DATA ON 9TH CENTURY BC PALEOTSUNAMI IN UTICA (TUNISIA)

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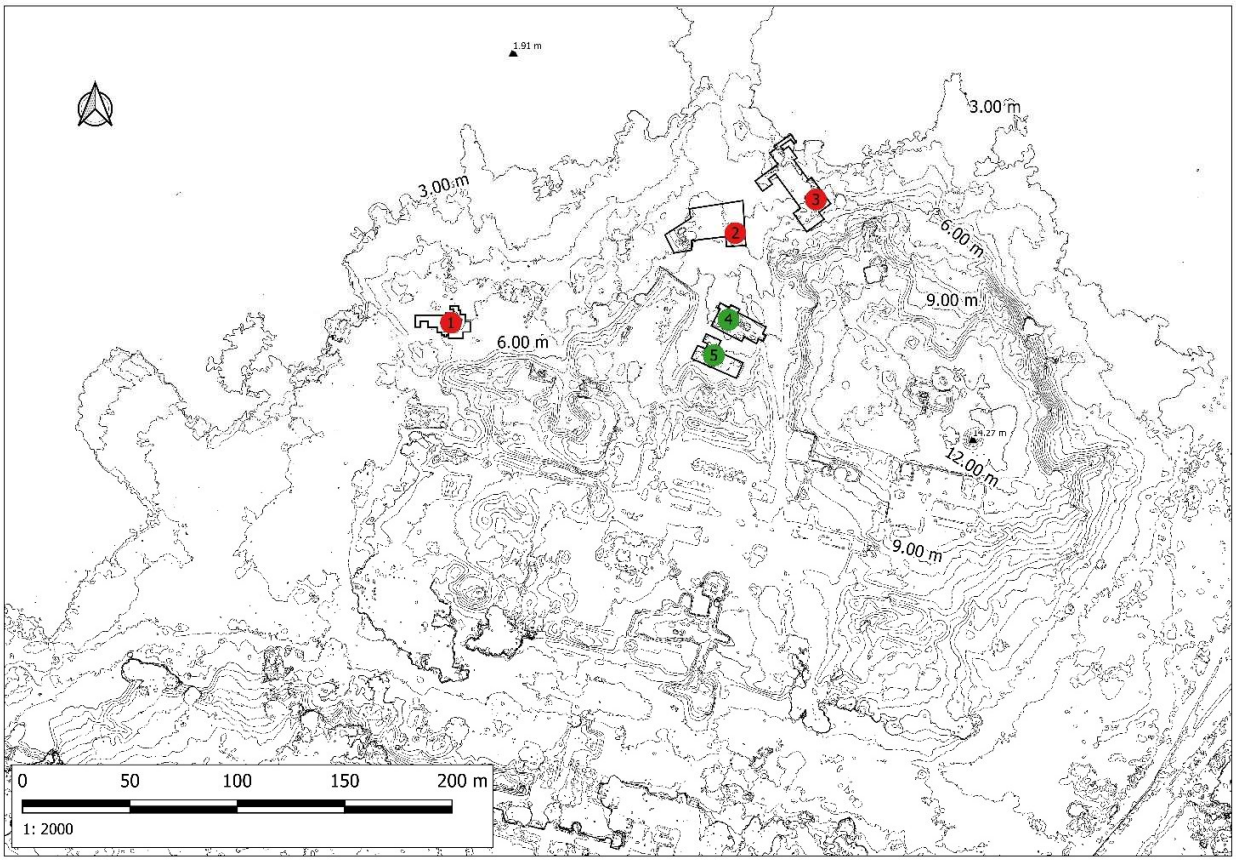
1. *Spatial and stratigraphical location of tsunami stratum remains* ***[2]***

2. *Data of the sedimentary analysis of samples from Utica beach, Bizerta beach and Utica excavation tsunami stratum in Sector 21* ***[17]***

3. *Marine fauna of paleotsunami stratum from Utica excavations Sector 21* ***[65]***

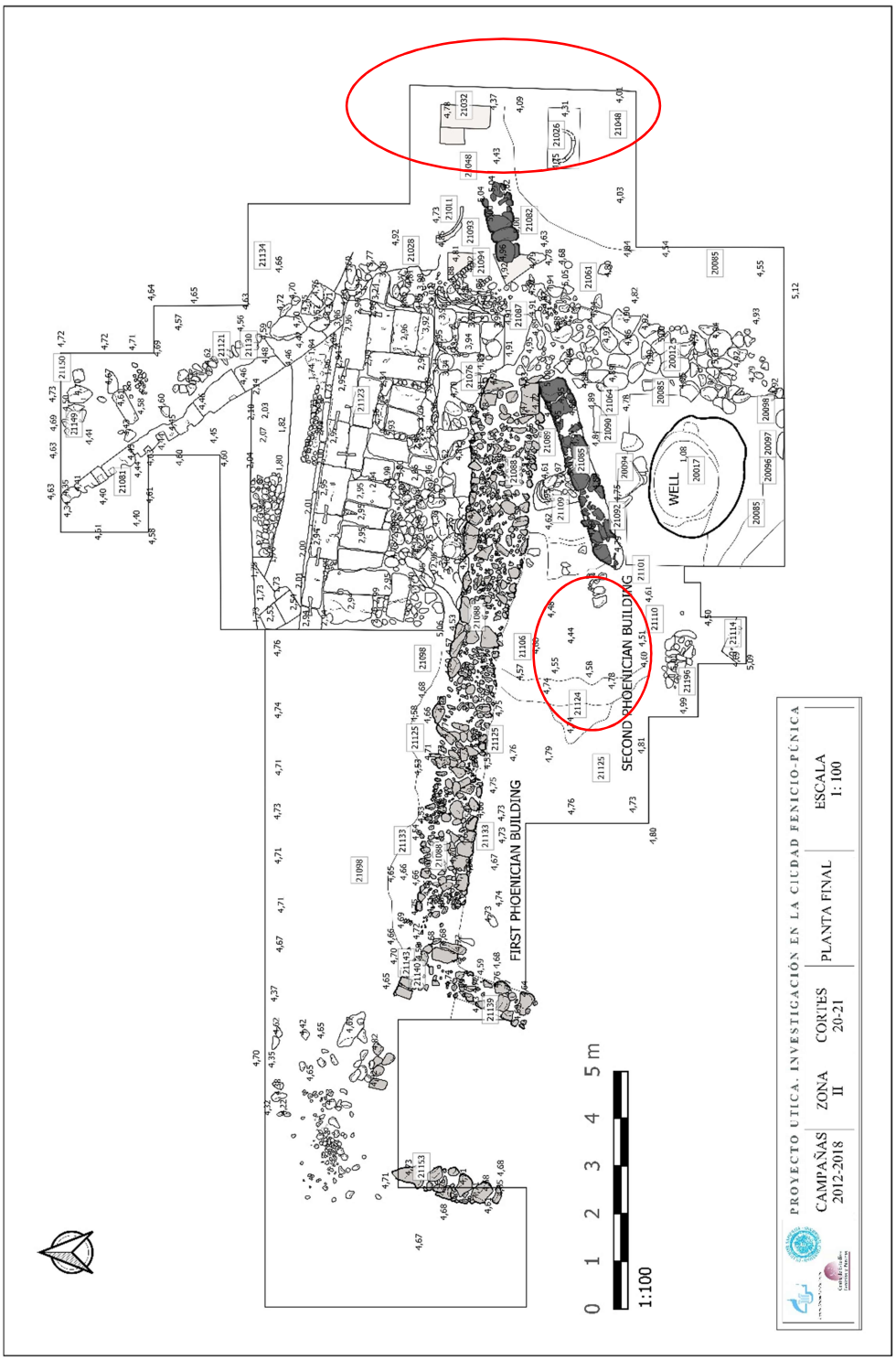
4. *C14 datations of marine fauna of the tsunami sediment from Sector 21, Stratigraphic unit 21100 in Utica and North Africa context* ***[71]***

1. Spatial and stratigraphical location of tsunami stratum remains



Plan of modern excavations at Utica. Spatial distribution of marine faunal remains evidence of a high energy event in ancient Utica. Tunisian-spanish excavation project: (red) Sector 20-21 (1) Sector 10 (1) Sector 11 (3). Tunisian excavations (green) of T. Redissi (4) and I. Ben Jerbania (5).

1.1. Sector 21


SECOND PHOENICIAN BUILDING
FIRST PHOENICIAN BUILDING
WELL
PROYECTO UTICA. INVESTIGACIÓN EN LA CIUDAD FENICIO-PÚNICA
CAMPAÑAS 2012-2018
ZONA II
CORTES 20-21
PLANTA FINAL
ESCALA 1: 100
0 1 2 3 4 5 m
1:100

Plan of the remains of Phoenicians buildings in sector 21 marking the areas in which were recorded remains of the tsunami marine deposit stratum in 2013 (upper), 2014 and 2015 (lower) seasons

1.1.1. Sector 21. 2013 season

Situation of Straigraphic Unit 21044 in Sector 21 formed by the tsunami deposit of marine sediment in sector 21, east section, marked in red

Detail of Stratigraphic Unit 21044 with tsunami marine deposit on soil 21032 in the east section of sector 21

A more detailed view of Stratigraphic Unit 21044 containing marine faune

Fieldwork drawing scale 1:20 of the stratigraphic east section of sector 21, remarking the Stratigraphic Unit 21044

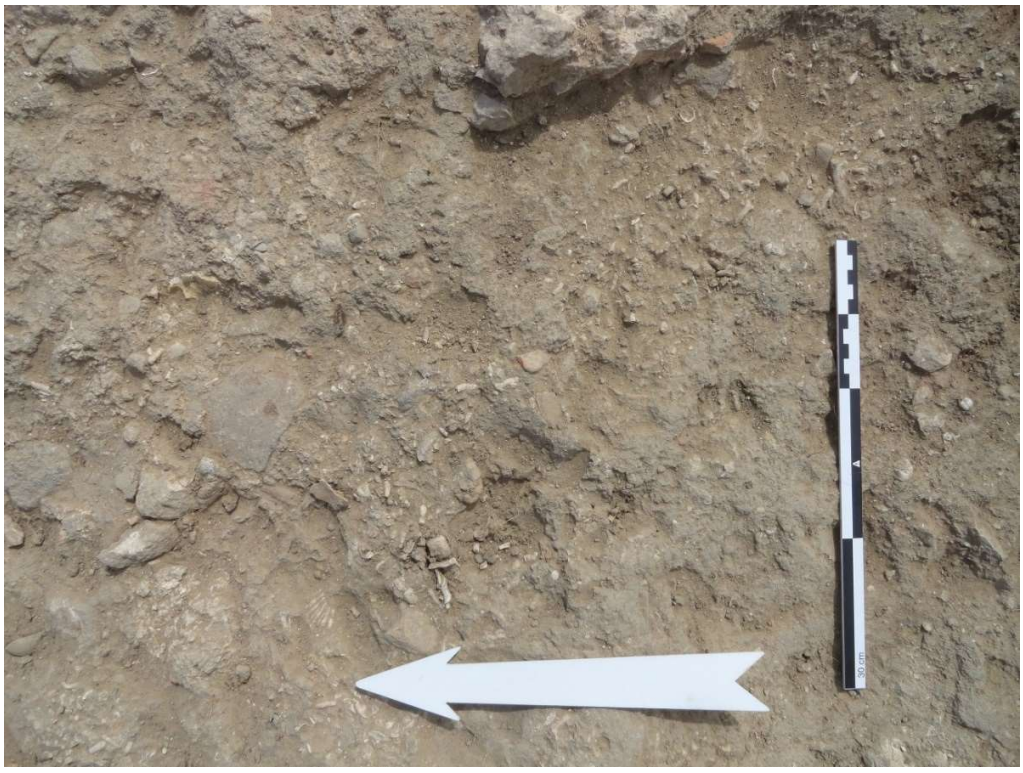
Situation of Straigraphic Unit 21044 in Sector 21 formed by the tsunami deposit of marine sediment in west section, marked in red

Detail of Stratigraphic Unit 21044 with tsunami marine deposit in the west section of sector 21

A more detailed view of Stratigraphic Unit 21044 containing remains of marine faune

1.1.2. Sector 21 2014 season

Remains of the tsunami deposit at the Stratigraphical Unit 21061



Detailed views of the tsunami deposit remains digging the Stratigraphic Unit 21061

1.1.3. Sector 21 2015 season

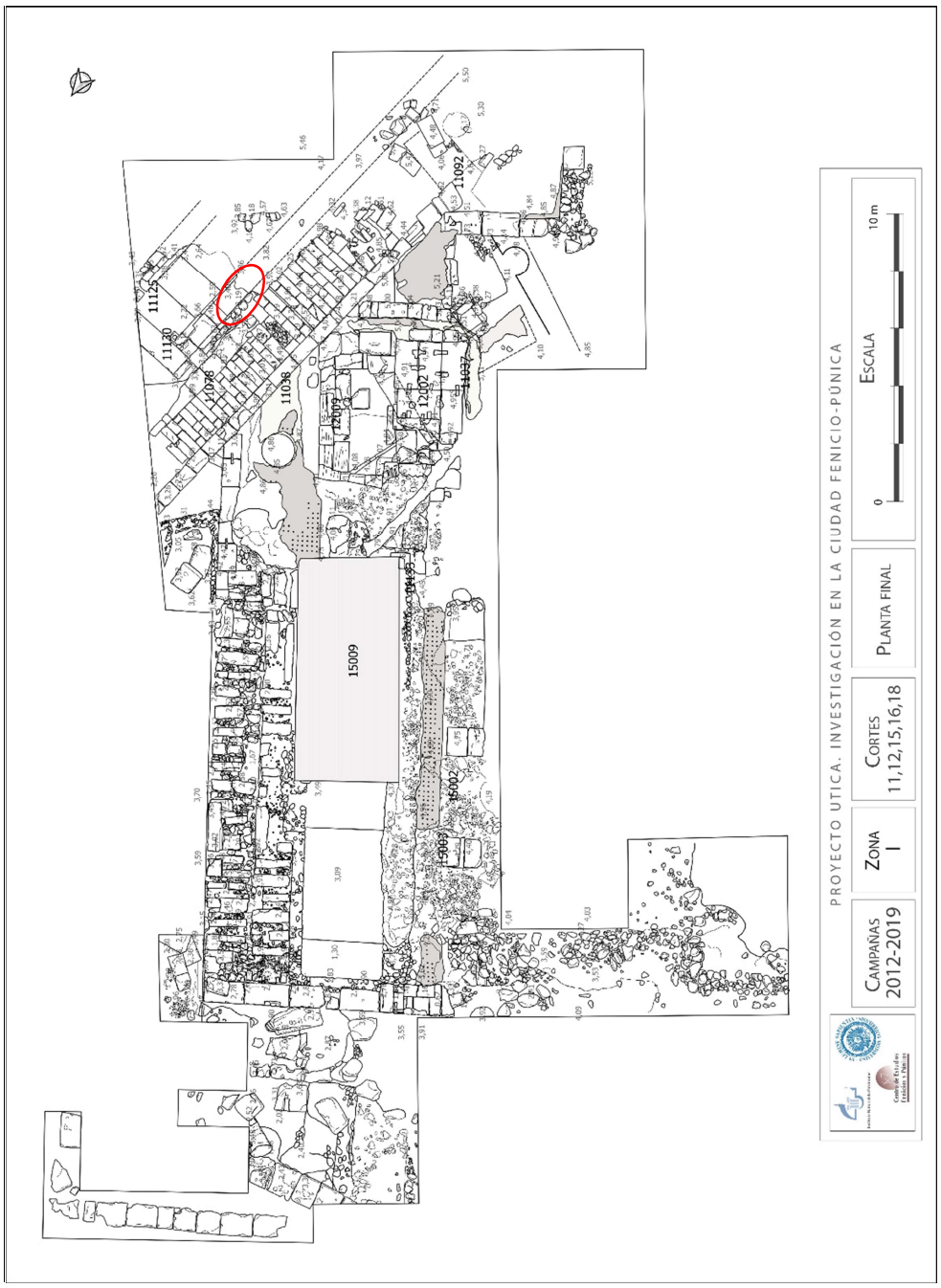
Remains of the tsunami deposit on Stratigraphic Unit 21100 in sector 21 during 2015 season

