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# Azraq al-Šišan

# ʿAYN SAWDA RESERVOIR PROJECT

Report of the work done in Yarmouk Museum, Nov. 2015

Responsible of the project:

L. Abu-Azizeh, architect, Ifpo Amman (French Institute for the near east)



## Introduction

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Located in Jordan, in the city of Azraq, the 'Ayn Sawda reservoir is partly integrated in the Wetland reserve and is part of Azraq al-Šišān cultural heritage. Since the 80's, the Azraq oasis has been exposed to many ecological changes linked to excessive pumping of the water table for agricultural reasons. Following the water decrease in the whole oasis and the progressive drying of Ayn Sawda's spring (drying up in 1993), the archaeological remains of the reservoir and its close nearby appeared, making the archaeological works possible (and necessary).

The first works have been led in 1981 by a DoAJ team (Dr. G. Bisheh). Carved basalt blocks have been discovered in the close vicinity of the platform that is located on the E side of the reservoir. The first restoration works on the remains have been done at the same period. An American team did some work in 1998 and C. Vibert-Guigue (CNRS), between 2004 and 2010, aimed at discovering and securizing as much blocks as possible. Despite the nice discoveries (69 blocks with bas reliefs), the necessary evolution of the project into an architectural study of the reservoir and the blocks quickly appeared.

That is the reason why, after a relay mission in 2013 with C. Vibert-Guigue, L. Abu-Azizeh (architect, Ifpo Amman) became responsible of the new «Azraq `Ayn Sawda Reservoir Project». This Ifpo project is funded by the French Ministry of Foreign Affairs and the CNRS (French research center). The team is composed of four permanent members : two architects (L. Abu-Azizeh and A. Stavy) and two archaeologists (Dr. J. Bonnéric, Ifpo Beyrouth ; Dr. B. Couturaud, ArScAn Paris).

The two fieldwork missions led in May 2014 and May 2015 in Azraq focused on archaeological soundings in the reservoir area, on documentation and restoration works on the reservoir and on the implementation of a new approach for the study of the carved blocks exposed in Qala't Azraq.

The carved blocks corpus is composed of 105 blocks, all found in the Azraq Ayn Sawda reservoir either in 1981 by the DoAJ or since 2004 by the French teams. The blocks discovered by the DoAJ have been stored in the Yarmouk Museum of Irbid, in the Qala't Azraq and in the Natural reserve of Shawmari. Since the discoveries in the 2000's, all the blocks have been grouped in Qala't Azraq (x91) except those in Irbid (x10) and 4 lost blocks. The study takes into account the whole corpus and that's why it was necessary to integrate the 10 blocks exposed in the Yarmouk Museum in Irbid.

Thanks to the support of the General Director of the DoAJ, Dr. Munther al-Jamhawi, and the help of the Yarmouk Museum team (special thanks to Dr. N. Bader, Dr. M. al-Nadaf and Dr. A. Ahmad), I went to Irbid on Monday the 16th of November to document the 10 concerned blocks.

## Methodology

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### New database

After the work led in 2014 in Azraq, we created a new database (Access software) aiming to integrate all the blocks found during the excavations in the reservoir since the first excavations in the 80's : with bas reliefs or without. Taking into account the many numberings already done until now on the blocks, we decided to create a new numbering of the blocks entering into the database, in order to have an homogeneous corpus. The blocks will be referred to B and a 3 numeral number like B024.

This year we have exclusively worked on the blocks exposed in Qala't Azraq and we have integrated the blocks discovered during the excavations this year (B001 to B095). All the blocks stored in the parkings in the reserve will need to be part of a specific work in the following months.

The database is divided into four main tables, as described below :

- General informations : location and year of discovery, archaeologist, block picture, general description of the block shape (top face, back face, lateral faces), dimensions;
- Assemblies ; description of the assemblies type per face;
- Bas-reliefs : description, iconographic parallels;
- Documentation : graphic documentation, pictures and photogrammetry, 3D printing process.

The database filling has been begun in 2015 and will have to be continued in the following months.

### 3D modelling

Following the trials done in 2014 and 2015, we have been able to do the 3D models for all the blocks exposed in Qala't Azraq, 91 blocks. As a reminder, we are using the photogrammetry technique (Photoscan software) to create 3D models of the basalt blocks. The technique consists in taking pictures of the same element from different point of view, to load them in the software that can then reconstitute the block volume.

