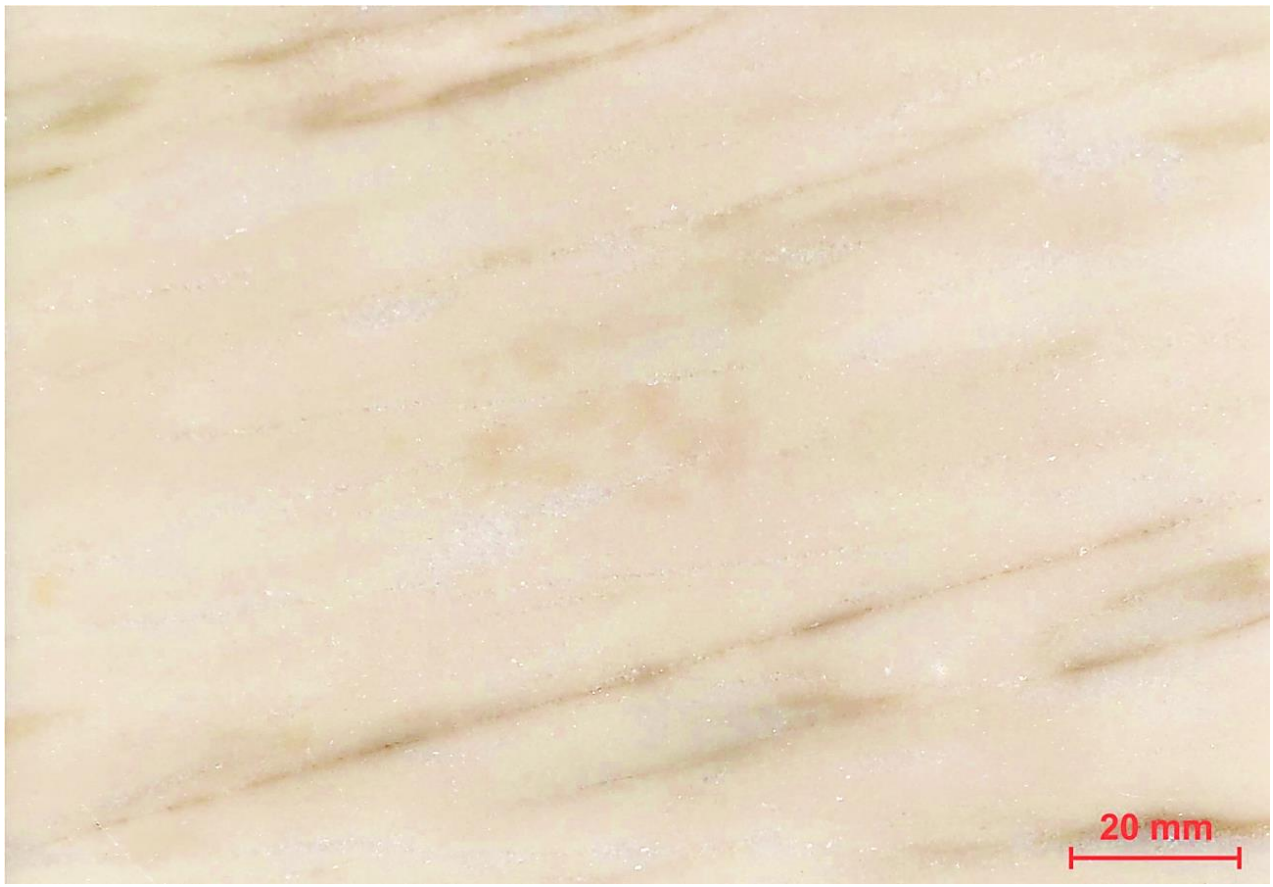
Creme Estremoz

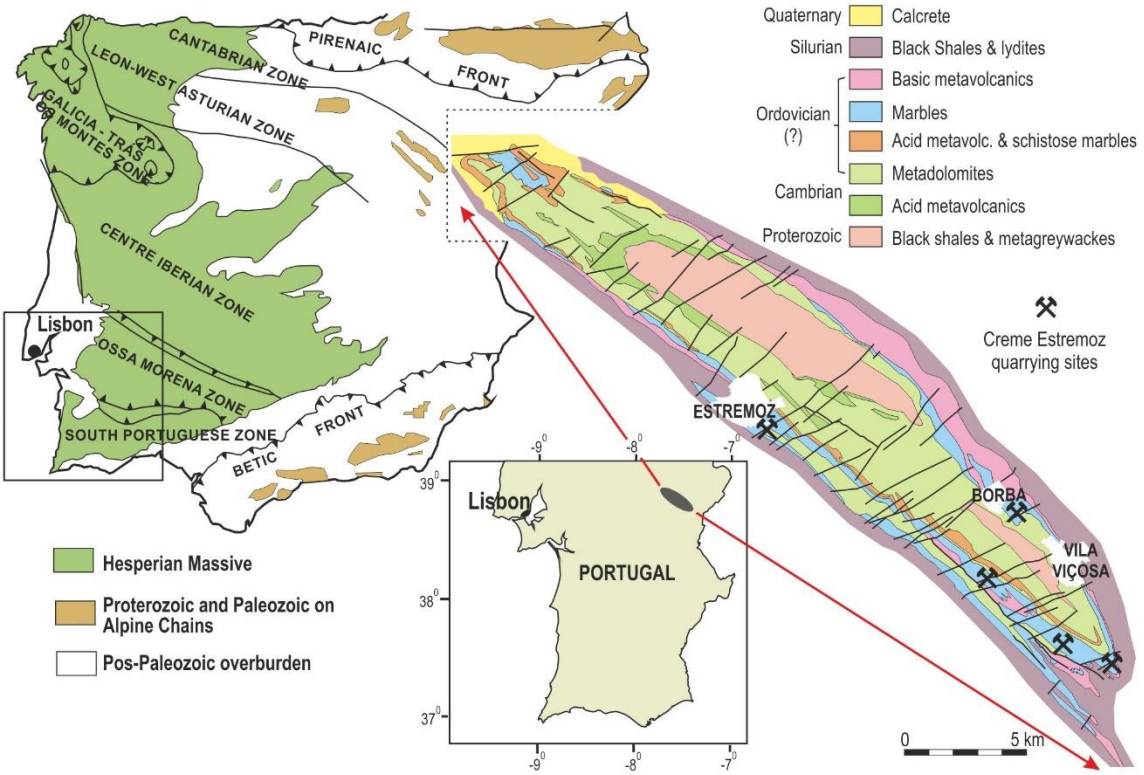
Creme da Lagoa, Creme do Mouro



Short description:
Light beige calcitic marble, thin-grained. May present thin greyish or brownish coloured streaks and stains.

Commodity	Lithology	Typical colour	Place of origin			
			Country	District	Municipality	Place
Commercial Marble	Calcitic Marble	White	Portugal	Évora	Estremoz, Borba, and Vila Viçosa	

Geological setting



Geology:
The Paleozoic Estremoz Anticline is the primary mining district of origin of most of the Portuguese marbles. It is a 40 km long and 8 km wide anticline with a dominant NW-SE orientation. It integrates the Ossa Morena Zone, which is a tectonostratigraphic unit of the Iberian Variscides. The stratigraphic sequence of the Estremoz Anticline was deformed and metamorphosed under green-schist to lower-amphibolite metamorphic conditions during the Carboniferous Variscan Orogeny, responsible for the development of two non-coaxial folding events and NW-SE oriented brittle-ductile shear zones, parallel to the later folding event.
Marbles in the Estremoz Anticline are part of the Estremoz Carbonate Volcano-Sedimentary Complex of probable Ordovician age. Several varieties of marble occur within this complex, reflecting, not only the original composition of the limestones, but also the interaction with volcanic rocks during deformation and metamorphism. They are fine to coarse grain calcitic marbles with granoblastic texture. Their background colours range from white to beige, pink and dark grey and may or may not have coloured streaks and spots. The folding complexity makes it impossible to determine the exact places where the different varieties may occur.

Production:
The marbles of the Estremoz Anticline have been extracted since antiquity. With the introduction of modern exploration and manufacturing technologies in the 70s of the 20th century, the production had a strong increase and started to be exported all over the world.
Extraction is carried out in dozens of quarries grouped into five main extraction sites called Estremoz, Borba, Vigária, Lagoa and Pardais, the last three in the municipality of Vila Viçosa. Mainly because of geological constraints, but also due to the quarries' arrangement in space, production yields are very low, usually, less than 15%.

