Geophysical Research Abstracts
Vol. 13, EGU2011-3007-1, 2011
EGU General Assembly 2011

Re-evaluation of Bohemian Lower Palaeozoic limestones for the production of alternative hydraulic binders

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Although ordinary Portland cement (OPC) makes the most widespread type of hydraulic binder in current building practice the alternative hydraulic binders like natural hydraulic lime (NHL), hydraulic lime (HL) and natural cement (NC) can serve as important substitutes and more environmentally friendly alternatives (due to e.g. lower firing temperatures). Bohemia (western part of the Czech Republic) is well known for its medieval production of highly hydraulic limes, known in older archive sources as 'pasta di Praga' or 'Prague Old Town lime'. These binders were used from Gothic times as confirmed by analysis of original mortars from Charles Bridge (constructed 1357-1406) or from numerous Baroque structures (e.g. plasters from St. Nicolas Church in Prague). Different hydraulic limes have been produced till very late 19th century when extensive manufacturing of OPC gradually replaced traditional binders.

Sources of raw material are located in Prague surroundings in the geological unit called Barrandian basin. This large oval syncline structure extending SW-NE comprises non-metamorphosed and low-metamorphosed sedimentary and volcanosedimentary rocks belonging to Upper Proterozoic and Lower Palaeozoic (Cambrian to mid-Devonian). In terms of limestone occurrences, Ordovician to Devonian beds of Prague subbasin are the most important. Especially during Lower Devonian, the Prague territory occurred in an equatorial position with warm climate. This meant development of coral reefs and sedimentation of pure limestones rich in fossils (brachiopods, corals, bryozoa, sea-lilies and trilobites) for which the area was well known between palaeontologists from 18th century. Muddy limestones and limy mud were deposited offshore and from these non-pure limestones originated. These limestones were searched for the production of non-cement hydraulic binders in the past and some of them are currently used for cement production.

In the recent study, we have focused on the re-evaluation of the archive chemical analyses (several thousands data) aiming the find which of the 12 different stratigraphic members would be most suitable for the production of moderately to eminently hydraulic limes and/or for natural (Roman) cement. The data were processed by using hydraulic and cementation indices. Nine stratigraphic members show weak to moderate hydraulicity but three members seem to be able to produce either eminently hydraulic limes and/or natural cement. The study will be extended to laboratory scale experiments during which the representative material will be burned at appropriate temperatures and further tested for the presence of hydraulic phases.