In 2014, we realized some technical problems that didn't allow us to work as well as we wanted. In order to improve our work in 2015, we devoted the first day to the emptying of the exhibition room, the cleaning of the room, the cleaning of the blocks outside the room, and the last trials to improve the methodology for the photogrammetry process. The conclusions have been very positive and we were then able to work in a clean space, on clean blocks, with good light (4 spotlights instead of three in 2014) and the possibility to create the 3D models from only 25 pictures for the top face and 13 pictures for the back face.

We worked following the steps described below:

- Choose a block and identify it with the new number (Fig.1);
- Put 4 marker points with a blue pen on the block, half height on the lateral faces (Fig.2);

- Do the first pictures shoot with the top face on top (Fig.3);
- Do the second pictures shoot with the back face on top (Fig.3);
- Load the pictures in the computer and launch a fast model processing to check the pictures quality.

In order to guarantee the quality of our work, we did the entire 3D modelling process for three of the blocks. It is about generating a 3D model for the first pictures shoot, then to generate a model for the second pictures shoot. The final 3D model is generated thanks to the 2 partial 3D models and the blue point markers. The tests showed that there was no difficulty for the software to do so. (Fig.4a).

However we noticed that there is a visual screen difference between the whole 3D block and the partial 3D models. Indeed, it seems that the software is losing quality when it creates the whole block model and the outlines seem softer (Fig.4b). The problem has been solved thanks to the new version of the software that is much more performant (dense cloud function).

### **3D printing**

The 3D modelling of the blocks is not only a very good way to document them but it is a way too to do 3D printing of them. Indeed, 3D printing small scale blocks would be the ideal tool to work on the assemblies and to validate some hypothesis that we can barely verify with the real blocks (weight problems mainly).

In 2015, we implemented a collaboration between the Ifpo and an Engineer School in France (CESI) in order to do small scale (scale 1/5) 3D printings of the 100 blocks. Printing trials have been done during 2 months to test the printing color, the printing scale and all the printers parameters (Fig.5). Almost 80 blocks are now printed and a base system has been thought and printed to allow installing all the blocks faces at the same level (what is almost impossible to imagine with the real blocks !).

The 10 blocks exposed in the Yarmouk Museum in Irbid have been integrated to the corpus.

## The corpus in Yarmouk Museum, Irbid

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As it was said above, there are 10 carved blocks coming from the Ayn Sawda reservoir and exposed in the Yarmouk Museum. See the list below:

New numbering	Museum numbering	Cl. Vibert-Guigue numbering	
B100	A831	25	Bird
B101	A825	26	Senmurv
B102	A818	27	Fish
B103	A829	28	Leopard
B104	A832	29	Vase with vegetal
B105	A827	30	Winged horse
B106	A826	31	Leopard
B107	A829	32	Dog
B108	A830	33	Vase with vegetal
B109	A822	34	Vase with pomegranate

The work on site consisted in measuring the blocks, taking all the needed informations for the database and photographing them for the 3D model creation process.

All the blocks have been removed from their exhibition support and installed on the floor in order to work easily. The 10 blocks are very similar to the blocks in Azraq (basalt blocks presenting tenons and mortises systems), all of them present either bas-relief (7) or engraved relief with a peripheral frame (3). The relief represents either an animal, a creature or a vegetal element, exactly like in Azraq. The blocks are in quite good condition, some of them are partially broken or deteriorated but the external contours are in good conditions except for B105 (Fig.6a and 6b).

The new numbering of the blocks has not been inscribed on the stones and the reference points used for the 3D modelling process have been put on tape in order not to let any mark on the block itself.

The work has been very successful and the 3D models have been created without any problem and sent to France for the 3D printing phase.