Geological age: Ordovician (?)
Geological unit: Estremoz Carbonate Volcano Sedimentary Complex

Application, use and heritage

Dating back to the Roman Empire, marbles from the Estremoz Anticline were used for the construction of buildings and monuments in Iberia. In Portugal, they have been used in the construction of about two hundred national monuments. Currently, they are used on several applications around the world: interior and exterior cladding, interior flooring and decoration (fireplaces, staircases, countertops, etc.), funerary art, masonry in engineering works and are still used as structural elements in buildings.

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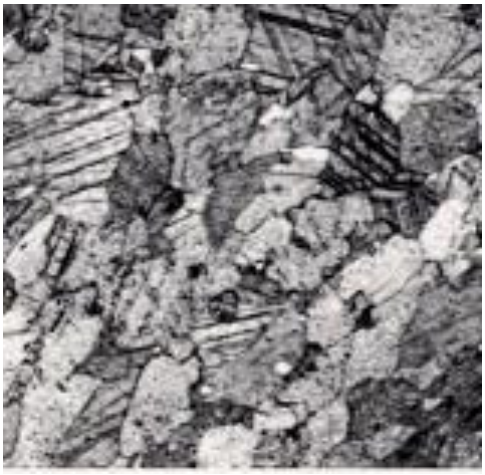
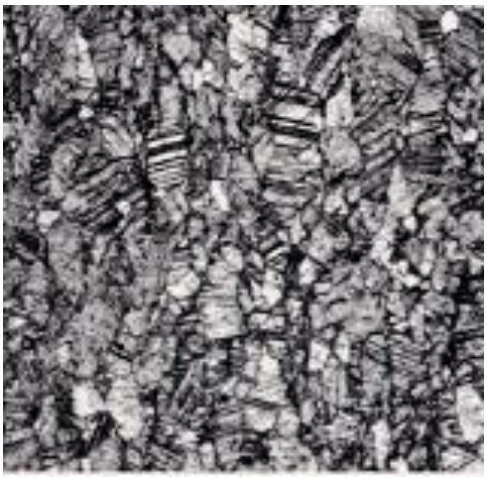
Petrography



Thin section parallel to the preferred orientation plane, when applied.



Thin section perpendicular to the preferred orientation plane, when applied.

Description:
Calcitic marble with granoblastic texture and slightly deformed, as it is clearly seen in the cleavage lines of the calcite crystals.

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

Mineral composition

Calcite (%)	Quartz, microcline and muscovite/sericite (%)				
~100	vest.*				

* vestiges (traces)

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
2710	0.2	0.0	69	13.1

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
—	—	—	—

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	
11.1	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
22.5	—	—	—	—	—

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		
—	—	—	6	—

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	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	TiO_2	SO_3	LOI
0.40	0.07	< 0.04	< 0.02	0.47	55.82	0.18	< 0.03	< 0.03	< 0.04	—	42.81

Trace elements (ppm)

V	Cr	Mn	Co	Ni	Cu	Zn	As
—	—	—	—	—	—	—	—
Sr	**Cd**	**Ba**	**Pb**	**Be**	**Rb**	**Bi**	**U**
138	—	13	—	—	< 3	—	—
Sc	**Y**	**Th**	**Sb**	**Ta**	**Nb**	**Zr**	**Sn**
—	< 3	< 5	—	< 15	6	4	< 4
Ag	**B**	**Mo**	**W**	**Ga**	**Ge**	**Se**	**Cs**
—	—	—	—	—	—	—	—
Tl							
—							

REE (ppm)

La	Ce	Pr	Nd	Sm	Eu	Gd	Tb
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/creme-com-veios-castanhos/
	Naturstein	https://www.naturalstone-online.com/index.php?id=360&user_dnsaeng_pi1%5BsteinID%5D=1041
Commercial directory:		
Scientific publication:	Geological Society, London, Special Publications	http://dx.doi.org/10.1144/SP407.10
	Journal of Archaeological Science	http://dx.doi.org/10.1016/j.jas.2012.12.030
	International Journal of Rock Mechanics and Mining Sciences	https://doi.org/10.1016/j.ijrmms.2008.01.005
	Environmental Earth Sciences	https://doi.org/10.1007/s12665-018-7328-3
Other publication:		

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