☐ **Talk** ■ **Poster**

Geochemistry and Luminescence Sensitivity in Quartz Grains from Chemically Active Soils

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Optically Stimulated Luminescence (OSL) is a geochronological technique that estimates the time since mineral grains (quartz or feldspar) were last exposed to sunlight. It does so by measuring light emitted when those grains are stimulated after absorbing radiation over time [1]. OSL is widely used in sediment dating and increasingly in sediment provenance studies, as it also reflects the history of grain transport and environmental exposure. A key parameter in this method is quartz sensitivity, the amount of luminescence emitted per unit of radiation dose. This depends on crystal defect structures, particularly electron traps and recombination centers, which are influenced by trace element chemistry and environmental processes [2].

Understanding the origin and nature of these defects is crucial for improving OSL dating, especially at the single-grain level, where differences in sensitivity can lead to significant uncertainty in age estimates. The defect structure affects both the brightness of the signal and the reliability with which a grain stores radiation dose over time. Without this understanding, it remains challenging to distinguish between geological scatter (e.g. sediment mixing) and intrinsic mineral variability, which complicates dose distribution analysis and age modeling.

To explore how environmental processes in the sub-surface influence defect chemistry, we analyzed quartz grains from deeply weathered soils at a well-studied archeological site in the Oaxaca region of southern Mexico. Using μ-XRF mapping at beamline 5-ID of NSLS-II (BNL), we mapped trace elements (Cu, Ti, Fe, and Zn) in individual grains that show unexpectedly high sensitivity despite low doses and young depositional contexts.

These enrichments may result from prolonged chemical weathering or biological cycling processes that promote the formation of luminescence-relevant defects [3]. Although the course and transport history of the quartz is not fully constrained, these findings suggest that a chemically active surface environment can enhance luminescence properties in ways that sensitize quartz. Future work will examine grains from different environments.

References

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