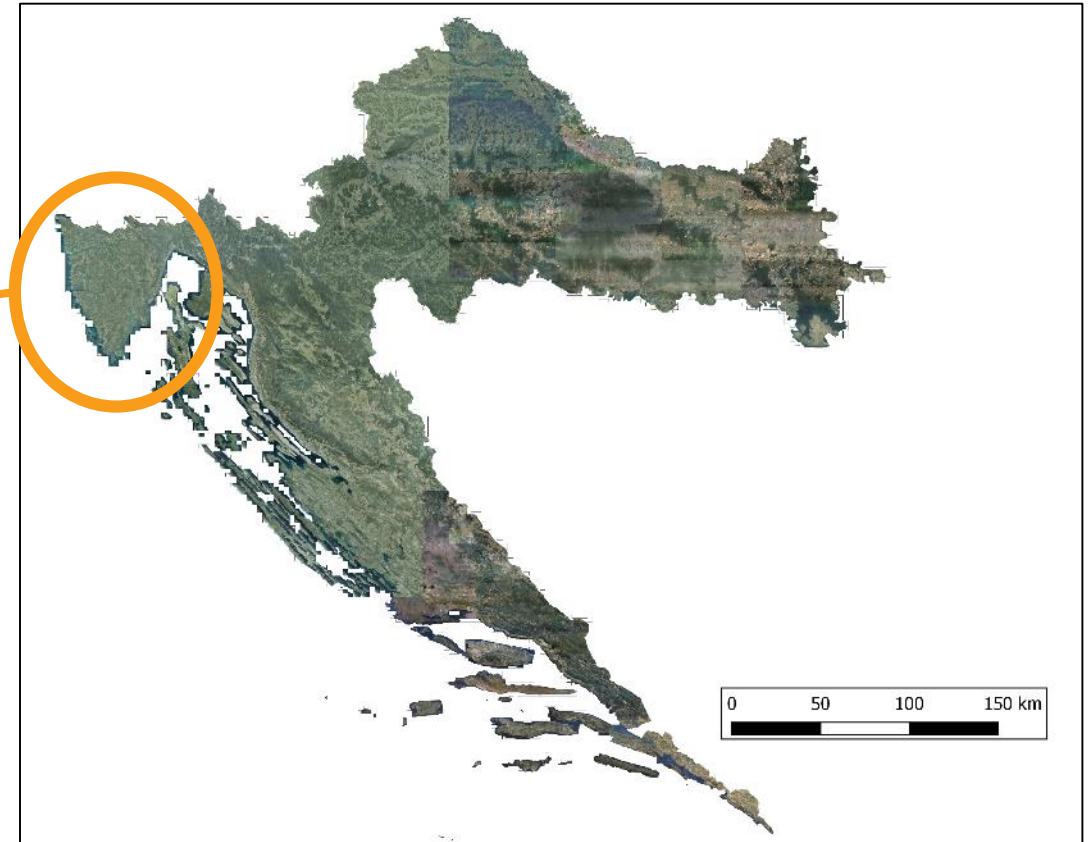
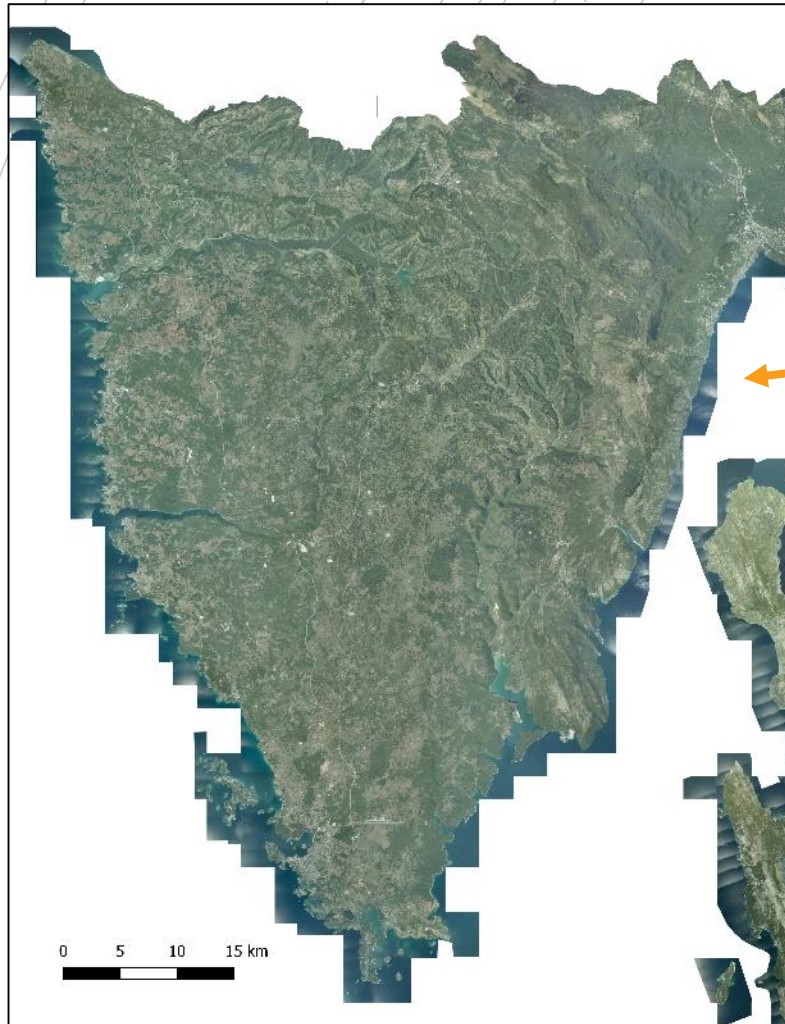
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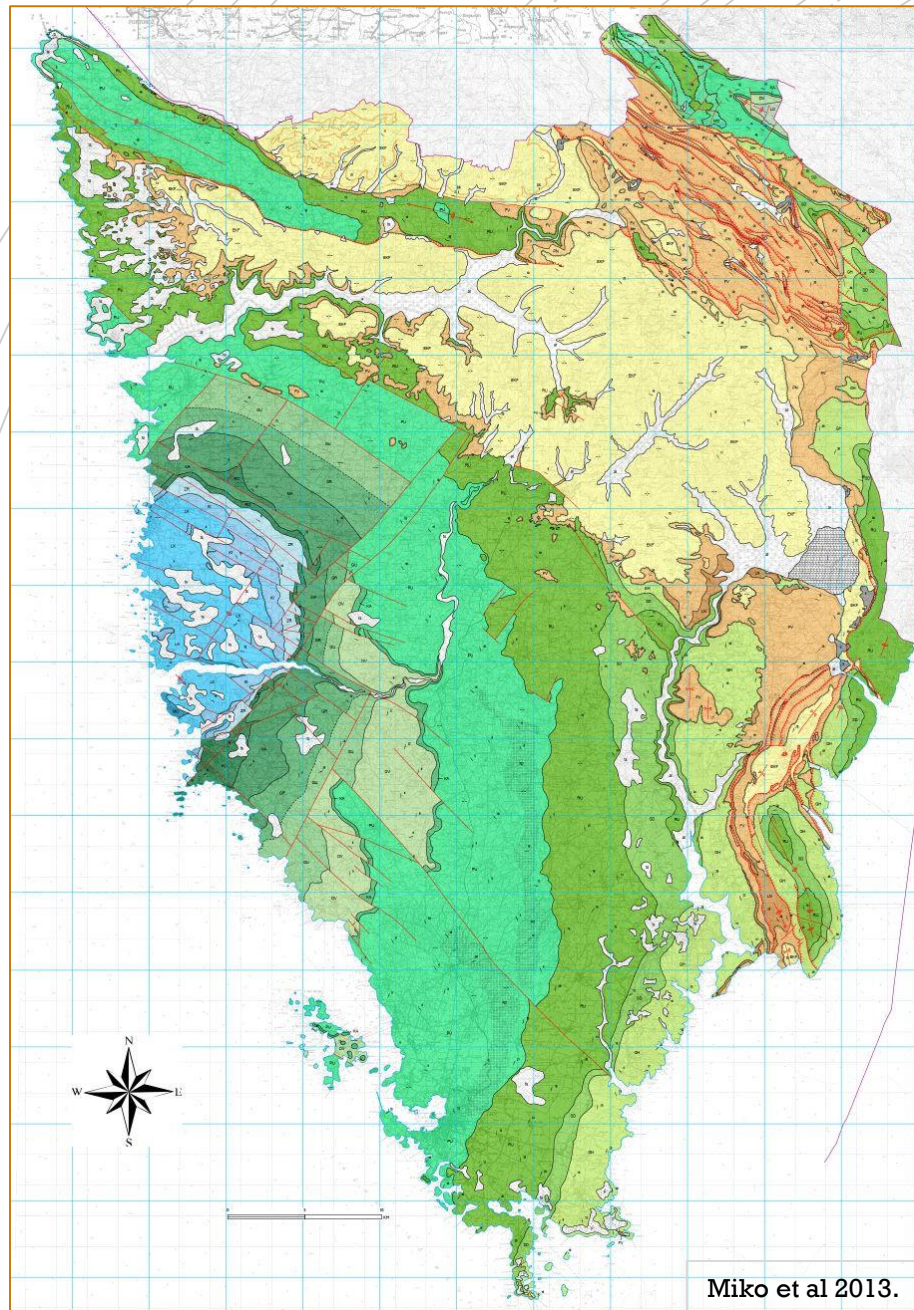
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Vršar Tourist Board



