

Dimension and ornamental stones in the Sabaean city of Sirwâh (Marib province, Yemen)

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Abstract: Accompanying archaeological excavations, dimension and ornamental stones in the Sabaean city of Sirwâh (Yemen, 1st mill. B.C.) were studied. Rock types used are limestone, travertine, caliche, calcite sinter, lapillistone, and basaltic lava. For prestigious surfaces Jurassic limestone was preferred. The most precious material used for wall claddings and artefacts is calcite sinter (called “alabaster” by archaeologists) from inactive spring mounds. Several ancient quarries and subsurface mines, which provided limestone and calcite sinter, respectively, could be identified.

This study focuses on the weathering behaviour of the limestone. The limestone belongs to the Jurassic Amran Group and shows partially severe damage. Frequently are back weathering, relief formation, break outs, salt efflorescences, granular disintegration and contour scaling. Mapping of the damage was carried out for representative blocks of the main sanctuary, the Almaqah temple. In addition, a map of the damage on the inscription monument was carried out. Principal cause of damage is anthropogenic discharge, such as faeces, which caused stone disintegration due to crystal growth of salts (salt burst). Seeping in of the solution was possible due to high secondary porosity (moldic porosity in bioclasts and peloids including oomoldic porosity, fracture porosity, opened stylolites).

In particular the famous inscription monument was investigated. It is made from two inscription monoliths, which are placed on top of each other. While the inscription of the lower one is almost free of damage, the upper one is destroyed to about 48 %. The reason for that is the difference in bedding orientation: whereas in the lower monolith the orientation of the bedding is horizontal, the upper stone was erected with its bedding plane in a vertical orientation. This allowed anthropogenically contaminated water to seep in along bedding planes, joints, stylolites, and pores.

Historic copies of the inscription made in 1843, 1894, and 1947 allow a precise retrospective weathering analysis in comparison of the damage of the inscription monument observed today (2004) with the status at several points in time in the past. Weathering of the upper monolith starts with building up thin crusts, followed by back weathering and ends in deep reaching relief formation. Reconstructing the retrospective weathering status on a letter to letter basis allows quantifying the weathering progression. The annual weathering rate of the northern front of the monument was 3 cm²/year between 685 B.C. and 1894, 105 cm²/year between 1894 and 1947, and 301 cm²/year between 1947 and 2004, on average. The rapid acceleration of weathering progression after 1894 can be attributed to anthropogenic influence, whereas natural weathering (insolation) was acting solely up to this time. Furthermore, the retrospective weathering analyses show that the damage is mainly restricted to a set of joints perpendicular to the bedding plane.

Kurzfassung: Begleitend zu archäologischen Ausgrabungen wurden die Naturwerksteine der sabäischen Stadtanlage von Sirwâh (1. Jt. v. d. Z.) im Jemen untersucht. Das Gesteinsinventar umfasst Kalkstein, Travertin, Caliche, Calcitsinter, Lapillistein und Basaltlava. Bevorzugtes Material für repräsentative Flächen waren jurassische Kalksteine. Als wertvollster Stein fand Calcitsinter („Alabaster“ der Archäologen) aus inaktiven Sinterhügeln Verwendung für Verkleidungsplatten und Kunstgegenstände. Mehrere antike Steinbrüche und Untertageabbau, die Kalkstein bzw. Calcitsinter geliefert haben, konnten lokalisiert werden.

Der Schwerpunkt der Untersuchungen lag auf dem Verwitterungsverhalten der Kalksteine. Sie gehören der Amran Group (Jura) an und zeigen partiell schwere Schäden. Verbreitet sind Rückverwitterung, Reliefbildung, Ausbrüche, Salzausblühungen, Absanden/Abgrusen und Abschalen. Eine Schadenskartierung wurde an repräsentativen Werksteinen des Hauptheiligtums, des Almaqah-Tempels, und an dessen Inschriftenmonument durchge-

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