IMTO -Italian Mission To Oman-

University of Pisa

SUMHURAM

PRELIMINARY REPORT

November – December 2006

(SUM06B)



SUM06B

The second IMTO'S campaign of 2006 (SUM06B), directed by prof. A. Avanzini, started on 04/11/2006 and finished on 07/12/2006.

IMTO's activities were focused in different fields thanks to the participation of scholars of different subjects.

The two main projects concerned archaeology and consolidation of the ancient masonry structures.

Excavations were conducted, under the direction on the field of prof. A. Sedov, by dr. V. Buffa, dr. Said al Mashani, dr. B. Bottoni, dr. I. Montanaro, dr. I. Rossi and dr. F. Wiig. Dr. R. Santoni was the responsible of the topographic survey. Dr. F. Matteini was the responsible for the archaeological documentation. The interested area were: area A (residential area and city gate), area B (small gate to the sea and area in front of the storehouses) and area E (outside the city wall).

The catalogues of small finds were completed by dr. Federica Matteini and dr. Vittoria Buffa.

The updating of the general plan and the completing of the different plans relating to the different phases of the city have been made by prof. A. Sedov and dr. R.Santoni.

S. Martelli was the draftman of the small finds.

The team dealing in consolidation was under the supervision of prof. M. Sassu (Department of Structural Engineering, University of Pisa) and was constituted by eng. M. Andreini, eng. C. Cei and eng. A. Soru.

From 01/11/2006 to 10/11/2006 an intensive survey in the area of Khor Rori has been made by dr. M. Benvenuti and dr. L. Chiarantini from the Department of Earth Sciences of University of Florence and by dr. P. Pallecchi, geologist from Archaeological Superintendence of Tuscany, Florence.

Palinology analysis were made by the archaeobotanists of University of Florence, dr. Marta Mariotti, G. Lippi, on the site of Sumhuram and on the territory nearby from 01/11/2006 to 10/11/2006.

The work of IMTO has been possible thanks to the collaboration of the Office of the Adviser of His Majesty the Sultan for Cultural Affairs in Muscat and in Salalah.

Sumhuram Preliminary Report SUM06B November-December 2006-12-06

INDEX

- 1. Archaeological Report Area A Area B Area E
- 2. Future archaeological investigations
- 3. Technical Report of the Engineering team activities
- 4. Surveys

ARCHAEOLOGICAL REPORT

ARCHAEOLOGICAL PRELIMINARY REPORT (SUM06B)

November-December 2006

During the campaign in the autumn 2006 (SUM06B), which started on November 4th and finished on December 7th, the field activities were focused on the diggings at the ancient town of Sumhuram. The excavations were concentrated in several areas: in the Area A to the south of the Gate Complex, in the Area B in the south-eastern part of the city, and in the Area E outside the north-western defence wall of the ancient town.

The main objectives of the present campaign were to continue wide scale explorations of different parts of the ancient town, to arrange the most convenient trespassing roads for visitors, to beautify the general view of the site.

Area A (trench supervisor V. Buffa).

Excavations were concentrated immediately south of the Monumental Building 1, west of the ruins of Building BA5. A new room of apparently a new building was excavated here.

Room A85

The room, rectangular in layout and 3.25x2.50 m in size, was located west of the 'tower' M174 of the Building BA5 (fig.1). Its perimetral walls are the wall M17 of the Monumental Building 1 to the NE, wall M192 to the NW, wall M191 to the SE and wall M193 to the SW. The entrance to the room, 0.70 m wide, was located in the center of wall M193. The floor of the room, US214floor, was reached at the elevation of 28.07 m. The floor was well plastered. On the floor one bronze coin (Co397) and two large fragment of vessels were found. A complete whale vertebra was also present. The filling above the floor (US214), only 0.15 m deep, consisted in grayish loam mixed with few small stones, charcoals and animal bones. The following objects were recovered from US214: two complete upper stones of hands mills and a fragmentary one laid on the floor (S1039, S1040, S1038), together with several stone tools, two pestles (S1032, S1041), two polisher (S1035, S1036), two whetstones (S1033, S1034) and four oil lamps made from *Chlamys townsendi* shells (Sh282, Sh283, Sh284, Sh285). Just above US214 a charcoal sample has been taken for analysis.

Soon after the room seems to have gone at least partially out of use. The deposit above US214 has been denoted as US209. It was 1.30 m thick. It consisted in homogeneous, rather compact reddish brown loam mixed with a quantity of mud-bricks and fragments of mortar. A quantity of pottery with a high percentage of amphorae (Dressel 2-4 type) in large fragments was recovered together with a kitchen bowl with arch handle with an incised drawing. Very few animal bones and shells were recovered. The filling US209 most probably represents the collapse of the upper floor of the room and of its furnishings after abandonment or of installations on the Monumental Building 1. A number of objects were found in the deposit US209: grindings stones (S1009, S1011, S1019), whetstones (S993, S1006, S1010), polishers (S1024, S1026, S1027, S1030), a stone lid (S994), two fragments of soft-stone vessels (S1025, S1029), bronze objects (a spoon MB422, a pin MB420, a rivet MB421, a nail MB431),

oil lamps made from *Chlamys townsendi* shells (Sh277, Sh278, Sh279), a fragment of glass vessel (G88), a fragment of offering table (S1028). Numerous bronze coins were also found (Co382, Co386, Co387, Co388, Co390, Co391, Co395). At the end of the formation of the filling US209 the wall M195 was built. It consisted of only one row of limestone blocks. It lower elevation was at 29.35 m, its upper one 29.55 m.

The finds allow to date the room A85 to the 1^{st} phase of the existence of Sumhuram ($3^{rd} - 2^{nd}$ cent. BC).

Street A75

In this campaign the street A75 was excavated down to floor US22.

In the western part of the excavated area, square i 9, the floor US22 had covered the ruins of room A85. Over wall M192 the floor was reached at the elevation of 30.27 m; over wall M191 at the elevation of 29.90 m. To level the area over the ruins of the room a filling was set above US209, a kind of preparation for the floor US22 (US206). It consisted of reddish homogenous loam mixed with few pottery fragments and animal bones. The following objects were found in US206: a bronze clamp (MB413), a glass bead (G81) and a polisher (S981).

The floor US22 had been greatly disturbed by the digging of a large pit (US203) that transformed the area in a garbage dump, filled with many ashes, charcoals, burned stones from fireplaces. The following finds were recovered from US203: bronze coins (Co374, Co375, Co378), a fragment of a soft-stone vessel (S972), fragments of glass vessels (G72, G73, G77, G78, G79), a fragment of a crucible (G71), a grinding stone (S976), an iron tool (MI113), a net sinker (S980).

Over US22 and US203, US21 was removed in the area. It consisted of a thick layer of crumbled reddish brown loam mixed with a large number of roughly dressed limestone blocks and smaller stones fallen from wall M17 of the Monumental Building 1 and a quantity of fragments of mortar from the same wall. It incorporated a small quantity of pottery shards, animal bones and shells. The following finds were recovered from US21: bronze coins (Co364, Co365, Co366, Co367, Co368, Co369, Co370, Co371, Co372, Co373), a fragment of a bronze plaque (MB407), two whetstones (S973, S983).

In the eastern part of the excavated area, square i 10, the stratigraphic sequence of *strata* already found in previous campaigns above floor US22 was confirmed.

The floor was raising from East to West and from North to South. On floor US22, hard packed grayish loam, and its filling (US22), the following objects were found together with fragments of pottery and animal bones: a glass bead (G83), a crucible (G84), three bronze coins (Co379, Co380, Co399). The channel running in the SW-NE direction was cleared.

Above US22, floor US 29 consisted in reddish brown loam; the floor was trumped with small stones and sometimes with small sandstone slabs. It was reached at an elevation of 29.52 m. Few finds were present in US29: some pottery fragments, shells, animal bones, and a fragment of a bronze plaque (MB436).

The excavation of the pit US191, found during the SUM05B campaign, was completed. It had been dug for the setting of the floorUS29 and filled with burned stones, ashes and bones; some pottery fragments were also found. Two fragments of soft-stone vessels were recovered in US191 (S1046, S1047).

Above US29, US21 have been removed in the SW part of the trench. US21 consisted of crumbled grayish brown loam mixed with limestone blocks and amorphous stones. Floor US21 consisted in hard packed brownish loam, sometimes trumped with small stones. The floor has been reached at an elevation of 29.74. Few pottery shards were recovered. US21 covered the wall M219 discovered in the

SW part of the excavated area, belonging to a room of a new building. Wall M219 has a door 0.95 m wide.

Area B (trench supervisors S. al-Mashani, B. Bottoni, F. Wiig)

Excavations were concentrated in several parts of the area: in the square A77 and in the storage-rooms (the so-called 'bins') on both sides of the square.