GEOGRAPHICAL INTRODUCTION – the Istrian peninsula



Surface deposits in Istria



Middle & Upper Jurassic

Lower Cretaceous

Upper Cretaceous

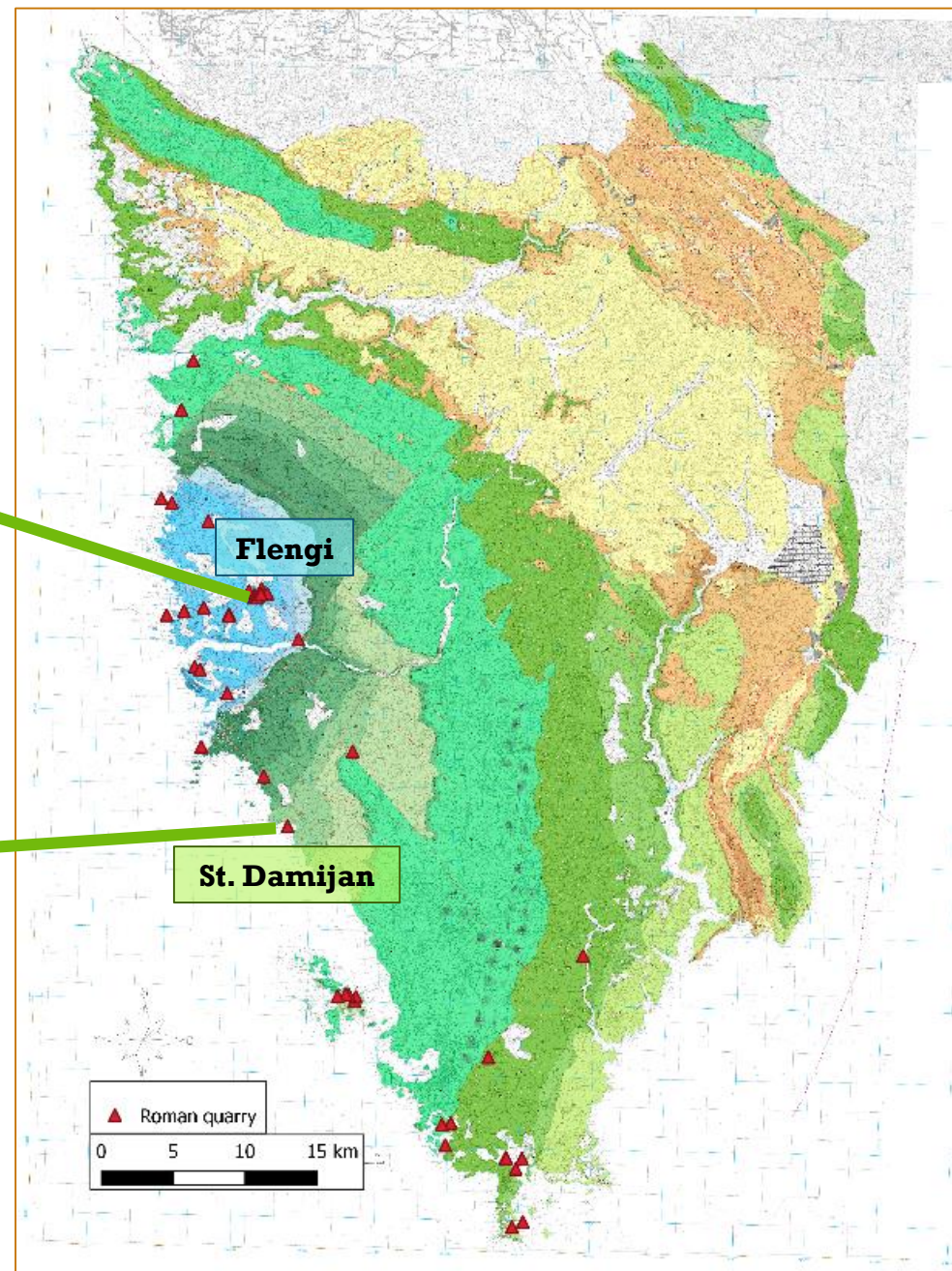
Paleogene

Quaternary

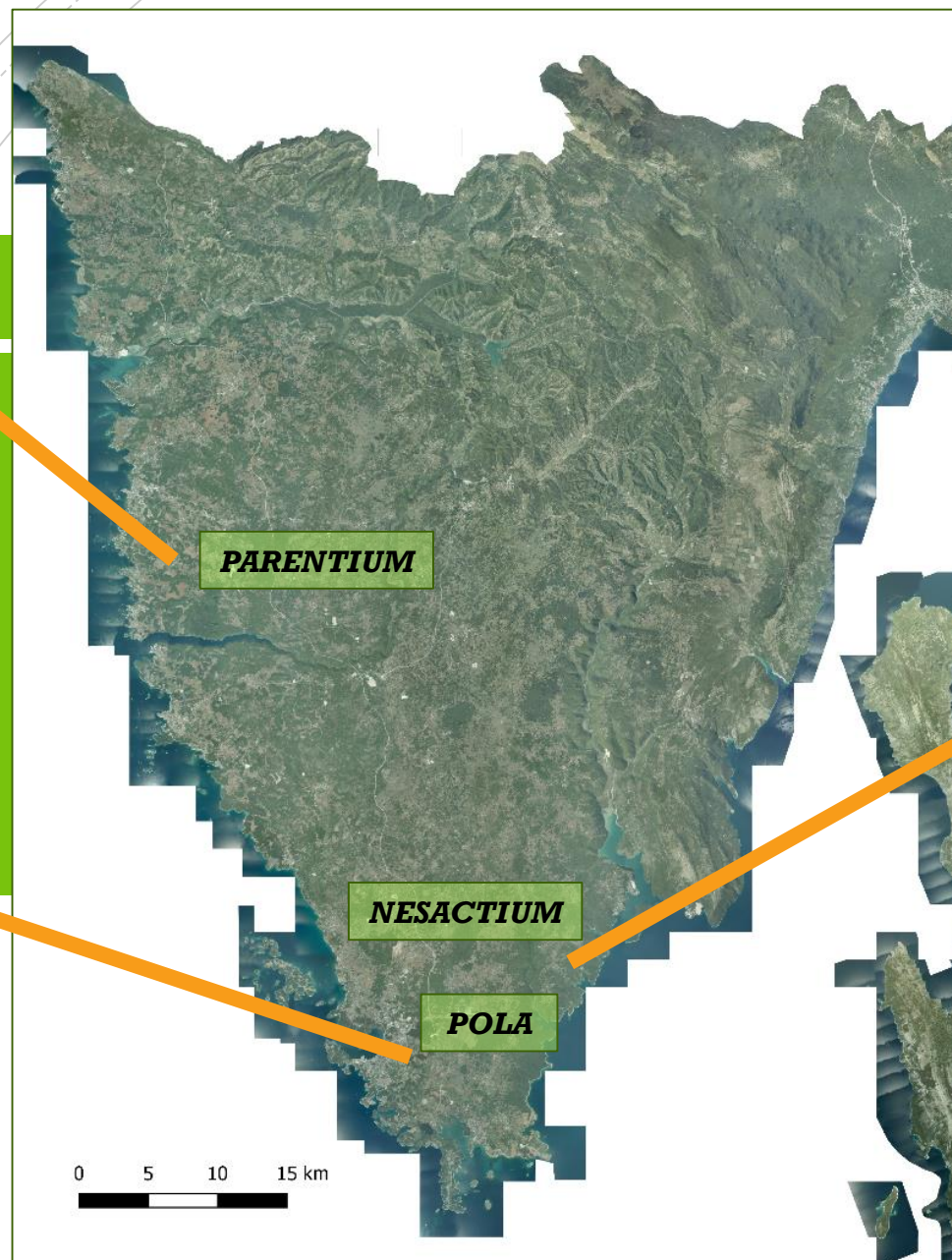
- limestone, dolomite
- no marble!



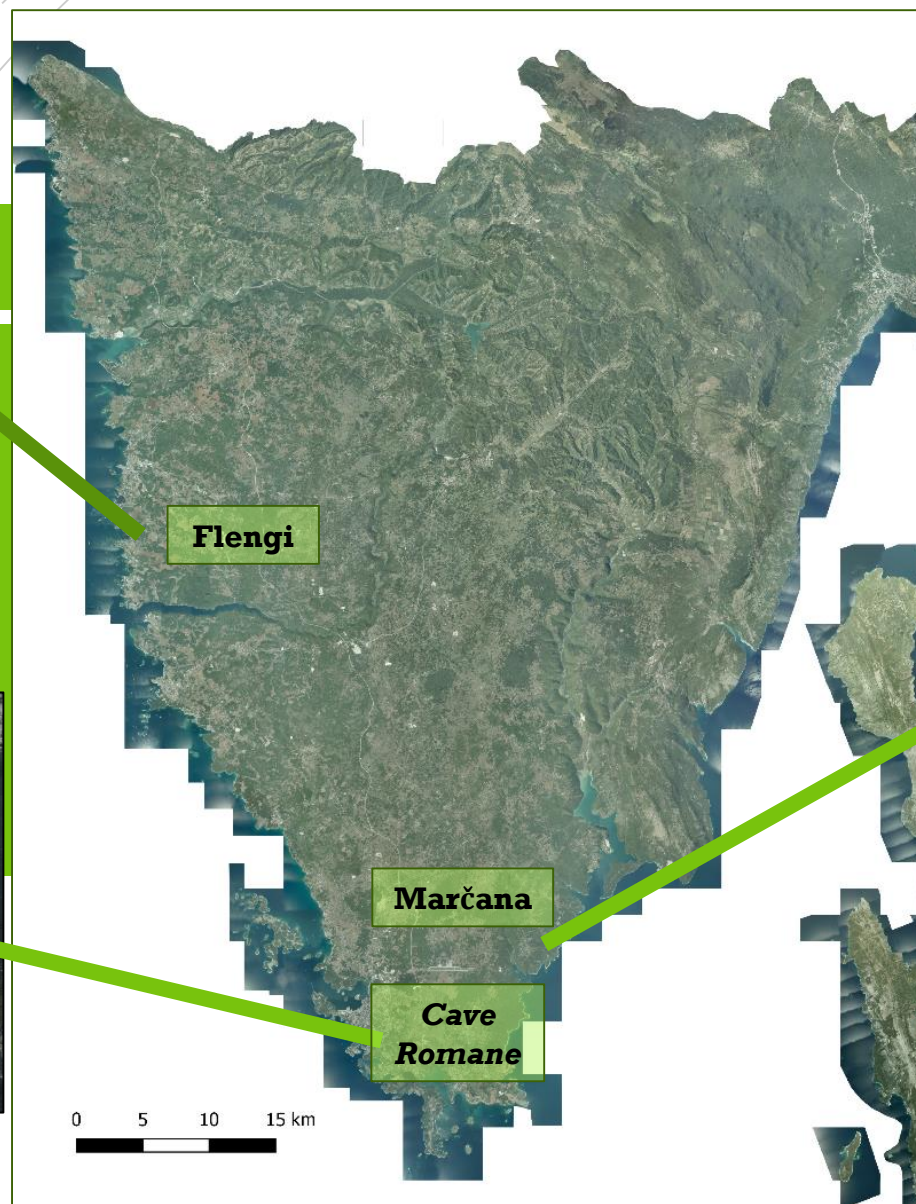
More than 60 quarries, and counting...



