

## **CLEANSTONE**

Recupero e valorizzazione degli scarti di lavorazione lapidea per la  
sostenibilità ambientale

Rückgewinnung und Aufwertung von Steinaufbereitungsabfällen für  
ökologische Nachhaltigkeit

## **SUMMARY OF UNIUD ACTIVITIES**

**Alfredo Soldati, Cristian Marchioli, Alberta Simonetto,  
Marina Campolo, Stefano Maschio, Erika Furlani**

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Università degli Studi di Udine

## **WP3: Development of innovative protocols for assessing and reducing the environmental impact of stone processing**

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### Objectives:

- Characterize the extraction and cutting process
- Analyse Italian legislation for quarry's waste disposal
- Give added value to secondary raw material from the cutting process
- Define best practices as technical and organizational guidelines for process optimization and enhanced reuse/recycle policies

# METHODOLOGY

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## Analysis of product's life cycle:

- Identification of boundaries for the system to be analysed
- Data collection
- Process characterization
- Environmental impact

**ISO 14040  
STANDARD**

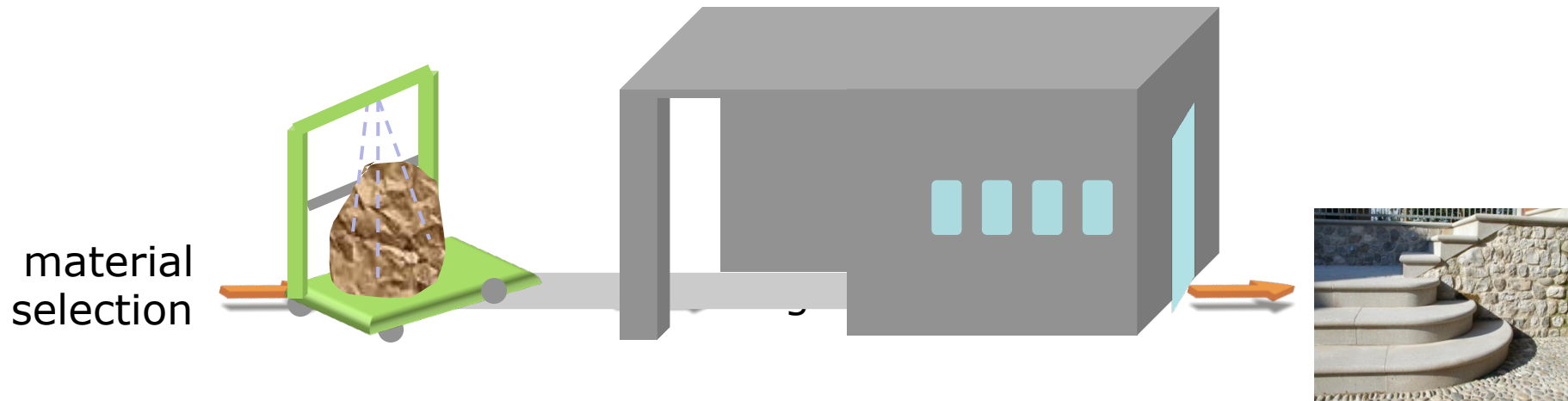
## Tools:

- In-person visits to the cutting sites
- Preparation of surveys for data collections
- Chemical analysis of the lime

# STATUS OF ACTIVITIES

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1. First analysis of the production process with in-person visits to 2 productions sites: Julia Marmi & S.A.P.P.T. (Consorzio Pietra Piasentina)

