



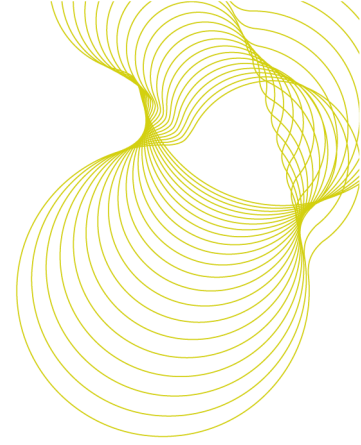
bre

**Testing of Clipsham
Hooby Lane Limestone
Bed 1**

Prepared for:
Phil Kerry
Goldholme Stone Ltd.
Irnham Grange
Irnham Road
Corby Glen
Grantham
Lincolnshire
NG 33 4 NE

25th July 2013

Test report number 287818 - 1



Prepared by

Name Geoff Ashall
Position Principal Consultant, Building Technology Group
Date 25/07/13

Signature *G. Ashall*

Approved on behalf of BRE

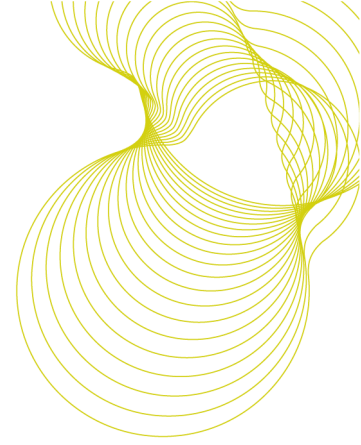
Name Dr. Martyn Webb
Position Principal Consultant, Building Technology Group
Date 25/07/13

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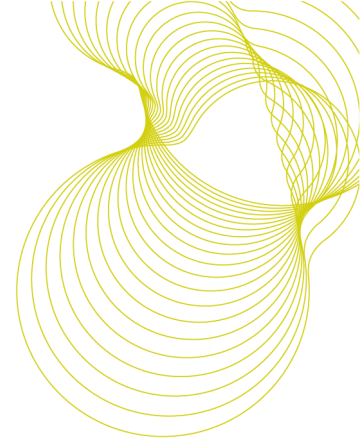
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1 Introduction

Following instruction from Phil Kerry (Goldholme Stone Ltd.), BRE have completed a series of tests on specimens of stone reported to be Clipsham Hooby Lane Limestone Bed 1. The stone was delivered to BRE on the 29/05/13. This report provides a factual account of the testing carried out.

2 Test Details

The following tests were carried out:

BS EN 1936: Natural stone test methods. Determination of real density and apparent density, and of total and open porosity *

BS EN 13755, Natural stone test methods. Determination of water absorption at atmospheric pressure*

BS EN 772-1 Natural stone test methods. Determination of uniaxial compressive strength*

BS EN 12372: 2006, Natural stone test methods. Determination of flexural strength under concentrated load.

BSEN 772-11, Methods of test for masonry units - Part 11: Determination of water absorption of aggregate concrete, manufactured stone and natural stone masonry units due to capillary action and the initial rate of water absorption of clay masonry units*

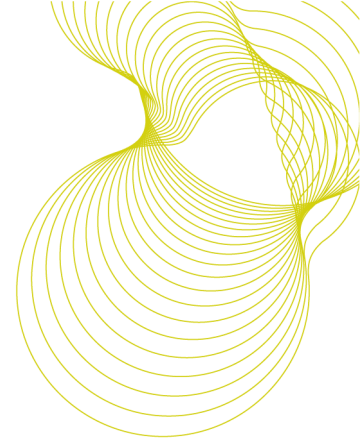
BS EN 12407:, Natural stone test methods. Petrographic examination

* Please note BRE is UKAS accredited for this test.

