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Cathodoluminescence of quartz and feldspar in provenance research

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Quartz often dominates in siliciclastic sandstone and feldspar mostly is present. Despite this, the use of quartz and feldspar in provenance research is limited. Feldspar is less stable than both quartz and many other minerals that are used to trace sources rocks, such as zircon and rutile. Nevertheless, particularly quartz and zircon may survive many sedimentary recycling phases. Therefore they do not necessarily give information about first-cycle sources. Hence, the wide occurrence of feldspar and quartz in sedimentary rocks is an excellent condition to trace both first-cycle and multi-cycle sediment sources. The cathodoluminescence (CL) technique enables the consideration of both minerals. We analysed ca. 1000 quartz crystals and ca. 1200 feldspar crystals in ca. 60 samples each for their CL colour spectra to investigate their provenance potential. They originate from different plutonic, volcanic, metamorphic, and pegmatitic rocks. The CL colours of quartz vary from red over violet to different shades of blue and brown. They are due to lattice defects and trace element contents that are caused by different crystallisation conditions and later lattice reorganisation. The corresponding CL spectra are dominated by two apparent intensity peaks at 470-490 nm (blue) and at 600-640 nm (red). Distinctive relative intensity differences in these two peaks occur for (1) quartz of volcanic origin, (2) felsic plutonic and high-temperature metamorphic quartz, and (3) low-temperature metamorphic quartz. Feldspar often luminesces in different shades of blue, green, yellow, and red due to substitution elements. Alkali feldspar usually has a bright blue colour and plagioclase often is green. The corresponding CL spectra are dominated by three apparent intensity peaks at 420-500 nm (blue), 540-570 nm (green) and 690-760 nm (red to infrared). The CL is particularly useful for the distinction of plagioclase from alkali feldspar. Here, a dominance of the peak in green over the peak in blue for plagioclase is present. The colour and spectral variation due to source rock type is less distinct. Nevertheless, among the plagioclase, a peak in red to infrared with a main wavelength < 700 nm is uncommon for plagioclase from felsic rocks. We conclude that the CL spectra of both quartz and feldspar can be use for provenance studies. The measurement of wavelength spectra is a fast and straightforward method to determine both quartz-bearing source rocks and to identify the feldspar type and plagioclase of mafic origin.