1.2. Sector 10

Location of tsunai deposit remains in sector 10, 2019 season

Sector 10, 2019 season, Tsunami deposit remains in Stratigraphic Unit 10423

1.3. Sector 11D



Location of tsunami deposits remains in Sector 11D, in altered sedimentation caused by roman imperial period foundation of stairs and building

Sector 11 D

Sector 11 D. Location of tsunami deposit remains in a fill of early imperial roman period in the south section

Detailed views of the marine corals and faunal remains from tsunami deposit moved by the roman foundation and erection of stairs and building of the Early imperial period in Sector 11D, south section

Sector 11D. East section view of the marine corals and faunal remains from tsunami deposit

2. Data of the sedimentary analysis of samples from Utica beach, Bizerta beach and Utica excavation tsunami stratum in Sector 21

LABORATORIO DE GEOGRAFÍA FÍSICA
Dpto. Geografía U.A.M.
SEDIMENTOLOGÍA

HOJA DE ANÁLISIS

DATOS DE LOCALIZACIÓN DE LA MUESTRA

* Titulo: UT 14 Playa

* Muestra obtenida por:

* T. M. / Provincia / Coordenadas geográficas
(X,Y,Z):Útica, Tunez

* Posición Geomorfológica:

CROQUIS DE SITUACIÓN	POSICIÓN EN EL DEPÓSITO

2 mm
1,5 mm
1 mm
0,8 mm
0,6 mm
0,5 mm
0,4 mm
0,3 mm
0,2 mm
0,16 mm
0,12 mm
0,063 mm
0.05
< 0,05 mm

UT 14 Playa

ANÁLISIS FÍSICO Y MECÁNICO

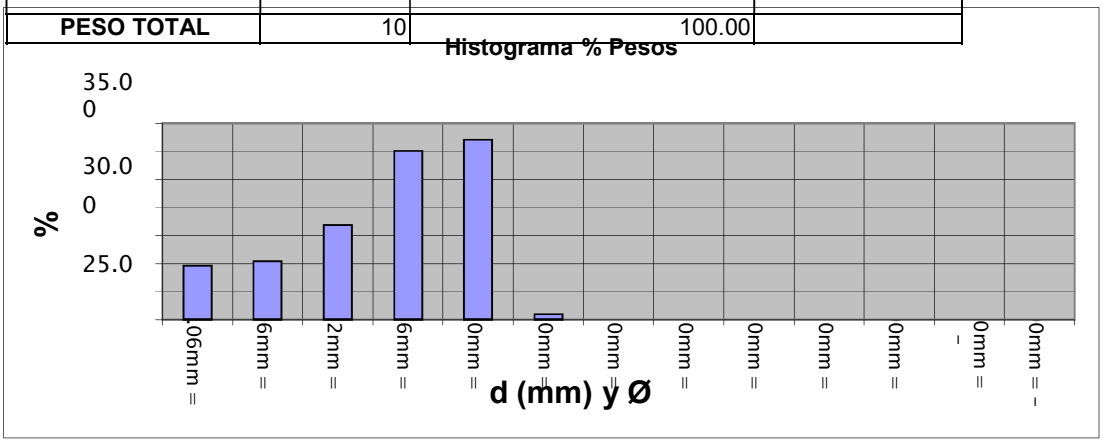
N. EXPEDIENTE DE LA MUESTRA		
COLOR MUNSELL		0
RECHAZO TEXTURA > 2 mm. %		
ARENAS GRUESAS 0.5 – 2 mm. %		
ARENAS TAMAÑO MEDIO 0.2 – 0.5 mm. %		0
ARENAS FINAS 0.05 – 0.2 mm.		

ANÁLISIS QUÍMICO PARCIAL

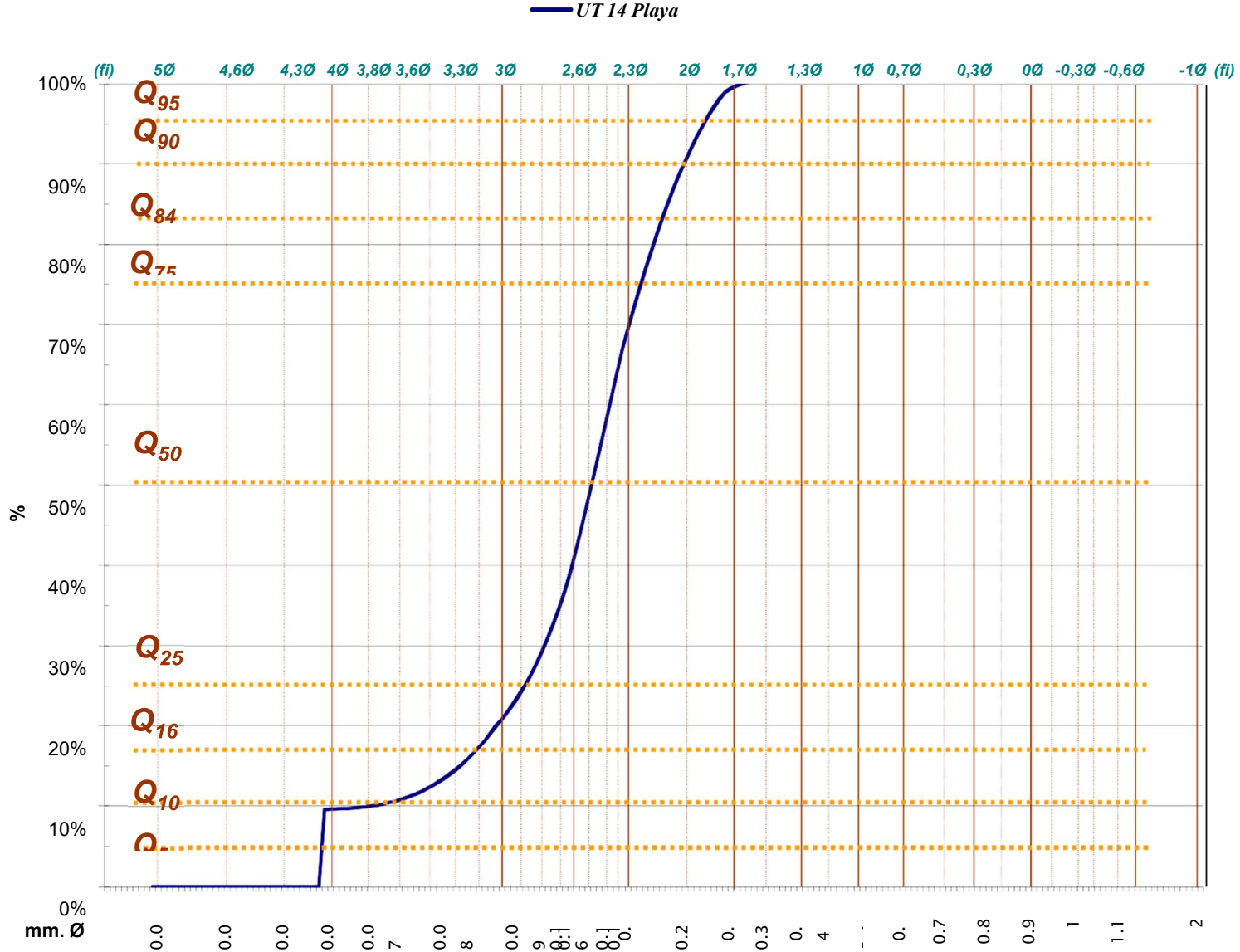
PH (en H2O)	NI	

ANÁLISIS ESTADÍSTICO DE LA FASE ARENOSA

DIMENSIONES (mm)	PESO (grs)	% SOBRE FASE ARENOSA	% ACUMULADO
TARA			0
<0.06mm = <4Ø	0.96	9.60	0.00
0.06mm = 4Ø	1.04	10.40	9.60
0.12mm = 3Ø	1.68	16.80	20.00
0.16mm = 2,64Ø	3.01	30.10	36.80
0.20mm = 2,32Ø	3.21	32.10	66.90
0.30mm = 1,74Ø	0.1	1.00	99.00
0.40mm = 1,32Ø	0	0.00	100.00
0.50mm = 1Ø	0	0.00	100.00
0.60mm = 0,74Ø	0	0.00	100.00
0.80mm = 0,32Ø	0	0.00	100.00
1.00mm = 0Ø	0	0.00	100.00
1.50mm = -0,58Ø	0	0.00	100.00
2.00mm = -1Ø	0	0.00	100.00
PESO TOTAL	10	100.00	



CURVA ACUMULATIVA DE DISTRIBUCIÓN GRANULOMÉTRICA DE ARENAS



UT 14 Playa

INTERPRETACIOPN Y RESULTADOS

	d (mm)	Ø (fi)		d (mm)	Ø (fi)
Q_5 =	0.06	4.09	Q_{75} =	0.21	2.23
Q_{10} =	0.07	3.82	Q_{84} =	0.23	2.09
Q_{16} =	0.11	3.22	Q_{90} =	0.25	1.99
Q_{25} =	0.13	2.89	Q_{95} =	0.28	1.86
Q_{50} =	0.17	2.52			

Índice de Task

$So = \sqrt{(Q_{75}/Q_{25})} =$ **1.2589 mm**

Índice de Krumbein

$(Q_{75}+Q_{25}-2xQ_{50})/2 =$ **0.0006 mm**

Índice dispersión global:

$Dg=Q_{90}-Q_{10} =$ **0.1804 mm**

Tamaño gráfico promedio

Arena muy gruesa	-1Ø a 0Ø
Arena gruesa	0Ø a 1Ø
Arena media	1Ø a 2Ø
Arena fina	2Ø a 3Ø
Arena muy fina	3Ø a 4Ø

$Mz = (Ø_{16}+Ø_{50}+Ø_{84})/3 =$ **2.61 Ø**

Arena fina

Desviación estándar gráfica inclusiva

Muy bien clasificado	<0,35Ø
Bien clasificado	0,35Ø a 0,50Ø
Moderadamente bien clasificado	0,50Ø a 0,71Ø
Moderadamente clasificado	0,71Ø a 1,00Ø
Mal clasificado	1,00Ø a 2,00Ø
Muy mal clasificado	2,00Ø a 4,00Ø
Extremadamente mal clasificado	>4,00Ø

$\delta_I =((Ø_{84}-Ø_{16})/4)+((Ø_{95}-Ø_5)/6,6) =$ **-0.62 Ø**

Muy bien clasificado

Grado de asimetría gráfica inclusiva

Muy asimetrico hacia finos	+1,00Ø a +0,30Ø
Asimetrico hacia finos	+0,30Ø a +0,10Ø
Simetrico	+0,10Ø a -0,10Ø
Asimetrico hacia gruesos	-0,10Ø a -0,30Ø
Muy asimetrico hacia gruesos	-0,30Ø a -1,00Ø

$SKi =((Ø_{16}+Ø_{84}-2Ø_{50})/2(Ø_{84}-Ø_{16}))+$
$+((Ø_5+Ø_{95}-2Ø_{50})/2(Ø_{95}-Ø_5)) =$ **-1.15 Ø**

Muy asimetrico hacia gruesos

Curtosis

Muy platicúrtico	<0,67Ø
Platicúrtico	0,67Ø a 0,90Ø
Mesocúrtico	0,90Ø a 1,11Ø
Leptocúrtico	1,11Ø a 1,50Ø
Muy leptocúrtico	1,50Ø a 3,00Ø
Extremadamente leptocúrtico	>3,00Ø

$Kg =(Ø_{95}-Ø_5)/2,44(Ø_{75}-Ø_{25}) =$ **0.61 Ø**

Muy platicúrtico

Y=4,34294481903252*LN(Fi)+16 662 38

Fi=EXP((Y-16)/4,34294481903252)

Cm.eje.mili.	% Acum.	d (mm)	Uni.Dib.	Ø (fi)
0.8	0	0.03	65.9	5.1
2.0		0.04	107.7	4.6
3.0		0.05	142.5	4.3
3.8	9.6	0.06	170.4	4.1
4.5		0.07	194.8	3.8
5.0		0.08	212.2	3.6
5.5		0.09	229.6	3.5
6.0		0.1	247.1	3.3
6.4		0.11	261.0	3.2
6.8	20	0.12	274.9	3.1
7.1		0.13	285.4	2.9
7.5		0.14	299.3	2.8
7.8		0.15	309.8	2.7
8.0	36.8	0.16	316.7	2.6
8.3		0.17	327.2	2.6
8.6		0.18	337.6	2.5
8.8		0.19	344.6	2.4
9.0	66.9	0.2	351.6	2.3
10.0		0.25	386.4	2.0
10.8	99	0.3	414.3	1.7
11.4		0.35	435.2	1.5
12.0	100	0.4	456.1	1.3
12.5		0.45	473.5	1.2
13.0	100	0.5	490.9	1.0
13.8	100	0.6	518.8	0.7
14.5		0.7	543.2	0.5
15.0	100	0.8	560.6	0.3
15.5		0.9	578.1	0.2
16.0	100	1	595.5	0.0
16.4		1.1	609.4	-0.1
16.8		1.2	623.3	-0.3
17.1		1.3	633.8	-0.4
17.5		1.4	647.7	-0.5
17.8	100	1.5	658.2	-0.6

2.00
0.20
0.03

0.5	54.9	314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0
0.6	14.4	46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0
0.8	3.8	6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0
0	-9.6	-20	-36.8	-66.9	-99	-100	-100	-100	-100
54.9	314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0
14.4	46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0
3.8	6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0
-9.6	-20	-36.8	-66.9	-99	-100	-100	-100	-100	-100
314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0	5639.8
46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0	316.8
6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0	17.8
-20	-36.8	-66.9	-99	-100	-100	-100	-100	-100	-100
512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0	5639.8	6859.0
64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0	316.8	361.0
8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0	17.8	19.0
-36.8	-66.9	-99	-100	-100	-100	-100	-100	-100	-100

1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-0.2	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