Roman stone monuments



Roman quarries?



From archaeology to geology – forth and back

Common question – to identify the STONE (ROCK) sources (quarries?)

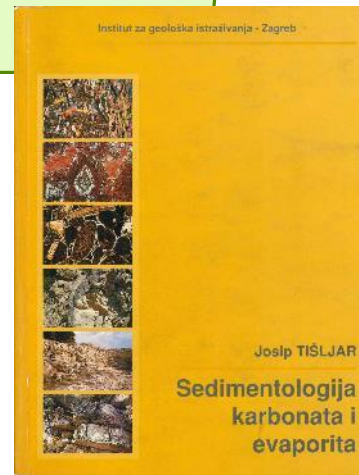
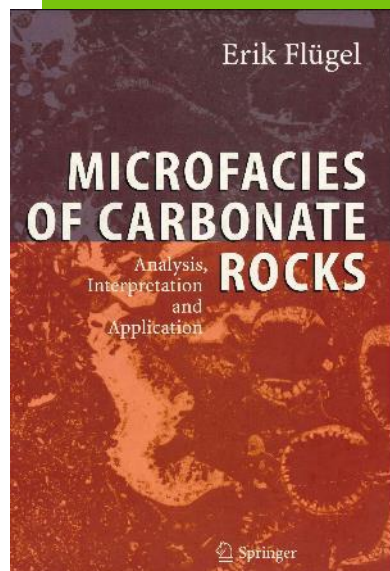
Micropetrographic analysis

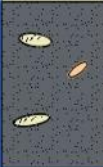
Sedimentary carbonate ROCKS - limestones and dolomites – mainly marine rocks, with relatively simple mineralogy, commonly contain fossil remains

Common determining method - (micro)petrographic analysis

Micropetrographic analysis of limestones:

- to identify its composition, fabric and diagenetic changes
- to classify the rock – to give it the name/surname
- to determine facies (lithofacies, biofacies, microfacies)



