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Optically stimulated luminescence of quartz separated from different rocks and its potential influential factors

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The luminescence properties of quartz and its suitability for OSL (Optically Stimulated Luminescence) dating of Late-Pleistocene and Holocene sediments show local differences. For example, in some places of Hungary, quartz has much dimmer luminescence than in other areas of the country, or it is saturated due to lower radioactive radiation, which makes OSL dating challenging.

Luminescence properties of quartz related to its crystal lattice defects are, therefore, influenced by the impurities of quartz, probably by its source rock, by the amount of radioactive radiation which reached it in the source rock, and by its sedimentological history. To study these factors, quartz was separated from some plutonic, volcanic, metamorphic and older sedimentary rocks of Hungary. After crashing and sieving these rocks, the quartz was separated in the same way as for OSL dating, but not in dark conditions. Then OSL measurements, Micro-Fourier Transform Infrared Spectroscopy (Micro-FTIR), Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), and Thermal Analysis (Differential Scanning Calorimeter: DSC) were applied on the quartz separates. The radioisotope concentration of the studied rocks was also determined based on laboratory High-Resolution Gamma-Ray Spectrometry.

The OSL measurements indicate that the quartz separates of some older sedimentary rocks and volcanic tuffs give brighter luminescence than the quartz of the studied metamorphic and plutonic rocks. Based on the luminescence test measurements, only the quartz fractions of a few older sediments could be suitable for OSL dating. The results of gamma spectrometry show that probably there is no correlation between the OSL intensity of the quartz and the radioisotope concentration of its host rock. Micro-FTIR analysis detected coupled substitution of $Al^{3+}+H^{+} \rightarrow Si^{4+}$, furthermore structural hydroxyl, and molecular water in the quartz of some older sedimentary rocks which give bright OSL. Meanwhile, the amount of element impurities in the quartz, measured by LA-ICP-MS, seemingly does not influence the OSL intensity.

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