	100	2	700.0	-1.0							
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
					-1.0	1.4	4.6	-7.0	-6.7	-0.4	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
					-0.8	1.9	-0.1	-6.9	-5.3	-0.3	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					-14.7	-79.2	643.0	-22.4	-572.6	-63.3	0.0	0.0	0.0	0.0
				c	14.7	79.2	-643.0	22.4	572.6	63.3	0.0	0.0	0.0	0.0
				b	-3.9	-14.7	76.9	4.6	-47.7	-4.9	0.0	0.0	0.0	0.0
				a	0.3	0.9	-2.9	-0.3	1.3	0.1	0.0	0.0	0.0	0.0
				d	-9.5	-130.0	1754.9	-269.5	-2186.3	-171.8	100.0	100.0	100.0	100.0
			0		0	9.6	20	36.8	66.9	99	100	100	100	100
			0		9.6	20	36.8	66.9	99	100	100	100	100	100
					20	36.8	66.9	99	100	100	100	100	100	100
					36.8	66.9	99	100	100	100	100	100	100	100

100
100

7.3E-12

7.3E-12

100

100

0.0							0.0
0.1							0.1
0.2							0.2
0.3							0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7							0.7
0.8	2.242	0.03	2.23	0	0.00	0	0.8
0.9				0.893	0.00	0	0.9
1.0				1.726	0.00	0	1.0
1.1				2.504	0.00	0	1.1
1.2				3.226	0.00	0	1.2
1.3				3.897	0.00	0	1.3
1.4				4.517	0.00	0	1.4
1.5				5.088	0.00	0	1.5
1.6				5.613	0.00	0	1.6
1.7				6.094	0.00	0	1.7
1.8				6.533	0.00	0	1.8
1.9				6.931	0.00	0	1.9
2.0	0	0.04		7.291	0.00	0	2.0
2.1				7.616	0.00	0	2.1
2.2				7.906	0.00	0	2.2
2.3				8.164	0.00	0	2.3
2.4				8.393	0.00	0	2.4
2.5				8.593	0.00	0	2.5
2.6				8.768	0.00	0	2.6
2.7				8.919	0.00	0	2.7
2.8				9.048	0.00	0	2.8
2.9				9.158	0.00	0	2.9
3.0	0	0.05		9.25	0.00	0	3.0
3.1				9.327	0.00	0	3.1
3.2				9.39	0.00	0	3.2
3.3				9.441	0.00	0	3.3
3.4				9.484	0.00	0	3.4

3.5				9.519	0.00	0	3.5
3.6				9.548	0.00	0	3.6
3.7				9.575	0.00	0	3.7
3.8	5.289	0.06	5.26	9.6	9.60	9.6	3.8
3.9				9.626	9.63	9.626	3.9
4.0				9.655	9.66	9.655	4.0
4.1				9.689	9.69	9.689	4.1
4.2				9.731	9.73	9.731	4.2
4.3				9.781	9.78	9.781	4.3
4.4				9.842	9.84	9.842	4.4
4.5	0	0.07		9.917	9.92	9.917	4.5
4.6				10.01	10.01	10.01	4.6
4.7				10.11	10.11	10.11	4.7
4.8				10.24	10.24	10.24	4.8
4.9				10.39	10.39	10.39	4.9
5.0	0	0.08		10.56	10.56	10.56	5.0
5.1				10.76	10.76	10.76	5.1
5.2				10.98	10.98	10.98	5.2
5.3				11.24	11.24	11.24	5.3
5.4				11.52	11.52	11.52	5.4
5.5	0	0.09		11.84	11.84	11.84	5.5
5.6				12.2	12.20	12.2	5.6
5.7				12.59	12.59	12.59	5.7
5.8				13.02	13.02	13.02	5.8
5.9				13.5	13.50	13.5	5.9
6.0	0	0.1		14.02	14.02	14.02	6.0
6.1				14.58	14.58	14.58	6.1
6.2				15.2	15.20	15.2	6.2
6.3				15.86	15.86	15.86	6.3
6.4	0	0.11		16.57	16.57	16.57	6.4
6.5				17.34	17.34	17.34	6.5
6.6				18.17	18.17	18.17	6.6
6.7				19.06	19.06	19.06	6.7
6.8	7.32	0.12	7.28	20	20.00	20	6.8
6.9				20.81	20.81	20.81	6.9

7.0				21.71	21.71	21.71	7.0
7.1	0	0.13		22.7	22.70	22.7	7.1
7.2				23.79	23.79	23.79	7.2
7.3				24.99	24.99	24.99	7.3
7.4				26.3	26.30	26.3	7.4
7.5	0	0.14		27.72	27.72	27.72	7.5
7.6				29.27	29.27	29.27	7.6
7.7				30.95	30.95	30.95	7.7
7.8	0	0.15		32.76	32.76	32.76	7.8
7.9				34.71	34.71	34.71	7.9
8.0	10.84	0.16	10.78	36.8	36.80	36.8	8.0
8.1				39.49	39.49	39.49	8.1
8.2				42.3	42.30	42.3	8.2
8.3	0	0.17		45.21	45.21	45.21	8.3
8.4				48.21	48.21	48.21	8.4
8.5				51.26	51.26	51.26	8.5
8.6	0	0.18		54.37	54.37	54.37	8.6
8.7				57.5	57.50	57.5	8.7
8.8	0	0.19		60.65	60.65	60.65	8.8
8.9				63.78	63.78	63.78	8.9
9.0	12.98	0.2	12.91	66.9	66.90	66.9	9.0
9.1				69.49	69.49	69.49	9.1
9.2				71.99	71.99	71.99	9.2
9.3				74.41	74.41	74.41	9.3
9.4				76.74	76.74	76.74	9.4
9.5				78.98	78.98	78.98	9.5
9.6				81.12	81.12	81.12	9.6
9.7				83.18	83.18	83.18	9.7
9.8				85.13	85.13	85.13	9.8
9.9				86.99	86.99	86.99	9.9
10.0	0	0.25		88.75	88.75	88.75	10.0
10.1				90.41	90.41	90.41	10.1
10.2				91.96	91.96	91.96	10.2
10.3				93.41	93.41	93.41	10.3
10.4				94.75	94.75	94.75	10.4
10.5				95.98	95.98	95.98	10.5

10.6				97.1	97.10	97.1	10.6
10.7				98.11	98.11	98.11	10.7
10.8	23.47	0.3	23.34	99	99.00	99	10.8
10.9				99.43	99.43	99.43	10.9
11.0				99.77	99.77	99.77	11.0
11.1				100	100.03	100	11.1
11.2				100.2	100.22	100.2	11.2
11.3				100.3	100.34	100.3	11.3
11.4	0	0.35		100.4	100.40	100.4	11.4
11.5				100.4	100.41	100.4	11.5
11.6				100.4	100.38	100.4	11.6
11.7				100.3	100.32	100.4	11.7
11.8				100.2	100.23	100.4	11.8
11.9				100.1	100.12	100.4	11.9
12.0	29.1	0.4	28.94	100	100.00	100.4	12.0
12.1				100	100.00	100.4	12.1
12.2				100	100.00	100.4	12.2
12.3				100	100.00	100.4	12.3
12.4				100	100.00	100.4	12.4
12.5	0	0.45		100	100.00	100.4	12.5
12.6				100	100.00	100.4	12.6
12.7				100	100.00	100.4	12.7
12.8				100	100.00	100.4	12.8
12.9				100	100.00	100.4	12.9
13.0	38.11	0.5	37.9	100	100.00	100.4	13.0
13.1				100	100.00	100.4	13.1
13.2				100	100.00	100.4	13.2
13.3				100	100.00	100.4	13.3
13.4				100	100.00	100.4	13.4
13.5				100	100.00	100.4	13.5
13.6				100	100.00	100.4	13.6
13.7				100	100.00	100.4	13.7
13.8	51.78	0.6	51.5	100	100.00	100.4	13.8
13.9				100	100.00	100.4	13.9
14.0				100	100.00	100.4	14.0
14.1				100	100.00	100.4	14.1

14.2				100	100.00	100.4	14.2
14.3				100	100.00	100.4	14.3
14.4				100	100.00	100.4	14.4
14.5	0	0.7		100	100.00	100.4	14.5
14.6				100	100.00	100.4	14.6
14.7				100	100.00	100.4	14.7
14.8				100	100.00	100.4	14.8
14.9				100	100.00	100.4	14.9
15.0	67.44	0.8	67.07	100	100.00	100.4	15.0
15.1				100	100.00	100.4	15.1
15.2				100	100.00	100.4	15.2
15.3				100	100.00	100.4	15.3
15.4				100	100.00	100.4	15.4
15.5	0	0.9		100	100.00	100.4	15.5
15.6				100	100.00	100.4	15.6
15.7				100	100.00	100.4	15.7
15.8				100	100.00	100.4	15.8
15.9				100	100.00	100.4	15.9
16.0	100	1	99.45	100	100.00	100.4	16.0
16.1				100	100.00	100.4	16.1
16.2				100	100.00	100.4	16.2
16.3				100	100.00	100.4	16.3
16.4	0	1.1		100	100.00	100.4	16.4
16.5				100	100.00	100.4	16.5
16.6				100	100.00	100.4	16.6
16.7				100	100.00	100.4	16.7
16.8	0	1.2		100	100.00	100.4	16.8
16.9				100	100.00	100.4	16.9
17.0				100	100.00	100.4	17.0
17.1	0	1.3		100	100.00	100.4	17.1
17.2				100	100.00	100.4	17.2
17.3				100	100.00	100.4	17.3
17.4				100	100.00	100.4	17.4
17.5	0	1.4		100	100.00	100.4	17.5
17.6				100	100.00	100.4	17.6
17.7				100	100.00	100.4	17.7

17.8	100	1,5mm	0	100	100.00	100.4	17.8
17.9				100	100.00	100.4	17.9
18.0				100	100.00	100.4	18.0
18.1				100	100.00	100.4	18.1
18.2				100	100.00	100.4	18.2
18.3				100	100.00	100.4	18.3
18.4				100	100.00	100.4	18.4
18.5				100	100.00	100.4	18.5
18.6				100	100.00	100.4	18.6
18.7				100	100.00	100.4	18.7
18.8				100	100.00	100.4	18.8
18.9				100	100.00	100.4	18.9
19.0	100	2	0	100	100.00	100.4	19.0
19.1				100	100.00	100.4	19.1

LABORATORIO DE GEOGRAFÍA FÍSICA
Dpto. Geografía U.A.M.
SEDIMENTOLOGÍA

HOJA DE ANÁLISIS

DATOS DE LOCALIZACIÓN DE LA MUESTRA

* Titulo:

* Muestra obtenida por:

* T. M. / Provincia / Coordenadas geográficas
(X,Y,Z):UT 14 Puete Bizerta

* Posición Geomorfológica:

CROQUIS DE SITUACIÓN	POSICIÓN EN EL DEPÓSITO

2 mm
1,5 mm
1 mm
0,8 mm
0,6 mm
0,5 mm
0,4 mm
0,3 mm
0,2 mm
0,16 mm
0,12 mm
0,063 mm
0.05
< 0,05 mm

0

ANÁLISIS FÍSICO Y MECÁNICO

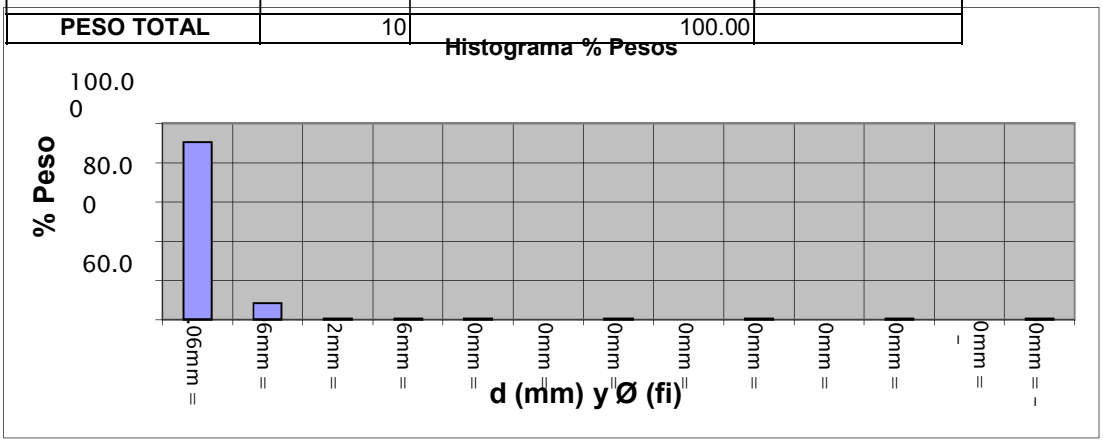
N. EXPEDIENTE DE LA MUESTRA		
COLOR MUNSELL		0
RECHAZO TEXTURA > 2 mm. %		
ARENAS GRUESAS 0.5 – 2 mm. %		
ARENAS TAMAÑO MEDIO 0.2 – 0.5 mm. %		0
ARENAS FINAS 0.05 – 0.2 mm.		

ANÁLISIS QUÍMICO PARCIAL

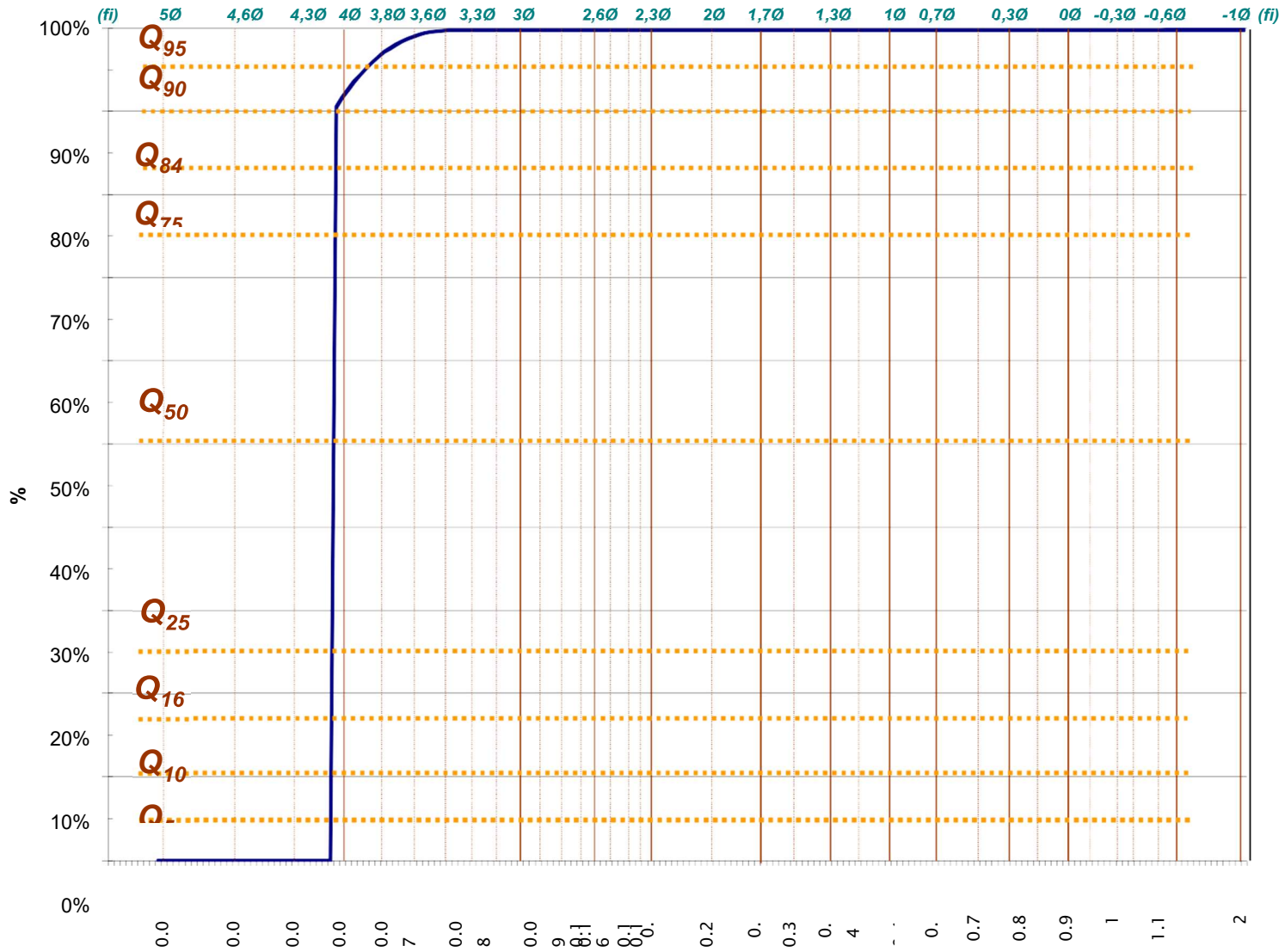
PH (en H2O)	NI	

ANÁLISIS ESTADÍSTICO DE LA FASE ARENOSA

DIMENSIONES (mm)	PESO (grs)	% SOBRE FASE ARENOSA	% ACUMULADO
TARA			0
<0.06mm = <4Ø	9.05	90.50	0.00
0.06mm = 4Ø	0.84	8.40	90.50
0.12mm = 3Ø	0.03	0.30	98.90
0.16mm = 2,64Ø	0.02	0.20	99.20
0.20mm = 2,32Ø	0.01	0.10	99.40
0.30mm = 1,74Ø	0	0.00	99.50
0.40mm = 1,32Ø	0.01	0.10	99.50
0.50mm = 1Ø	0	0.00	99.60
0.60mm = 0,74Ø	0.01	0.10	99.60
0.80mm = 0,32Ø	0	0.00	99.70
1.00mm = 0Ø	0.01	0.10	99.70
1.50mm = -0,58Ø	0	0.00	99.80
2.00mm = -1Ø	0.02	0.20	99.80
PESO TOTAL	10	100.00	



