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Laboratory-scale experimental burning of selected Palaeozoic limestones from the Barrandian area (Prague Basin, Bohemian Massif, Czech Republic): re-evaluation of properties of historical raw material

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Palaeozoic limestones from the Barrandian area (Prague Basin, Bohemian Massif, Czech Republic) have been quarried and utilized, among others, for manufacturing of inorganic binders. Certain beds, e.g. Devonian dvorecko-prokopské limestones were historically burnt for high quality hydraulic lime which is not produced recently. Aiming to evaluate potential of this specific raw material for small-scale production of restoration hydraulic lime, we have conducted some laboratory experimental burning tests in an electrical furnace up to 1200°C.

Prior to the burning, all studied lithotypes (4 in total) have been examined for their mineralogy (optical microscopy, cathodoluminescence study, X-ray diffraction of insoluble residue) and geochemistry (wet chemical analyses). Studied biomicritic limestones can be classified as wackstones to packstones. Carbonate content varies from 80 to 90 %, the rest is due to dominant illite and silica, and subordinate kaolinite, feldspars, and/or chlorite. Specific composition of non-carbonate component (specifically high content of illite and silica) positively influences formation of CS, Ca, and/or CAS phases when burnt at calcination temperatures from 850 to 1200°C (in steps of 50°C).

In the products formed during firing, mineral phases typical for hydraulic lime, such as larnite, brownmillerite, and gehlenite, along with free lime, quartz and silica phases, and portlandite were identified by X-ray diffraction. The amount of the dominant hydraulic phase, larnite, increased with higher firing temperature. On the other hand, content of free lime, quartz and silica decreased. The amount of portlandite was almost independent of the firing temperature. Higher amounts of larnite and other hydraulic phase were detected during the peak firing temperature of 1200°C in specimens containing higher amount of insoluble residue.

From the study performed, it is evident that studied dvorecko-prokopské limestone, which included favourable amount of clay minerals (mainly illite) and silica represents raw material suitable for production of hydraulic limes of moderate hydraulicity. It is evident that high content of clay minerals, quartz and other forms of silica, as well as temperature of firing, have significant influence on the formation of mineral phases typical for hydraulic lime.