

## **Medieval stained glass in a Mediterranean climate: Typology, weathering and glass decay, and associated biomineralization processes and products**

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### **ABSTRACT**

Medieval stained glass (13<sup>th</sup>–15<sup>th</sup> centuries) from three restoration works (Santa Maria del Mar and the Pedralbes Monastery church in Barcelona, and the Tarragona Cathedral in the northwestern Mediterranean area) have been studied to characterize glass decay. Electron microprobe analysis gave evidence of two types of glass: an Na-rich type (stable, Mediterranean, of Roman-like tradition), and a K-Ca-rich type, similar to coeval Central European medieval stained glasses. The latter shows glass decay in the form of destructive (micro- and mesopitting) and constructive (patina and microcrust) glass surfaces. Nevertheless, this type of decay in the K-Ca-rich group of glasses is in terms of thickness reduction in flat glass an order of magnitude less than that commonly found in Central European countries with a continental climate. Macroscopic and microstructural studies (SEM-EDS, XRD) allowed us to identify biodeterioration decay with chemical effects similar to that for pure chemical hydration leaching and corrosion, associated with biomineralization with unspecific sulfate (gypsum, syngenite) and calcite mineralization as well as bioinduced (weddellite, whewellite, etc.) mineralization. Medieval-stained glass biodeterioration decay in the Mediterranean area shows patterns and products comparable to those developed on stone in the same historic buildings.