Square A77

The entire square located between two complexes of the storage 'bins' and east of the building BB1 was unearthed during the present campaign (fig.2) Wall M167 from the north, walls M186 and M 141 from the south, and walls M163 and M168 from the west delimited the square (from the east it was delimited by the city-walls M139 and M140 with the so-called 'Small Gates'). The stratigraphy of cultural deposits determined in the A77 during the previous campaigns was confirmed in the present excavations.

A complete bronze weight (MB402, see Object card) was found on the US183 floor; a fragment of bracelet (MB403), a fragment of ring (MI 112) and a stone bead (S968) were also found in the stratum.

A fragment of stone vessel (S978; S979), a soft stone bead (969) and a bronze object which is probably a key (MB404, see Object card)) were found in the US195.

An iron hook (MI114), a bronze coin (Co 377) and a fragment of crucible (G80) were found in the US 198

Finally the US202 revealed a number of small finds such as fragments of bronze (MB414, probably a bronze vessel;MB416;MB417MB439), a fragment of glass (G85, see below); a fragment of crucible (G87) fragments of stone vessels (S898;S996;S997) and a stone bead (S988).

The total size of the deposit excavated during this campaign in the square A77 is 6.1x11.7-11.8 m. The 'Small Gates', circa 1.0 m wide, was located in the city-wall M139/M140 close to the SE corner of the square. Another door, circa 0.7 m, was located roughly in the middle of the NW wall M164/M168 of the square and led to the city interior. A steep ramp, *circa* 1.0x1.6 m in size, made from roughly dressed stones, was built above the bedrock (US202floor) in front of the door. A retaining or supporting wall M187, circa 7.1 m length and 0.5-0.6 m wide, made from one course of roughly dressed stones, was built parallel to the wall M186 on the bedrock in the SW part of the square A77. It ends with flat stone, which was probably used as a base of a pillar. One more pillar's base, 25x30 cm in size and 20 cm high, was mounted on the US202 floor on the same line in SE corner of the square, at the distance circa 6.0 m from the end of the wall M187. As we know, usually such retaining or supporting walls were built as foundations of the pillar bases. If it is so, we can suppose that a sort of roofed gallery was constructed in the square A77 along its SW wall M141/M186. The width of such gallery was circa 2.3-2.5 m, and probably the inner door of the 'Small Gates' led straight to this 'gallery'. The 'gallery' was existed during the 1st period of occupation of A77 (US198floor) and was, probably, destroyed during the next constructional phase: at least no remains of any pillars were recorded on the US195floor.

The so-called 'mint' and 'bins' excavated by AFSM mission in 1952-53 were cleaned in order to draw their real plans.

Room A81 (IXK15)

The room, roughly trapezoidal in layout and 4.1x5.1-6.5 m in size, was situated immediately south of the SE corner of the square A77 (fig.3). Walls M197, M198 and city-walls M140 and M199 delimited the room. F.P. Albright interpreted it, together with adjacent room located southwards, as 'mint'. The floor of the room as well as lower parts of the walls was plastered. Number of limestone blocks, nine of them rounded and five – rectangular, were found scattered on the floor of the room. Only four rectangular blocks were *in situ* while the rest of blocks were definitely from a collapsed structure. Shallow round pit or better to say 'imprint' in the floor was discovered roughly in the centre of the room. We may suggest that a pillar to support the ceiling was once stood here. In this case the round blocks could be considered as trunks of this collapsed pillar. The rectangular blocks found *in situ* may have been, as Albright suggested, "tool stands or bases for the craftsmen to work on". An 'imprint' of low ledges 10 cm high and 60 cm wide was traced along the city-walls M140 and M199.

Two entrances to the room were determined. One, *circa* 1.0 m wide, was located roughly in the middle of the wall M141 and connected the room with the square A77. Its threshold was about 0.5 m above the floor of the room. Later the entrance was blocked with masonry. The second door, situated in the wall M198, once connected the room with adjacent premises located southwards. It was 0.8-0.9 m wide and *circa* 0.6 m above the floor. As the previous one it was blocked with stones.

The deposits unearthed in the room above the floor level were denoted as US204. It was mostly blown up sand. The US204 revealed fragments of metal objects such as a fragment of a bronze vessel (MB411), two iron nails (MI115 and MI116), and fragments of iron tools (MI117, MI119, MI120, MI121).

Room A82 (IXL15)

The adjacent room A82, also trapezoidal in layout and 3.0-4.5x3.1-5.0 m in size, was located south of the room A81 (fig.4). Walls M197, M198 and city-walls M199 and M200 delimited the room. An 'imprint' in the plastered floor roughly in the middle of the room also suggests that a base of a pillar to support the ceiling was once stood here. Continuation of 'imprint' of low ledges was traced in the interior along the city-walls M199 and M200, which suggested that once it was a single unit without partition wall M198, which was constructed later.

The deposits unearthed in the room above the floor level were denoted as US205. Like in previous case, it was mostly blown up sand. Fragments of iron tools (MI122, MI123 and MI124) were also found in the stratum.

Room A83 (IXK13)

Long storage-room, the so-called 'bin', was located SW of the square A77 and W of the rooms A81 and A82 (fig.5). It was narrow long room, 2.0-2.1x11.0-11.5 m in size. Walls M141, M197, M202 and city-wall M200 delimited the room. The floor of the room and the interior walls were heavily covered with cement-like plaster (plaster preserved only on the lower parts of the walls).

The deposits unearthed in the room above the floor (US207) were mostly blown up sand.

Room A84 (IXK11)

Long storage-room, the so-called 'bin', was located SW of the square A77 and W of the room A83. It was narrow long room, 2.1xcirca11.0-11.5 m in size. Walls M186, M202, M203 and city-wall M201

delimited the room. The floor of the room and the interior walls were heavily covered with cement-like plaster (plaster preserved only on the lower parts of the walls).

The room was only partially excavated by AFSM mission. The untouched deposits in the unexcavated part of the room were denoted as US208 directly above the floor level and US213 above that to the surface.

US208 is a fine light brown soil packed with many small pebbles and large stones. It's average thickness was *circa* 0.70. At the southern end of A84 plaster floor is very disturbed by medium and large stones collapsed from walls M201, M202 and M203. A whetstone (S998), a grinding stone (S1005), a very small fragment of broken glass (G86), a fragment of a mortar (S1001), a fragment of an offering table (S1002), a worked bone or horn pendant (B46), a fragmant of crucible (G90), three bronze coins (CO391, CO392, CO393) as well as a fragment of clay with an imprint of a woven basket or mat (D24) were found in the US208.

US213 is a harder packed light brown soil mixed with many roughtly dressed limestone blocks and fragments of mortar. It's average thickness was *circa* 0.50 Only part of the room, for a lenght of 6.50 from wall M201, was excavated till the floor. US 213 revealed another fragment of an offering table (S1080), a stone bead (S1022), a fragment of crucible (G89), two possible shell pendants (Sh280, Sh281) three fragments of bronze plaque (MB429, MB434, MB438) and a fragment of a bronze ring (MB437).

Room A94

Long storage-room, the so-called 'bin', was located NE of the square A77, NW of the storage-room A93 partially excavated by IMTO in 1997-98 (see paper of D. Morandi Bonacossi in the *Report I*). The width of the room was 1.5 m, the appr. length was *circa* 11.0 m. Walls M167, M211, M214 and M216 delimited the room.

Only small part of the room, for a length of 1.7 m from M167, was excavated. The deposits were denoted as US211 and it is made of very compact greyish brown loam and stones mixed with roughtly dressed limestone blocks, from the collapse of the walls. The US was excavated down to the elevation of 28.74 m.

Two bronze coins (Co389 and Co394) and a fragment of nail (MI 127) have been found in the stratum together with some pottery shards, a large amount of bones and few sea shells.

Room A95

Long storage-room, the so-called 'bin', was located NE of the square A77, NW of the storage-room A94. The width of the room was 1.4 m, the length was *circa* 11.0 m. Walls M167, M214, M215 and M216 delimited the room.

Only small part of the room, 3.50 m length, was excavated. Two layers were distinguished in the accumulation of the room. The top layer designated as US212 is the natural accumulation after the abandonment of the city and is made of compact grey sand and loam mixed with stones and some roughly dressed limestone blocks. It's average thickness was *circa* 0.80-0.60m. Large amount of bones and sea shells and few pottery shards were founded.

Under US212 the stratum US 210 was excavated down to the elevation of 29.12 m. US210 is the late accumulation inside the room and is made of very compact greyish brown loam and some roughly dressed limestone blocks, from the collapse of the walls. Along the walls M167, M214, M215 large traces of fire (from which samples of charcoal have been taken) were visible. A coin (Co398), fragments of bronze object (MB424; MB435) and a bone handle (B47) were found in the stratum.

