



حولية الآثار اليمنية

العددان الثالث والرابع



الهيئة العامة للآثار والمخطوطات والمتاحف

صنعاء

١٤٤٤هـ - ٢٠٢٣م



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العددان الثالث والرابع

المشرف العام

مهند أحمد السياني

رئيس التحرير

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

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The conservation of the new found inscription stone in the Almaqah temple Sirwah, March 2006.

Christian Weiss

Introduction

After the re-erection of the new inscription stone in December 2005, the stone had to be restored in a short time to avoid further damages and to stop the loss of the material and the destruction of the back side. The main work was the stabilisation of the basement and the stabilisation of loss pieces and areas endangered by material loss. The work was done by the restorator Ralf Carnietzki (Riehlsrt. 7, 90489 Nürnberg/Germany). He is specialised in fissure filling and owns a company which runs several restoration projects. The system is the so-called 'System Kaiser' (see capital fissure fillings):

Pre - investigations of the Stone

The stone is contaminated by salt. Tree samples were taken shortly after the excavation. The salts are chloride and nitrate, the amount of nitrate is significantly higher than the chloride, a sign for the source from the sediment load. The highest amount of salt was in the backside of the stone. Thin sections from the backside of the stone show that the substance is heavily damaged, fractures among single stone components are open and partly they are soluted. This means that the stone will be destroyed by a long-time contact with rain, which allows water to penetrate the open pores and to destabilise the substance.

Sample	Description	Chloride (weight-%)	Nitrate (weight-%)
New inscription stone	Stone sample (see thin sections)	0,2	0,3
New inscription stone	Sediment subsurface	0,07	0,15
New inscription stone	Sediment upper side	0,07	0,15

Fig. 1: The results of the salt analyses. Sediment sample means, sediment from fractures inside the stone.

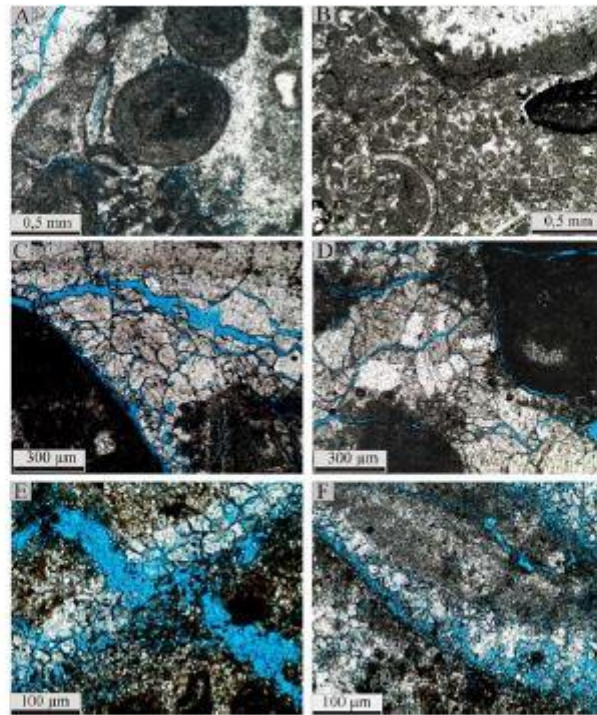


Fig. 2: Thin sections, the blue colour is pore space with a origin by stone destruction.

Fundament stabilization

The basement of the stone, made of limestone-mortars was, stabilised. The transport belts and the woods beams from the transport are removed and the space of estimated 3 cm between the stone and the fundament is now filled by a limestone-mortar. This mortar consists of medium to coarse grained, badly sorted sand and slake lime in a relation from 2:1,3. The mortar was injected under the stone to the same level like the surface.

Cleaning

The dust and salt crusts of the stone have been removed by hand with soft brushes to avoid scratches in the surface. After finishing the restoration work the stone was washed with clean water and soft brushes, this lead to a removal of the salt crusts from the surface, but during the next rainy seasons a new occurrence of such salts is to expect. The reason is the high salt contamination.

Fissure fillings

The technique of fissure fillings is to close the whole fissure by hot glue. Before the stone was prepared with a so called primer, a solution which prevent a contact between the stone surface and the hot glue. Than the fissures were closed by hot glue with few injection channels connected by the fissures. The epoxy resin is injected by injection syrons with low pressure. After 24 h the hot glue becomes removed and the stone is cleaned. After that the upper part of the fissure is closed by the sloping mortar.

According to the rescue work on the stone during the November/December campaign the epoxy resins used in this campaign were similar to those used there.



Fig 3: Left: Eastern side of the stone with fissures covered by hot glue. Right: the fissures after fillings with epoxy resin.



Fig. 4: The large loose part in the middle of the stone covered by hot glue. The injection channels are closed by red caps.



Fig. 5: The closed fissure on the western front side of the stone.

Small extensional fissures

Fissures with a small extension were filled by a high viscous epoxy resin. This resin enables the filling of fractures up to 0,3 mm. This allows the stabilisation of the stone structure in large parts.

Large fissures

The large fissure in the middle part was filled with a lime whitewash consisting of slake lime and fine grained well sorted sand dispartaged in water. This method allows the filling of high volume fissures. The use of epoxy resins is not necessary in the sense that no static function is influenced and there is no danger of material loss by back weathering. On the front and the back side the fissure was closed by the coloured lime mortar and the while wash was filled inside from the topside. The volume of whitewash was about 12 l.



Fig. 5: The large fissure on the front site of the stone with the filling made of lime mortar.

Reconstruction of broken pieces on the back of the stone

During the transportation by the re-erection several parts of the stone were lost. Those lost parts were collected and could be reinstalled. The first step was the cleaning of the surface by hand. The single parts were adapted to the place on the stone and fixed with the described epoxy-resin, with very low viscosity. After 24 h the fissures between the broken pieces and the stone were filled by the sloping lime mortar.



Fig. 6: Area with heavy material loss on the western back side.



Fig. 7: The stone with the new installed broken pieces. The fissures between them and the stones are free.



Fig. 8: The pieces with the filling of sloping mortar.

Further work

In the near future the stone has to be saved by a roof. Although the restoration work the substance of the stone is unstable in moisture conditions like the rainy season. Furthermore the stone has to be watched. Especially the mortars can become unstable during wet condition or can become lost. In this case they have to be replaced. Altogether the stone should be stable during the next years but single restoration methods could be possible (desalination).

Material list

Epoxy resin: EP 510 (Carnietzki stone restoration).

Lime mortar (fundament): slake lime (Nura) and fine grained sand.

Sloping lime mortar (surface damages): slake lime, fine grained sand, colour 'siena nature' (Yellow) and 'red earth' (Red).

Lime whitewash: slake lime and fine grained sand.