심포지움 1) Microanalysis at the Interface of Environmental and Cultural Heritage Research

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X-ray spectrometry and especially electron probe X-ray microanalysis (EPXMA), in their many forms, are ideal techniques for studying the inorganic composition and speciation of atmospheric aerosols collected on filters or by impaction. We have developed recently a technique, called "low-Z" EPXMA, to determine the concentration of low-Z elements such as C, N, and O, in addition to the higher-Z elements which are observed using conventional energy dispersive EPXMA. The quantitative determination of low-Z elements (using full Monte Carlo simulations, from the electron impact to the X-ray detection) in individual environmental particles has allowed to carry out chemical speciation at the single particle level. Indeed, many environmentally important atmospheric particles, e.g. sulfates, nitrates, ammonium and carbonaceous particles, contain mostly low-Z elements. Furthermore, we have also developed "beam energy variation" EPXMA, which allows to get information on the depth heterogeneity with respect to chemical composition, of single particles.

We have invoked classical automated EPXMA and these two recent variant techniques for characterizing millions of aerosol particles in numerous environmental projects, and recently, mostly at the interface of environmental and CH research, i.e. in studies on the effects of pollution on CH, often in combination with passive gas analyses. This included studies in and around classical museums in Venice, Vienna and Antwerp and modern ones in Sendai and Norwich. E.g. in the first case, the XRS methods proved that the particles that were most threatening for the paintings were released by the deteriorating plaster renderings, while in the latter case, outdoor pollution particles were found to enter the museum easily. Another specific study concerned the possible accumulation of air pollutants in the interspace between the original medieval stained glass windows and the recently installed protective glazing, in several cathedrals in Europe. Along with many other particle types, mostly soot (candle burning, incense) and soil particles, were found, not significantly different from those outside the interspace. Because of the strong drafts (due to the strong temperature gradient) in the interspace, no worrisome increase in particulate concentrations in the interspace air was noted, but the enhanced (about tenfold) delivery (due to the draft) of sulfur dioxide in the interspace appeared to present a new and serious problem for the stained glass windows. Finally, these methodologies were applied to study the effect of different heating systems on the indoor pollution and CH deterioration in several relevant mountain churches in Europe.