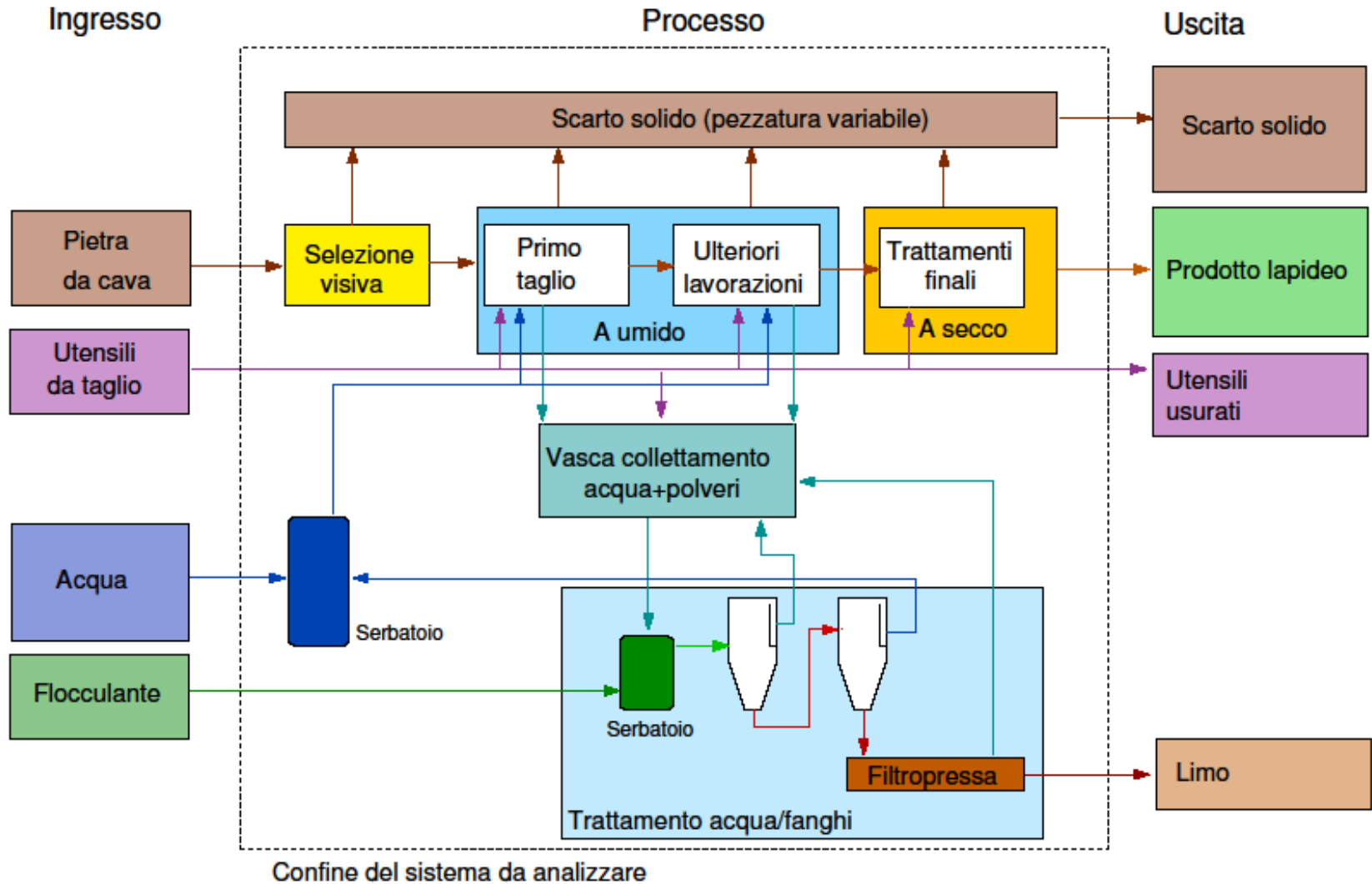


# STATUS OF ACTIVITIES

## 2. Preparation of survey for data collection (in italian for the time being)

INGRESSI: MATERIE PRIME					
	UdM	2017	2018	2019	Fonte / metodo di stima
Pietra lavorata	t/anno				
Acqua (acquedotto)	m³/anno				
Acqua (pozzi)	m³/anno				
CARATTERISTICHE DEL PROCESSO: CIRCUITO ACQUA/FANGHI					
Tecnologia per trattamento acque	vasche di raccolta	Decantatori a cono	Altro		
Filtropressa	SI	NO			
FLOCCULANTE (se utilizzato)					
	UdM	2017	2018	2019	Fonte / metodo di stima
Nome commerciale					
Quantità acquistata	kg/anno				
USCITE: MATERIE PRIME					
	UdM	2017	2018	2019	Fonte / metodo di stima
Pietra riportata in cava (residuo solido / REPIAS)	t/anno				
Limo riportata in cava (residuo liquido/ LIMPIAS)	t/anno				
Totale materiale riportata in cava (LIMPIAS+REPIAS)	t/anno				
Prodotto finito	t/anno				

# WORKFLOW



## NEXT STEPS IN WP3

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1. Delivery of the survey to Associate Partners (AP):
  - Consorzio Pietra Piasentina: contacted
  - Verona Stone District: ??
  - MINERAL ABBAU Gmbh: ??
2. Analysis of national and regional legislation
3. Analysis of collected data
4. Assessment of the productive process of the different AP and comparison
