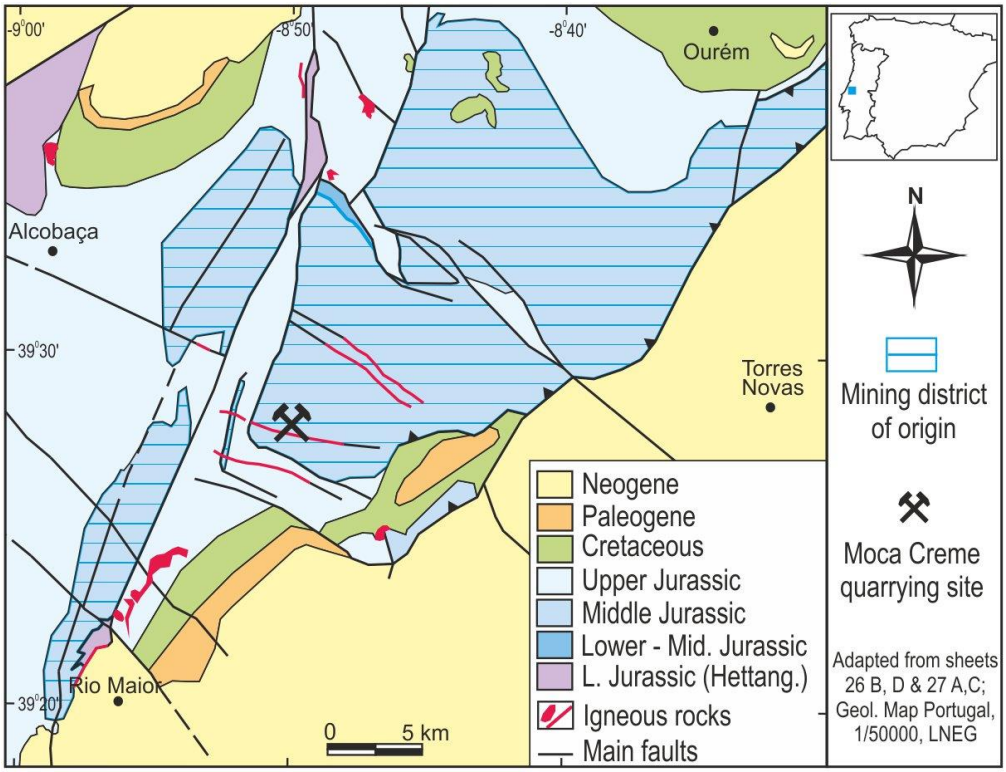
Moca Creme

Moca Creme de Grão Médio

Short description:
Beige coloured limestone, clastic, medium to coarse grain. Marked sedimentary lamination represented by alternating levels with different grain sizes and preferential alignment of elongated grains.

Commodity	Lithology	Typical colour	Place of origin			
			Country	District	Municipality	Place
Commercial Limestone	Limestone	Beige	Portugal	Santarém	Santarém	Pé da Pedreira

Geological setting



Geology:
The Maciço Calcário Estremenho (MCE) is a morphostructural unit of the Lusitanian Basin in Portugal, which has been uplifted during the alpine orogeny. Jurassic limestones partially covered by Cretaceous sandstones and Pliocene sand patches are the main rocks of the MCE.
MCE corresponds to a mining district for several ornamental limestone varieties, in which the Santo António - Candeeiros Formation of Bathonian - Callovian age stands out.
The Pé da Pedreira Member (upper Bathonian age) is part of this formation and consists of massive beds of limestones, which are characterized by meter-scale cross-stratification sets. Ornamental varieties extracted from this unit have a direct correspondence to these cross-stratification sets, or even to individual beds with uniform sedimentary lamination.
Moca Creme is a coarse-grained, bioclastic and oncolitic limestone facies that occurs preferentially at the base of the Pé da Pedreira Member. During the processing stage, the final cut of the blocks is made perpendicularly to the sedimentary lamination.