As we can judge from the results of the excavations, the huge storage complex was located in the SE corner of the ancient town. The core of the complex was square A77, from which apparently the long storage rooms, the so-called 'bins', were accessible. Unfortunately, the entrances to these rooms were mostly not determined, but this was, probably because they were situated quite high up from the floor of the square. At least in one case (room A94, see above) the entrance to the room from the square A77 was found in 0.6-0.7 m above the initial floor of the square (fig.6-7). It seems that blocked entrances to the rooms were also determined by AFSM excavations in the rooms A81 and A89. Later, when the floor level in the square A77 was raised up, the old entrances were blocked with masonry and the new ones were apparently constructed on the high level (didn't preserved because of the poor preservation of the walls).

The total dimensions of the storage complex was circa 20.0x31.0 m. Seven storage rooms (A89, A90, A91, A92, A93, A94, A95) were located to the NE of the square A77, and four storage rooms (A83, A84, A86, A87) were located to the SW of the square A77. The layout of the rooms (long narrow premises) and its interior carefully covered with cement-like lime plaster well suggested that they were used as magazines to store some products, most probably frankincense. Interesting item (D24) was discovered in the filling of the room A84 just above its plastered floor – a piece of mud with imprint of palm basket. As we know such containers were used to store and to transport frankincense from the production areas in the mountains. There is also a good parallel – Hanun storage complex with similar layout.

The functional purpose of the rooms A81 and A82 is not clear. Albright's supposition that it was the 'mint' was not confirmed during our excavations. We may suggest that both rooms were either storages or a sort of working rooms where, for instance, counting or similar fiscal practice took place.

It seems that the room A88 with central row of five pillars was added later to the complex. It could be also a storage room.

The storage complex was quite isolated from the interior of the city, and was accessible only through a narrow passage with the ramp and high threshold constructed in the NW wall M163/M168 of the square A77. It had a separate passage towards outside the city, the so-called 'Small Gates'. As far as we can judge from the available material, the complex was built during the 1st phase of the city existence (see fragment of glass alabaster of 3rd-2nd cent. BC of Egyptian (?) provenience (G85) found above the bedrock in A77 as well as early series of coinage from US198). It was also in function during the following phases of Sumhuram occupation (US195 and US183 in the A77), although underwent a series of modifications (see several layers of renovation of the cement-like floors and walls' plaster in the long storage-rooms).

Area E (trench supervisor A. Sedov).

The work at the Area E was carried out in order to beautify the external view of the ancient city and to determine the phases of construction of its fortification system. To match these objectives, the dumps remained outside the city-walls M133-M89 as well as dumps against the SE wall of the corner-tower A62 were removed (fig.8-9).

The overall impression is that the city-walls M133, M89 and the corner-tower A62 were built simultaneously during the 1st constructional phase. Even the extension of the corner-tower A62, which enlarged the square of tower in north and east directions is contemporary construction in spite of the fact that the masonry of the extension didn't bend the masonry of the SE wall of the tower.

The foundation of the SE corner of extension of the tower was reached at the point 22.58. The foundation of the corner between extension and the SE wall of the corner-tower A62 was reached at the point 23.22. It means that the outer walls of extension were built on the slope, and in spite of significant efforts of its consolidation (see below) the elevation was quite significant and caused the forthcoming destruction, especially in the SE corner of extension.

Before the construction of the corner-tower and its extension, the natural slope was consolidated with a thick (8-10 cm) layer of cement-like lime plaster. The lowest rows of the masonry of the corner-tower and its extension were placed on this layer. A sort of lime pavement was constructed also on the slope started from the lowest row of masonry.

An almost complete bronze lamp (MB418, see the Object card) and large lime-stone incense-burner (S999, see Object card) were found in the corner formed by the wall M69 and the SE wall of the corner tower A62 (US157). A bronze coin (series with eagle) (Co385) was also found in this layer. The same US157 revealed a triangular anthefix (S1023) made from lime-stone (it crowned the top of the corner-tower A62), a toe of amphora Dressel 2-4 type, fragment of kitchen bowl with arch handle. All these finds could date the construction of the corner-tower A62 and its extension close to the 1st period of the city existence (3rd-2nd cent. BC).









Sumhuram, Area A, A85 phase 1



Sumhuram, Area A, A85 phase 2











Sumhuram, Area B, A77 Section





Sumhuram, Area B, A77 Section



Fig. 1: Area A, room A85, view from north east



Fig. 2: Area B, room A77, view from north west



Fig. 3: Area B, room A81, view from south east



Fig. 4: Area B, room A 82, view from north



Fig. 5: Area B, room A83, view from south west



Fig. 6: Area B, entrance to the square A77 from room A94



Fig. 7: Area B, entrance to room A94 from square A77 blocked with masonry



Fig. 8: Area E, view of M133 and M89



Fig. 9: Area E, corner tower A 62

Registration Nr. SUM06B US183,13 floor MB402 Provenance Area B, A77 Drawing code Nr.				
Definition	State of	Measures		Shane
Weight	nreservation	1 5		composite
weight	good	w 3.5		composite
Material	Preserved	h. max. 5.2		Section
Bronze	part	th.		rectangular
	complete	diam.		6
Complete rectangula short sides. The han SA letters, but the ob The weight of the ob	ar shaped weigh dle is rounded i oject needs to bo oject is 370 gr.	ht. On the top it has in section. On both w e restored. The high o	a handle, placed in the reight's sides there are profined for the rectangular body is	middle of his robably some 2.5.
Responsible Federica Matteini		Date 07/11/06		

Registration Nr. SUM06B US195,6 MB404 Provenance Area B, o 12-13, A77		SURCE USING	INGLAGA
Drawing code Nr.			
Definition	State of preservation	Measures	Shape
Key?	good	1. max. 9 w.	Composite
Material	Preserved part	h.	Section
Bronze	Complete	th. max. 0.4	Rectangular
Description Bronze object, probabl other extremity is flatte (d. 0.3) in the middle. This object is very simi	y a key, made from a r ened and worked in orde lar to MB352 and MB33	rod twice folded at one er to have a rhomboidal 57, found during SUM0	of its extremities. The shape with a little hole 5B.
Mill 332			IE 357
Responsible		Date	
Federica Matteini		09/11/06	

Registration Nr.			
SUM06B	A COLUMN TO A COLUMN TO A	- National States of the	
US157,3			
MB418	-	Allow an	- Alle
Provenance	- 10 M		
Area E, corner tower		A	
A62		and the	
	COLUMN STREET		
Definition	State of preservation	Measures	Shape
Lamp	fair	1.	
		W.	~ .
Material	Preserved part	h.	Section
Bronze	Fragments	th.	
Description		diam.	
Description	and at the compan of MOO	and AG	
Freemontary bronze ler	and at the corner of Mas	allu A02.	ng The object people
riaginentary biolize lai	np, broken in nve nagn	ents, the handle is missi	ing. The object needs
to be restored.			
Responsible		Date	
Responsible Federica Matteini		Date 22\11\2006	

Registration Nr. SUM06B US157,4 S999 Provenance Area E	SLAMAND US15/2-4 3935		
Definition	State of preservation	Measures	Shape
Incense burner	fair	1. 41 w. 20	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Material	Preserved part	h.	Section
Whitish compact	Complete	th.	
limestone covered by a		diam.	
yellowish-brown patina			
Description			

Complete incense burner with a high truncated pyramid shaped base (41x20; at his top 10x13), surmounted by a projecting cuboid element (18x18, th. 14), broken on two sides. On the top there is a recess, partially preserved, without traces of burning. The rim (2.5x2.5), very damaged, is straight. The surface of the object is roughly dressed: only the base is worked in form of a fluted column with a rectangular base. One side of the object is particularly damaged: breakages are visible at the lower edge of the cuboid element and at the corresponding edge of the base; the entire side of the base is work. Other breakages are visible at the other side of the base.

The object has been found at the corner of M69 and tower A62.

Responsible	Date
Federica Matteini	23\11\2006

Registration Nr. SUM06B M15,1 G91 Provenance M15 (filling)			
Definition	State of preservation	Measures	Shape
Crucible	good	1. 4	Conical
		W.	
Material	Preserved part	h.	Section
Vitrified clay	complete	th.	
	_	diam. 3	
Description Complete conical-shap external surface is clea inside.	ed crucible, the base is p rly vitrified and black in	pointed. The rim's thickn colour. Some traces of	ness is 0.3 cm, the bronze are visible

Responsible	Date
Federica Matteini	2\12\2006

Future investigations

The results of the excavations carried out at Sumhuram by the Italian Mission to Oman (IMTO) during more than ten campaigns have already made an important contribution to the general understanding of the history of site and also to its presentation to the general public. For further studies the following suggestions might be considered.