CURVA ACUMULATIVA DE DISTRIBUCIÓN GRANULOMÉTRICA DE ARENAS



mm. Ø

0

INTERPRETACIOPN Y RESULTADOS

	d (mm)	Ø (fi)		d (mm)	Ø (fi)
Q_5 =	0.06	4.09	Q_{75} =	0.06	4.09
Q_{10} =	0.06	4.09	Q_{84} =	0.06	4.09
Q_{16} =	0.06	4.09	Q_{90} =	0.06	4.09
Q_{25} =	0.06	4.09	Q_{95} =	0.07	3.92
Q_{50} =	0.06	4.09			

Índice de Task

$So = \sqrt{(Q_{75}/Q_{25})} =$ **1.0000 mm**

Índice de Krumbein

$(Q_{75}+Q_{25}-2xQ_{50})/2 =$ **0.0000 mm**

Índice dispersión global:

$Dg=Q_{90}-Q_{10} =$ **0.0000 mm**

Tamaño gráfico promedio

Arena muy gruesa	-1Ø a 0Ø
Arena gruesa	0Ø a 1Ø
Arena media	1Ø a 2Ø
Arena fina	2Ø a 3Ø
Arena muy fina	3Ø a 4Ø

$Mz = (Ø_{16}+Ø_{50}+Ø_{84})/3 =$ **4.09 Ø**

Arena muy fina

Desviación estándar gráfica inclusiva

Muy bien clasificado	<0,35Ø
Bien clasificado	0,35Ø a 0,50Ø
Moderadamente bien clasificado	0,50Ø a 0,71Ø
Moderadamente clasificado	0,71Ø a 1,00Ø
Mal clasificado	1,00Ø a 2,00Ø
Muy mal clasificado	2,00Ø a 4,00Ø
Extremadamente mal clasificado	>4,00Ø

$\delta_I = ((Ø_{84}-Ø_{16})/4)+((Ø_{95}-Ø_5)/6,6) =$ **-0.03 Ø**

Muy bien clasificado

Grado de asimetría gráfica inclusiva

Muy asimetrico hacia finos	+1,00Ø a +0,30Ø
Asimetrico hacia finos	+0,30Ø a +0,10Ø
Simetrico	+0,10Ø a -0,10Ø
Asimetrico hacia gruesos	-0,10Ø a -0,30Ø
Muy asimetrico hacia gruesos	-0,30Ø a -1,00Ø

$SKi = ((Ø_{16}+Ø_{84}-2Ø_{50})/2(Ø_{84}-Ø_{16}))+$
$+((Ø_5+Ø_{95}-2Ø_{50})/2(Ø_{95}-Ø_5)) =$ **0.01 Ø**

Simetrico

Curtosis

Muy platicúrtico	<0,67Ø
Platicúrtico	0,67Ø a 0,90Ø
Mesocúrtico	0,90Ø a 1,11Ø
Leptocúrtico	1,11Ø a 1,50Ø
Muy leptocúrtico	1,50Ø a 3,00Ø
Extremadamente leptocúrtico	>3,00Ø

$Kg = (Ø_{95}-Ø_5)/2,44(Ø_{75}-Ø_{25}) =$ **0.00 Ø**

Muy platicúrtico

Y=4,34294481903252*LN(Fi)+16 662 38

Fi=EXP((Y-16)/4,34294481903252)

Cm.eje.mili.	% Acum.	d (mm)	Uni.Dib.	Ø (fi)
0.8	0	0.03	65.9	5.1
2.0		0.04	107.7	4.6
3.0		0.05	142.5	4.3
3.8	90.5	0.06	170.4	4.1
4.5		0.07	194.8	3.8
5.0		0.08	212.2	3.6
5.5		0.09	229.6	3.5
6.0		0.1	247.1	3.3
6.4		0.11	261.0	3.2
6.8	98.9	0.12	274.9	3.1
7.1		0.13	285.4	2.9
7.5		0.14	299.3	2.8
7.8		0.15	309.8	2.7
8.0	99.2	0.16	316.7	2.6
8.3		0.17	327.2	2.6
8.6		0.18	337.6	2.5
8.8		0.19	344.6	2.4
9.0	99.4	0.2	351.6	2.3
10.0		0.25	386.4	2.0
10.8	99.5	0.3	414.3	1.7
11.4		0.35	435.2	1.5
12.0	99.5	0.4	456.1	1.3
12.5		0.45	473.5	1.2
13.0	99.6	0.5	490.9	1.0
13.8	99.6	0.6	518.8	0.7
14.5		0.7	543.2	0.5
15.0	99.7	0.8	560.6	0.3
15.5		0.9	578.1	0.2
16.0	99.7	1	595.5	0.0
16.4		1.1	609.4	-0.1
16.8		1.2	623.3	-0.3
17.1		1.3	633.8	-0.4
17.5		1.4	647.7	-0.5
17.8	99.8	1.5	658.2	-0.6

2.00
0.20
0.03

0.5	54.9	314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0
0.6	14.4	46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0
0.8	3.8	6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0
0	-90.5	-98.9	-99.2	-99.4	-99.5	-99.5	-99.6	-99.6	-99.7
54.9	314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0
14.4	46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0
3.8	6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0
-90.5	-98.9	-99.2	-99.4	-99.5	-99.5	-99.6	-99.6	-99.7	-99.7
314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0	5639.8
46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0	316.8
6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0	17.8
-98.9	-99.2	-99.4	-99.5	-99.5	-99.6	-99.6	-99.7	-99.7	-99.8
512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0	5639.8	6859.0
64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0	316.8	361.0
8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0	17.8	19.0
-99.2	-99.4	-99.5	-99.5	-99.6	-99.6	-99.7	-99.7	-99.8	-99.8

1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	99.8	2	700.0	-1.0							
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
					-12.4	-0.9	-0.1	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
					-11.3	-0.8	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					-70.0	-21.7	0.8	-3.2	-5.8	15.4	-17.7	16.5	-10.8	8.2
				c	70.0	21.7	-0.8	3.2	5.8	-15.4	17.7	-16.5	10.8	-8.2
				b	-10.8	-2.7	0.1	-0.3	-0.5	1.3	-1.3	1.2	-0.7	0.5
				a	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				d	-49.4	40.9	99.5	87.5	78.4	162.1	19.9	178.4	42.8	145.4
				0	7.8E-14	90.5	98.9	99.2	99.4	99.5	99.5	99.6	99.6	99.7
				0	90.5	98.9	99.2	99.4	99.5	99.5	99.6	99.6	99.7	99.7
					98.9	99.2	99.4	99.5	99.5	99.6	99.6	99.7	99.7	99.8
					99.2	99.4	99.5	99.5	99.6	99.6	99.7	99.7	99.8	99.8

100
100

7.3E-12

7.3E-12

100

100

0.0							0.0
0.1							0.1
0.2							0.2
0.3							0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7							0.7
0.8	2.242	0.03	2.23	8E-14	0.00	0	0.8
0.9				5.279	0.00	0	0.9
1.0				10.37	0.00	0	1.0
1.1				15.28	0.00	0	1.1
1.2				20.01	0.00	0	1.2
1.3				24.56	0.00	0	1.3
1.4				28.94	0.00	0	1.4
1.5				33.15	0.00	0	1.5
1.6				37.19	0.00	0	1.6
1.7				41.06	0.00	0	1.7
1.8				44.78	0.00	0	1.8
1.9				48.34	0.00	0	1.9
2.0	0	0.04		51.75	0.00	0	2.0
2.1				55	0.00	0	2.1
2.2				58.11	0.00	0	2.2
2.3				61.07	0.00	0	2.3
2.4				63.9	0.00	0	2.4
2.5				66.58	0.00	0	2.5
2.6				69.13	0.00	0	2.6
2.7				71.56	0.00	0	2.7
2.8				73.85	0.00	0	2.8
2.9				76.02	0.00	0	2.9
3.0	0	0.05		78.07	0.00	0	3.0
3.1				80	0.00	0	3.1
3.2				81.81	0.00	0	3.2
3.3				83.52	0.00	0	3.3
3.4				85.12	0.00	0	3.4

3.5				86.61	0.00	0	3.5
3.6				88	0.00	0	3.6
3.7				89.3	0.00	0	3.7
3.8	5.289	0.06	5.26	90.5	90.50	90.5	3.8
3.9				91.61	91.61	91.61	3.9
4.0				92.63	92.63	92.63	4.0
4.1				93.57	93.57	93.57	4.1
4.2				94.42	94.42	94.42	4.2
4.3				95.2	95.20	95.2	4.3
4.4				95.9	95.90	95.9	4.4
4.5	0	0.07		96.53	96.53	96.53	4.5
4.6				97.09	97.09	97.09	4.6
4.7				97.59	97.59	97.59	4.7
4.8				98.03	98.03	98.03	4.8
4.9				98.41	98.41	98.41	4.9
5.0	0	0.08		98.73	98.73	98.73	5.0
5.1				99	99.00	99	5.1
5.2				99.22	99.22	99.22	5.2
5.3				99.4	99.40	99.4	5.3
5.4				99.54	99.54	99.54	5.4
5.5	0	0.09		99.64	99.64	99.64	5.5
5.6				99.7	99.70	99.7	5.6
5.7				99.73	99.73	99.73	5.7
5.8				99.73	99.73	99.73	5.8
5.9				99.71	99.71	99.73	5.9
6.0	0	0.1		99.66	99.66	99.73	6.0
6.1				99.6	99.60	99.73	6.1
6.2				99.52	99.52	99.73	6.2
6.3				99.43	99.43	99.73	6.3
6.4	0	0.11		99.33	99.33	99.73	6.4
6.5				99.22	99.22	99.73	6.5
6.6				99.11	99.11	99.73	6.6
6.7				99	99.00	99.73	6.7
6.8	7.32	0.12	7.28	98.9	98.90	99.73	6.8
6.9				98.95	98.95	99.73	6.9

7.0				99	99.00	99.73	7.0
7.1	0	0.13		99.04	99.04	99.73	7.1
7.2				99.07	99.07	99.73	7.2
7.3				99.1	99.10	99.73	7.3
7.4				99.12	99.12	99.73	7.4
7.5	0	0.14		99.14	99.14	99.73	7.5
7.6				99.16	99.16	99.73	7.6
7.7				99.17	99.17	99.73	7.7
7.8	0	0.15		99.18	99.18	99.73	7.8
7.9				99.19	99.19	99.73	7.9
8.0	10.84	0.16	10.78	99.2	99.20	99.73	8.0
8.1				99.22	99.22	99.73	8.1
8.2				99.25	99.25	99.73	8.2
8.3	0	0.17		99.27	99.27	99.73	8.3
8.4				99.29	99.29	99.73	8.4
8.5				99.31	99.31	99.73	8.5
8.6	0	0.18		99.33	99.33	99.73	8.6
8.7				99.35	99.35	99.73	8.7
8.8	0	0.19		99.37	99.37	99.73	8.8
8.9				99.38	99.38	99.73	8.9
9.0	12.98	0.2	12.91	99.4	99.40	99.73	9.0
9.1				99.41	99.40	99.73	9.1
9.2				99.42	99.40	99.73	9.2
9.3				99.44	99.40	99.73	9.3
9.4				99.44	99.40	99.73	9.4
9.5				99.45	99.40	99.73	9.5
9.6				99.46	99.40	99.73	9.6
9.7				99.47	99.40	99.73	9.7
9.8				99.47	99.40	99.73	9.8
9.9				99.48	99.40	99.73	9.9
10.0	0	0.25		99.48	99.40	99.73	10.0
10.1				99.49	99.40	99.73	10.1
10.2				99.49	99.40	99.73	10.2
10.3				99.49	99.40	99.73	10.3
10.4				99.5	99.40	99.73	10.4
10.5				99.5	99.40	99.73	10.5

10.6				99.5	99.40	99.73	10.6
10.7				99.5	99.40	99.73	10.7
10.8	23.47	0.3	23.34	99.5	99.50	99.73	10.8
10.9				99.5	99.50	99.73	10.9
11.0				99.5	99.50	99.73	11.0
11.1				99.5	99.50	99.73	11.1
11.2				99.49	99.50	99.73	11.2
11.3				99.49	99.50	99.73	11.3
11.4	0	0.35		99.49	99.50	99.73	11.4
11.5				99.49	99.50	99.73	11.5
11.6				99.49	99.50	99.73	11.6
11.7				99.49	99.50	99.73	11.7
11.8				99.49	99.50	99.73	11.8
11.9				99.5	99.50	99.73	11.9
12.0	29.1	0.4	28.94	99.5	99.50	99.73	12.0
12.1				99.51	99.51	99.73	12.1
12.2				99.52	99.52	99.73	12.2
12.3				99.53	99.53	99.73	12.3
12.4				99.54	99.54	99.73	12.4
12.5	0	0.45		99.55	99.55	99.73	12.5
12.6				99.56	99.56	99.73	12.6
12.7				99.57	99.57	99.73	12.7
12.8				99.58	99.58	99.73	12.8
12.9				99.59	99.59	99.73	12.9
13.0	38.11	0.5	37.9	99.6	99.60	99.73	13.0
13.1				99.6	99.60	99.73	13.1
13.2				99.6	99.60	99.73	13.2
13.3				99.6	99.60	99.73	13.3
13.4				99.6	99.60	99.73	13.4
13.5				99.6	99.60	99.73	13.5
13.6				99.6	99.60	99.73	13.6
13.7				99.6	99.60	99.73	13.7
13.8	51.78	0.6	51.5	99.6	99.60	99.73	13.8
13.9				99.61	99.61	99.73	13.9
14.0				99.61	99.61	99.73	14.0
14.1				99.62	99.62	99.73	14.1

