EGU2020-18178
https://doi.org/10.5194/egusphere-egu2020-18178
EGU General Assembly 2020

Weathering and conservation of tuff stone

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Tuff stone, a porous pyroclastic rock, is a light and soft material. Hence, tuff is easy to handle and to transport. It is used as construction material in numerous historical buildings. Due to its high water absorption and retention potential, heterogeneous pore structure, and clay mineral content, tuff is highly sensitive to weathering by moisture expansion and salt crystallization [1; 2]. The search for a protective agent for tuff stone has been subject to scientific studies for several decades. Yet, due to the high variability and heterogeneity of tuff stone, no generally applicable means to protect tuff against weathering has been found to date. Instead, case specific solutions are developed to preserve historical buildings. Often it is necessary to remove weathered parts of the stone or exchange whole tuff ashlars to ensure the stability of the construction. Since tuff is a limited resource, it is crucial to find suitable protective agents that prolong the life-cycle of tuff stone to preserve historical buildings

To favourably influence water absorption, effective porosity, and the pore structure of tuff stone, a thorough impregnation of the stone with the protective agent is desirable. This can be achieved by the application of silica sol products, which are dispersions of colloidal amorphous silicon dioxide particles. The small particle sizes (between 10 and 100 nm) facilitate a high penetration depth. Despite of the promising results of several studies, colloidal silicas are rarely used as protective agents for tuff stone in the restauration practice [3; 4]. This may be due to the lack of long-term experiences with these materials. Furthermore, the performance of protective agents is closely related to the pore structure and chemical and mineralogical composition of the rock [5; 6]. To understand these interactions, further research is needed.

The aim of a current research project is to study the application of colloidal silica as protective agent for Weiberner tuff. In first tests, penetration depth and changes in the pore structure are analyzed. Furthermore, the influence of the treatment on the hygric and mechanical properties and on the durability of the stone is studied. The new data will contribute to a better understanding of tuff stone deterioration and conservation.

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