For academic research:

- 1) In order to understand more fully the history of the site the wide scale excavations at the Area A and Area F should be continued. The main objectives of these excavations will be to determine the real planning of the most important parts of the ancient city: around the Monumental Building 1. At the areas the excavations of the building BF6 closing the temple square from the east should be completed; the streets A68 and A80 should be excavated down to the earliest strata, which give us as well as excavations of the new structure representing by the room A85 an important contribution for characteristic of the most ancient period of the city existence. At the Area B it is the most important to complete excavations of at least one of the long storage-rooms NE of the square A77 (for instance, the room A95). It is also important to start the cleaning of the old excavations of AFSM. As we can judge from the similar works at the Building BA6, the majority of the structures must be documented (descriptions and plans) according to the modern standarts of excavations. These works could be planned for 2007-2008 seasons.
- 2) The works inside the Monumental Building 1 to understand fully the purpose of its construction (if it was not a temple, for which purpose such a monumental edifice was erected?), to determine its constructional phases and to correlate them with building activities in other areas of the ancient city should be also started. But it must be stressed that archaeological investigations, especially excavations inside the Monumental Building 1, should be carried out simultaneously with consolidation works of the monument (the inner facades of the walls M17 and M18 should be rebuilt prior the excavations). These works could be planned for 2007 (excavations outside the building) and 2008-2009 seasons (consolidation works and excavations inside the building).

For presentation to general public:

- 1) Consolidation of the city-walls M15, M133, M89 and the corner-tower A62 should be scheduled in the next seasons.
- 2) The eastern part of the city-wall as well as the north-eastern corner of the tower A6 of the Gate Complex requires more attention in the nearest future. Its restoration will beautify significantly the general view of Sumhuram especially from the cafeteria. A trench along the foundation of the wall M3 should be excavated previously any consolidation works of the masonry will start. This work of restoration, asked by HE Abdulaziz Al-Rowas to IMTO, should be scheduled in the 2007A season.

IMTO – Italian Mission to Oman University of Pisa

TECHNICAL REPORT of the Engineering team activities

November - December 2006

TABLE OF CONTENTS		
		<u> </u>
	PREFACE	
1	CENERAL DESCRIPTION OF THE INTERVENTION	
1.		
	1.1 Restoration of wall M15	
	1.2 Restoration of the SMALL GATE	
2.	WORKS ACCOUNT	
	2.1. Restoration of wall M15	
	2.1.1. Used materials	
	2.1.2. Dismantling phase of the corner	
	2.1.3. Rebuilding phase of the corner	
	2.1.4. Dismantling phase of M15 western side	
	2.1.5. Rebuilding phase of M15 western side	
	2.2. Restoration of the SMALL GATE	
	2.2.1. Used materials	
	2.2.2. Dismantling phase	
	2.2.3. Rebuilding phase	
2		
3.	CUNCLUSION	
	ANNEX A. MORTAR TESTS	
	ANNEAA, MONTAN LEDIN	
	ANNEX B: ADDITIONAL WORKS	

PREFACE

In relation to the archaeological campaign hold by the Italian Mission to Oman in the site of Khor Rori from November the 6^{th} to December the 7^{th} , and managed by prof. Alessandra Avanzini of the Department of Ancient History of the University of Pisa, structural restoration interventions were programmed on collapsing or collapsed masonry walls, with the aim of achieving a satisfactory level of safety to permit further studies and the opening of the site to public visitors.

The programmed restoration interventions mainly consisted in:

- dismantling and reconstructing of the collapsing west corner of M15;

- removing of the steel structure made at the end of the 90's with the aim of supporting the collapsing corner;
- dismantling and reconstructing of the collapsing western side of wall M15, between the corner and M19;
- restoration of the "small gate", located in the south-eastern side of the city complex, between M139 and M140.

Restorations were done following the same proceedings of the past campaigns, according to the UNESCO issues.

1. GENERAL DESCRIPTION OF THE INTERVENTION

1.1. Restoration of wall M15

M15 wall is a masonry structure belonging to the city complex. It is characterised by a rectangular footprint, with a longer side of 4,6 m and a smaller one of 3 m; the height varies along its borders, reaching a maximum of 3.30 m. The eastern side of the wall had been consolidated in the past campaign and just needed to be covered with small stones and mortar ("beautification").

The crucial part of the intervention was the consolidation of the west corner behind the west side of M8 and the subsequential removing of the steel support. The corner was in a very bad state of preservation caused by the pushing of the filling clay. A steel pipe structure was made at the end of the 90's with the aim of supporting the wall and stop the spread of the high rotation of some stones. This structure was 7.3 m long and 2.8 m high and weighted more than 60 ton.

Beyond achieving a satisfactory level of safety, the structural integrity of the wall has been improved, and particular attention has also been payed to respect the historical aspect of the wall and to give it a pleasant appearance, consistent with the other ancient walls of the site.

In order to achieve this purposes, it has been determined the most adequate construction technique to reproduce as closest as possible the type of masonry used in the past, on the base of what was observed on the wall itself and on the surrounding ones. The ancient building technique and the stones arrangement haven't been changed, excepted only for those areas where some problems of stability and duration have been noticed.

In this outlook, the earth used in the past to link adjacent stones has been replaced by lime mortar in the lateral surface region, to realise a more stiff and resistant structural system. A proper mix has been chosen to reproduce as closest as possible the colour of the old stones. The rebuilt part has been separated by the old undamaged one by using a geotextile film inserted in the first mortar joint.

On the other hand, small stones and lime mortar have been employed in rebuilding the inner part of the wall, with the only difference that the mortar has been done with no colors and using bigger granulometry sand to increase the mixture cohesion and reduce the possibility of the loss of internal transverse strength during the raining seasons. To realize the upper closure of the wall, some stones have been put in an irregular arrangement, so that the wall looks similar to the others in the site.

The dismantling of the damaged part of the corner has started from the top down to the integer level, which was the same level of the stone above the steel support.

This intervention has so consisted in four different phases:

- numbering of the stones which needed to be removed, by the mean of a graphite stick;
- removing of the stones of the corner and of the clay inner part;
- removing of the steel support;
- rebuilding of the corner.

After the restoration of the corner, the restoration of M15 western side has been done. As in the above described restoration of the corner, the programmed intervention has involved static, historical and aesthetical aspects, since it was aimed to put the wall in safety conditions, besides to endow it with a pleasant appearance, consistent with the other masonry structures in the site. To attain this purpose, a first phase has been prescribed, in which the damaged parts of the wall have been dismantled, while the integer ones have remained unmodified. The removed stones have been heaped nearby, in the outlook of their future usage during the rebuilding phase. As this operation has been fulfilled, the wall has been rebuilt, using the same technique already described for the corner restoration. The reached level constitutes an authentic estimation of the minimal height the wall featured in the past, using the collapsed stones removed before, and thereby represents an attainable level in terms of archaeological correctness. Prior to the wall rebuilding, a narrow geo-textile strip has been applied on the upper face of the old stones on the external surface, to remark the separation between the unmodified ancient masonry and the new part introduced with the present restoration.

For this reason the intervention program has been characterized by the following aspects:

- rebuilding the masonry structure according the original order;
- preserving the original aspect of the wall, according the UNESCO issues;
- denoting the rebuilding phases by way of a geotextile layer between the unimpaired wall and the reassembled part.

To realize the upper closure of the wall, some stones have been put in an irregular arrangement, so that the wall looks similar to the others in the site.

1.2 Restoration of the SMALL GATE

The so called Small Gate is a gate located in the south-eastern side of the city complex, in front of the sea, between M139 and M140. Since the gate goes through the external walls of the city complex, it is characterised by two openings; the one on the inner side is 0.60 m large while the one on the outer side is 0.80 m large. The thickness of the external wall, which means the distance between these two openings, is 2.0 m. Even if this part of the walls didn't show significative structural problems, a restoration intervention was required because of the historical importance of the small gate, which is also planned to be one of the parts of the city complex where visitors are allowed to go.

The problems which have been noticed in the small gate are the almost complete collapse of side M140, both in the inner and outer corners and in the central part of the wall, and the partial collapse of the outer and inner corners of side M139.

So the intervention consisted in removing the rows of stones which were crumbled down, until a level where the stones showed structural integrity and a proper arrangement. Then, a film of geotextile has been posed in the first mortar joint, with the aim of separating the new rebuilt part of the wall from the old one. The wall has then been rebuilt by using local stones found on the environment around, with the same building technique described in § 1.1. Particular care has been given to the positioning of the angular stones, which bounded the small gate both in its inner and outer side, in order to give, as far as possible, a reasonable historical appearance to the whole gate.

The reached level constitutes an authentic estimation of the minimal height the walls featured in the past, and thereby represents an attainable level in terms of archaeological correctness.
At the end, in order to realize the upper closure of the walls, some stones have been put in an irregular arrangement and linked together with mortar, so that the walls look similar to the other ruined ones in the site.

2. WORKS ACCOUNT

2.1. Restoration of wall M15

2.1.1. Used materials

As in the past campaigns, walls have been rebuilt using local stones, earth and a particular mortar mixture.

- *Mortar mixture*. The mortar mixture has been determined by making several tests (see annex A) with different proportions of colour and lime and two kind of sand in order to obtain the right colour. The chosen mixture was essentially determined by observing the outcomes of the mixtures previously employed in the site of Khor Rori. On the base of such assessments, it was decided to give up the cement component and neither to employ natural earth withdrew from the ground, according to the UNESCO issues. This because many mixtures containing those elements showed in the past sensible colour variations, reasonably as a consequence of chemical reactions which led to formation of mineral salts. In this aim, artificial brownish sand, produced crushing local stones, was selected; and the 1:4 mix proportion was regarded as the most suitable in this case.

