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LETTER

Periodic precipitation pattern formation in hydrothermally treated metamict zircon

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ABSTRACT

For more than 100 years mineralogists, physicists, chemists, geologists, and biologists have discussed the formation of periodic Liesegang patterns observed in natural and experimental systems. Spectacular examples of minerals showing complex periodic patterns are agate, malachite, and sphalerite. Here we report the first observation of Liesegang-like patterns in hydrothermally treated metamict (i.e., amorphous) zircon. The structures observed show curved bands, radial sets of pocket-like wave fronts or irregular curved patterns in both cathodoluminescence and backscattered electron images. They are composed of alternating zones of crystallographically well-aligned, polycrystalline zircon along with remnant amorphous pockets and a phase assemblage of randomly oriented zircon crystallites, monoclinic ZrO_2, and amorphous SiO_2, as revealed by transmission electron microscopy. Analyses by secondary ion mass spectrometry and electron microprobe reveal that the latter zones are characterized by higher hydrogen concentrations and higher Zr-Si ratios. Both zones are also distinguishable by a distinctly different crystallite size. We propose a possible pattern-forming mechanism that is based on a feedback of hydrogen diffusion, zircon nucleation, and the displacement of hydrogen atoms from growing crystallites.