

ESR and OSL variability in quartz extracted from magmatic, metamorphic or sedimentary rock

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Sediment routing systems in fluvial catchments are primarily governed by intertwined climatic, tectonic and man-induced drivers at the centennial/millennial timescales. Among the various geomorphological and geochemical approaches developed to trace sediment dynamics, the scientific community has recently explored the potential of (palaeo-)dosimetric methods, which are extensively used to date e.g. Quaternary alluvial environments. Recently, Optically Stimulated Luminescence (OSL) and Electron Spin Resonance (ESR) signals have been successfully transposed to decipher sediment provenance and transport in fluvial catchments.

In this context, the French ANR QUARTZ research project aims at using quartz grains as an ubiquitous marker of sediment dynamics to understand (i) how each quartz grain holds a source-specific signature, and (ii) how this signature evolves along sediment routing systems. This contribution specifically focuses on the first research topic.

Quartz-bearing rocks located upstream in catchments deliver the material that is usually dated by OSL and/or ESR in fluvial sequences/deposits for geological or archaeological purposes. Here, we analyzed with ESR and OSL methods quartz grains originating from different source rocks in the Strengbach and Séveraise catchments (France), draining a low mountain range (Vosges Mountains) and the Alps (Ecrins Massif), respectively. These rocks comprise magmatic, metamorphic and sedimentary lithologies of distinct age and composition, and provide quartz minerals present in the transposed and deposited sediments. The quartz grains were analyzed with ESR and OSL methods on the quartz minerals from different quartz-bearing rock formations in both catchments, i.e. mostly granites, gneisses and sandstones of distinct ages and/or compositions. The source-specific signature of the different ESR signals (Ti/Al ratio, signal shape, non-optically bleachable intensity of the Al centre) was investigated. The bleaching kinetics of the different ESR centres used in dating and present in these quartz from different rock types were also investigated. Depending on the history of the quartz-bearing rock and therefore of the quartz nature (magmatic, metamorphic or sedimentary), we suggest that the ESR response varies in terms of signal shapes and intensity ratios of the different centres measured. Similarly, quartz OSL characteristics have been investigated (OSL signal intensities, contributions of fast/medium/slow OSL components, dose-response curves and saturation behavior) between rocks of different origins, as well as the bleaching potential (residual doses) between different quartz origins.

These analyses are currently complemented in a near future by quantified trace element analyses on quartz samples from the same sources. This will allow us not only to provide encouraging results in terms of tracing quartz in fluvial deposits, but also a better understanding of the processes at the origin of ESR and OSL signals variability. This will constitute a first step towards understanding the dosimetric behaviour of the sediments to be dated, and towards even more reliable dating techniques.

Keywords (max. 5): quartz, ESR, OSL, rocks, variability