After these tests, the natural colours proportion has been set to: 1 part of yellow, 0,5 part brown, 20 parts of lime. So the standard mixture was made with four buckets of sand and one bucket of the previous mix of lime and colours.

- *Stones arrangement.* The masonry units were withdrawn from the heaps present in the site, resulting from dismantling phase.

- *Surface refinement*. After rebuilding the wall for a certain length, the external surface was adjusted filling carefully the leaks between the stones with mortar, and then, as soon as the mortar had became enough consistent, smoothing the joints with soft brushes. Finally, the stones external faces have been cleaned with sponges and clear water.

2.1.2. Dismantling phase of the corner

The restoration works on the corner of wall M15 began on November the 6th with the surveying of the collapsed zone of M15 corner and the numbering of the stones which needed to be removed.

The crumbled material has been removed starting from the top of the wall, by means of hand instruments. Ten rows of stones have been removed from the two sides of the corner. The stones and the earth forming the wall body were heaped nearby, in the outlook of a following usage during the wall reconstruction. No stone was removed from those parts of the wall featuring structural integrity and a proper masonry arrangement.

After the removing of the stones has been terminated, the steel support has been removed by knocking on it and pulling it down with ropes. It has then been lifted and put away by the help of the motor scraper (JCB). All these operations have been terminated on November the 12th.

2.1.3. Rebuilding phase of the corner

On November the 13th, after the removing phase had been terminated, the rebuilding operations on the corner of wall M15 have been started and they have been terminated on November the 28th with the completion of the upper closure. The reconstruction works mainly concerned the following issues:

- *Outer sides*. They have been rebuilt on the wall outer structures remained essentially undamaged over the centuries, which were saved in the dismantling phase, and they were realized according to the abovementioned procedure, elaborated through the wall sampling. A film of geotextile has been posed in the first mortar joint to separate the new rebuilt part of the wall from the old one.

- *Inner part*. The wall body was rebuilt using stones and mortar, the latter made by using a different kind of sand then the one used in the external sides and with no colours. This kind of mixture, instead of local earth which had been used for the other walls in the past campaigns, has been chosen in order to give more strenght to the restored corner.

- *Upper closure*. It was realized arranging stones irregularly, to reproduce the appearance shown by the tops of the other walls. At the end, every hole among the stones has been closed with mortar, and the joints have been then smoothed with soft brushes, as usual.

2.1.4. Dismantling phase of M15 western side

The restoration works on the western side of wall M15, between the corner and M19, began on November the 18th with the surveying of the wall.

It has been decided to start this operations before the rebuilding phase of the corner had been completed because it has been seen that the dismantling of this part was also useful for a easier and more safe reconstruction of the corner, which could so proceed at the same time.

In front of M15, on its very western side, it has been found another smaller and less tall wall, built in a second phase, with the aim of retaining the collapsing original one. Both walls were in a very bad state of preservation, showing high rotation, and leaned on the big embankment in front of them. In the outlook of following excavation and removing of the embankment, it has been decided to remove also the higher step of the embankment, up until reaching a reasonable high. The crumbled material has always been removed starting from the top of the wall, by means of hand instruments. Ten rows of stones of the wall M15 have so been removed but no stones of the retaining wall in front of it have been removed. Certain amounts of the earth of the filling have also been removed, with the aim of both lightening the pushing body of the wall and creating enough space for a later easier reconstruction. The stones forming the wall body were heaped nearby, in the outlook of a following usage during the wall reconstruction.

This phase has been terminated on November the 26th.

2.1.5. Rebuilding phase of M15 western side

On November the 26th, after the dismantling phase had been completed, and the beautification of the corner was almost completed, the rebuilding phase of the western side of wall M15 has started.

A film of geotextile has been posed in the first mortar joint to separate the new rebuilt part of the wall from the old one. The stones used to rebuild the wall were the same ones which had been removed from the outer side and heaped nearby, as described in § 2.1.4.

After the ten rows of removed stones have been rebuilt with the same technique described in § 2.1.3., it has been decided to built an additional row of stones with the aim of better retaining the earth behind. The wall body has always been rebuilt using stones and mortar, the latter being made by using a different kind of sand then the one used in the external sides and with no colours.

On December the 3^{rd} , all the eleven rows of the wall have been completed, and then the realisation of the upper closure has been started. Small stones and mortar have been used to realise the upper closure, which has been shaped with a light slope towards the outer region of the wall, in order to facilitate the rainwater runoff. The upper and back part of the closure reaches the highest level of the wall behind. All these operations have been completed on December the 6^{th} .

2.2. Restoration of the SMALL GATE

2.2.1. Used materials

The same materials and the same procedures described in § 2.1.1. have been used.

2.2.2. Dismantling phase

The restoration works on the Small Gate began on November the 26th, with the surveying of the walls.

The crumbled material has always been removed starting from the top of the walls, by means of hand instruments. Three rows of stones of the wall M140 have so been removed, and only some stones of the corners of wall M139, in order to create enough space for a easier positioning of the angular stones. Certain amounts of the earth of the filling of M140 have also been removed, with the aim of both lightening the pushing body of the wall and creating enough space for a later easier reconstruction. The stones forming the wall body were heaped nearby, in the outlook of a following usage during the wall reconstruction.

This phase has been terminated on November the 26th all the same.

2.2.3. Rebuilding phase

On November the 26th, after the dismantling phase had been completed, the rebuilding phase has started.

A film of geotextile has been posed in the first mortar joint to separate the new rebuilt part of the wall from the old one. Some of the stones used to rebuild the wall were the same ones which had been removed from the outer side and heaped nearby, and some others were found in the environment around. In order to give to the small gate its most probable original appearance, the angular stones found nearby have been used, paying particular attention to their positioning.

After the three rows of removed stones on wall M140 have been rebuilt with the same technique described in § 2.1.3., it has been decided to built other three additional rows of stones with the aim of better retaining the earth behind and reaching a level which constitutes an authentic estimation of the minimal height the walls featured in the past, and thereby represents an attainable level in terms of archaeological correctness. The wall body was always rebuilt using stones and mortar.

On wall M139 side, the angular stones have been positioned and linked together with mortar.

On November the 28th, all the stones of the walls M139 and M140 have been fixed, and then the realisation of the upper closure has been started. Small stones and mortar have been used to realise the upper closure, which has been shaped with a light slope towards the outer region of the wall, in order to facilitate the rainwater runoff. The upper and back part of the closure reaches the highest level of the wall behind.

All these operations have been completed on November the 29th.

3. CONCLUSION

When all the abovementioned works have been successfully completed, some "cleaning" interventions have been programmed. In particular, it has been started the dismantling of the embankment in front of the western side of M15, with the help of the motor scraper (JCB). But not all the embankment has been completely removed. In fact, its more western side, just the one in front of the small retaining wall in front of M15, has just been reduced giving to it the same shape it had before, in order to retain the abovementioned retaining wall, which still lays in unknown preservation conditions.

Then, it has been tried to dismantle the concrete base of the steel structure which has been removed at the beginning of this campaign (see § 2.1.2.). It has been tried to remove it by the means of a pneumatic hammer and a electric drill, but some vibrations problems have been encountered, since the concrete

base was connected to wall M8. It has so been decided to stop the usage of such instruments and continue the dismantling phase by the only mean of hand instruments, in order not any safety problem to occur. At the very end, the earth and the stones remained in front of the wall after the works have been removed, and all the working instruments have been put to their place.

ANNEX A: MORTAR TESTS

Two groups of tests (Group A and Group B) were made with the aim of finding the right colour of the mortar, as close as possible to the colour of the natural earth.

In each test an artificial brownish sand has been used, produced crushing local stones. In the samples belonging to Group A, the sand had bigger granulometry and lighter colour. The 1:4 mix proportion was regarded as the most suitable in each test.

Group A consisted in 5 tests:

- Test 1A: 20 parts of lime, 1 part of yellow, 1 part of brown, 1 part of red;
- Test 2A: 20 parts of lime, 1 part of yellow, 0.5 part of brown;
- Test 3A: 20 parts of lime, 1 part of yellow and 1 part of brown;
- Test 4A: 20 parts of lime, 0.5 parts of yellow and 1 part of brown;
- Test 5A: 20 parts of lime, 2 parts of yellow and 0.5 parts of brown;

Group B consisted in 3 tests:

- Test 1B: 20 parts of lime, 1 part of yellow and 0.5 parts of brown;
- Test 2B: 20 parts of lime, 2 parts of yellow and 0.5 parts of brown;
- Test 3B: 20 parts of lime, 1 part of yellow.

At the end, the mortar tests have been compared with ancient stones and natural earth and the test 1B has been chosen as the most suitable color.

