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BSE contrast in altered zircon: structure, texture and chemistry

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It has recently been shown that the main source of contrast on backscattered electron (BSE) images of zircon single crystals is very often not chemical heterogeneity due to impurity elements (changes in average atomic number, $\bar{Z}$) but structural state (different electron penetration properties due to self-irradiation damage). Secondary altered zircon may, however, appear significantly darker in BSE images than zircon in the pristine, unaltered state. This contribution shows that the effects on BSE yield related to structural reasons only are not enough to explain such strong differences; some chemical variation must also contribute to the BSE contrast.

Detailed characterization of altered zircon samples from the Jack Hills, Australia, the Ural Mountains, Russia, and the La Pedriza pluton, Spain, was done using BSE imaging, electron microprobe, analytical TEM and micro-spectroscopic techniques (Raman and IR absorption spectroscopy). It was shown that alteration patches with unusually low BSE signal intensity in zircon always exhibit low analytical totals in the electron microprobe. TEM imaging of such areas indicate a spongy texture with a large number of submicron-sized pore holes. The phase in question is strongly hydrated, may contain up to several wt% water according to IR measurements. Deficient analytical totals and BSE intensities are related to both the chemical composition (water content) and textural peculiarities (porosity) of secondary altered zircon. High water contents are explained by hydration during secondary zircon formation and a subsequent water

uptake due to porosity.