The Saint-Julien Cathedral southern Portal (le Mans, France) : a Stone-Weathering Study

Abstract

The cathedral, which was originally built around AD 840 in the romanesque style, was turned into a gothic monument in mid 13th century when a large, tall choir was erected on its romanesque foundations. The sculptures of the southern portal, which are of a fine, pale limestone, are now covered with a relatively thick layer composed of various powdrey materials in the protected upper areas and with a thin black crust in the lower unprotected ones.

It has been previously demonstrated that the SO_2, which causes the growth of the black crust, is not only deposited from its gaseous form but is also transported as solid microscopic particles (Del Monte *et al.*, 1984, Del Monte and Sabboine, 1984, Ausset, Lefèvre and Philippon, 1989). These particles are part of the atmospheric aerosols which reach the surface of the stone through dry or wet deposition. We have been concerned with observing and characterizing the carbonaceous and siliceous microspherules contained in the deposits and the black crusts and in trying to quantify the total sulphur content of each. The microspherules were either numerous and mixed with the superficial disorganized calcite and gypsum microcrystals or scarce and embedded in the hardened gypsum crusts. The major elements of the microspherules were, in decreasing order of concentration : Fe, Si, Ca, Al, and Na. The amount of sulphur was approximately 12 %. About 70 % of the microspherules fell in the 4-5 µm diameter size range. 62 % had a smooth surface, 23 % were porous and 14 % rough. It was then possible to assess experimentally the Al/Si, Fe/Si nad Fe/Al ratios which were 50 %, 22 % and 47 % respectively, and to observe that 42 % of the particles were of the metalic type, 36 % of the aluminosilicate type and 22 % of an intermediate type (Venet, 1990).

The presence of these microspherules with a high sulphur content on the weathered limestone surfaces of the Le Mans cathedral reinforces the idea of their importance as sulphur vectors and as catalysts in subsequent chemical reactions with monument surfaces.

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