14.2				99.63	99.63	99.73	14.2
14.3				99.64	99.64	99.73	14.3
14.4				99.65	99.65	99.73	14.4
14.5	0	0.7		99.66	99.66	99.73	14.5
14.6				99.67	99.67	99.73	14.6
14.7				99.68	99.68	99.73	14.7
14.8				99.68	99.68	99.73	14.8
14.9				99.69	99.69	99.73	14.9
15.0	67.44	0.8	67.07	99.7	99.70	99.73	15.0
15.1				99.7	99.70	99.73	15.1
15.2				99.7	99.70	99.73	15.2
15.3				99.7	99.70	99.73	15.3
15.4				99.7	99.70	99.73	15.4
15.5	0	0.9		99.7	99.70	99.73	15.5
15.6				99.7	99.70	99.73	15.6
15.7				99.7	99.70	99.73	15.7
15.8				99.7	99.70	99.73	15.8
15.9				99.7	99.70	99.73	15.9
16.0	100	1	99.45	99.7	99.70	99.73	16.0
16.1				99.7	99.70	99.73	16.1
16.2				99.71	99.70	99.73	16.2
16.3				99.71	99.70	99.73	16.3
16.4	0	1.1		99.72	99.70	99.73	16.4
16.5				99.72	99.70	99.73	16.5
16.6				99.73	99.70	99.73	16.6
16.7				99.74	99.70	99.73	16.7
16.8	0	1.2		99.74	99.70	99.73	16.8
16.9				99.75	99.70	99.73	16.9
17.0				99.76	99.70	99.73	17.0
17.1	0	1.3		99.76	99.70	99.73	17.1
17.2				99.77	99.70	99.73	17.2
17.3				99.77	99.70	99.73	17.3
17.4				99.78	99.70	99.73	17.4
17.5	0	1.4		99.79	99.70	99.73	17.5
17.6				99.79	99.70	99.73	17.6
17.7				99.8	99.70	99.73	17.7

17.8	100	1,5mm	0	99.8	99.80	99.8	17.8
17.9				99.8	99.80	99.8	17.9
18.0				99.81	99.80	99.8	18.0
18.1				99.81	99.80	99.8	18.1
18.2				99.81	99.80	99.8	18.2
18.3				99.81	99.80	99.8	18.3
18.4				99.81	99.80	99.8	18.4
18.5				99.81	99.80	99.8	18.5
18.6				99.81	99.80	99.8	18.6
18.7				99.81	99.80	99.8	18.7
18.8				99.81	99.80	99.8	18.8
18.9				99.81	99.80	99.8	18.9
19.0	100	2	0	99.8	99.80	99.8	19.0
19.1				99.79	99.80	99.8	19.1

LABORATORIO DE GEOGRAFÍA FÍSICA
Dpto. Geografía U.A.M.
SEDIMENTOLOGÍA

HOJA DE ANÁLISIS

DATOS DE LOCALIZACIÓN DE LA MUESTRA

* Titulo: Muestra Útica 2015

* Muestra obtenida por:

* T. M. / Provincia / Coordenadas geográficas (X,Y,Z):

* Posición Geomorfológica:

CROQUIS DE SITUACIÓN	POSICIÓN EN EL DEPÓSITO

2 mm
1,5 mm
1 mm
0,8 mm
0,6 mm
0,5 mm
0,4 mm
0,3 mm
0,2 mm
0,16 mm
0,12 mm
0,063 mm
0.05
< 0,05 mm

Muestra Útica 2015

ANÁLISIS FÍSICO Y MECÁNICO

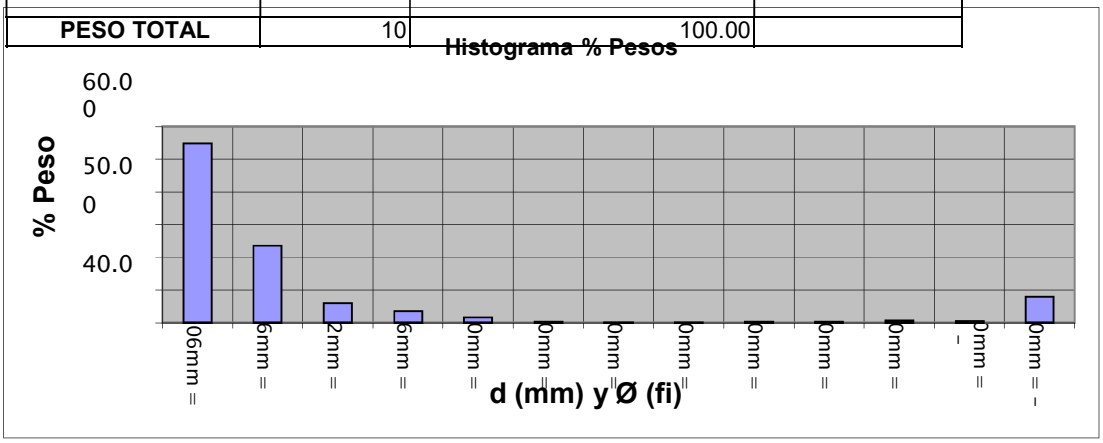
~~N. EXPEDIENTE DE LA MUESTRA~~		
COLOR MUNSELL		0
RECHAZO TEXTURA > 2 mm. %		
~~ARENAS GRUESAS 0.5 – 2 mm. %~~		
		0
ARENAS TAMAÑO MEDIO 0.2 – 0.5 mm. %		NI
		NI
ARENAS FINAS 0.05 – 0.2 mm.		

ANÁLISIS QUÍMICO PARCIAL

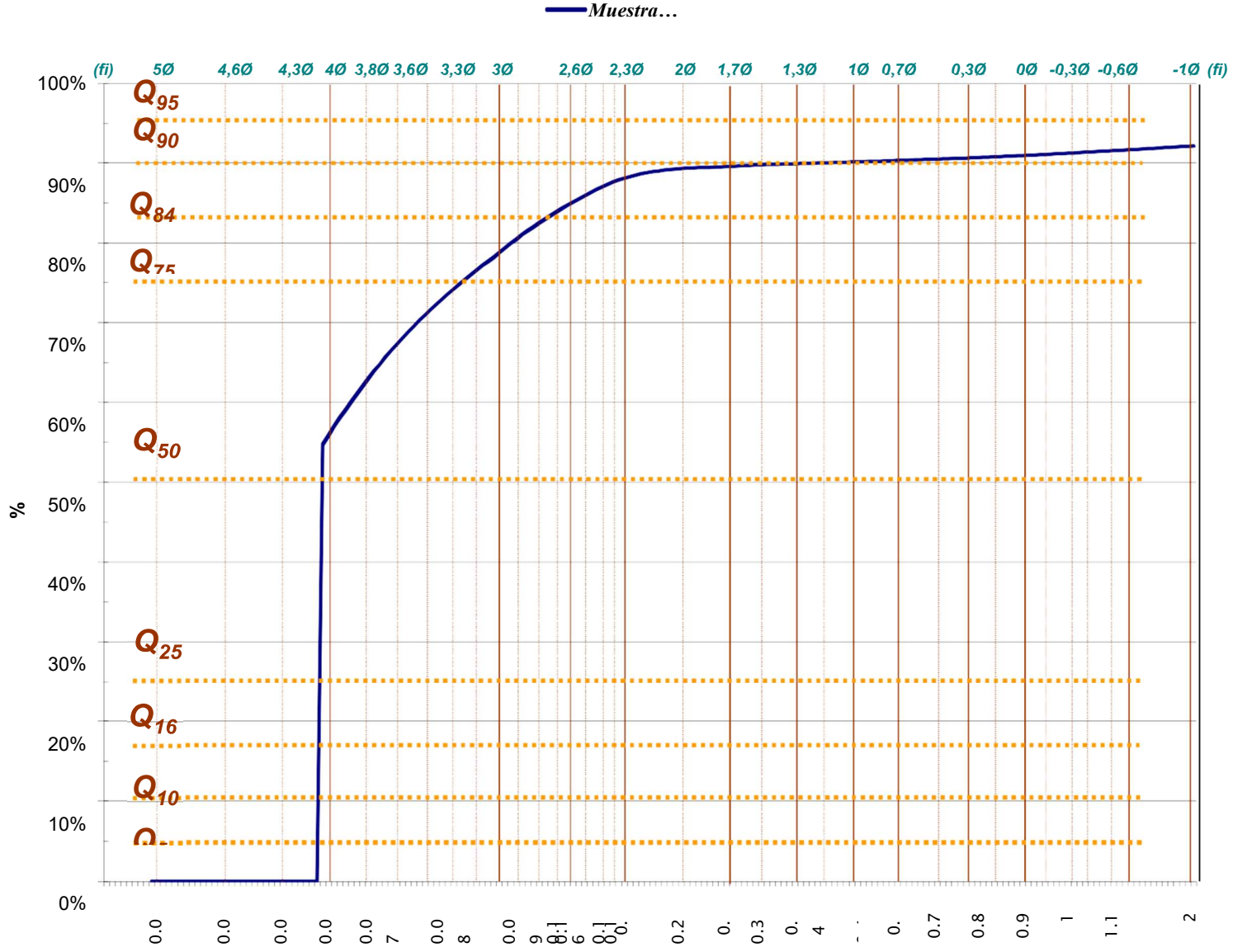
~~PH (en H2O)~~	NI	

ANÁLISIS ESTADÍSTICO DE LA FASE ARENOSA

DIMENSIONES (mm)	PESO (grs)	% SOBRE FASE ARENOSA	% ACUMULADO
TARA			0
<0.06mm = <4Ø	5.47	54.70	0.00
0.06mm = 4Ø	2.35	23.50	54.70
0.12mm = 3Ø	0.61	6.10	78.20
0.16mm = 2,64Ø	0.36	3.60	84.30
0.20mm = 2,32Ø	0.16	1.60	87.90
0.30mm = 1,74Ø	0.04	0.40	89.50
0.40mm = 1,32Ø	0.02	0.20	89.90
0.50mm = 1Ø	0.02	0.20	90.10
0.60mm = 0,74Ø	0.03	0.30	90.30
0.80mm = 0,32Ø	0.03	0.30	90.60
1.00mm = 0Ø	0.07	0.70	90.90
1.50mm = -0,58Ø	0.05	0.50	91.60
2.00mm = -1Ø	0.79	7.90	92.10
PESO TOTAL	10	100.00	



CURVA ACUMULATIVA DE DISTRIBUCIÓN GRANULOMÉTRICA DE ARENAS



mm. Ø

Muestra Útica 2015

INTERPRETACIOPN Y RESULTADOS

	d (mm)	Ø (fi)		d (mm)	Ø (fi)
Q_5 =	0.06	4.09	Q_{75} =	0.10	3.26
Q_{10} =	0.06	4.09	Q_{84} =	0.15	2.69
Q_{16} =	0.06	4.09	Q_{90} =	0.44	1.20
Q_{25} =	0.06	4.09	Q_{95} =	2.04	-1.03
Q_{50} =	0.06	4.09			

Índice de Task

$So = \sqrt{(Q_{75}/Q_{25})} =$ **1.3335 mm**

Índice de Krumbein

$(Q_{75}+Q_{25}-2xQ_{50})/2 =$ **0.0229 mm**

Índice dispersión global:

$Dg=Q_{90}-Q_{10} =$ **0.3776 mm**

Tamaño gráfico promedio

Arena muy gruesa	-1Ø a 0Ø
Arena gruesa	0Ø a 1Ø
Arena media	1Ø a 2Ø
Arena fina	2Ø a 3Ø
Arena muy fina	3Ø a 4Ø

$Mz = (Ø_{16}+Ø_{50}+Ø_{84})/3 =$ **3.62 Ø**

Arena muy fina

Desviación estándar gráfica inclusiva

Muy bien clasificado	<0,35Ø
Bien clasificado	0,35Ø a 0,50Ø
Moderadamente bien clasificado	0,50Ø a 0,71Ø
Moderadamente clasificado	0,71Ø a 1,00Ø
Mal clasificado	1,00Ø a 2,00Ø
Muy mal clasificado	2,00Ø a 4,00Ø
Extremadamente mal clasificado	>4,00Ø

$\delta_I = ((Ø_{84}-Ø_{16})/4)+((Ø_{95}-Ø_5)/6,6) =$ **-1.12 Ø**

Muy bien clasificado

Grado de asimetría gráfica inclusiva

Muy asimetrico hacia finos	+1,00Ø a +0,30Ø
Asimetrico hacia finos	+0,30Ø a +0,10Ø
Simetrico	+0,10Ø a -0,10Ø
Asimetrico hacia gruesos	-0,10Ø a -0,30Ø
Muy asimetrico hacia gruesos	-0,30Ø a -1,00Ø

$SKi = ((Ø_{16}+Ø_{84}-2Ø_{50})/2(Ø_{84}-Ø_{16}))+$
$+((Ø_5+Ø_{95}-2Ø_{50})/2(Ø_{95}-Ø_5)) =$ **14.06 Ø**

Muy asimetrico hacia finos

Curtosis

Muy platicúrtico	<0,67Ø
Platicúrtico	0,67Ø a 0,90Ø
Mesocúrtico	0,90Ø a 1,11Ø
Leptocúrtico	1,11Ø a 1,50Ø
Muy leptocúrtico	1,50Ø a 3,00Ø
Extremadamente leptocúrtico	>3,00Ø

$Kg = (Ø_{95}-Ø_5)/2,44(Ø_{75}-Ø_{25}) =$ **1.74 Ø**

Muy leptocúrtico

Y=4,34294481903252*LN(Fi)+16 662 38

Fi=EXP((Y-16)/4,34294481903252)

Cm.eje.mili.	% Acum.	d (mm)	Uni.Dib.	Ø (fi)
0.8	0	0.03	65.9	5.1
2.0		0.04	107.7	4.6
3.0		0.05	142.5	4.3
3.8	54.7	0.06	170.4	4.1
4.5		0.07	194.8	3.8
5.0		0.08	212.2	3.6
5.5		0.09	229.6	3.5
6.0		0.1	247.1	3.3
6.4		0.11	261.0	3.2
6.8	78.2	0.12	274.9	3.1
7.1		0.13	285.4	2.9
7.5		0.14	299.3	2.8
7.8		0.15	309.8	2.7
8.0	84.3	0.16	316.7	2.6
8.3		0.17	327.2	2.6
8.6		0.18	337.6	2.5
8.8		0.19	344.6	2.4
9.0	87.9	0.2	351.6	2.3
10.0		0.25	386.4	2.0
10.8	89.5	0.3	414.3	1.7
11.4		0.35	435.2	1.5
12.0	89.9	0.4	456.1	1.3
12.5		0.45	473.5	1.2
13.0	90.1	0.5	490.9	1.0
13.8	90.3	0.6	518.8	0.7
14.5		0.7	543.2	0.5
15.0	90.6	0.8	560.6	0.3
15.5		0.9	578.1	0.2
16.0	90.9	1	595.5	0.0
16.4		1.1	609.4	-0.1
16.8		1.2	623.3	-0.3
17.1		1.3	633.8	-0.4
17.5		1.4	647.7	-0.5
17.8	91.6	1.5	658.2	-0.6