Tabulated data has been used to provide

BSEN 13501 – 1, Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

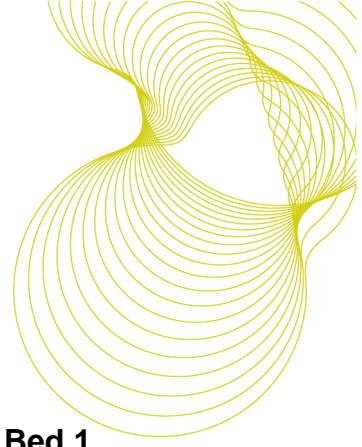
BSEN 12524, Building materials and products. Hygrothermal properties. Tabulated design values



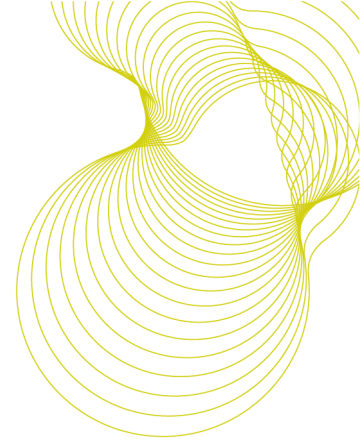
3 Test Results



Given below is a summary of the test results, full details can be found in the Appendix.

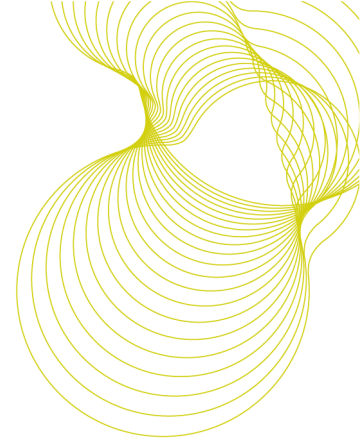
Test	Standard	Value	Unit
Determination of Open Porosity	BSEN 1936	13.8	% by vol.
Apparent Density	BSEN 1936	2340	Kgm ⁻³
Water Absorption	BSEN 13755	5.3	% by mass
Compressive Strength	BSEN 772-1	49 (35)	MPa
Flexural Strength	BSEN 12372	5.8 (4.8)	MPa
Water Absorption by Capillarity	BSEN 772-11	42.0	g.m ² .s ^{-0.5}
Petrographic Examination	BSEN 12407	Oosparitic Limestone	
Design Thermal Conductivity	BSEN 12524	1.91	Kgm ⁻³
Specific Heat Capacity	BSEN 12524	1000	J(kg.K)
Water Vapour Resistance Factor dry	BSEN 12524	250	
Water Vapour Resistance Factor wet	BSEN 12524	200	
Reaction to fire (Declared value)	Without testing (see decision 96/603/EC, as amended)	A1	





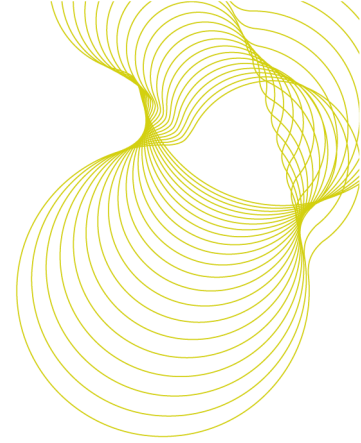
4 **Appendix A: Detailed Test Results for Clipsham Hooby Lane Bed 1**



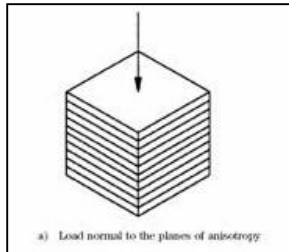
BSEN 1936: Determination of Open Porosity And Apparent Density					
Name of Stone:	Clipsham Hooby Lane B1	Petrographic Nature:	Limestone		
Block No:	Data not supplied	Anisotropic Features:	Visible		
Supplier:	Goldholme Stone	Country of Origin:	UK		
Dimensions:	50 x 50 x 50 mm	Project Reference:	Data not supplied		
Surface Finish:	Sawn	Preparation /Conditioning:	Prepared to BSEN 1936		
Date Tested:	17/06/2013	19/06/2013	Tested by:	Ian Rance	
BRE No	Md	Mh	Ms	Apparent Density	Open Porosity
287818/13/01	g	g	g		
211	308.62	195.04	327.14	2330	14.0
212	310.51	196.22	328.43	2340	13.5
213	309.21	195.40	327.93	2330	14.1
214	309.66	195.69	328.48	2330	14.2
215	312.97	197.81	330.07	2360	12.9
216	308.68	195.06	327.06	2330	13.9
			Mean	2340	13.8
<p>* The calculation of apparent density assumes the density of water to be 998Kgm⁻³ at 20^oC Open Porosity is defined as the ratio of volume of open pores to the apparent volume of the specimen Apparent Density is defined as the ratio of the mass of the dry specimen to its apparent volume</p>					
Mean open porosity (%):				13.8	
Mean apparent density (Kgm⁻³)				2340	
Approved by:			Date:	25/07/2013	
Name:	Geoff Ashall				
Position:	Principal Consultant, Building Technology Group				
				 0578	