ANNEX B: ADDITIONAL WORKS

In this campaign some coverings and beautification of three walls have been completed, fixing the stones of the top with mortar and brushing the joints with a wet brush. These works referred to M8, M15 and tower A61, already restored and consolidated in the past campaign SUM06A.

Salalah, December 06th 2006

The staff of the Department of Structural Engineering – University of Pisa: Mauro Sassu (co-ordinator), Marco Andreini, Chiara Cei, Alessandro Soru.



M15 before restoration



M15 after restoration



SMALL GATE before restoration



SMALL GATE after restoration



Mortar test

SURVEYS

ARCHAEOMETRIC ANALYSES ON POTTERY, STONE VESSEL AND PLASTER OF THE ANCIENT TOWN OF SUMHURAM (DHOFAR, SULTANATE OF OMAN) Report of the season October December 2006.

<u>Pasquino Pallecchi</u> Geologist, Archaeological Superintendence of Tuscany. Florence, Italy. Salalah, 2 – 10 november 2006

A great amount of archaeological evidences of extraordinary variety were discovered in the excavation of the ancient town of Sumhuram. This allowed to start a detailed analytical survey on the different kinds of objects, in order to define both the composition and the technological features. Such a study gives results that are of primary importance for identifying which raw materials were used to produce the various handworks. Ceramic pots and stone vessels are the most significant materials; their study enables to reconstruct the relations between men and environment, and also the import-export trading routes.

The present expedition gave an opportunity to examine a significant portion of ceramic materials and stone vessels from the ancient town of Sumhuram. It was possible to carry out a preliminary sampling on amphorae, jars and common pottery. The analyses on these materials will give valid information about the production techniques and the hypothetical provenance of ceramic handworks.

Some samples were taken also from vessel stones, mud bricks and plaster, in order to point out probable interactions in the supplying of raw materials for the different kinds of objects. A geological survey in the surroundings of Khor Rori allowed to take samples of hypothetical local raw materials.

Sampling

Sampling concerned the following findings, depending on the observation of macroscopic features of different materials.

Anphorae:

SUM 01A US79 nn. 10, 11, 12, 13 SUM 02A US 99 n.6 SUM 02A US100 n. 8 (fig. 1 and 2) SUM 02A US113 nn. 2, 3, 10 SUM 03A US 3 n. 4 SUM 03A US 125 nn. 17, 45, 49, 53, 54, 56 SUM 04A US 114 n. 8 SUM 00B US 48 n.8 SUM 00B US50 nn.19, 20, 21, 22, 23, 24, 26, 27, 38

Pottery, area A, 03A e 06A:

SUM 03A US 56 nn. 14, 18, 19, 21; SUM 03A US 80 nn. Street, 9, 11, 16, 19, 22, 27, 31, 37; SUM 03A US 119 n. 1 SUM 03A US 120 nn. 1, 2, 7, 8; SUM 03A US 121 n. 3; SUM 03A US 126 n. 8; SUM 03A US 127 nn. 6, 7, 8; SUM 03A US 132 n. 1; SUM 06A US 106 n. 22 SUM 06A US 153 n. 3 SUM 06A US 172 nn. 4, 5, 6, 9 SUM 06A US 187 n. 6 SUM 06A US 195 nn. 1, 2, 4, 6, 8, 17, 23, 26, 28 SUM 06A US 193 n. 3

Sampling of pottery suggested by Prof. Sedov:

SUM 0A lucerna; SUM 00A US 48 n. 10; SUM 00A F47/1, US 29 n. 5; SUM 00B US 48 n. 2, 7; SUM 00B US 56 n. 4; SUM 00B US 58 n. 9; SUM 03A US 29 n. 3; SUM 03A US 93 n. 29; SUM 03A US 122 n. 1; SUM 03B US 84 n. 70; SUM 03B US 93 nn. 35 e 30; Sample s.n.

Jar. Comparison samples suggested by Prof. Sedov:

Jar, Ain Humran (preislamic). Sample 1, 2, 3, 4, 5, 6, Shisr.

Local alluvional deposit :

Some samples were taken to identify the raw material for the local ceramic production. *Red silt*, Khor Rori (Fig. 8), *Clay*, West Khawr and Taqah areas.

At the present time we are analysing amphorae's samples; the other samples will be examined afterward.

The sampling for the provenance study of ceramic products will be arranged on the base of the analysis results.

Stone Vessel

SUM 03A US22 S543 (fig. 3, 3a); SUM04A US 54, 4 S711; SUN 01A S193; SUN 01A S175 US90; US 85 (2 fragments); Khor Rori 01A, Room A22;

The preliminary survey on these materials principally shows that ophiolite comes from the southeastern Oman. In fact, the vessel stones consist in great measure of serpentine (fig. 3, 3a). Only one specimen is made of mica-schists near Mirbat.

The research on raw materials even provided the sampling on walls coating materials, as well as on a mud-brick with the respective filling. Analyses on these materials might improve and complete the information about the raw materials provenance.

Mud-brick and plaster

- SUM site 1 Mud-brick
- SUM site 2 Mud-brick filling.
- SUM site 5 Plaster (fig.5)
- SUM site 7 Plaster (fig. 6, 7)
- SUM site 9 Plaster, Monumental Building B1 M17 (fig. 9)

The analyses on these samples might suggest which raw materials were used for the production of the town walls mud-bricks, as well as those used for the inside walls coating.

Analyses results will also be revealing of plasters conservation state.



Fig. 1. Fragments of amphorae SUM 02A US100 n. 8.



Fig. 2 .Amphorae SUM 02A US100 n. 8: sample for analysis.



Fig. 3. Fragment of vessel stone SUM 03A US 22.





Fig. 4. Sampling of mud-brick



Fig. 5. Sample SUM site 5, plaster.



Fig 6. Wall made of roughly worked stones assembled dry and plaster.



Fig. 7. Wall made of roughly worked stones assembled dry and plaster: samples of stone (1), coating (2) and plaster (3).



Fig. 8. Red silt near Khor Rori.



Fig. 9. Monumental Building B1 M17, plaster.

Report of the Preliminary Field Survey at Khor Rori, November 2006

Dr. Laura Chiarantini, Dipartimento di Scienze della Terra, Università di Firenze, Italy

Our research team at the Department of Earth Sciences, University of Florence, is currently involved in a number of archaeometallurgical projects in Tuscany and elsewhere mainly focussed on the characterization of metallurgical processes and provenance of smelted metals.

In the framework of a cooperation with Alessandra Avanzini and coworkers, one of us (Laura Chiarantini) took part in a preliminary field survey (1st-10th November 2006) at Sumhuram, (Khor Rori, Oman). Our main task has been the inventory, macroscopic description and preliminary classification of slag samples excavated in the course of recent (2000-2006) archaeological campaigns and stored in the Al Balid Museum. The main goal was to obtain a preliminary, general view of metallurgical production at this site by analysis of slag's macroscopic features (colour, texture, porosity, weight, etc.).

IRON

Most of the investigated slags can be ascribed to the <u>iron production chain</u>. This basically includes two main step: the bloomery process (by which iron ores are reduced to raw iron metal, the bloom) and the smithing process, during which the final iron objects are produced by hot-working the bloom (including heating, quenching, and hammering). Through smithing not only the external shape, but also the inner structure, composition (and hence physical properties) of the raw iron bloom are deeply modified.

All iron slags from Sumhuram so far analysed can be attributed to the smithing step. They are planoconvex slags, (Fig. 1a), formed by accumulation of fused material (metallic particles, slag inclusion, fluxes, furnace lining fragments, charcoal...) in the lower part of the smithing hearth (Fig. 1b).



Fig. 1a - Typical plano-convex slag from Sumhuram (section and top views). Fig. 1b – Formation of plano-convex slag on the bottom of smithing hearth.

Macroscopic investigation of samples allowed us to recognize different types of plano-convex slags on the basis of their shape, texture and thickness. At the moment it is not possible to relate one given type of plano-convex slag to a specific smithing step, for example if they are related to purification of row iron ingots rather than to shaping and/or forging of iron tools. Further mineralogical and compositional analyses could eventually help to refine the metallurgical interpretation of these slags.

About 50 kilos of smithing slags have been found during 2000-2006 archaeological excavation. In general the total weight of slags is a good indicator of the "amount" of metallurgical work carried out at a certain site, and not of the "type" of working activity.

Only scanty evidences of furnaces have been identified. This is not surprising, since in most ancient sites metallurgical structures are only poorly preserved. Thus we could observe "in situ" only the remains of one smithing earth, located in the B area, building BB1, on the ground floor of room A73. It consists of a fireplace dug into the floor. It was an elongated furnace (0.75 m long, 0.44 m wide and 0.26 m deep) made by stone blocks (Fig. 2). The furnace was completely filled with light grey ashes mixed with few burnt bones, marine shells and pieces of charcoal.