2.00
0.20
0.03

0.5	54.9	314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0
0.6	14.4	46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0
0.8	3.8	6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0
0	-54.7	-78.2	-84.3	-87.9	-89.5	-89.9	-90.1	-90.3	-90.6
54.9	314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0
14.4	46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0
3.8	6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0
-54.7	-78.2	-84.3	-87.9	-89.5	-89.9	-90.1	-90.3	-90.6	-90.9
314.4	512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0	5639.8
46.2	64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0	316.8
6.8	8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0	17.8
-78.2	-84.3	-87.9	-89.5	-89.9	-90.1	-90.3	-90.6	-90.9	-91.6
512.0	729.0	1259.7	1728.0	2197.0	2628.1	3375.0	4096.0	5639.8	6859.0
64.0	81.0	116.6	144.0	169.0	190.4	225.0	256.0	316.8	361.0
8.0	9.0	10.8	12.0	13.0	13.8	15.0	16.0	17.8	19.0
-84.3	-87.9	-89.5	-89.9	-90.1	-90.3	-90.6	-90.9	-91.6	-92.1

1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-1.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	92.1	2	700.0	-1.0						
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
					-7.0	-1.8	-1.2	-1.2	-0.2	-0.1	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
					-6.5	-1.7	-1.2	-1.0	-0.2	-0.1	0.0	0.0	0.0	0.0
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
					-31.3	-14.4	-1.3	-70.1	-15.0	-14.3	5.1	-4.7	-1.1	5.1
			c		31.3	14.4	1.3	70.1	15.0	14.3	-5.1	4.7	1.1	-5.1
			b		-3.4	-0.6	1.1	-6.4	-1.2	-1.1	0.4	-0.3	-0.1	0.3
			a		0.1	0.0	-0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
			d		-23.0	8.8	42.9	-166.4	25.6	28.4	111.8	66.5	84.1	117.7
		0			3.6E-14	54.7	78.2	84.3	87.9	89.5	89.9	90.1	90.3	90.6
		0				54.7	78.2	84.3	87.9	89.5	89.9	90.1	90.3	90.6	90.9
						78.2	84.3	87.9	89.5	89.9	90.1	90.3	90.6	90.9	91.6
						84.3	87.9	89.5	89.9	90.1	90.3	90.6	90.9	91.6	92.1

100
100

7.3E-12

7.3E-12

100

100

0.0							0.0
0.1							0.1
0.2							0.2
0.3							0.3
0.4							0.4
0.5							0.5
0.6							0.6
0.7							0.7
0.8	2.242	0.03	2.23	3E-14	0.00	0	0.8
0.9				2.582	0.00	0	0.9
1.0				5.104	0.00	0	1.0
1.1				7.566	0.00	0	1.1
1.2				9.968	0.00	0	1.2
1.3				12.31	0.00	0	1.3
1.4				14.6	0.00	0	1.4
1.5				16.83	0.00	0	1.5
1.6				19.01	0.00	0	1.6
1.7				21.13	0.00	0	1.7
1.8				23.2	0.00	0	1.8
1.9				25.21	0.00	0	1.9
2.0	0	0.04		27.18	0.00	0	2.0
2.1				29.09	0.00	0	2.1
2.2				30.95	0.00	0	2.2
2.3				32.77	0.00	0	2.3
2.4				34.53	0.00	0	2.4
2.5				36.25	0.00	0	2.5
2.6				37.92	0.00	0	2.6
2.7				39.55	0.00	0	2.7
2.8				41.13	0.00	0	2.8
2.9				42.67	0.00	0	2.9
3.0	0	0.05		44.17	0.00	0	3.0
3.1				45.62	0.00	0	3.1
3.2				47.03	0.00	0	3.2
3.3				48.41	0.00	0	3.3
3.4				49.74	0.00	0	3.4

3.5				51.03	0.00	0	3.5
3.6				52.29	0.00	0	3.6
3.7				53.51	0.00	0	3.7
3.8	5.289	0.06	5.26	54.7	54.70	54.7	3.8
3.9				55.85	55.85	55.85	3.9
4.0				56.97	56.97	56.97	4.0
4.1				58.05	58.05	58.05	4.1
4.2				59.11	59.11	59.11	4.2
4.3				60.13	60.13	60.13	4.3
4.4				61.12	61.12	61.12	4.4
4.5	0	0.07		62.08	62.08	62.08	4.5
4.6				63.02	63.02	63.02	4.6
4.7				63.92	63.92	63.92	4.7
4.8				64.8	64.80	64.8	4.8
4.9				65.66	65.66	65.66	4.9
5.0	0	0.08		66.49	66.49	66.49	5.0
5.1				67.29	67.29	67.29	5.1
5.2				68.07	68.07	68.07	5.2
5.3				68.83	68.83	68.83	5.3
5.4				69.57	69.57	69.57	5.4
5.5	0	0.09		70.29	70.29	70.29	5.5
5.6				70.99	70.99	70.99	5.6
5.7				71.67	71.67	71.67	5.7
5.8				72.34	72.34	72.34	5.8
5.9				72.98	72.98	72.98	5.9
6.0	0	0.1		73.61	73.61	73.61	6.0
6.1				74.23	74.23	74.23	6.1
6.2				74.83	74.83	74.83	6.2
6.3				75.42	75.42	75.42	6.3
6.4	0	0.11		76	76.00	76	6.4
6.5				76.56	76.56	76.56	6.5
6.6				77.12	77.12	77.12	6.6
6.7				77.66	77.66	77.66	6.7
6.8	7.32	0.12	7.28	78.2	78.20	78.2	6.8
6.9				78.78	78.78	78.78	6.9

7.0				79.35	79.35	79.35	7.0
7.1	0	0.13		79.91	79.91	79.91	7.1
7.2				80.45	80.45	80.45	7.2
7.3				80.98	80.98	80.98	7.3
7.4				81.49	81.49	81.49	7.4
7.5	0	0.14		81.99	81.99	81.99	7.5
7.6				82.48	82.48	82.48	7.6
7.7				82.96	82.96	82.96	7.7
7.8	0	0.15		83.42	83.42	83.42	7.8
7.9				83.87	83.87	83.87	7.9
8.0	10.84	0.16	10.78	84.3	84.30	84.3	8.0
8.1				84.73	84.73	84.73	8.1
8.2				85.14	85.14	85.14	8.2
8.3	0	0.17		85.54	85.54	85.54	8.3
8.4				85.93	85.93	85.93	8.4
8.5				86.3	86.30	86.3	8.5
8.6	0	0.18		86.65	86.65	86.65	8.6
8.7				86.99	86.99	86.99	8.7
8.8	0	0.19		87.31	87.31	87.31	8.8
8.9				87.61	87.61	87.61	8.9
9.0	12.98	0.2	12.91	87.9	87.90	87.9	9.0
9.1				88.12	88.12	88.12	9.1
9.2				88.31	88.31	88.31	9.2
9.3				88.49	88.49	88.49	9.3
9.4				88.64	88.64	88.64	9.4
9.5				88.78	88.78	88.78	9.5
9.6				88.9	88.90	88.9	9.6
9.7				89.01	89.01	89.01	9.7
9.8				89.1	89.10	89.1	9.8
9.9				89.18	89.18	89.18	9.9
10.0	0	0.25		89.25	89.25	89.25	10.0
10.1				89.31	89.31	89.31	10.1
10.2				89.35	89.35	89.35	10.2
10.3				89.39	89.39	89.39	10.3
10.4				89.42	89.42	89.42	10.4
10.5				89.45	89.45	89.45	10.5

10.6				89.47	89.47	89.47	10.6
10.7				89.49	89.49	89.49	10.7
10.8	23.47	0.3	23.34	89.5	89.50	89.5	10.8
10.9				89.55	89.55	89.55	10.9
11.0				89.59	89.59	89.59	11.0
11.1				89.63	89.63	89.63	11.1
11.2				89.67	89.67	89.67	11.2
11.3				89.71	89.71	89.71	11.3
11.4	0	0.35		89.74	89.74	89.74	11.4
11.5				89.77	89.77	89.77	11.5
11.6				89.8	89.80	89.8	11.6
11.7				89.83	89.83	89.83	11.7
11.8				89.85	89.85	89.85	11.8
11.9				89.88	89.88	89.88	11.9
12.0	29.1	0.4	28.94	89.9	89.90	89.9	12.0
12.1				89.92	89.92	89.92	12.1
12.2				89.94	89.94	89.94	12.2
12.3				89.96	89.96	89.96	12.3
12.4				89.98	89.98	89.98	12.4
12.5	0	0.45		90	90.00	90	12.5
12.6				90.02	90.02	90.02	12.6
12.7				90.04	90.04	90.04	12.7
12.8				90.06	90.06	90.06	12.8
12.9				90.08	90.08	90.08	12.9
13.0	38.11	0.5	37.9	90.1	90.10	90.1	13.0
13.1				90.12	90.12	90.12	13.1
13.2				90.15	90.15	90.15	13.2
13.3				90.17	90.17	90.17	13.3
13.4				90.2	90.20	90.2	13.4
13.5				90.22	90.22	90.22	13.5
13.6				90.25	90.25	90.25	13.6
13.7				90.27	90.27	90.27	13.7
13.8	51.78	0.6	51.5	90.3	90.30	90.3	13.8
13.9				90.32	90.32	90.32	13.9
14.0				90.35	90.35	90.35	14.0
14.1				90.37	90.37	90.37	14.1

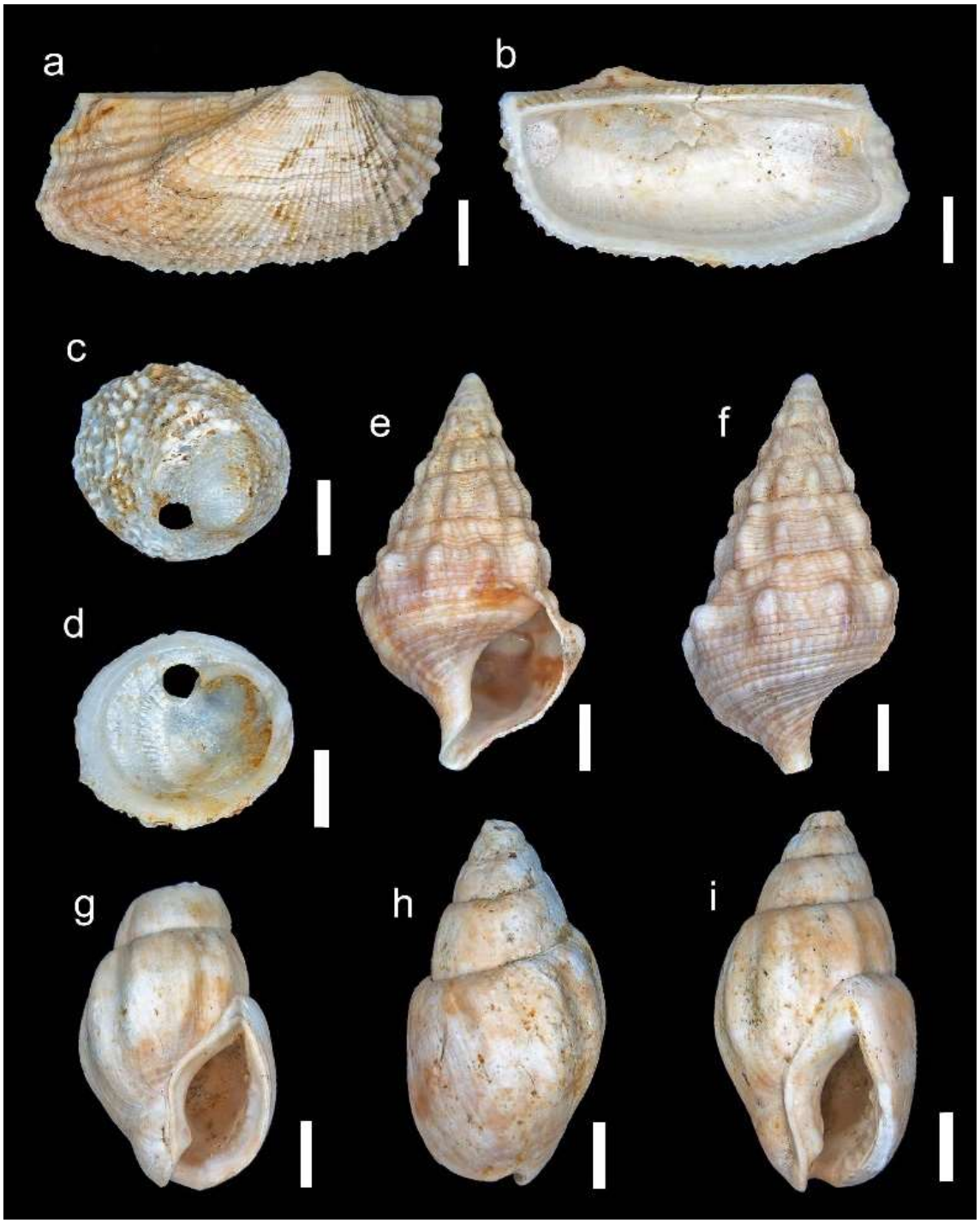
14.2				90.4	90.40	90.4	14.2
14.3				90.42	90.42	90.42	14.3
14.4				90.45	90.45	90.45	14.4
14.5	0	0.7		90.47	90.47	90.47	14.5
14.6				90.5	90.50	90.5	14.6
14.7				90.52	90.52	90.52	14.7
14.8				90.55	90.55	90.55	14.8
14.9				90.57	90.57	90.57	14.9
15.0	67.44	0.8	67.07	90.6	90.60	90.6	15.0
15.1				90.63	90.63	90.63	15.1
15.2				90.66	90.66	90.66	15.2
15.3				90.68	90.68	90.68	15.3
15.4				90.71	90.71	90.71	15.4
15.5	0	0.9		90.74	90.74	90.74	15.5
15.6				90.77	90.77	90.77	15.6
15.7				90.8	90.80	90.8	15.7
15.8				90.84	90.84	90.84	15.8
15.9				90.87	90.87	90.87	15.9
16.0	100	1	99.45	90.9	90.90	90.9	16.0
16.1				90.93	90.93	90.93	16.1
16.2				90.97	90.97	90.97	16.2
16.3				91.01	91.01	91.01	16.3
16.4	0	1.1		91.04	91.04	91.04	16.4
16.5				91.08	91.08	91.08	16.5
16.6				91.12	91.12	91.12	16.6
16.7				91.16	91.16	91.16	16.7
16.8	0	1.2		91.19	91.19	91.19	16.8
16.9				91.23	91.23	91.23	16.9
17.0				91.27	91.27	91.27	17.0
17.1	0	1.3		91.31	91.31	91.31	17.1
17.2				91.35	91.35	91.35	17.2
17.3				91.39	91.39	91.39	17.3
17.4				91.43	91.43	91.43	17.4
17.5	0	1.4		91.48	91.48	91.48	17.5
17.6				91.52	91.52	91.52	17.6
17.7				91.56	91.56	91.56	17.7