Production:
The production of ornamental stones in MCE started in the 1970s. The introduction of advanced technologies and machineries in the late-1980s led to a strong development of the exploitations, which continues today in large contiguous quarries. This was favoured by the fact that the productive unit (the Pé da Pedreira Member) corresponds to a massive subhorizontal limestone body about 50 m thick, not intensely affected by the existing orthogonal system of fractures, allowing to obtain large commercial blocks.

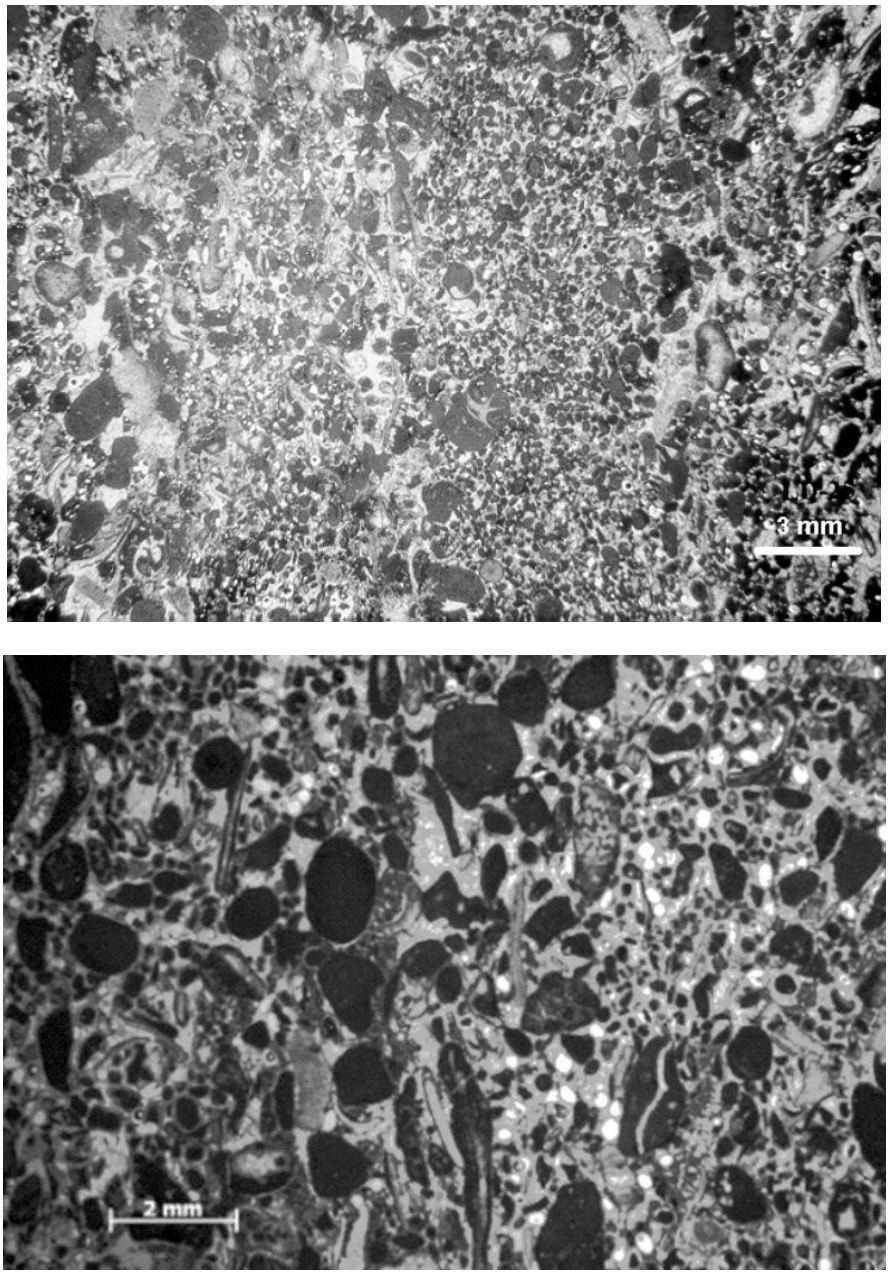
Geological age: Middle Jurassic / upper Bathonian
Geological unit: Santo António - Candeeiros Formation / Pé da Pedreira Member

Application, use and heritage

Moca Creme, like other varieties of ornamental stones from Maciço Calcário Estremenho, is spread all over the world, both in public and private buildings. It has been used mainly for interior and exterior cladding of buildings, paving, and staircases.

