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Microscopic scale characterization of ancient building sandstones from Saxony (Germany)

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Abstract

Sandstone has been a traditional building material all over the world for centuries and is still used for this purpose today. Because of the various geological origin, sandstones may differ in petrography and mineralogy, which mainly determine their technical properties and weathering behavior. Therefore, a careful investigation of sandstone building materials is required and a complex analytical scheme was developed for this purpose.

Sample material from important quarry regions of the Elbe Zone (Saxony, Germany) was investigated, which supplied material for a lot of famous buildings in the historic city center of Dresden, in Meißen and in the whole state of Saxony. The complex study included macroscopic rock description and detailed investigations by polarizing microscopy (phase composition, texture, grain size distribution), cathodoluminescence (CL) microscopy (quartz types, feldspar and kaolinite content), scanning electron microscopy (SEM; accessories, pore cement, diagenetic grain surface features), and pore-size distribution by Hg porosimetry.

In a case study, mineralogical and technical properties of building sandstones from the Meißen cathedral (Saxony, Germany) were investigated and compared with material from potential historical source quarries. The results of the present study allowed to assign unequivocally historically used material to specific sandstone occurrences, and provide a comprehensive basis for the interpretation of weathering damage on the historical monuments. These data are useful for current conservation and reconstruction activities.

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1. Introduction

Sandstone has been a traditional building material all over the world for centuries and is still used for this purpose today. A lot of ancient buildings as well as sculptures and tombstones of high artistic and cultural

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rank are made of different types of locally occurring sandstones. Depending on their geological formation they differ in mineral composition, texture, color, technical properties and weathering behavior.

Various local sandstones have been used for building purposes in distinct geographic areas for a long time and are well known to the practical experience of stone masons, architects and restorers. In many cases, however, detailed information about their petrography and petrographic varieties is still lacking. Because of the narrow relation between sandstone petrography and its properties such as hydric swelling, chemical resistance, frost and salt resistance and others, a sound assessment of the stone quality apart from very general statements is impossible without a minimum of petrographic data.

Even if the macroscopic appearance of a sandstone allows its rough classification, and the main technical properties such as strength, total porosity and total water uptake are known for most of the building sandstones, more petrographic information is needed especially in the following cases:

- Weathered ancient building sandstones have to be replaced by new material or remnants (ruins) of a destroyed building have to be rebuilt. The origin of the historic sandstones (variety, quarry) is not clear and has to be found by comparison with material from existing quarries. If the original material is not available any more and has to be substituted by a sandstone from another region, the new material has to be as similar as possible to the original to

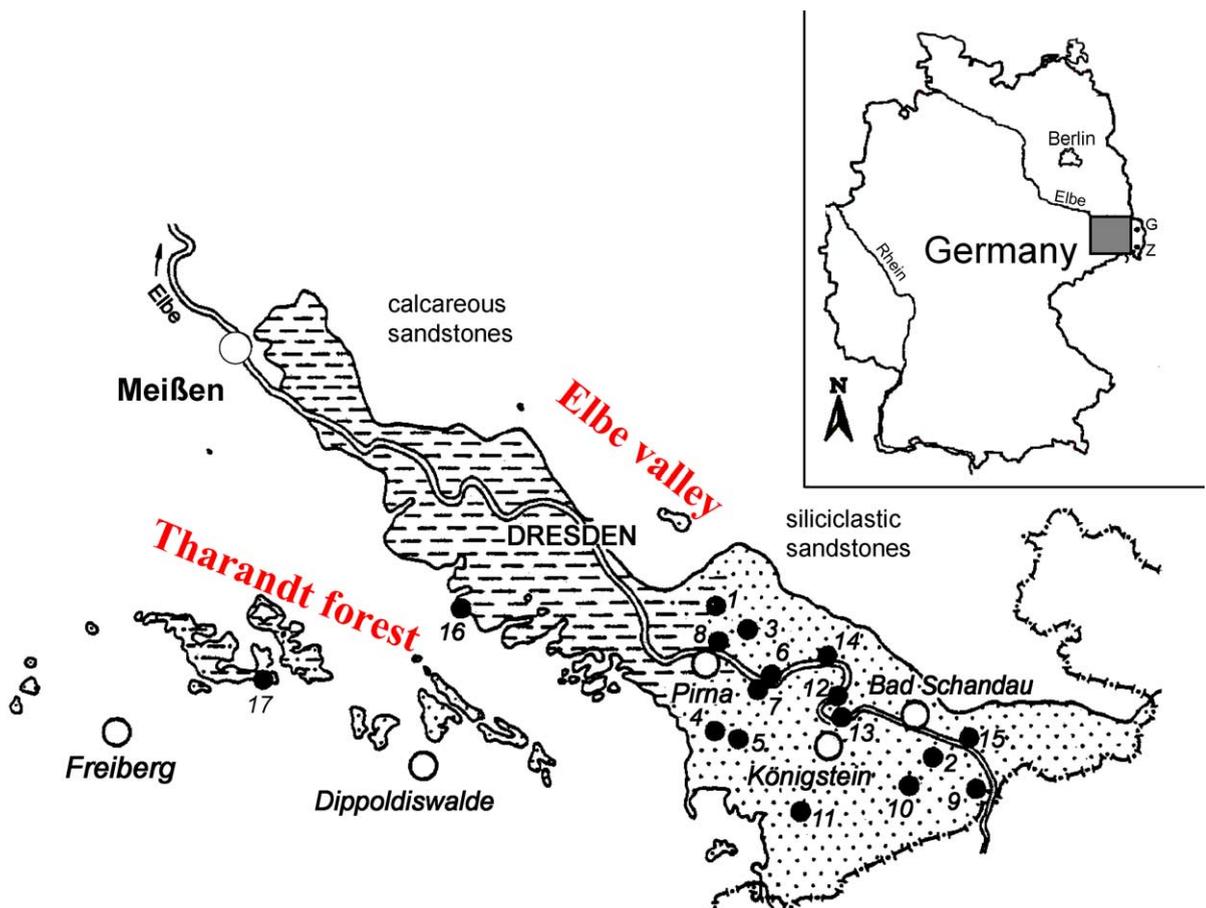


Fig. 1. Schematic map showing the occurrence of Cretaceous sandstones in the Elbe Valley and Tharandt Forest, respectively (Saxony, Germany) used as historical building material (modified after Grunert [8]) the numbers mark different sandstone quarries).

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