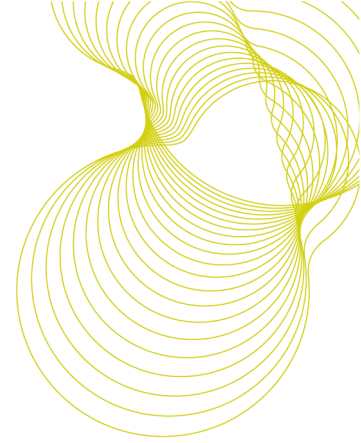
BSEN 13755: Water absorption at atmospheric pressure					
Name of Stone:	Clipsham Hooby Lane B1	Petrographic Nature:	Limestone		
Block No:	Data not supplied	Anisotropic Features:	Visible		
Supplier:	Goldholme Stone	Country of Origin:	UK		
Dimensions:	50 x 50 x 50 mm	Project Reference:	Data not supplied		
Surface Finish:	Sawn	Preparation /Conditioning:	Prepared to BSEN 13755		
Date Tested:	14/06/2013	21/06/2013	Tested by:	Ian Rance	
	Dry mass	Wet mass	Wet mass		
BRE No	1 hr	48 hrs	72 hrs	Difference	Water
287818/13/01	md	mi	ms	(ms-mi)	Absorption
				%	%
221	307.65	324.32	324.47	0.046	5.5
222	310.21	325.83	325.93	0.028	5.1
223	308.79	325.66	325.76	0.031	5.5
224	307.67	324.60	324.72	0.038	5.5
225	310.43	326.78	326.91	0.038	5.3
226	309.89	325.66	325.79	0.042	5.1
				Mean	5.3
Mean Water Absorption of Sample:				5.3 (%)	
Approved by:			Date:	25/07/2013	
Name:	Geoff Ashall				
Position:	Principal Consultant, Building Technology Group				
			 <small>0378</small>		



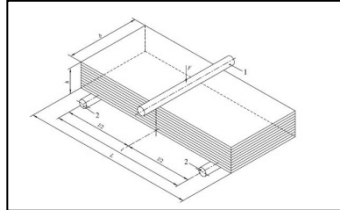
BSEN 772-1: Determination of Compressive Strength (Dry)



Name of Stone:	Clipsham Hooby Lane B1	Petrographic Nature:	Limestone			
Block No:	Data not supplied	Anisotropic Features:	Visible			
Supplier:	Goldholme Stone	Country of Origin:	UK			
Dimensions:	70x 70 x 70 mm	Project Reference:	Data not supplied			
Surface Finish:	Sawn	Preparation /Conditioning:	Prepared to BSEN 1926			
Date Tested:	05/07/2013	Tested by:	Ian Rance			
	Load	Height	Mean	Mean	Failure	Comp.
BRE No	Rate		Length	Width	Load	Strength
287818/13/01	KPa s-1	mm	mm	mm	kN	MPa
171	600	71	71.2	71.0	194	38
172	600	71	71.2	71.4	225	44
173	600	71	70.8	71.8	275	54
174	600	71	70.8	71.5	209	41
175	600	71	71.1	71.7	263	52
176	600	71	71.2	71.7	289	57
177	600	71	71.2	71.5	288	57
178	600	71	71.2	71.7	274	54
179	600	71	71.2	71.6	226	44
180	600	71	70.9	71.5	223	44
					Mean	49
					St. Dev	7.0
					Co of var	0.14
					LEV	35
Approved by:			Date:	25/07/2013		
Name:	Geoff Ashall					
Position:	Principal Consultant, Building Technology Group					
					 0578	



