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Improved electron probe microanalysis of trace elements in quartz

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ABSTRACT

Quartz occurs in a wide range of geologic environments throughout the Earth's crust. The concentration and distribution of trace elements in quartz provide information such as temperature and other physical conditions of formation. Trace element analyses with modern electron-probe microanalysis (EPMA) instruments can achieve 99% confidence detection of ~100 ppm with fairly minimal effort for many elements in samples of low to moderate average atomic number such as many common oxides and silicates. However, trace element measurements below 100 ppm in many materials are limited, not only by the precision of the background measurement, but also by the accuracy with which background levels are determined. A new "blank" correction algorithm has been developed and tested on both Cameca and JEOL instruments, which applies a quantitative correction to the emitted X-ray intensities during the iteration of the sample matrix correction based on a zero level (or known trace) abundance calibration standard. This iterated blank correction, when combined with improved background fit models, and an "aggregate" intensity calculation utilizing multiple spectrometer intensities in software for greater geometric efficiency, yields a detection limit of 2 to 3 ppm for Ti and 6 to 7 ppm for Al in quartz at 99% t-test confidence with similar levels for absolute accuracy.

Keywords: Electron microprobe, trace elements, quartz, detection limit, accuracy, background artifacts, blank correction, aggregate intensities