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Structural recovery in zircon under an electron beam

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Electron beam microanalysis is commonly associated with "beam damage", a deterioration of sample structure or chemistry upon interaction with the electron beam. Causes for beam damage may be e.g. heating, electrolysis and redox reactions. Self-irradiation damage in natural zircon is caused by the accumulation of alpha decay-induced defects in crystallinity. This damage is preserved in zircon under normal conditions. However, damage accumulation may be reversed and damage in zircon may be annealed. Most commonly this is done by heating (e.g. Nasdala L. et al. 2001, *Contrib. Mineral. Petrol.* **141**:125).

In this study we show that the stationary electron beam used e.g. in electron beam microanalysis (SEM-EDX, EPMA) also causes a recrystallisation in zircon. Four zircon samples covering a broad range of initial degrees of damage (ca. 0.9–4.9$\times10^{18}$ decay events per gram calculated alpha dose) were subjected to various electron doses using a fully focused electron beam (JEOL Superprobe 733, 20 kV accelerating voltage) by varying the beam current (10–200 nA) and irradiation time (10–500 s). The annealing effect is demonstrated using the FWHM of the $\nu_3(\mathrm{SiO_4})$ Raman band of zircon (Nasdala L. et al. 1995, *Eur. J. Mineral.* **7**:471). The rate of recovery has been found to be proportional to beam current as well as to irradiation time. The recovery rate has been found to increase with increasing initial damage level. For a given initial alpha damage, equal electron doses produce essentially the same degrees of recovery, thus ruling out the role of the heating effect of the electron beam.

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