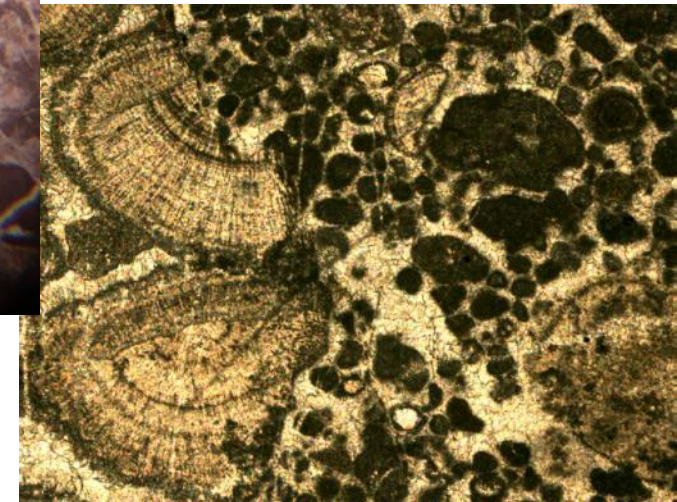
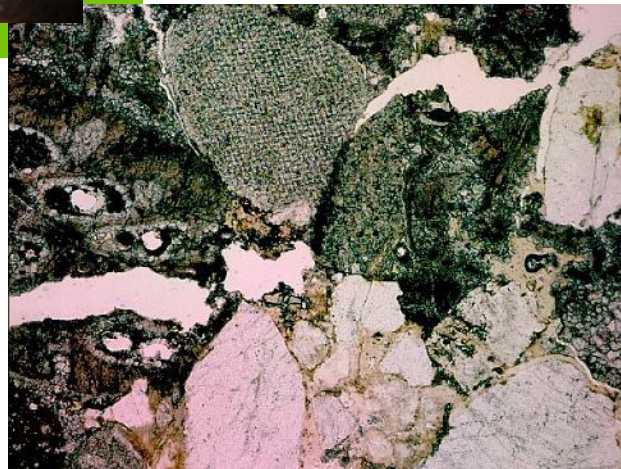
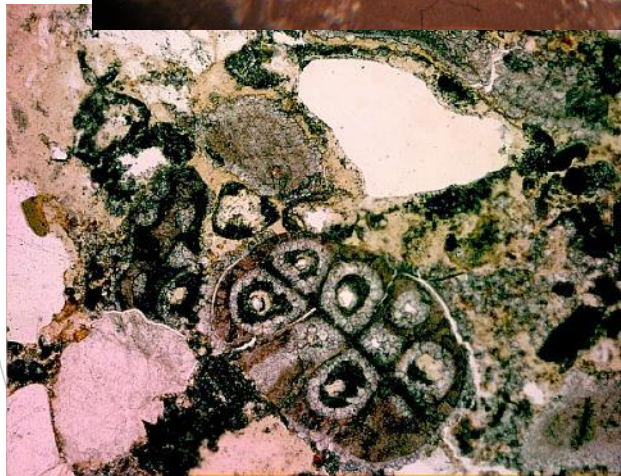
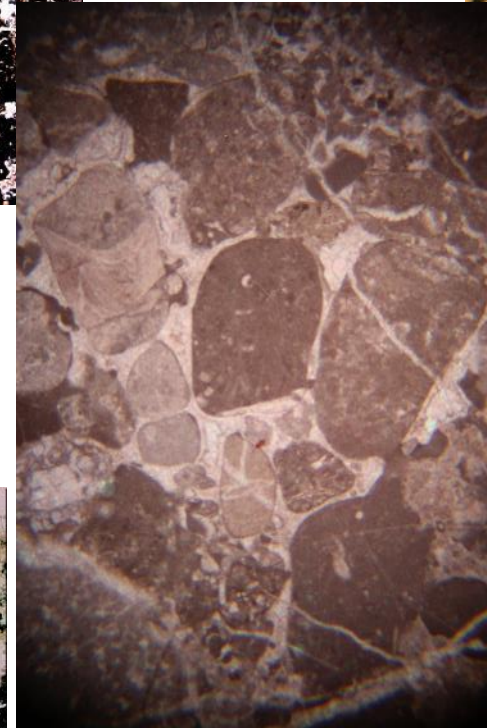
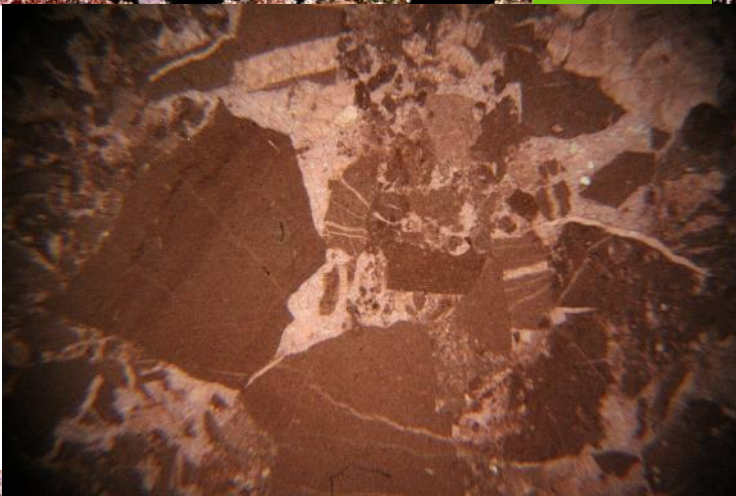
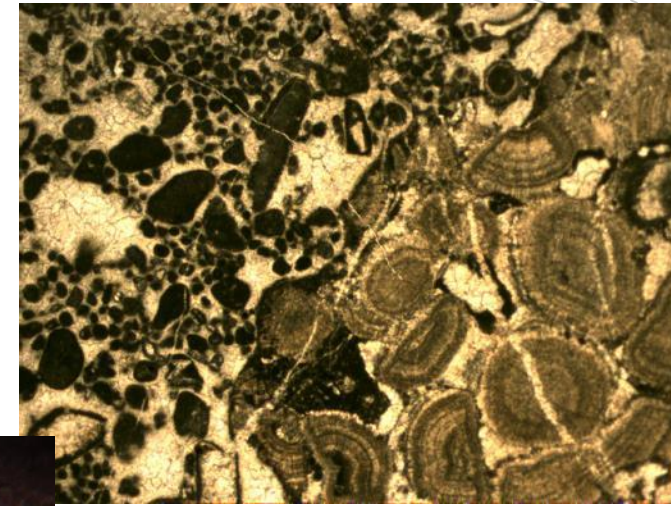
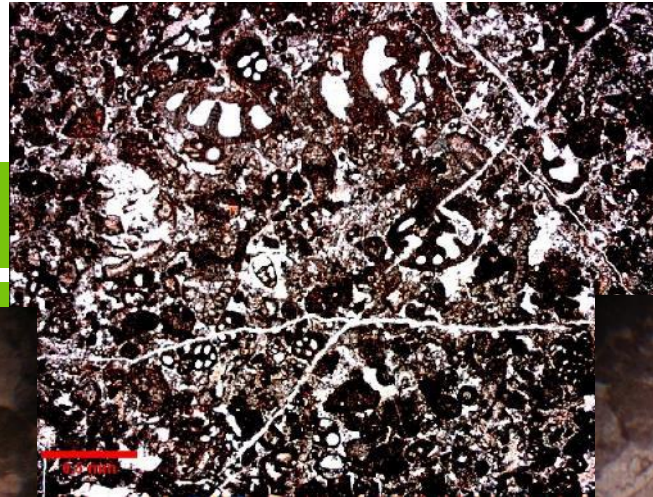
PRIMARNE KOMPONENTE NISU PRI TALOŽENJU MEĐUSOBNO ORGANOGENO VEZANE						PRIMARNE KOMPONENTE SU PRI TALOŽENJU ORGANOGENO VEZANE		
< 10% KOMPONENTATA IMA DIMENZIJE > 2 mm				>10% KOMPONENTATA > 2 mm		LITIFIKACIJA ORGANIZAMA NA STANIŠTU I U POLOŽAJU RASTA ILI VEZIVANJE KOMPONE- NATA ŽIVOTNOM DJELATNOSTU ORGANIZAMA		
STIJENE SADRŽE MULJ - MIKRIT				BEZ MULJA				
< 10% KOMPONENTATA IMA PROMJER 0,03 - 2 mm	> 10% KOMPONENTATA IMA PROMJER 0,03 - 2 mm	ZRNA IMAJU MEĐUSOBNU POTPORU (međusobno se