Some slag portions was still attached to furnace wall and abundant hammerscales were scattered around the furnace. This finding suggests the presence of very simple organization of smithing workshops. Furnaces were probably partially excavated into the soil and made up with stone blocks. From the size of plano-convex slags we can deduce that the inner size of these furnaces should have been comparatively small.



Fig. 2 – The smithing heart found in Room A73

COPPER

Very few slags related to copper metallurgy have been recognised, especially if compared with the abundant copper/bronze findings.

Due to the scarcity and small size of copper slags it is not possible to ascertain (at least at this stage of the research) what type of metallurgical process they belong to. Nevertheless the copper slags we have analyzed (only from a macroscopic point of view) seem to be more properly related to post-reduction, copper alloying or metal working processes, rather than to primary copper smelting. However, further laboratory analyses will be necessary to confirm this hypothesis.

A number of crucibles probably employed for copper/bronze melting and refining have been also identified. We have sampled small portions of the metal residues adhering to crucibles' internal surfaces for chemical analyses, which could provide additional information on refining processes at Sumhuram.

We could not find any fragment of copper or iron ores among metallurgical wastes. During a brief field survey in the surroundings of Sumhuram, together with colleagues Pasquino Pallecchi from Soprintendenza per i Beni Archeologici della Toscana, and M.G. Benvenuti from the Department of Earth Sciences of Florence), we did not find any clear evidence of ore showings. These facts, together with the absence of process indicators of smelting activities, seem to suggest that the Sumhuram inhabitants imported row metals (copper/iron) for local production from elsewhere. Further indications could come from lab analyses and future developments of the research.

PALYNOLOGICAL RESEARCH - Report of field activity 2006

Marta Mariotti, Tiziana Gonnelli, Giovanni Lippi

During 2006 (March and November) samples for palynological investigation were collected from three different stratigraphic sections in Sumhuram.

The sections are located inside the city wall:

- 1. section A68, located in area F, near the temple
- 2. section A 80, area F, near the previous one
- 3. section A 77 area B



In March, samples were collected every 10 cm ca. from all the stratigraphic units (**A68**: US193, US 174, US 162, US 172; US 187; **A80**: US 201, US 196, US 187, US 80; **A77**: US 202, US 198, US 183, US, 188).

In November, a new collection was carried out from the middle part of the sections A68 (US 174 and 162) and A12.

The aim of the study is to verify the first results from the previous analyses and to acquire a better detail in the history of the city. In fact, the results from the pollen analyses carried out during 2001-2005 indicate that the city of Sumhuram was inserted by a landscape characterized by a rather rich flora. The occurrence of significant pollen percentages of plants of wet environments and the low values of halophytes indicate a wider extension of the fresh water-conditioned habitats, probably due to a greater

amount of precipitations and/or water supply from Wady Darbat. A decrease of the pollen percentages of several wild shrubs is evident in the spectra, particularly in the sequence collected inside the urban area. This impoverishment of the local flora may be attributed to the human activity in the surroundings of the city or it may be considered one of the first consequences of a climatic trend towards dryness.

However, the trend toward dryness is not continuous, but interrupted by evident gaps: during some span of time, in fact, a reversion of this tendency and an increase of the plants of wet environment is clearly readable in the pollen spectra. The new sample collection carried out in November has deliberately the aim to detail the timing and the extent of these interruptions of the general climatic trend.

The occurrence of pollen belonging to cereals and other crops testifies the exploitation of the soil for agricultural purposes. The grains are not equally present in all the levels. An accurate detection of their presence and amount may improve our knowledge about the livelihood in Sumhuram during the time.

During March, a collection of flowers of *Boswellia sacra* was carried out with the aim to study the reproductive biology of this plant.

The sampled material from Wadi Dowka and Al Mughsail was immediately treated with fixative solutions (glutaraldehyde or FAA solution). Samples for Scanning Electron Microscopy and Transmission Electron Microscopy were then postfixed in 2% OsO4 in a phosphate buffer. The same buffer was also used for washing the material. The dehydration was carried out until 30% of water. Subsequent treatment phases were performed in Italy.

The material will be analyzed also at light microscopy, particularly after using fluorescence staining methods, useful to evidentiate some important reproductive stages.

Report of Field Activity at Khor Rori and coastal Dhofar, November 2006

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In the field mission to Khor Rori, carried out from november 3 to november 10, preliminary geomorphological, stratigraphic and sedimentological observations have been performed. Fieldwork has been subdivided in three major themes:

1) overview of the general geomorphology and geology of the Dhofar with special reference to the coastal area included between Mughsayl to the west and Hasik to the east.

The survey has been carried out starting from the existing geological maps published by the Ministry of Petroleum and Minerals, Sultanate of Oman (sheet "Salalah", scale 1:100.000 and Geological Map of Oman, scale 1:1.000.000, Fig.1).

The survey, involving also a botanist (Prof. Marta Mariotti Lippi, University of Florence) and two further geologists (Dr Pasquino Pallecchi, Soprintendenza ai Beni Archeologici della Toscana, Florence; Dr Laura Chiarantini, University of Florence), benefited of a multidisciplinary discussion that introduced the group into the different aspects of the Dhofar physical and biological environments.

Discussion with Prof. Mariotti Lippi, involved since 2001 on IMTO research activities, outlined the relations between vegetation cover, present climate and geomorphic gradients across the Dhofar landscape. In particular the arid environment of *Boswellia sacra* at Wadi Doka and the ecologic distribution of vegetation in the Khor-type estuaries (Figs. 2, 3) were presented and discussed with special reference to the setting and history of Sumhuram.

Fieldwork with drs Pallecchi and Chiarantini focussed on the recognition of geo-lithological units (Figs. 4, 5) possibly exploited as raw materials for pottery production and metallurgy at Sumhuram.

A specific goal of this overall survey was also to localize and preliminarily describe upper Quaternary coastal deposits (Fig. 6) for comparing the stratigraphic and sedimentological features of similar deposits described at Khor Rori (Hoorn & Cremaschi, 2004).

2) preliminary high-resolution geo-morphological survey of the Khor Rori nearby the Sumhuram citadel.

A detailed survey of the landforms and deposits occurring on the left bank of the estuary has been started (Fig. 7). Field observations have been digitally acquired through a GPS device connected to a pocket pc. Data have been automatically georeferenced in UTM coordinates and plotted on a highresolution satellite image downloaded from Google Earth. Taking as a reference the geomorphological survey published by Hoorn and Cremaschi (2004), attention was paid on fluvial and estuarine deposits of presumed Holocene age. In particular a cobble-boulder lag flanked by overbank sandy silts, identified NW the Sumhuram citadel, points to high-magnitude Holocene flood events. This evidence, if supported by some future datings, could open interesting perspectives for understanding the human presence and activity outside Sumhuram in relation to the fluvial dynamics. The external temple, erected few meters above the flood gravels and silts (Figs. 7, 8), apparently was used by the Sumhuran people in the early stage of the settlement and suddenly abandoned (V. Buffa, pers. comm., 2006). Such an abandonment could have been forced by the perception of hydraulic risk following large floods which could have damaged or partially destroyed the temple. The hypothesis of large floods during the late Holocene is in agreement with the large river discharge suggested for the Khor Rori during the lifespan of Sumhuram (Hoorn & Cremaschi, 2004), an referred to a climate moister than the present.

3) detailed stratigraphic and sedimentologic logs of selected archaeological sections of the Sumhuram citadel (Fig. 9).

After a presentation and discussion on the urban structure and development of Sumhuram given by the archaeological team, three sections were selected for detailed analysis. This selection was discussed with Prof. Mariotti Lippi who had already collected samples for palynological analysis during the field mission to Sumhuram of March 2006. Thus, the fieldwork was concentrated on sections A68, A80 and A12: in sections A68 (Fig. 10) and A80 (Fig. 11), the archaeological stratigraphy was re-examined following a sedimentological approach based on description of sediment texture, bedding and eventual depositional structures. For section A12 (Fig. 12), an archaeological stratigraphy was lacking. Samples of sediment and charcoal were collected in the three sections respectively for further palynological and radiocarbon analyses.

Despite the complex and variable stratigraphic architecture, a common feature of the three sections is the occurrence of graded, cm-mm thick, beds of fine sands and silts indicating tractional currents, interbedded with anthropogenic debris. This evidence points to some flowing water which in specific periods may have partially flooded the streets and other open spaces in the north-western portion of Sumhuram. An additional evidence of flowing water is provided by laminated fine sand and silt pockets between stones in the walls flanking the sections (Fig. 13). These deposits possibly accumulated during the waning of "flood" events in voids emptied of the loose and dry earth originally used to fill the stony framework of the walls.

Basing on the available topography (Fig. 9), the examined part of Sumhuram is 5-3 meters lower than the surrounding areas, suggesting an original topographic gradient of the limestone plateau on which it was built, that could have regulated an eventual internal drainage of the town. In agreement with this consideration, archaeological sections in more elevated parts of the town, such as section A77 (Fig. 14), lack such waterlain sediments being exclusively characterized by a complex interfingering of anthropogenic debris and deposits related to the degradation and fall of walls.

