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Quader sandstones – porosity, durability and deterioration

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The group of Upper Cretaceous quader sandstones is one of the most important as construction stones. The mentioned rocks are widely used not only in Poland but also in Germany (Saxony), in the past and present, as they have been quarried since the early 13th century. These sandstones are found from the Cenomanium up to the Santonium strata. The mineral composition of the rocks is relatively uniform (quartzose sandstones). The most important feature is their good workability and comparatively high weathering-resistance. Still, regardless the apparent resemblance, the observations carried on buildings and monuments, show differences in weathering processes.

The investigated sample material comes from the actual quarry regions of Lower Silesia (Poland): the North-Sudetic Basin and the Intra-Sudetic Basin. The procedure of sandstone analysis in the aspect of their durability and deterioration resistivity is mainly based on the combination of macroscopic rock description, thin section polarizing microscopy with image analysis (mineral composition, texture, grain size distribution), supported by scanning microscopy, and pore space analysis. The accurate understanding of porosity, permeability and reactive surface is essential for quantifying chemical mass transport in the rock. Porosity characteristics is helpful, or in some cases essential, for: stone durability characterization, rating of stone deterioration or evaluation of stone treatments effectiveness.

Pore area characteristic of examined sandstones was carried out using the polarizing microscopy with image analysis, as well as mercury injection capillary pressure method. It was found that the sandstones are rocks of rather high porosity, from about 10% to 30%. Microanalysis shows the intergranular porosity type. It was found that basing on the porosity characteristic it is not possible to determine sandstone samples origin from particular deposits. Hence, the pore area distribution is not the essential criterion for establishing the provenience of the sandstones. On the other hand, the pore area characterization is important for weathering-resistivity determination, which was shown by the performed quader sandstone classification, basing on the analysis of capillary pressure saturation curves.

The examination of analysed quader sandstones included the modeling of accelerated weathering. Rock samples were put into the Chamber for Aging Acceleration, where some weather circumstances were simulated (insolation, rain and frost). In general, it can be stated, that the most important factor, influencing rock deterioration, is the rock texture. Hence, the detailed petrographical analysis, especially with use of porosimetry is the best device for determination of the weathering resistivity of clastic rocks. Moreover, it was stated that the increase of Fe2O3/K2O proportion correlates to decreasing weathering-resistivity and compressive strength of the rocks.