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Compositional changes of settling dust in time on buildings in Budapest: centennial evidence of air pollution trends

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Dust is one of the main pollutants that settle on historic structures and cause the blackening of stone surfaces. The stone facades of historic buildings became dark, and besides its aesthetic alteration, dust deposition and subsequent chemical reactions led to the deterioration of the construction material. The composition of dust changes in time due to climate change, clean air acts and changes in transportation, industrial activities and heat. The present study tries to detect the temporal changes in the composition of dust by using a stone buildings as dust traps in Budapest. The studied historic building is more than one hundred years old, and no façade cleaning was done in the past century. Visual inspection of the city centre building suggested that dust accumulation show a distinct pattern representing differences in the vertical profile in terms of thickness and colour. Dust samples were collected from layer to layer representing newly settled and historical dust. Scaffolds were made to reach the various elevations of the building facades. Besides the dust, host rock samples were also picked to detect textural and compositional changes of the porous oolitic limestone material. The textural-mineralogical analyses (XRD, SEM) and chemical compositional tests (XRF, LA-ICP-MS) provide evidence of changes in composition of dust with time. In all host rock samples, gypsum was detected but in various proportions. Good correlations were also found between water-soluble calcium and gypsum content and between sulphate and gypsum content both for black crusts and host rocks, forming two distinct fields in calcium vs gypsum and sulphate vs gypsum graphs. Gypsum was also found in the dust either as a primary or as a secondary mineral phase. Metals, transition metals and water-soluble ions also occur in various concentrations in different layers of dust. The detected elements primarily include Fe, Mn, Zn, Cu, Cr, Pb, Ni. From soluble salts, chloride, nitrate and sulphate were also detected. The changes in elemental and ionic concentrations reflect temporal changes in dust composition and provide indirect evidence for air quality changes and air pollution levels.