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Fig.1 : New numbering on the blocks (AS)



Fig.2 : the blocks marks written before to take the pictures for the 3D modeling (AS)

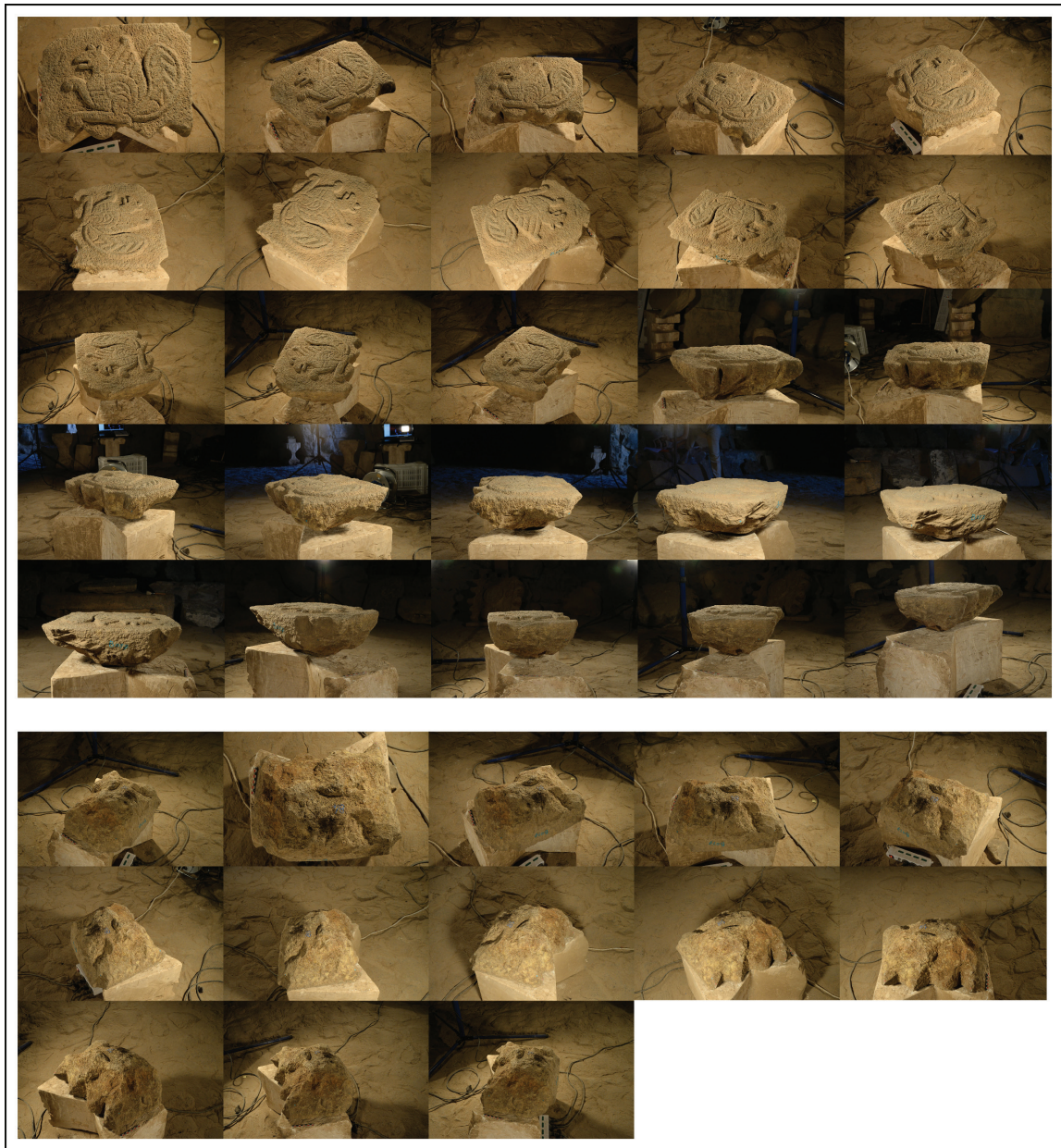


Fig.3 : Picture sequence for block B017, including top face and back face (AS)





Fig.4a : 3D model of the top face, the back face and the whole block (LAA and AS)



Fig.4b : Quality of the top face after the 3D model done (LAA and AS)



