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Recrystallization mechanisms of fergusonite from metamict mineral precursors

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Abstract

The metamict state and recrystallization of fergusonite in metamict natural samples were studied by thermal methods (TGA-DTA), X-ray powder diffraction (XRD), Raman spectroscopy (RS), transmission electron microscopy (TEM), selected area electron diffraction (SAED), and electron microprobe (EPMA). Two metamict mineral samples assumed to be fergusonite were investigated in order to identify the original premetamict crystal structure, and to reveal recrystallization mechanisms. The TEM data and partly RS provided evidence of the partial preservation of the original structure in the investigated minerals, which seem to be X-ray amorphous. The collected data indicated the fergusonite recrystallization from the metamict mineral originally having fergusonite structure or from parent pyrochlore, which was substantially altered during metamictization.

Two recrystallization mechanisms were recognized: (a) epitaxial growth occurring at the boundary between preserved premetamict fragments and completely metamictized areas, and (b) nucleation-crystal growth mechanism occurring in completely amorphous areas of the minerals, and resulting in recrystallization of the original mineral as well as in the crystallization of a new mineral with a modified chemical composition as compared to the initial matrix.

Keywords Fergusonite · Metamict state · Recrystallization mechanisms · Raman spectroscopy · TEM