Description:
Moca creme has been used for the exterior cladding of some reference buildings, as is the case of the headquarters of the Central Bank of Kuwait, built in 2016.
(https://www.skyscrapercenter.com/building/the-central-bank-of-kuwait-new-headquarters-building/1002

Petrography



Description:
Thin section microphotographs (parallel polarized light) of Moca Creme obtained perpendicularly to the sedimentary lamination. Both are limestones with a grainstone depositional texture, but the upper thin section corresponds to a biointrapelsparite and the lower thin section is a pelbiointrasparite. The different proportions of allochems, with regard to their nature and size, vary according to the sedimentary lamination, which is characteristic of these limestones, and the precise place where the thin section was made.

Source of information:
Geological Survey of Portugal (LNEG - Laboratório Nacional de Energia e Geologia, IP).

Mineral composition

Calcite (%)					
100					

Source of information:
Geological survey of Portugal (Laboratório Nacional de Energia e Geologia, IP)

Physical properties

Apparent density (EN 1936) kg/m3	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa
2480	6.9	3.1	135	14.9

Real density (EN 1936) kg/m3	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m2 x s0,5)	Flexural strength under constant moment (EN 13161) MPa
		17.4 (C_2)	

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	
12.4	48			

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, mm^3	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm
20.5				2900	30.5

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		
matt polished	71	64	3	

Source of information:
Geological survey of Portugal (Laboratório Nacional de Energia e Geologia, IP)

Chemical properties

Main elements (%)

SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MgO	CaO	Na_2O	K_2O	MnO	P_2O_5	SO_3	LOI
< 0.86	< 0.22	0.04	< 0.04	0.31	55.79	< 0.20	< 0.03	< 0.02	< 0.03		43.80

Trace elements (ppm)

V	Cr	Mn	Co	Ni	Cu	Zn	As
< 5	5		< 5	< 7	< 6	< 6	
Sr	**Cd**	**Ba**	**Pb**	**Be**	**Rb**	**Bi**	**U**
143		< 7	< 6		< 3		< 6
Sc	**Y**	**Th**	**Sb**	**Ta**	**Nb**	**Zr**	**Sn**
< 7	< 3	< 5		< 6	< 3	< 3	< 6
Ag	**B**	**Mo**	**W**	**Ga**	**Ge**	**Se**	**Cs**
			< 6	< 5	< 5		
Tl							

REE (ppm)

La	Ce	Pr	Nd	Sm	Eu	Gd	Tb
< 5	8		11				
Dy	**Ho**	**Er**	**Tm**	**Yb**	**Lu**		

Methods applied:
Determination of the main elements trace elements and REE: X-Ray Fluorescence.

Source of information:
Geological survey of Portugal (Laboratório Nacional de Energia e Geologia, IP)

Sources of more information

Type of information	Name of provider	URL
This data sheet:	Geological survey of Portugal (Laboratório Nacional de Energia e Geologia, IP)	www.lneg.pt https://rop.lneg.pt/rop/index_en.php
Non-commercial directory:	Primeira Pedra	http://www.primeirapedra.com/en/stones/moca-creme/
Commercial directory:		
Scientific publication:	Environmental Earth Sciences	https://doi.org/10.1007/s12665-018-7382-x
	Environmental Earth Sciences	https://doi.org/10.1007/s12665-018-7670-5
	Geol. Soc. London Spec. Publ.	https://doi.org/10.1144/SP333.15
Other publication:		

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