5. Start numerical simulations to evaluate the environmental impact of quarrying activities, in particular during extraction

## **WP4: Identification/development of new best practices for the recovery of waste as secondary raw material**

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### Objectives:

- Physico/chemical characterization of waste material
- Identification of testing protocols
- Identification of recycling options



# METHODOLOGY

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## **Investigations performed (by the Ceramics and Construction Materials group- Prof. Maschio, dott. Furlani):**

- Compressive and flexural strength tests;
- Water absorption measurements;
- X-Ray diffraction;
- Particles size distribution of the powders derived from the slurries;
- Water content of the slurries;
- Optical Microscope investigation;
- SEM investigation

## MATERIALS EXAMINED

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### **Stone samples from Consorzio Pietra Piasentina:**

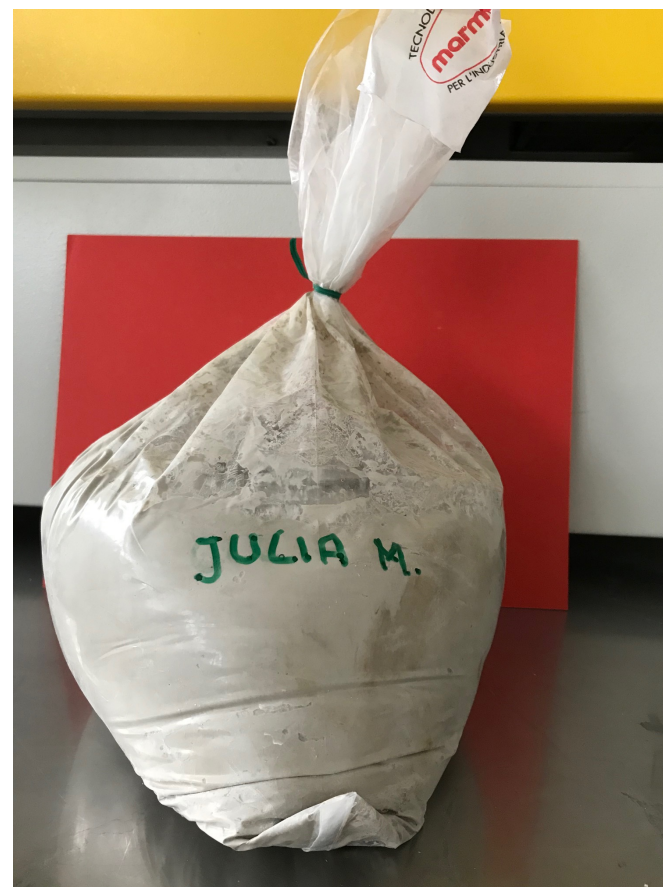
- Carbonaria quarry: cubic (100x100x100 mm) and parallelepipedal (40x40x100 mm) samples; slurry of waste wet powders
- Julia Marmi quarry: cubic (100x100x100 mm) and parallelepipedal (40x40x100 mm) samples; slurry of waste wet powders
- Cudicio quarry: cubic (100x100x100 mm) and parallelepipedal (40x40x100 mm) samples