BSEN 12372: Determination of Flexural Strength under Concentrated Load



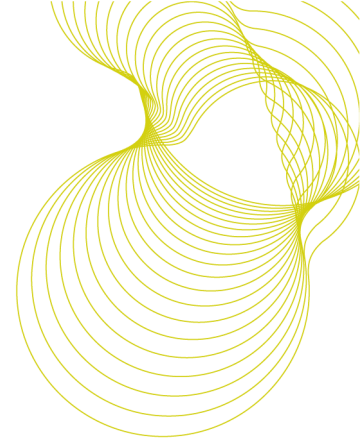
Name of Stone:	Clipsham Hooby Lane B1	Petrographic Nature:	Sandstone			
Block No:	Data not supplied	Anisotropic Features:	Visible			
Supplier:	Goldholme Stone	Country of Origin:	UK			
Dimensions:	300 x 75 x 50 mm	Project Reference:	Data not supplied			
Surface Finish:	Sawn	Preparation /Conditioning:	Prepared to BSEN 12372			
Date Tested:	18/06/2013	Tested by:	Geoff Ashall			
	Load Rate	Span	Width	Thickness	Failure Load	Flexural Strength
BRE no						
287818/13/01	MPa.s ⁻¹	mm	mm	mm	N	MPa
191	0.25	250	76.6	50.7	3090	5.9
192	0.25	250	76.9	50.7	3020	5.7
193	0.25	250	76.7	50.8	3110	5.9
194	0.25	250	76.6	51.1	2950	5.5
195	0.25	250	76.5	50.8	3010	5.7
196	0.25	250	77.0	50.7	2600	4.9
197	0.25	250	76.9	51.1	3350	6.3
198	0.25	250	76.6	51.3	3300	6.1
199	0.25	250	76.7	51.2	3570	6.7
200	0.25	250	76.6	51.2	2920	5.4

Mean	5.8
St. Dev	0.50
Co of var	0.09
LEV	4.8

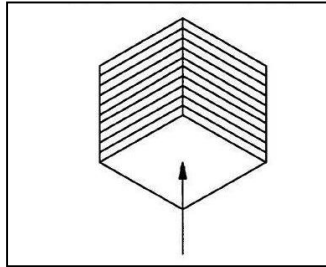
Approved by:  Date: 25/07/2013

Name: Dr. Martyn Webb
 Position: Principal Consultant, Building Technology Group





**BSEN 772-11 : Determination of Water Absorption Coefficient by Capillarity
Perpendicular to Bedding**



Name of Stone:	Clipsham Hooby Lane B1	Petrographic Nature:	Limestone
Block No:	Data not supplied	Anisotropic Features:	Visible
Supplier:	Goldholme Stone	Country of Origin:	UK
Dimensions:	70 x 70 x 70 mm	Project Reference:	Data not supplied
Surface Finish:	Sawn	Preparation /Conditioning:	BSEN 1925
Date Tested:	07/07/2013	09/07/2013	Tested by: Ian Rance

	Width 1	Width 2	Water absorption *
BRE No			
287818/13/01	m	m	gm ² s ^{-0.5}
251	0.0709	0.0706	39.3
252	0.0713	0.0707	48.2
253	0.0709	0.0707	37.2
254	0.0707	0.0716	32.5
255	0.0709	0.0716	43.7
256	0.0712	0.0718	50.8

*Calculated following procedure in note 1

Mean Water absorption: 42.0 g.m²s^{-0.5}

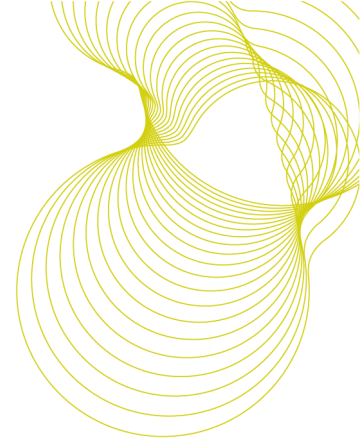
Approved by: 