dodiruju)		ZRNA BEZ MEĐUSOBNE POTPORE (zrna "plivaju" u mulju)	ZRNA IMAJU MEĐUSOBNU POTPORU (međusobno se dodiruju) U MEĐUZRNIM PORAMA IZLUČEN JE CEMENT	ORGANIZMI KOJI HVATAJU SEDIMENT (DENDROIDNI ORGANIZMI)	ORGANIZMI KOJI VEŽU SEDIMENT (CIJANOBAKTE- RIJSKE ALGE)	ORGANIZMI KOJI TVORE SKELETNU REŠETKU (KORALJI I KORALINACEJE)
BAUNDSTON (BOUNDSTONE)								
MADSTON (MUDSTONE)	VEKSTON (WACKSTONE)	PEKSTON (PACKSTONE)	GREJN- STON (GRAINSTONE)	FLOUTSTON (FLOATSTONE)	RADSTON (RUDSTONE)	BAFLSTON (BAFFLESTONE)	BINDSTON (BINDSTONE)	FREMSTON (FRAMESTONE)
								

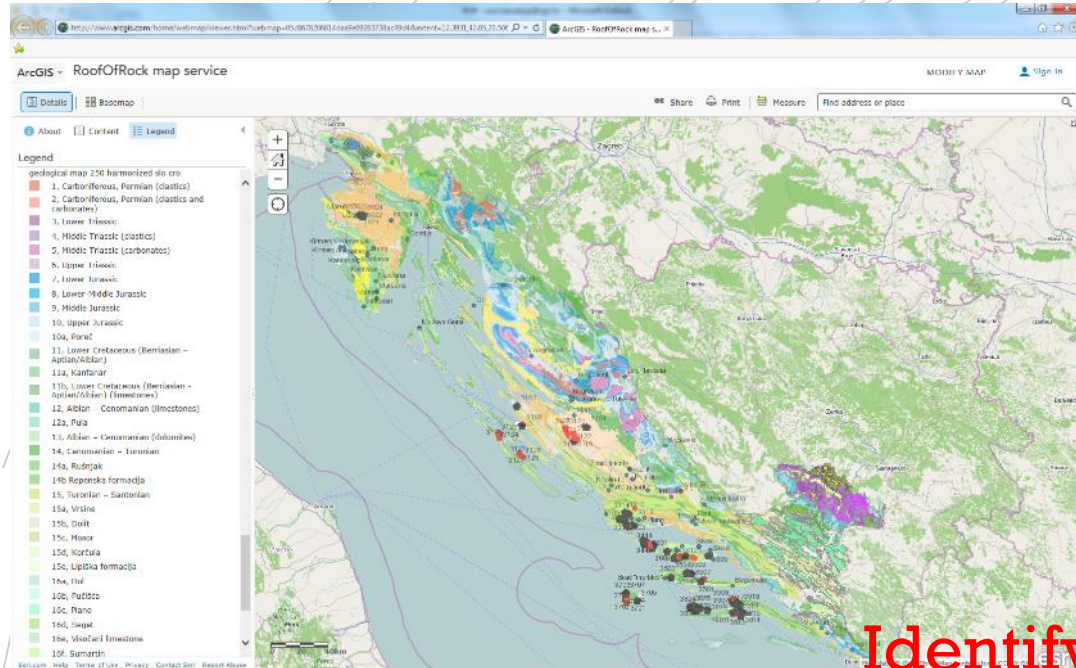
from Tišljarić (2001) - modified after Dunham (1962)

Application of the results – comparison with the STONE taken from the archaeological objects (buildings, monuments etc.)