17.8	100	1,5mm	0	91.6	91.60	91.6	17.8
17.9				91.64	91.64	91.64	17.9
18.0				91.68	91.68	91.68	18.0
18.1				91.73	91.73	91.73	18.1
18.2				91.77	91.77	91.77	18.2
18.3				91.81	91.81	91.81	18.3
18.4				91.85	91.85	91.85	18.4
18.5				91.89	91.89	91.89	18.5
18.6				91.94	91.94	91.94	18.6
18.7				91.98	91.98	91.98	18.7
18.8				92.02	92.02	92.02	18.8
18.9				92.06	92.06	92.06	18.9
19.0	100	2	0	92.1	92.10	92.1	19.0
19.1				92.14	92.14	92.14	19.1

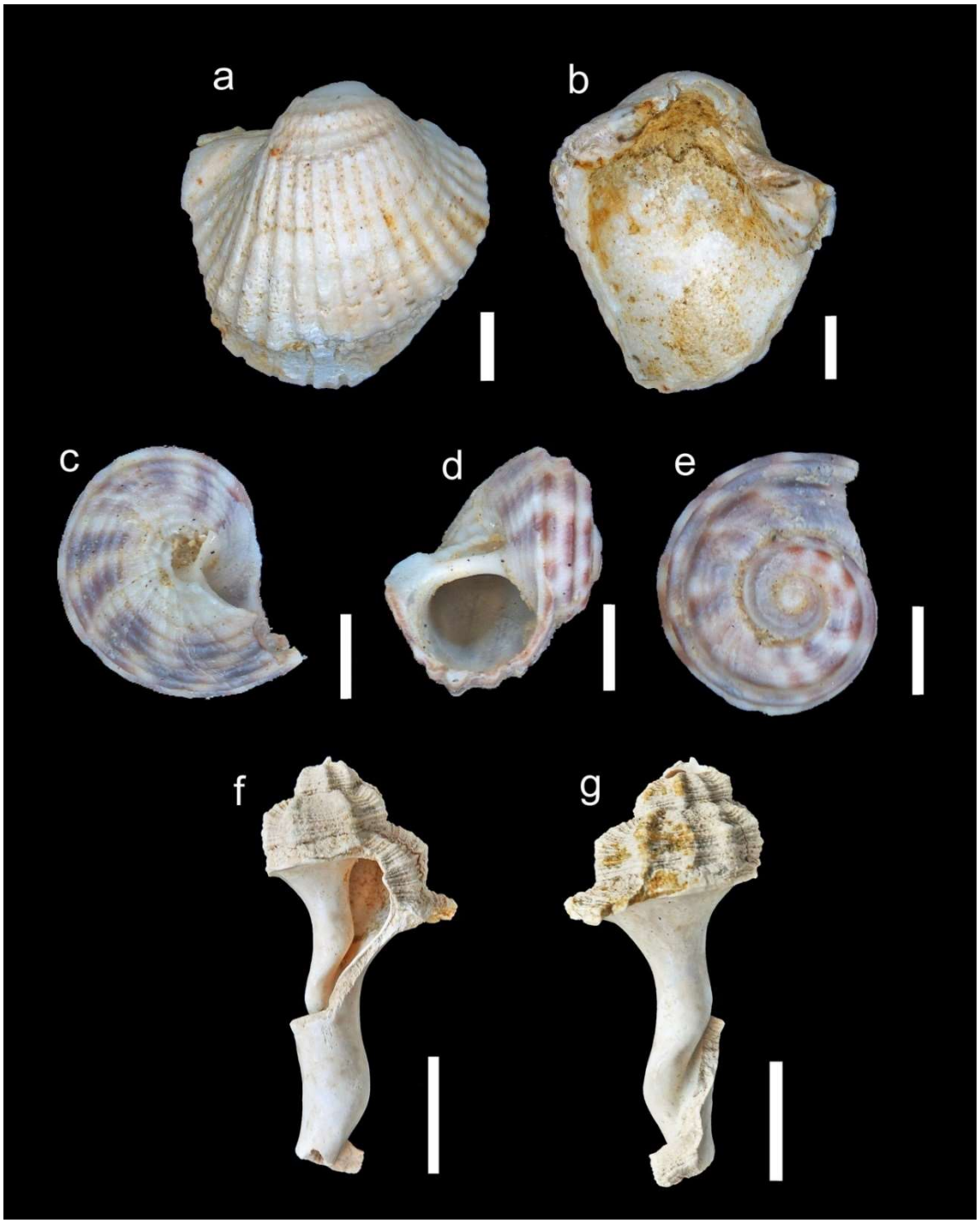
3. Marine fauna of paleotsunami stratum from Utica excavations Sector 21

3.1. Identified species of mollusks

Species	**Observations**
Filum Cnidaria	
Anthozoa Class	
incertae sedis Family	
Cladocora caespitosa (Linneo, 1767)	Very abundant in Tunisia (Zibrowius, 1980)
Filum Mollusca	
Bivalvia Class	
Arcidae Familiy	
Arca noae Linneo, 1758	Referenced by Antit & Azzouna (2012) to be present in the Gulf of Tunis
Cardiidae Family	
Acanthocardia tuberculata (Linneo, 1758)	Referenced by Antit & Azzouna (2012) to be present in the Gulf of Tunis
Chamidae Family	
Chama gryphoides Linneo, 1758	Referenced by Antit & Azzouna (2012) to be present in the Gulf of Tunis
Gastropod Class	
Cerithiidae Family	
Cerithium lividulum Risso, 1826	
Muricidae Family	
Hexaplex trunculus (Linneo, 1758)	Referenced by Antit & Azzouna (2012) to be present in the Gulf of Tunis
Nassariidae Family	
Tritia corniculum (Olivi, 1792)	Referenced by Antit & Azzouna (2012) to be present in the Gulf of Tunis
Trochidae Family	
Clanculus jussieui (Payraudeau, 1826)	



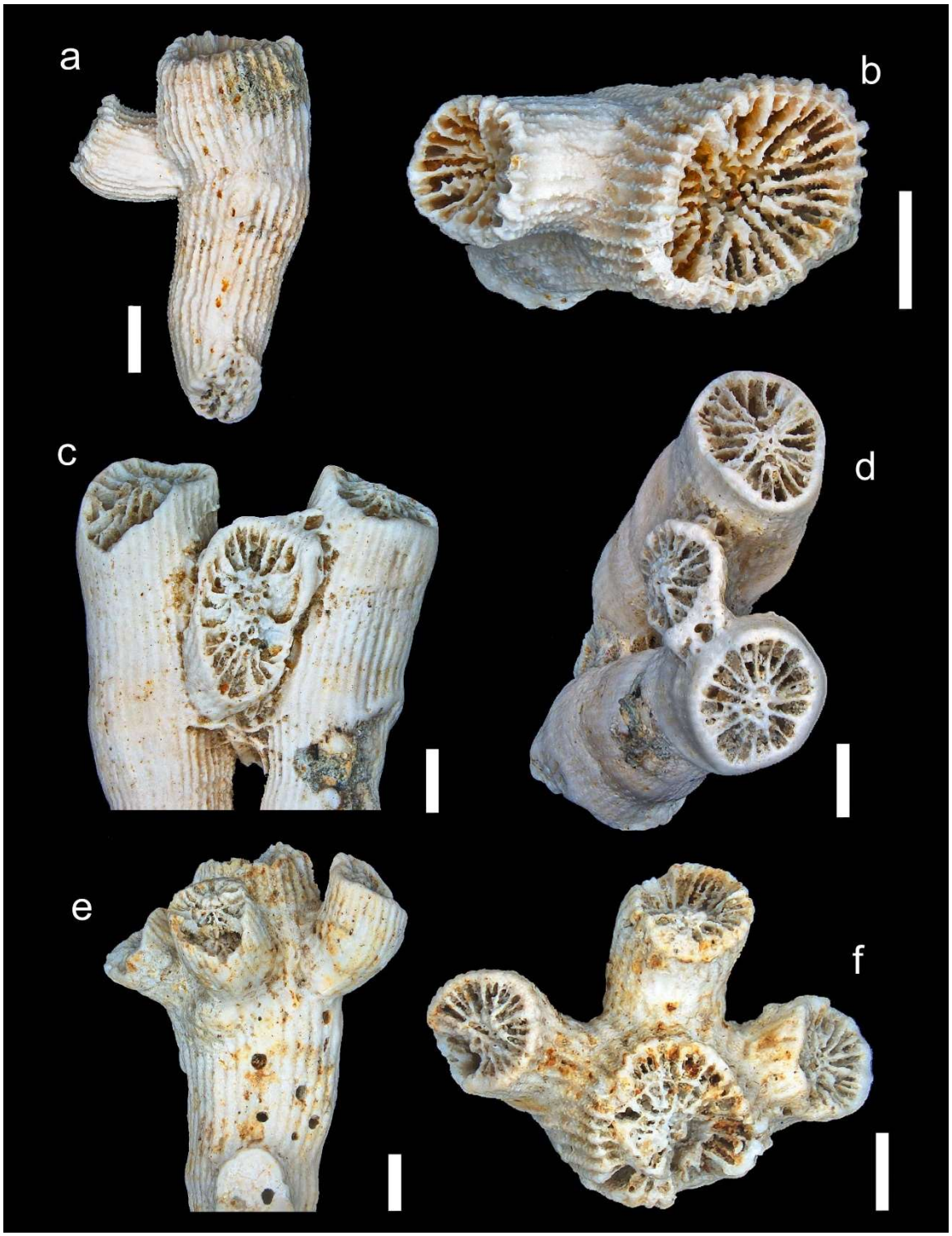
(a-b) *Arca noae* (Linneo, 1758). (c-d) *Chama gryphoides* (Linneo, 1758). (e-f) *Cerithium lividulum* (Risso, 1826). (g-i) *Tritia corniculum* (Olivi, 1792). Scale: 2.0 mm



(a-b) *Acanthocardia tuberculata* (Linneo, 1758) (c-e) *Clanculus jussieui* (Payraudeau, 1826), young individual (f-g) *Hexaplex trunculus* (Linneo, 1758). Scale: a, b= 2.0 mm; c-e= 0.5 mm; f, g= 10 mm.

3.2. Coral of Stratigraphic Units 21044, 21061 and 21105 from sector 21

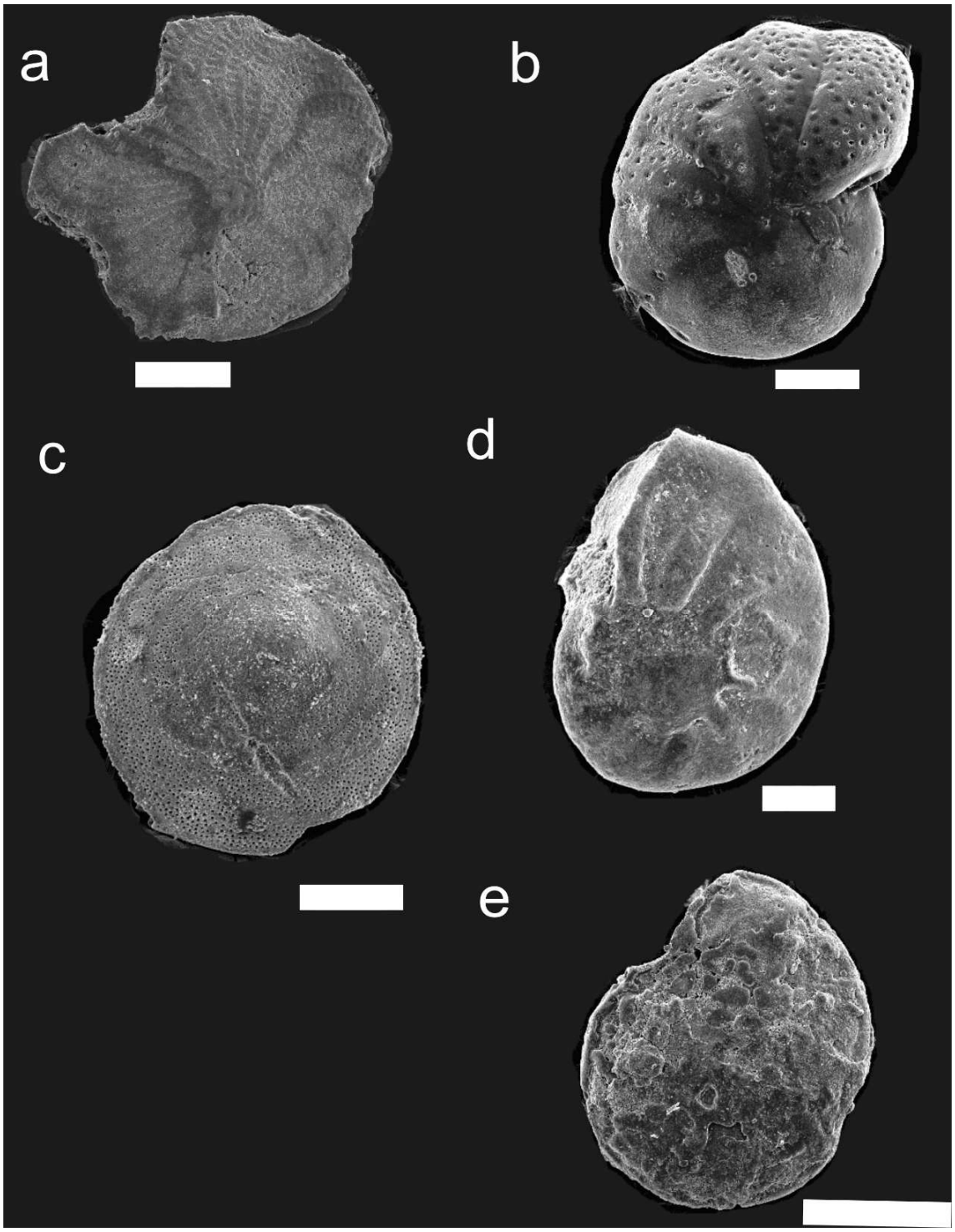
Identified species of coral



Cladocora caespitosa (Linneo, 1767). Different fragments of the coral. With the exception of samples (a) and (b), all the samples presented extended degrees of weathering, as seen in the calycinal edge, and the lack of ornamentation on the ribs. Scale= 2.0 mm.