Date: 25/07/2013

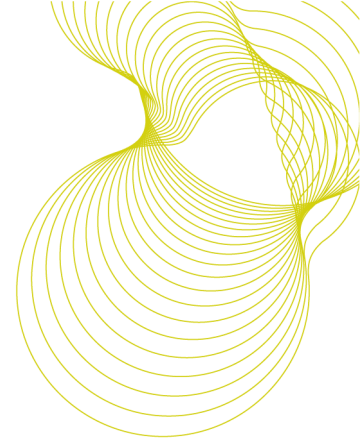


Name: Mr Geoff Ashall

Position: Principal Consultant, Building Technology Group



EN 12524:2000 Building materials and products - Hygrothermal properties - Tabulated design values																			
Name of Stone:	Clipsham Hooby Lane Bed 1																		
Block No:	Data not supplied.																		
Country of Origin:	UK																		
Supplier:	Goldholme Stone Ltd.																		
Date Assessed	25/07/2013																		
Petrographic Nature:	Limestone																		
<table border="1" style="margin: auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Property</th> <th style="text-align: center;">Value</th> <th style="text-align: center;">units</th> </tr> </thead> <tbody> <tr> <td>Density</td> <td style="text-align: center;">2340</td> <td style="text-align: center;">Kgm-3</td> </tr> <tr> <td>Design thermal conductivity</td> <td style="text-align: center;">1.91</td> <td style="text-align: center;">W/(mK)</td> </tr> <tr> <td>Specific heat capacity</td> <td style="text-align: center;">1000</td> <td style="text-align: center;">J/(kgK)</td> </tr> <tr> <td>Water vapour resistance factor dry</td> <td style="text-align: center;">250</td> <td></td> </tr> <tr> <td>Water vapour resistance factor wet</td> <td style="text-align: center;">200</td> <td></td> </tr> </tbody> </table>		Property	Value	units	Density	2340	Kgm-3	Design thermal conductivity	1.91	W/(mK)	Specific heat capacity	1000	J/(kgK)	Water vapour resistance factor dry	250		Water vapour resistance factor wet	200	
Property	Value	units																	
Density	2340	Kgm-3																	
Design thermal conductivity	1.91	W/(mK)																	
Specific heat capacity	1000	J/(kgK)																	
Water vapour resistance factor dry	250																		
Water vapour resistance factor wet	200																		
Approved by:																			
	Date: 25/07/2013																		
Name:	Dr. Martyn Webb																		
Position:	Principal Consultant Building Technology Group																		



BS EN 12407 Petrographic Examination of Natural Stone

Sample Description

Name of Stone:	Clipsham Hooby Lane B1	Petrographic Nature:	Limestone
Block No:	Not applicable	Anisotropic Features:	None
Supplier:	Client	Country of Origin:	UK
Dimensions:	75 x 50 mm x 30 µm	Project Reference:	Data not supplied
Surface Finish:	Cut	Preparation /Conditioning:	Prepared to BS EN 12407
Date Tested:	17/07/13	Tested By:	Martyn Webb
Project no	287818-HCV059	Sample I.D Number	287818/13/01/117



Figure 1: Image of hand specimen, width of image approximately 50 mm

Results summary

Based on the mineralogy identified in thin section and the texture seen in hand specimen, the stone has been given the classification of **Oosparitic Limestone.**

Final approved by: 

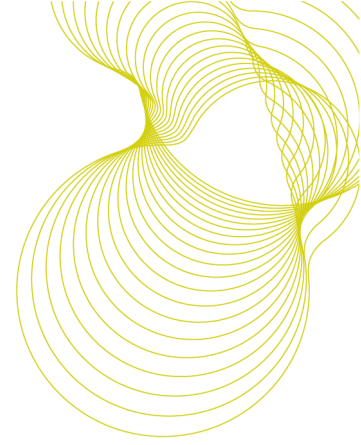
Name: Geoff Ashall

Date: 18/07/13

Position: Principal Consultant



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Macroscopic Examination of 287818/13/01/117

In hand specimen the stone was predominantly buff in colour and medium to coarse grained (Figure 1). Fossil fragments and ooliths could be identified, with these apparently contained within a sparite cement. There did not appear to be any alignment of elongate fossil fragments in the sample examined. The stone reacted vigorously to dilute hydrochloric acid, and showed a moderate rate of absorption of a water drop.

There did not appear to be any evidence of weathering and/or alteration at this level of examination.

Microscopic Examination of 287818/13/01/117

In thin section the mineralogy was composed primarily of ooliths, having a maximum size of approximately 1 mm but more usually 200 µm in diameter. A concentric structure was often visible within these, and a micrite rim with sparite core was typical. Occasionally fine organic grains were noted within the structure of the ooliths (Figure 2). Other constituents included intraclasts and bivalve fragments, with the latter often being a combination of micrite and sparite carbonate types. The typical appearance of the stone in thin section is shown in Figure 2. There was no clear orientation of elongate fossil fragments to suggest bedding alignment.

