



## **Understanding nature and properties of “opuka” stone, extraordinary natural stone of medieval Central Europe**

Richard Prikryl (1), Martin Racek (2), Jiřina Prikrylová (3), and Zuzana Weishauptová (4)

(1) Charles University in Prague, Faculty of Science, Institute of Geochemistry, Mineralogy and Mineral Resources, Praha 2, Czech Republic (prikryl@natur.cuni.cz), (2) Institute of Petrology and Structural Geology, Faculty of Science, Charles University in Prague, Albertov 6, 128 43, Prague 2, Czech Republic, (3) Academy of Fine Arts in Prague, Czech Republic, (4) Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, Prague, Czech Republic

Opuka stone is sedimentary rock bound to Upper Cretaceous sedimentary beds of the Bohemian Cretaceous Basin (Czech Republic). It has been extensively and systematically used not only as common building stone, but also for finely carved decorative architectural elements and for sculptures from about 10th c., although sculptural artefacts such as highly valued head of Celtic hero from pre-Christian period are known as well. Susceptibility of opuka stone to damage from decay processes such as freezing/thawing or salt crystallization restricted its use mainly for indoor purposes. The most amazing period of its sculptural application is linked to the so-called Beautiful Style at the end of 14th c. Numerous polychromous Pietas and Madonnas of this artistic style carved in opuka stone are spread not only in Central Europe but also in artistic collections world-wide. Linking of many of these works of art to medieval Prague workshops presents challenging tasks due to still not well-understood petrographic nature of opuka stone. Difficulties linked to its correct interpretation arise from its complex and variable composition and from extremely fine-grained nature. In our view, which is based on the complex analytical study of several tens artistic objects and numerous specimens from historical quarries, opuka stone is highly porous siliceous sedimentary rock containing also common, but variable admixture of carbonates (prevailing calcite, in some places accompanied with dolomite) and clay minerals (kaolinite, glauconite, illite, and/or mixed illite/ smectite structures), supplemented with minor (below 10 %) extrabasinal clastic component with fine- to medium-grained silt granulometry (dominant quartz fragments, with subordinate K-feldspar, muscovite, and accessory minerals such as biotite, rutile, ilmenite, zircon, monazite, and/or xenotime). Petrographic complexity of opuka stone arises from dominant rock-forming phase – silica – which is mostly amorphous (CT opal) to less crystalline extremely fine-grained (individual crystallite sizes often below 1 micron). Silica present in opuka stone can be linked to original siliceous bioclasts (siliceous ooze), which remnants can be found at some localities. Specific composition and character of rock fabric requires combination of several analytical and observational methods such as optical microscopy, scanning electron microscopy with microanalysis, powder X-ray diffraction and textural analysis of pore space by mercury porosimetry. Combination of these methods allows for correct fingerprinting of ancient quarry areas.