## MATERIALS EXAMINED (SLURRIES)

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40% H<sub>2</sub>O



25% H<sub>2</sub>O

## SOME RESULTS FROM THE ANALYSES

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### Compressive strength tests:

- Carbonaria quarry: average value 147 Mpa
- Julia Marmi quarry: average value 170 MPa
- Cudicio quarry: average value 160 Mpa

### Flexural strength tests:

(Equation used:  $\sigma_f = 3PL/2bd^2$ )

- Carbonaria: average value 26.3 Mpa
- Julia Marmi: average value 33.4 Mpa
- Cudicio: average value 25.1 MPa

$\sigma_f$  = Flexural strength

P = Failure load

L = Length of sample

b = Width of sample

d = Depth of sample

## SOME RESULTS FROM THE ANALYSES

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### **Water absorption (% H<sub>2</sub>O):**

- Carbonaria quarry: 0.030
- Julia Marmi quarry: 0.029
- Cudicio quarry: 0.055

# SOME RESULTS FROM THE ANALYSES

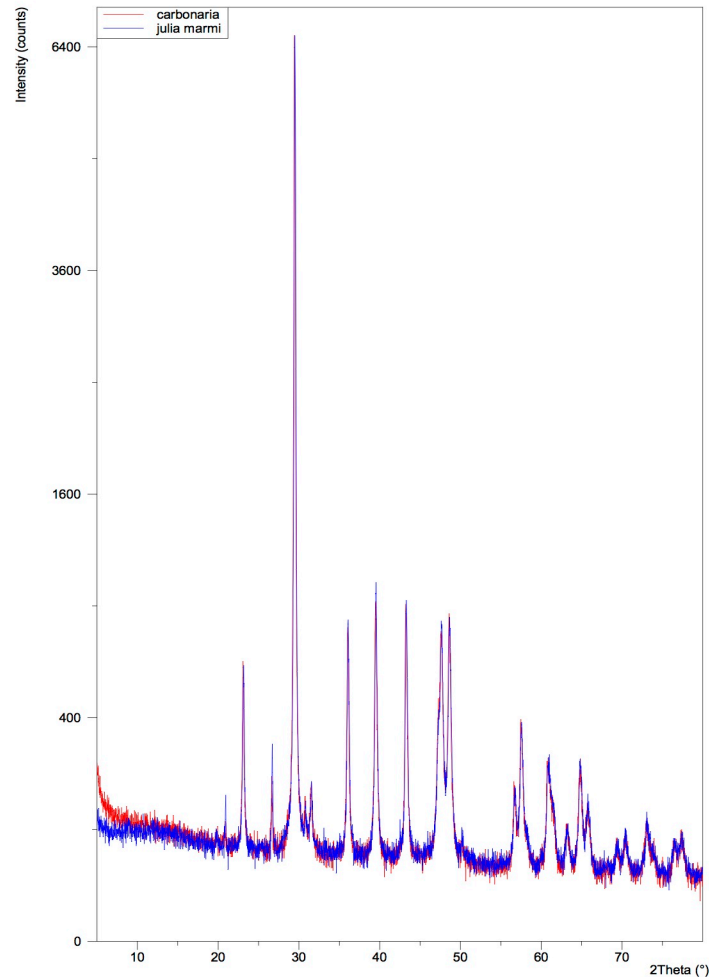
## X-Ray diffraction analysis:

Only two quarries shown:

Carbonaria (red)

Julia Marmi (blue)

Practically, no difference in the cristallography of the samples.



