

Isotope (sulphur, oxygen, boron) tracing of internal or external origin of sulphates involved in the degradation of French stone monuments (BOS project)

Duration: 2 years (2004- 2006)

Program

Water and soluble salts are the main factors of stones degradation in cultural heritage. It is generally very difficult to remedy salts effects because their origin is unknown. The aim of this study was to discriminate and to quantify the salts coming from different sources: natural and intrinsic (including pyrite which is contained in the stone), natural and extrinsic (marine aerosols), induced from anthropic activities (urban atmospheric pollution), due to restorations (plaster, roman cement). This study was focused on several monuments which are affected by salts coming from one or several causes previously mentioned. The monuments are: the cathedrals of Bourges, Chartres and Marseilles, the statues of the Versailles' castle park, the Chenonceaux' castle.

The isotopic signatures of oxygen and sulphur which are in solid sulphates, and boron which is also present in the sulphates as a trace were studied on samples (restoration materials, black crusts, decayed stones) of these five monuments. The combination of these isotopic signatures allowed to discriminate the main different sources and to know their contribution into the decayed stone samples. This isotopic approach is now performed in the field of cultural heritage and could be considered as the first step towards the set up of a multi-isotopic tool for the diagnosis of degradation of stone monuments.

The main targets of BOS project are:

- to study the formation of sulphates on different monuments (including different kind of stones, different environments, urban or coastal contexts)
- to develop a database on the isotopic signatures of the potential sources of sulphates
- to quantify the parts of the internal and external sources of sulphates in order to evaluate the contribution of the building or restoration materials for some more general recommendations (including the definition of restoration and conservation strategies, the limit in use of some materials, the loss or restriction of a few materials, the loss or the insulation of internal degradation sources)
- to propose a quantification method on the impact of sulphates sources which could be useful for the first studies prior to a restoration intervention

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Publications

KLOPPMANN W., VERGÈS-BELMIN V., GOSELIN C., ROLLAND O., BROMBLET P., VALLET J.-M., DOTSIKA E. (2006). Isotope (sulphur, oxygen, boron) tracing of internal or external origin of sulphates involved in the degradation of French stone monuments (BOS project). Safeguarded cultural heritage- Understanding and viability for the enlarged Europe, 7th European Commission Conference "Sauveur", 31/05-3/06 2006, volume 1 – papers, pp. 437-440.

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