There was very little particle to particle contact, and all constituents were held within a coarsely crystallised sparite cement. Some pore spaces remained where the cement was absent.

Staining with Alizarin Red S showed both the constituents and cement to be composed of calcite.

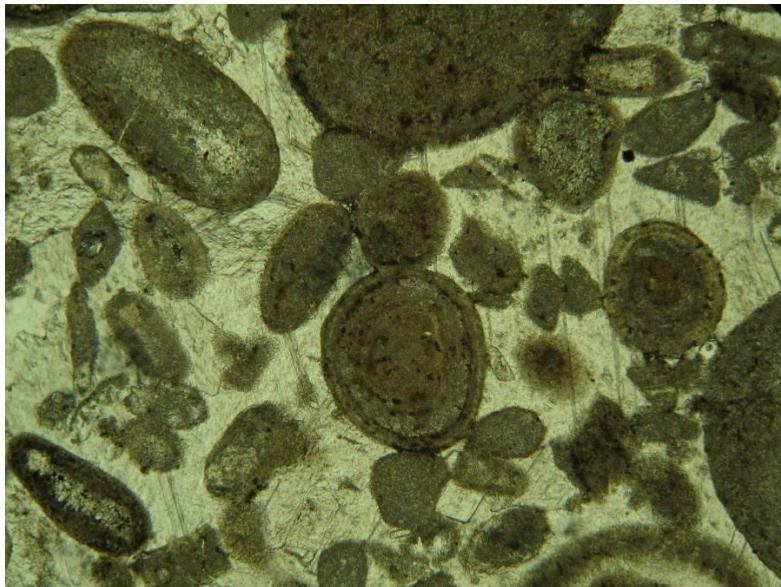


Figure 2. Typical oolith structure in sample 287818/01 showing the presence of fine organic grains (dark areas in the image). Plane polarised light, magnification x100.

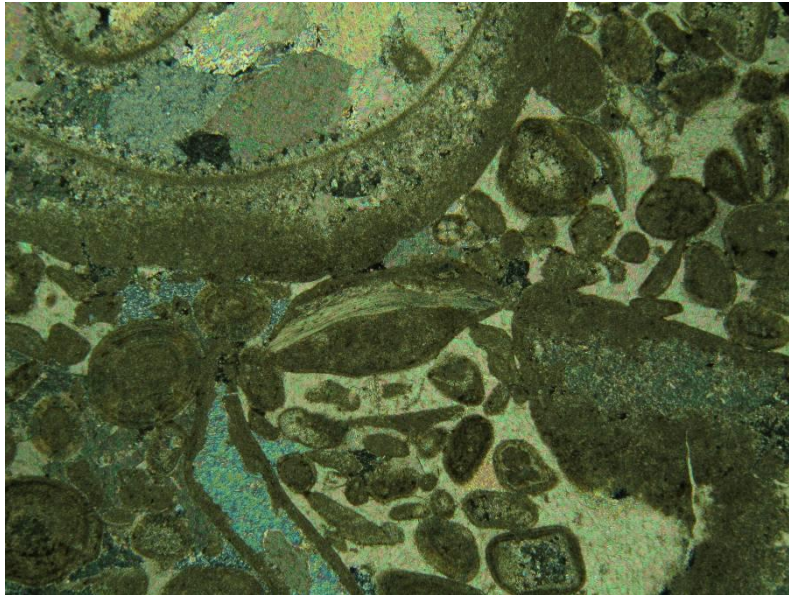
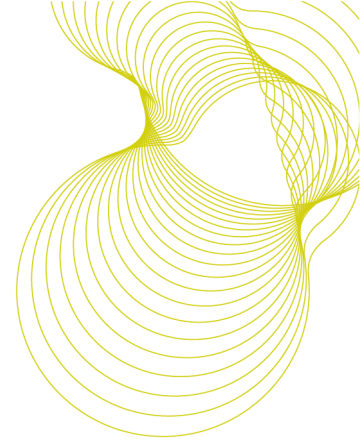


Figure 3. The typical appearance of sample 287818/01 in thin section showing the coarse sparite cement. Cross polarised light, magnification x 50.

Based on the mineralogy identified in thin section and the texture seen in hand specimen, the stone has been given the classification of **Oospirite**.

=====REPORT ENDS=====