## SOME RESULTS FROM THE ANALYSES

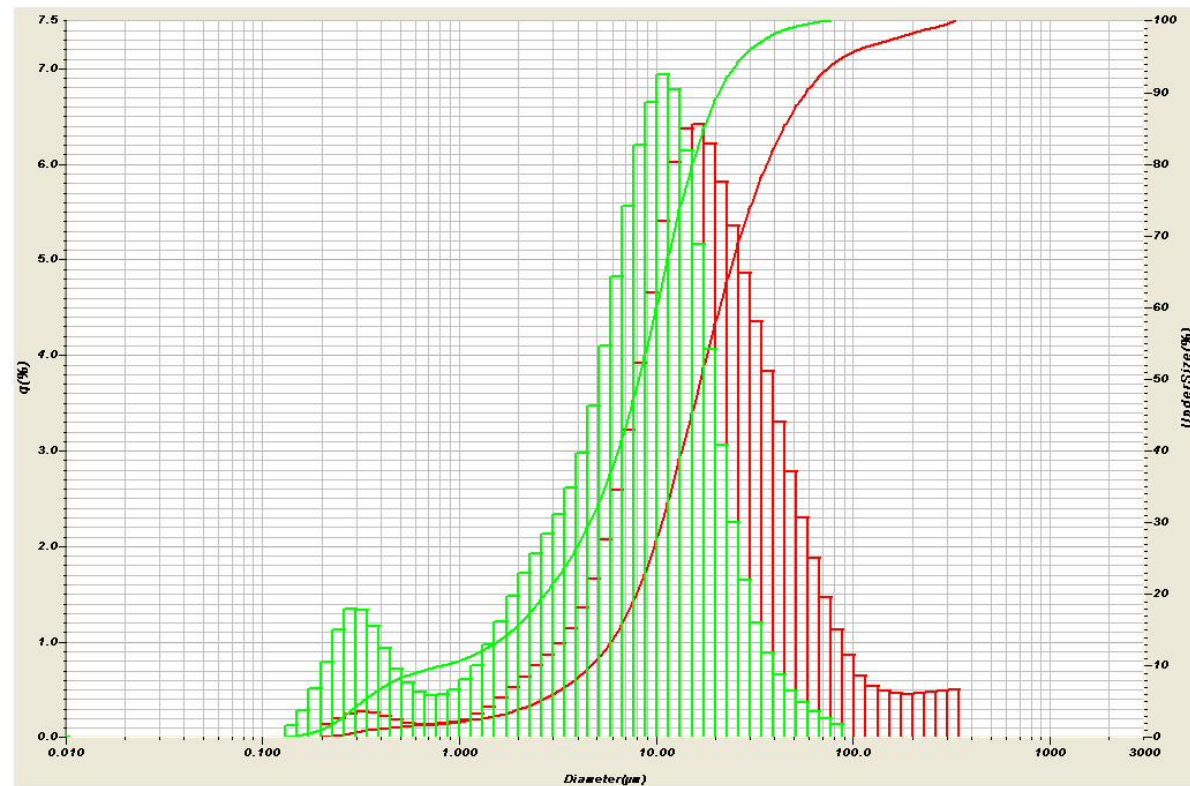
### Particle size distribution of the powders obtained from the slurries:

Two quarries shown:

Carbonaria (green)

Julia Marmi (red)