The possible evidence of flowing water, nevertheless, does not clarify the origin and significance of recurrent "flood" events. The location of the town, standing 24-28 meters a.s.l, makes highly improbable direct flooding from the Wadi Darbat-Khor Rori system. Such giant flood events firstly, should have been recorded by specific geomorphic lines of evidence not observed in the area, and secondly, would have completely destroyed Sumhuram. Alternative sources of water, thus, has to be searched for explaining the occurrence of water flowing in the town's streets.

A local source could have been represented by the well located inside the so-called Monumental Building from which water could have been redistributed, through canalizations, to different parts of the town included the examined area. In section A12, in fact, a channel is attached to wall M18 (i.e the external, western, wall of the Monumental Building), apparently continuing inside as indicated by a rectangular fissure almost filled with laminated sands and silts (Fig. 12). The latter again reflect transport and deposition from running water. Taking into consideration this hypothesis, water may have occasionally spilled out from a distribution network invading the adjacent streets. It has still to be explained why and when the fissure on wall M18 was definitely filled with waterlain sediments.

An alternative hypothesis may invoke periods of heavy rainfall over the town which generated relatively large surface run-off along the topographic gradient. This second explanation is apparently in agreement with a climate moister than the present during the town lifespan due to a stronger monsoon circulation over the southern Oman (Hoorn & Cremaschi, 2004).

A mix of the two preliminary explanations may be obviously possible. Whatever the causes, availability of water determined sheetflooding of the streets and consequent reworking and redeposition of the available debris in the thin beds observed in the studied sections. Possible radiocarbon dating of charcoal collected in the anthropogenic debris interbedded with the "flood" deposits will provide arguments to test the different hypotheses made above within a, hopefully, consistent chronology of the deposits burying Sumhuram.

Future development of the research

Despite the short visit to Dhofar, and specifically to Khor Rori and Sumhuram, the preliminary geomorphic, stratigraphic and sedimentologic surveys provided interesting data which could be implemented through future field and laboratory activities. Such extended research should be focussed on the following specific points:

- 1) the late Quaternary dynamics of the environment surrounding the town with special reference to the relative sea-level variations. A detailed sedimentological analysis on upper Pleistocene "beach rocks" identified in several outcrops along the coast may help in understanding the recent environmental transition of Khor Rori from an open to a close estuary (see Hoorn & Cremaschi, 2004). This transition reflects the potential interplay of different controlling factors such as climate change (i.e reduced river discharge in the last 2,000 years, see Hoorn & Cremaschi, 2004), sea-level rise and tectonic activity whose mutual roles has still to be assessed in details. The stratigraphic, sedimentologic and chronologic analyses of upper Pleistocene coastal deposits should provide information on the dynamic of similar transitions experienced by the coastal environment of Dhofar in past times. Radiocarbon and thermoluminescence dating of beach rocks could be performed to precisely calibrate the timing of past changes and correlate with the published dataset of the late Quaternary relative and absolute sea-level fluctuations.
- 2) Stratigraphy and sedimentology of Holocene flood deposit. Trenches across the landforms and related deposits preliminarily recognized on the left bank of the estuary (Figs. 7, 8) could provide access to detailed sediment description and possible sampling of datable organic materials to calibrate eventual large flood events occurred during the Holocene. Survey could be extended also down- and upstream the estuary-wadi system in order to physically correlate the different landforms and related deposits. A rough look to the upstream portion of Wadi Darbat, in fact, revealed the occurrence of large flood bars (Fig. 15) on the dry bed of the wadi. These bars, elongated in the direction of the main flow and made of imbricated boulders, reflect high-magnitude discharges which again point to a significantly different hydrologic regime of the river system compared with the present one.
- 3) Logging of further archaeological sections. New sections within Sumhuram, provided by the progressive excavation, could be surveyed in terms of accurate stratigraphic and sedimentologic analyses to test and confirm the hypothesis of small "flood" events punctuating the life of the town. In this sense the C14 dating of the charcoal collected in the present and eventual future missions would help in clarify the town chronology and calibrate the recurrence of small street's "floods".

The laboratory activities, mainly concerning absolute dating, planned under possible future research activities may involve scientific collaborations with Italian and/or foreign research groups in order to limit costs of analyses otherwise done by commercial laboratories.

References

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Fig. 1: Sketch from the Geological Map of Oman, scale 1:1,000,000. Blue lines trace itineraries in the zones of Dhofar visited during the November 2006 field mission



Fig. 2: *Boswellia sacra* at Wadi Doka, not far from Thumrayt. In the foreground a recently planted *Boswelia* nursery limited by a fence from other trees in the dry, gravely, bed of the wadi visible in the background.



Fig. 3: Typical fringe of palustrine vegetation of the Khor-type estuary (Khor Rori) made mostly of *Cyperaceae* (Cyp) *and Graminae* (Gra). The dry bank in the foreground is partially covered by grasses and *Chenopodiaceae*, indicative of salty and arid soils



Fig. 4: Dr Pallecchi is examining and sampling the muddy deposits of a small estuary few km east of Khor Rori for compositional analyses related to the Sumhuram pottery production



Fig. 5: Drs Chiarantini and Pallecchi examine granodiorite intrusion within Precambrian gneiss looking for eventual copper and lead mineralization. Road from Mirbat to Hasik



Fig. 6: Outcrop of presumably upper Quaternary coastal deposits few km east Khor Rori, encircled hammer for scale. Faults (red lines, arrows indicate downthrown blocks) crosscut plane-bedded, calcarenites indicating an ancient shoreface. These deposits are sharply overlain by a slope breccia unaffected by faulting. This outcrop reveals an active tectonics at this site in recent times.



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Fig. 7: Preliminary geomorphic map of the Late Quaternary surrounding Sumhuram, annotations are made on a high-resolution satellite image available in Google Earth, numbers in the grid refer to UTM coordinates. Legend for codes: pf: palustrine fringe; ss; salty soil; fg: flood gravel; os: overbank silt; sg: loose sand and gravel; af: alluvial fan; a: alluvial; sd: slope debris; as: abrasion surface; cg: cemented gravel; br: beach rock: ls: limestone



Fig. 8: River bank north-west of Sumhuram (in the background) charcterized by a cobbleboulder lag flanked by sandy silt. These deposits are tentatively referred to high-magnitude floods. The location of the external temple is indicated (arrow).



Fig. 9: Location and topography of Sumhuram. A) the excavated areas in February-March 2006; B) details of the NW portion with location of the studied sections



Fig. 10: Section A68. A) photograph taken on November 2006, rod is 2 m long; B) stratigraphic interpretation and position of the pollen and charcoal samples. The reference to the US stratigraphy is shown: US 193-172 should record the entire lifespan of the town. US 187 is referred to recent re-occupation or frequentation of the site. To notice that the US may bear one or more units made of waterlain deposits (WD) whereas periods of frequentation are recorded by debris made by a mix of sediment, bones, charcoal and other debris related to building waste or to human activities (AD).



Fig. 11: Section A80. A) photograph taken on November 2006, rod is 2 m long; B) stratigraphic interpretation and position of the pollen and charcoal samples: reference to the archaeological stratigraphy is shown. Codes and symbols as in Fig. 9. In analogy with section A68, US 187 is considered to record the abandonment of the town. Nevertheless, its internal architecture suggests a complex sequence of events: US187-a outlines a lobe of anthropogenic debris including dispersed large fish bones, charcoal, lenses of stones free of interstitial sediment; US187-b records a phase of intermitting waterlain and anthropogenic sedimentation (AD*: anthropogenic debris possibly reworked by some fluidal flows as indicated by the inclined layering in US196); US187-c records a further phase of massive anthropogenic deposition. In terms of sedimentary features, US187-c strictly resembles US 172 in section A68 whereas US 80 shows a closer similarity with US 187 and appears related to recent wasting of walls.



Fig. 12: Laminated sand and silt in section A12, rod is 1 m long. The waterlain deposits filling the fissure have been partially excavated during the American Archaeological Mission. A) photograph taken inside the fissure showing the complete filling by the laminated deposits.



Fig. 13: Evidence of waterlain sediments within the M175 wall, section A68. White arrow indicates laminated sand and silt which differs in texture and sedimentary structure from the massive earth (black arrows) originally used to fill the stony framework.


Fig. 14: Section A77 (south-eastern and more elevated portion of the town) on November 2006, rod is 1,4 m long. The stratigraphic architecture is characterized by sub-horizontal beds of mixed debris derived from human activity. Large clasts floating in the fine-grained sediment could reflect fall of stones from the adjacent walls. No clear evidence of flowing water has been detected.



Fig. 15: bouldery flood bar in the Wadi Darbat, road Taqah-Mirbat. Encircled hammer for scale. To notice the imbricate framework of the boulders pointing to a flow to the right (i.e downstream). The arrow points to the spectacular travertine barrage blocking the wadi upstream.