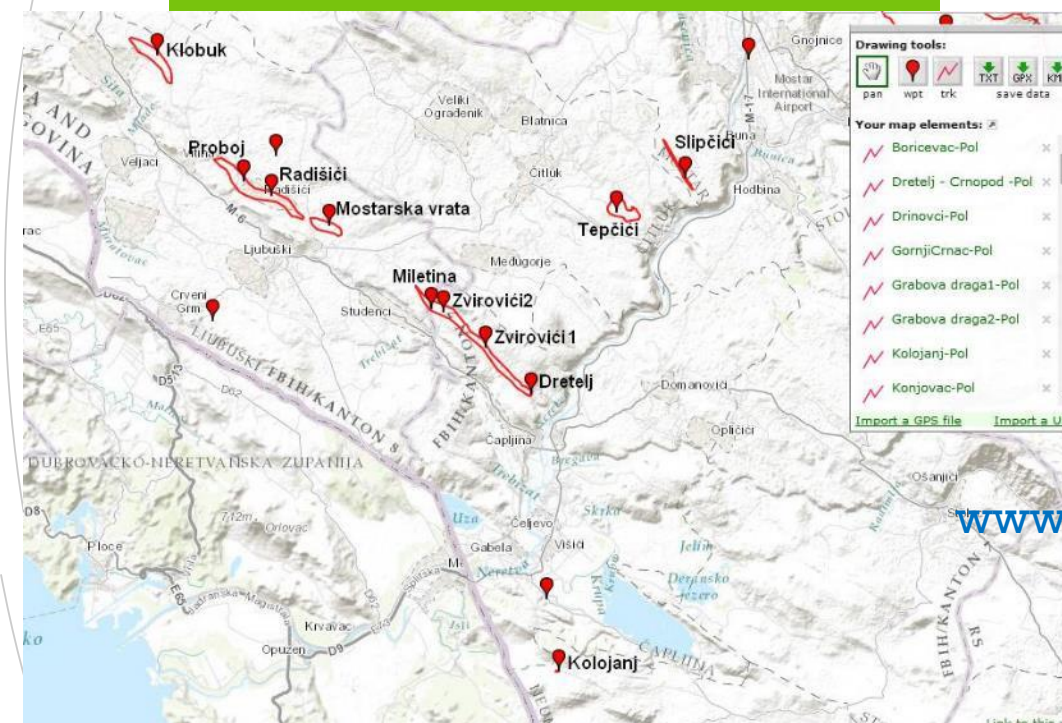
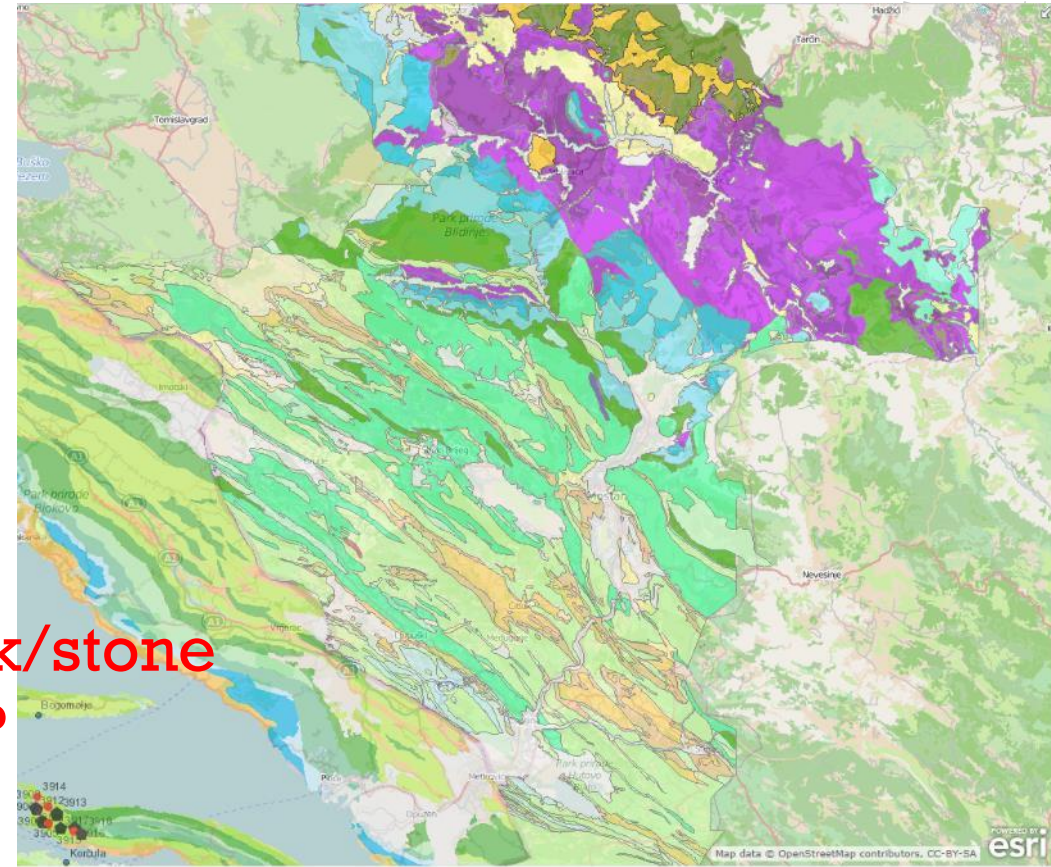
Not so simple/straightforward... 😞

Microfacies analysis of limestones





Identifying rock/stone sources?



