Use of isotopic tracers (D, ^{18}O) for the study of water transport within stained-glass windows alteration layer

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Glass alteration is widely studied, notably in the context of the storage of nuclear vitrified wastes. One of the main issue is to assess the potential passivating effect of the altered layer. Some experiments have shown that a progressive closure of the pores of the layer creates a barrier slowing down the water circulation. Atmospheric medium is characterized by variable conditions of water content, which could prevent this passivating role. Moreover, ancient stained glasses have been weathered in these conditions. In this study, in order to assess the kinetic role of the altered layer in atmosphere, an aging experiment was carried out in simulation chamber over periods ranging from 1 day to several months at 20 °C on two medieval glass samples. They date from the 14th century and have developed a thick altered layers (>100 µm). They were weathered at controlled relative humidity (from 25% to 90% RH) with an oxygen-18 and deuterium doped water vapor to trace the circulation of water and the pursuit of alteration. NanoSIMS mappings were then acquired in order to observe the distribution of the isotopes within the altered layer. The results demonstrate a linear correlation between the relative humidity and the isotope enrichments. They also show that the altered layer does not seem to limit the circulation of water on the gas state. Interdiffusion seems to be the major mechanism occurring in the alteration process.