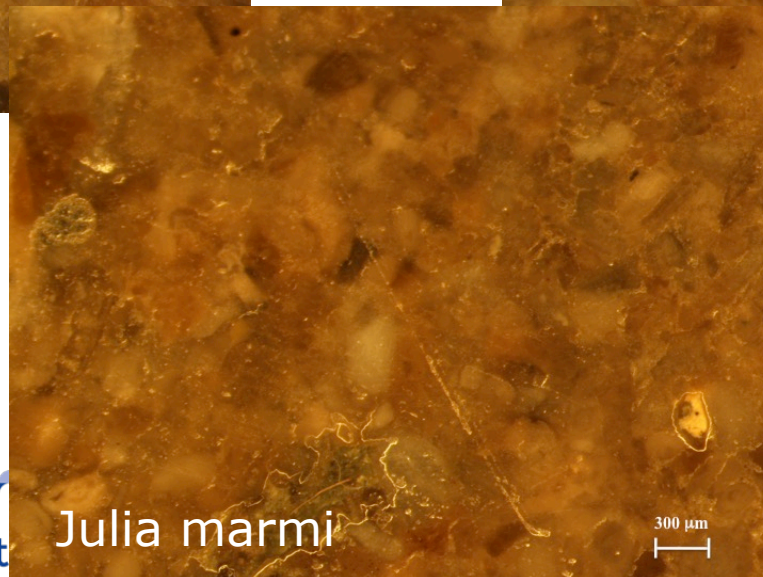
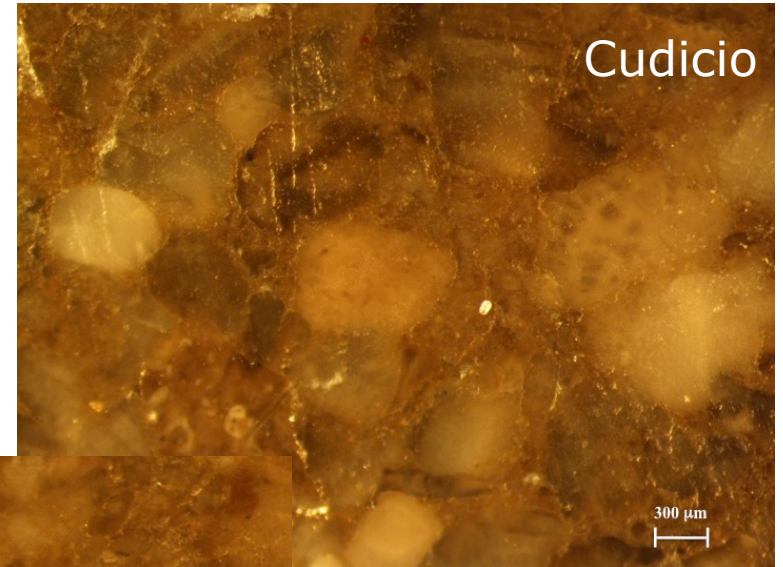
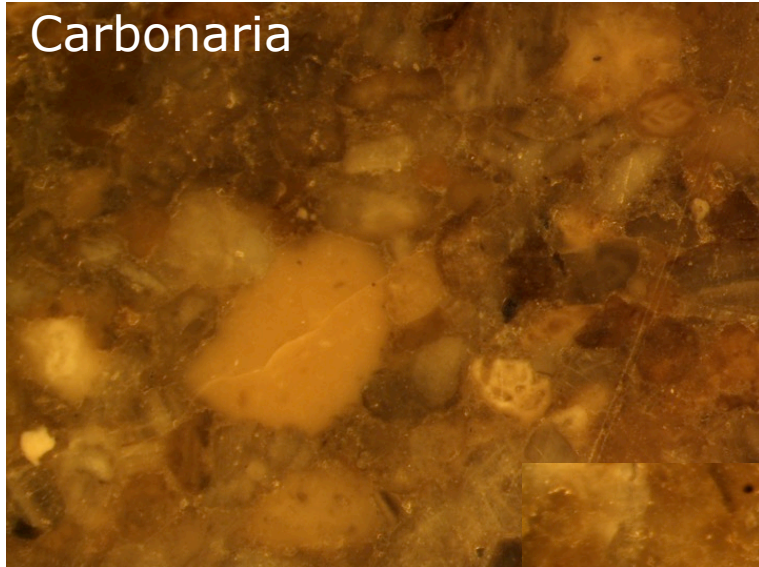
Small differences between the samples





# SOME RESULTS FROM THE ANALYSES

## Stereoscopic optical microscope images:





## NEXT STEPS IN WP4

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1. Extend the physico/chemical characterization to other quarries and types of stones
2. Propose options for reuse/recycle (e.g. as fluxing agents in iron or steel slag forming)