LEGEND OF INVESTIGATED AREA:

1	Permian-Triassic (clastics)	13	Cenomanian-Turonian (carbonates-platy limestones)
2	Middle Triassic (carbonates, clastics)	14	Turonian-Coniacian (carbonates)
3	Upper-Middle Triassic (carbonates)	15	Lower Senonian (limestones)
4	Upper Triassic (limestones)	16	Upper Senonian (limestones)
5	Lower Jurassic (limestones-carbonates)	17	Paleocene (Liburnian formation-platy limestones)
6	Middle Jurassic (limestones)	18	Early-Middle Paleogene (Foraminiferal limestones)
7	Lower-Upper Jurassic (limestones)	19	Early-Middle Paleogene (clastics-carbonates)
8	Upper Jurassic (limestones)	20	Late Paleogene-Oligocene (Promina)
9	Lower Cretaceous (Berriasian-Barremian)	21	Neogene (clastics-carbonates)
10	Lower Cretaceous (carbonates, platy limestones)	22	Quaternary
11	Lower Cretaceous (dolomites, platy limestones)		

Platy limestones case study



0 walls:

Turonian-Santonian	Upper Cretaceous	Greyish to light grey massive and thick-bedded limestones of packstone-wackestone texture
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1 Roof of the main tower

Dretelj platy limestone	Cenomanian	Light grey to light brownish platy limestone with horizontal lamination
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2 Southeast entrance

Turonian-Santonian	Upper Cretaceous	Greyish to light grey massive and thick-bedded limestones of packstone-wackestone structure
Dretelj platy limestone	Cenomanian	Light grey to light brownish platy limestone with horizontal lamination

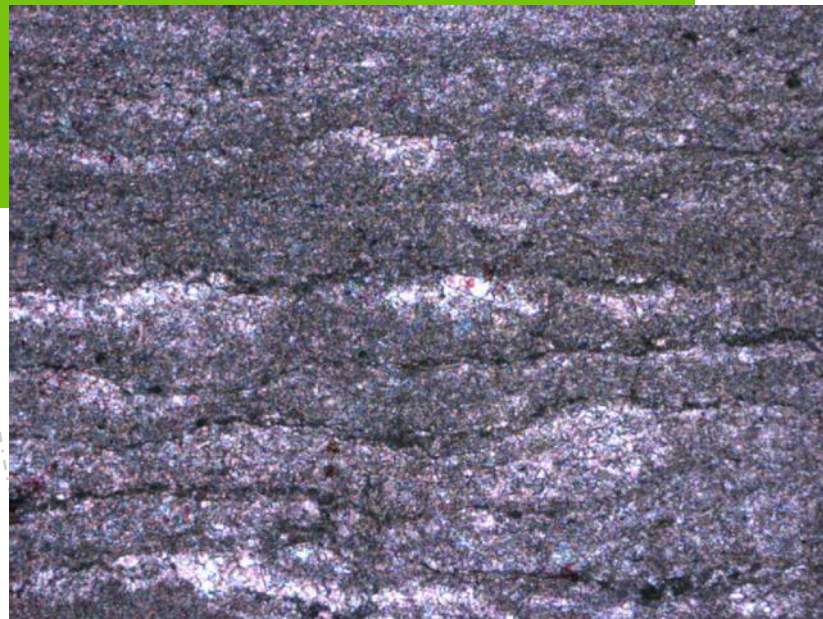
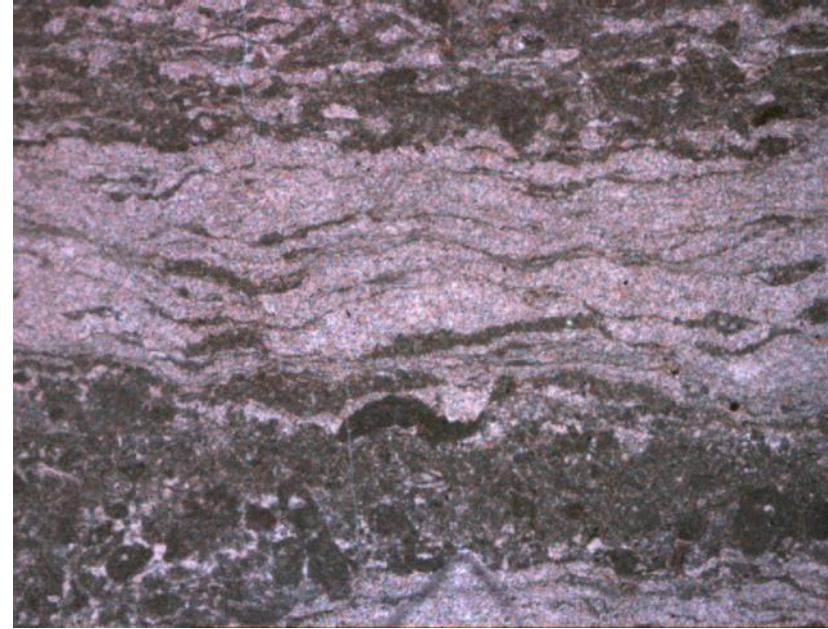
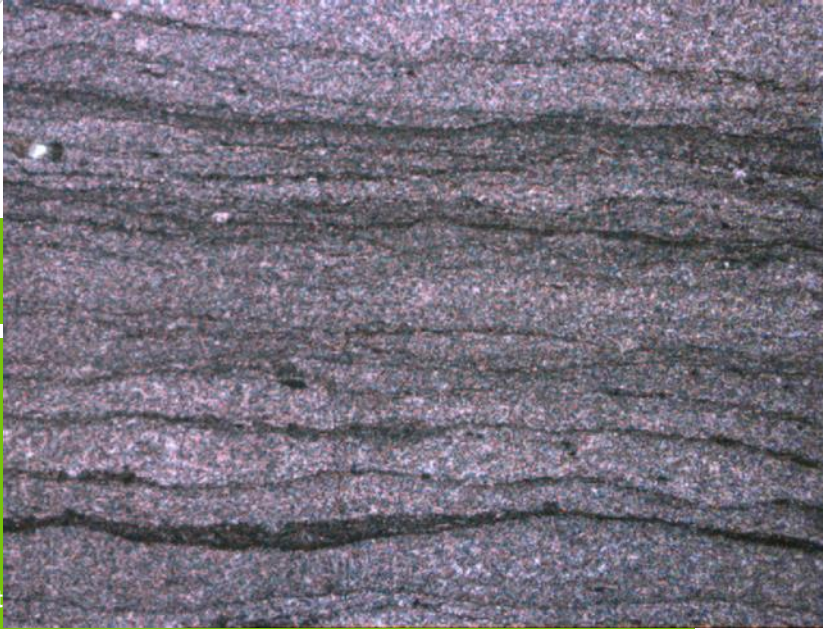
3 Western part of the tower

Dretelj platy limestone	Cenomanian	Light grey to light brownish platy limestone with horizontal lamination
Turonian-Santonian	Upper Cretaceous	Greyish to light grey massive and thick-bedded limestones of packstone-wackestone texture

4 Door belvedere

Turonian-Santonian	Upper Cretaceous	Greyish to light grey massive and thick-bedded limestones of packstone-wackestone texture
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Microfacies of platy limestones