Fig.5 : The first 3D printing trials done by CESI school in France



**Bloc B100** (25)  
Photo : L. Abu-Azizeh et A. Stavv  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



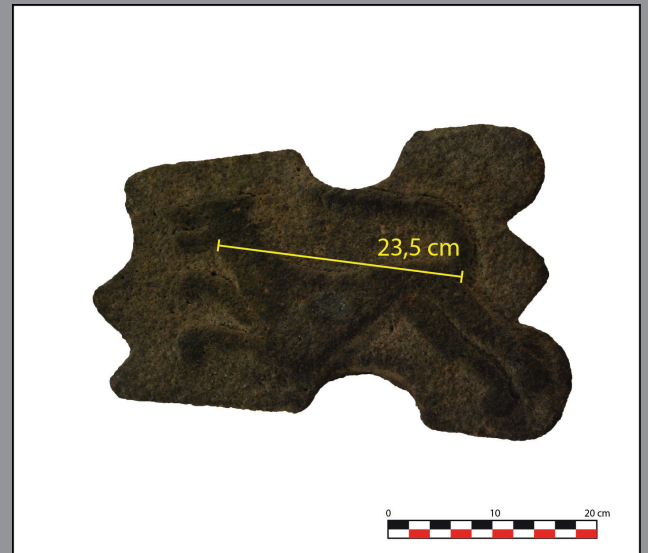
**Bloc B101** (26)  
Photo : L. Abu-Azizeh et A. Stavv  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



**Bloc B102** (27)  
Photo : L. Abu-Azizeh et A. Stavv  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



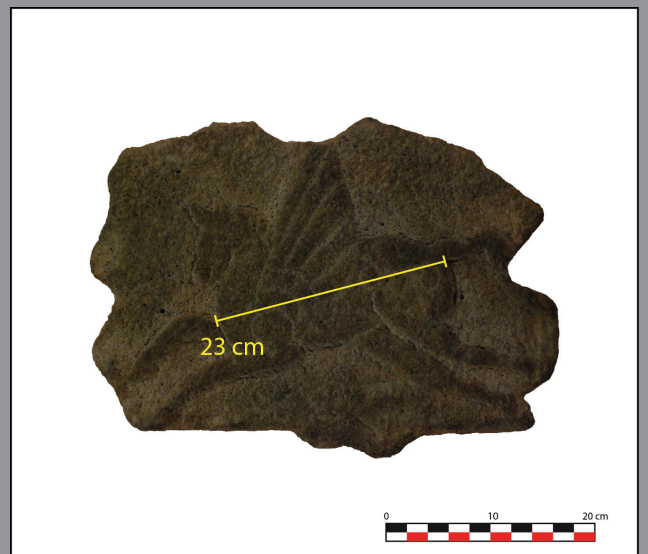
**Bloc B103** (28)  
Photo : L. Abu-Azizeh et A. Stavv  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



**Bloc B104** (29)  
Photo : L. Abu-Azizeh et A. Stavv  
Novembre 2015

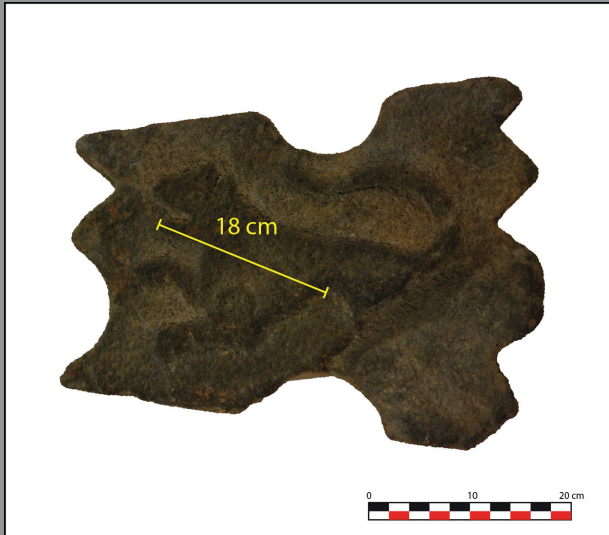
*Azraq Ayn Sawda Reservoir project*



**Bloc B105** (30)  
Photo : L. Abu-Azizeh et A. Stavv  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*

**Fig.6a : Blocks B100 to B105**



**Bloc B106** (31)  
Photo : L. Abu-Azizeh et A. Stavy  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



**Bloc B107** (32)  
Photo : L. Abu-Azizeh et A. Stavy  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



**Bloc B108** (33)  
Photo : L. Abu-Azizeh et A. Stavy  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*



**Bloc B109** (34)  
Photo : L. Abu-Azizeh et A. Stavy  
Novembre 2015

*Azraq Ayn Sawda Reservoir project*

**Fig.6b** : Blocks B106 to B109