3.3. Identified species of foraminifera

Species	Number of individuals	Observations
Elphidium macellum	2	Fichtel & Moll, 1798
Cibicides lobatulus	2	Walker and Jacob, 1798
Discorbis williamsoni	1	Chapman & Parr, 1932
Nonionella pulchella	1	Hada, 1931
Elphidium sp.	1	
Amphistegina spp.	1	
Ammonia tepida	1	Cushman, 1926
Buccella peruviana	1	d'Orbigny, 1893
Cancris sp.	1	



Electron microscopy images of foraminifera identified in the sediment: 1) *Elphidium gunteri*. 2) *Cancris sp.*. 3) *Nonionella pulchella*. 4) *Buccella peruviana*. 5) *Ammonia tepida*

4. C14 datations of marine fauna of the tsunami sediment from Sector 21, Stratigraphic unit 21100 in Utica and North Africa context

Site and localization	**Country**	**B.P.**	**±**	**BCE no CAL**	**max. CAL (2 δ)**	**Median CAL B.C.**	**min. CAL (2 δ)**	**nº lab. & material**
Utica, sector 21 Unit 21100	Tunisia	38120	360	36170 BCE	40510		39570	Beta-441.381-AMS/Coral *Cladocora caespitosa*
Utica, sector 21 Unit 21100	Tunisia	3060	30	1110 BCE	915	862	746	Beta-455.029-AMS/*Tritia corniculum*
Utica, sector 20 well 20017	Tunisia	2795	35	845 BCE	1045 1013	967 963 923	834 834	CNA-2403-AMS/S
Utica, Sector 20 well 20017	Tunisia	2765	35	815 BCE	1002 1000	903	829 828	CNA-2402-AMS/S
Utica, Sector 20 well 20017	Tunisia	2790	35	840 BCE	1041 1000	966 964 921	833 833	CNA-2400-AMS/S
Utica, Sector 21 Unit 21117	Tunisia	2770	30	820 BCE	996 999	904	832 831	Beta-490.784-AMS/S
Utica, Sector 21 Unit 21111	Tunisia	2700	30	750 BCE	904 904	830	806 803	Beta-490.782-AMS/S
Utica, Sector 21, Unit 21035	Tunisia	2700	30	750 BCE	904 904	830	806 803	Beta-405.200-AMS/S
Carthage, phase I, southern part of East Street	Tunisia	2710	30	760 BCE	910 917	832	807 804	GrN-26.091/B bos

Carthage, phase I?, Southern part of East Street	Tunisia	2540	30	590 BCE	796 798	779	547 542	GrN-26.092/B bos
Carthage, phase I?, Southern part of East Street	Tunisia	2510	30	560 BCE	786 793	762 678 671 607 602	541 415	GrN-26.479/B bos

Oldest dates about Phoenician settlements in central Mediterranan. Types of samples: B: Bone. C: Charcoal. I: Ivory. S: Seed. W: Wood. Sources: Utica in López Castro et al. 2016, 82 table 1; López Castro et al. 2020, 1319, 1322, 1324. Cartago *decumanus maximus* in Docter et al. 2005, 558 table A, 572 table B. Calibration curve Intcal20 after Reimer et al 2020. Calib v. 8.1, compared with calibration curve Intcal98, Calib v. 4.2 after Stuiver et al 1998.

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Consistent accuracy delivered on time

July 25, 2016

Prof. José Luis Lopez Castro
Universidad de Almeria
Departamento de Historia
Almería, Almería 04120
Spain

RE: Radiocarbon Dating Results.

Dear Prof. Castro:

Enclosed is the radiocarbon dating result for one sample recently sent to us. As usual, specifics of the analysis are listed on the report with the result and calibration data is provided where applicable. The Conventional Radiocarbon Age has been corrected for total fractionation effects and where applicable, calibration was performed using 2013 calibration databases (cited on the graph pages).

The web directory containing the table of results and PDF download also contains pictures, a cvs spreadsheet download option and a quality assurance report containing expected vs. measured values for 3-5 working standards analyzed simultaneously with your samples.

The reported result is accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all pretreatments and chemistry were performed here in our laboratories and counted in our own accelerators here in Miami. Since Beta is not a teaching laboratory, only graduates trained to strict protocols of the ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 program participated in the analysis.

As always Conventional Radiocarbon Ages and sigmas are rounded to the nearest 10 years per the conventions of the 1977 International Radiocarbon Conference. When counting statistics produce sigmas lower than +/- 30 years, a conservative +/- 30 BP is cited for the result. The reported d13C was measured separately in an IRMS (isotope ratio mass spectrometer). It is NOT the AMS d13C which would include fractionation effects from natural, chemistry and AMS induced sources.

When interpreting the result, please consider any communications you may have had with us regarding the sample. As always, your inquiries are most welcome. If you have any questions or would like further details of the analysis, please do not hesitate to contact us.

Our invoice will be emailed separately. Please, forward it to the appropriate officer or send a credit card authorization. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely ,

Beta Analytic Inc.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 **FAX:** 305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Prof. José Luis Lopez Castro

Report Date: 7/25/2016

Universidad de Almeria

Material Received: 7/13/2016

Sample Data	Measured Radiocarbon Age	Isotopes Results o/oo	Conventional Radiocarbon Age(*)
Beta - 441381	37770 +/- 360 BP	d13C= -3.6	38120 +/- 360 BP
SAMPLE: UT1321100/1		d18O= -4.4	
ANALYSIS: AMS-Standard delivery			
MATERIAL/PRETREATMENT: (coral): acid etch			
2 SIGMA CALIBRATION : Cal BC 40510 to 39570 (Cal BP 42460 to 41520)			

Results are ISO-17025 accredited. AMS measurements were made on one of 4 in-house NEC SSAMS accelerator mass spectrometers.The reported age is the "Conventional Radiocarbon Age", corrected for isotopic fraction using the d13C. Age is reported as RCYBP (radiocarbon years before present, abbreviated as BP, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C signature of NBS SRM-4990C (oxalic acid) and calculated using the Libby 14C half life (5568 years). Quoted error on the BP date is 1 sigma (1 relative standard deviation with 68% probability) of counting error (only) on the combined measurements of sample, background and modern reference standards. Total error at Beta (counting + laboratory) is known to be well within +/- 2 sigma. d13C values are reported in parts per thousand (per mil) relative to PDB-1 measured on a Thermo Delta Plus IRMS. Typical d13C error is +/- 0.3 o/oo. Percent modern carbon (pMC) and Delta 14C (D14C) are not absolute. They equate to the Conventional Radiocarbon Age. Calendar calibrated results were calculated the material appropriate 2013 database (INTCAL13, MARINE13 or SHCAL13). See graph report for references.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -3.6 o/oo : Delta-R = 71 ± 67 : Glob res = -200 to 500 : lab. mult = 1)

Laboratory number **Beta-441381 : UT1321100/1**

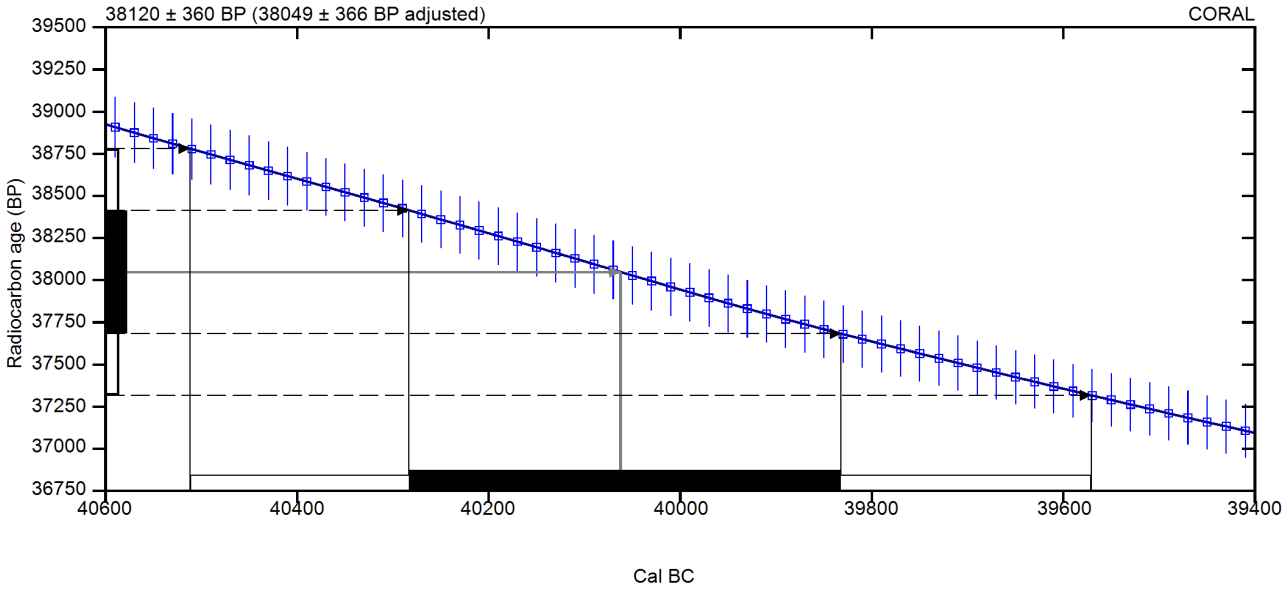
Conventional radiocarbon age **38120 ± 360 BP**

38049 ± 366 Adjusted for local reservoir correction prior to calibration

Calibrated Result (95% Probability) **Cal BC 40510 to 39570 (Cal BP 42460 to 41520)**

Intercept of radiocarbon age with calibration curve Cal BC 40060 (Cal BP 42010)

Calibrated Result (68% Probability) Cal BC 40285 to 39830 (Cal BP 42235 to 41780)



Database used

MARINE13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to MARINE13 database

Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE, Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H, Hajdas I, Hatté C, Heaton TJ, Hoffmann DL, Hogg AG, Hughen KA, Kaiser KF, Kromer B, Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Staff RA, Turney CSM, van der Plicht J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887.

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January 16, 2017

Mrs. Susana Carpintero Lozano
Universidad de Almeria
Canada de San Urbano s-n
Almeria, Andalucia 04120
Spain

RE: Radiocarbon Dating Results.

Dear Mrs. Carpintero Lozano:

Enclosed is the radiocarbon dating result for one sample recently sent to us. The report sheet contains the Conventional Radiocarbon Age (BP), the method used, material type, and applied pretreatments, any sample specific comments and, where applicable, the two-sigma calendar calibration range. The Conventional Radiocarbon age has been corrected for total isotopic fractionation effects (natural and laboratory induced).

All results (excluding some inappropriate material types) which fall within the range of available calibration data are calibrated to calendar years (cal BC/AD) and calibrated radiocarbon years (cal BP). Calibration was calculated using the one of the databases associated with the 2013 INTCAL program (cited in the references on the bottom of the calibration graph page provided for each sample.) Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric 14C contents at certain time periods. Looking closely at the calibration graph provided and where the BP sigma limits intercept the calibration curve will help you understand this phenomenon.

Conventional Radiocarbon Ages and sigmas are rounded to the nearest 10 years per the conventions of the 1977 International Radiocarbon Conference and consistent with all past Beta Analytic radiocarbon dates. When counting statistics produce sigmas lower than +/- 30 years, a conservative +/- 30 BP is cited for the result. The reported d13C was measured separately in an IRMS (isotope ratio mass spectrometer). It is NOT the AMS d13C which would include fractionation effects from natural, chemistry and AMS induced sources.

All work on this sample was performed in our laboratories in Miami under strict chain of custody and quality control under ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 accreditation protocols. Sample, modern and blanks were all analyzed in the same chemistry lines by professional technicians using identical reagents and counting parameters within our own particle accelerators. A quality assurance report is posted to your directory for each result.

As always, your inquiries are most welcome. If you have any questions or would like further details of the analysis, please do not hesitate to contact us.

Our invoice has been sent separately. Thank you for your prior efforts in arranging payment. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely ,

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REPORT OF RADIOCARBON DATING ANALYSES

Mrs. Susana Carpintero Lozano

Report Date: 1/16/2017

Universidad de Almeria

Material Received: 1/4/2017

Sample Data	Measured Radiocarbon Age	Isotopes Results o/oo	Conventional Radiocarbon Age
Beta - 455029 SAMPLE: UT13-21100/2 ANALYSIS: AMS-Standard delivery MATERIAL/PRETREATMENT: (shell): acid etch 2 SIGMA CALIBRATION : cal BC 915 - 735 (cal BP 2865 - 2685)	2630 +/- 30 BP	d13C= +1.4 d18O= +0.8	3060 +/- 30 BP

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" is corrected for isotopic fraction and was used for calendar calibration where applicable. The Age was calculated using the Libby half-life (5568 years), is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted error is 1 sigma of counting error on the combined measurements of sample, background and modern reference. Calculated sigmas less than 30 years are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C) and are reported in per mil relative to VPDB-1. Applicable calendar calibrated results were calculated using INTCAL13, MARINE13 or SHCAL13 as appropriate (see calibration graph report for references). Applicable d15N values are relative to VPDB-1 and applicable d18O and dD values are relative to VSMOW. Applicable water results are reported without correction for isotopic fractionation.

Calibration of Radiocarbon Age to Calendar Years

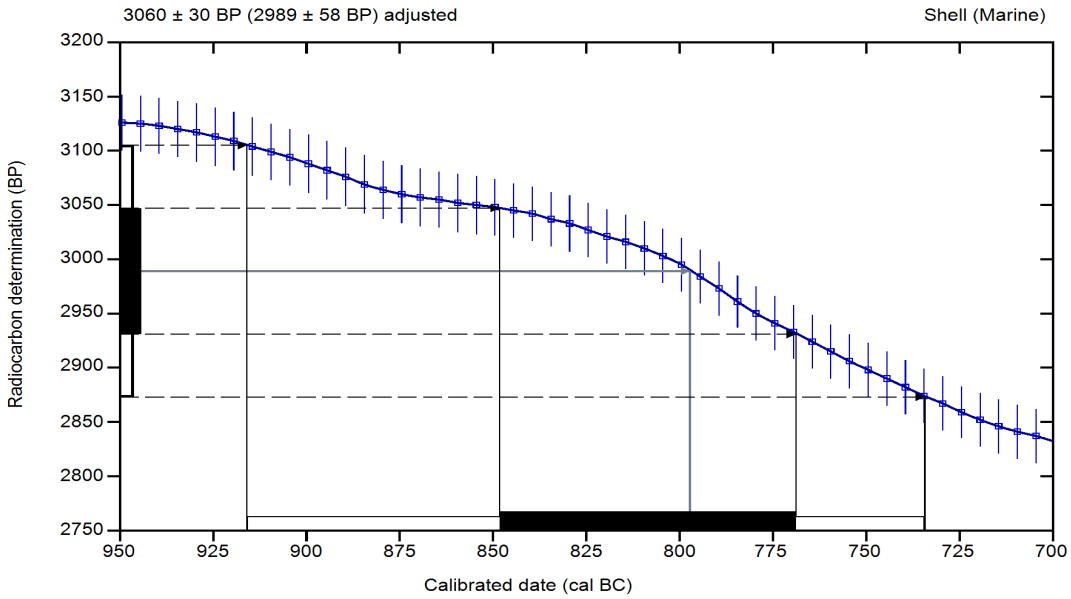
(Variables: d13C = +1.40 o/oo : Delta-R = 71 ± 50 : Glob res = -200 to 500)

Laboratory number **Beta-455029 UT13-21100/2**

Conventional radiocarbon age **3060 ± 30 BP**

2989 ± 58 Adjusted for local reservoir correction

2 Sigma calibrated result 95% probability	**cal BC 915 - 735**	**(cal BP 2865 - 2685)**
Intercept of radiocarbon age with calibration curve	cal BC 795 (cal BP 2745)	
1 Sigma calibrated results 68% probability	**cal BC 850 - 770**	**(cal BP 2800 - 2720)**



Database used

MARINE13

References

References to Intercept Method

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2) : 317-322

References to Database MARINE13

Reimer, et.al., 2013, Radiocarbon 55(4).

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