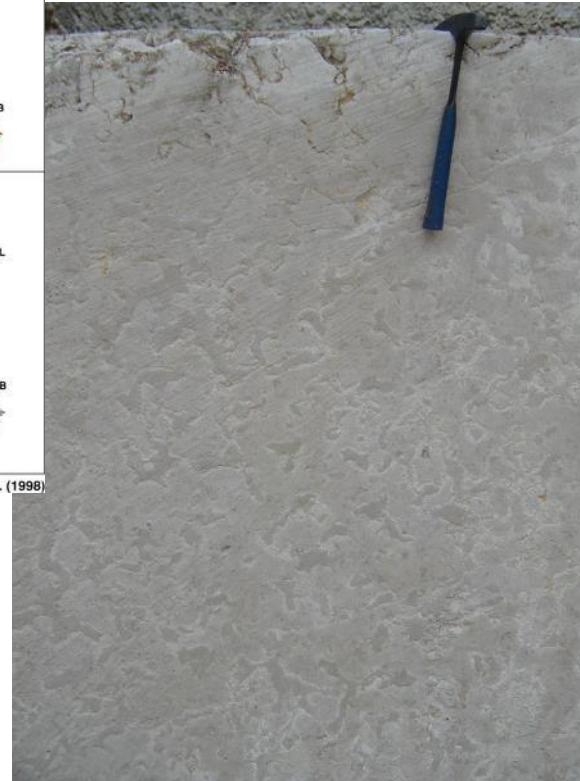
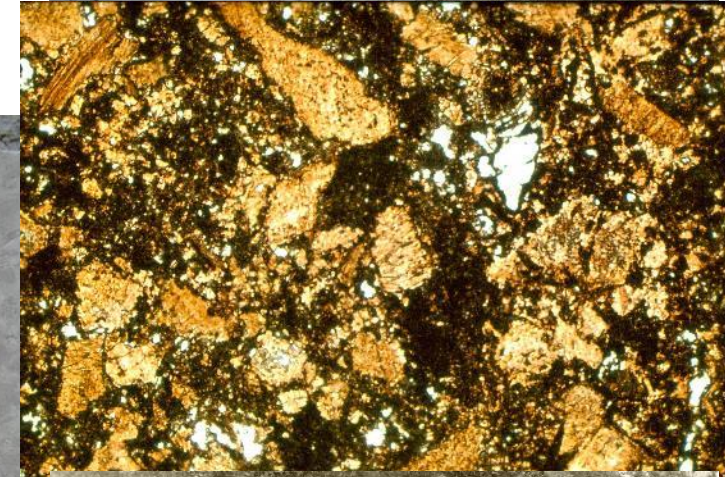
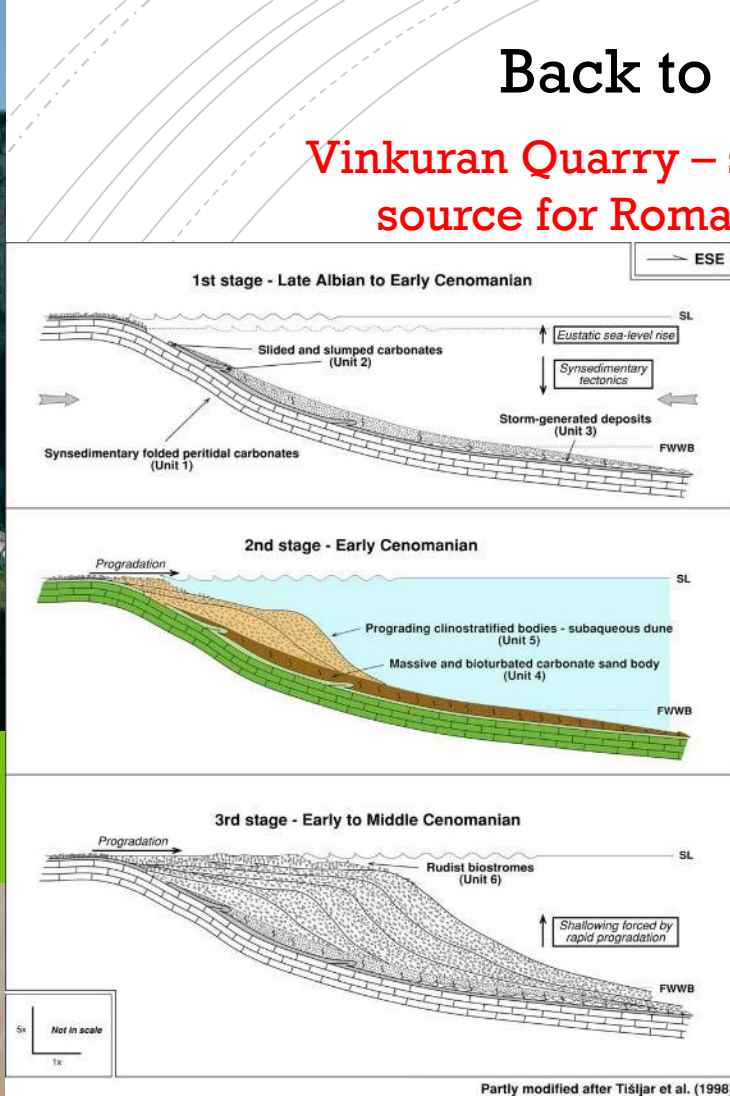
©Kat

Limitations – representative/comparable samples?

1. Samples taken from the specific outcrop possibly represent much larger area, instead of a single point, due to lateral extension of sedimentary rock layers along their strike – sometimes up to 10s or even 100s of kilometres!
2. Samples taken from the quarries often change vertically, even at the centimetre scale, due to possible (and highly probable) vertical change of different layers in the sedimentary column!
3. For limestones – identification of microfacies can be helpful, with some precautions...

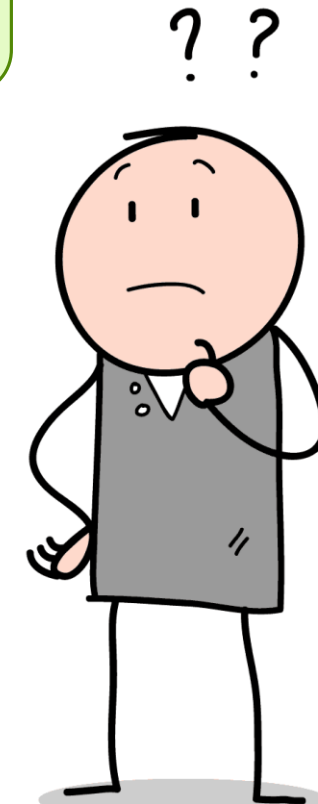
Back to Istria...

Vinkuran Quarry – stone raw material
source for Roman Arena in Pula



CONCLUSION

- Micropetrographic analysis not so simple/straightforward
- More of a guide than a definitive answer



Thank you!

■ References:

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- Tišljarić, J. (2001): *Sedimentologija karbonata i evaporita*. IGI, Zagreb, 375 p.
- Internet sources: www.roofofrock.eu – Final report for Herzegovina (HERAG)

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