

# Physico-chemical variability of quartz grains in various bedrock materials: insights from coupled ESR and Trace element analysis

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The scientific community has recently explored the potential of (palaeo-)dosimetric methods, which are extensively used to date e.g. Quaternary alluvial environments, to decipher sediment provenance and transport in fluvial catchments (e.g. Gray et al., 2019). Within this context, the French ANR QUARTZ research project aims to understand (i) how each quartz grain/aliquot holds a source-specific signature, and (ii) how this signature evolves along sediment routing systems. This contribution specifically targets the first aim. Our research focuses on the Strengbach catchment draining the Vosges Mountains (NE France). Despite its small size which allowed detailed geological mapping, plutonic (e.g. granite), metamorphic (e.g. gneiss or hydrothermal fractures filled with quartz), and sedimentary (e.g. sandstone) quartz-bearing formations occur throughout the catchment, thereby allowing exhaustive sampling of the different source materials. Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) and Laser Induced Breakdown Spectroscopy (LIBS) were applied on thick sections of bedrock samples and on 125-250 µm quartz grains extracted from this material. Quartz grains were also analysed by Electron Spin Resonance (ESR), focusing on signal intensities of both Al and Ti-Li paramagnetic centres.

Five main outcomes are observed.

1. Within the same bedrock type, elemental analyses on thick sections show that quartz grains vary in composition according to their nature, formation process, and alteration/weathering (e.g. hydrothermal, recrystallized, unrecrystallized, metamorphic quartz). For instance, hydrothermal quartz also show highest contents in Li.

2. Determining the origin of individual grains or assigning them to a rock type using Al, Ti, and Li content from a single grain remains difficult. However, the overall population of quartz grains analysed within a bedrock sample show composition trends characteristic of the major bedrock type.

3. The distinction between bedrock types is improved by combining geochemical analyses with ESR parameters.

4. Quartz-grains' ESR sensibility to irradiation seems to be rock dependent.

5. Comparing trace-element analysis in quartz grains from thick sections (whole bedrock) sample and in extracted quartz grains allow assessing the impact of sample preparation (crushing/sieving treatments). We aim to evaluate whether all quartz types are represented in the extracted grains or not. Assuming that laboratory-based crushing/sieving "mimics" natural erosion, transportation and sorting processes, we could then estimate whether they would be present in modern river sediment.

*References:*

*Gray, H. J., Jain, M., Sawakuchi, A. O., Mahan, S. A., & Tucker, G. E. (2019). Luminescence as a sediment tracer and provenance tool. Reviews of Geophysics, 57(3), 987-1017.*