In situ radiation damage studies of $Ca_3Zr_2FeAlSiO_{12}$ and $Ca_3Hf_2FeAlSiO_{12}$

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Garnets, $A_3B_2C_3O_{12}$, are considered to be potential host phases for the immobilization of high-level nuclear waste as they can accommodate a number of elements of interest, including Zr, Ti and Fe. The naturally occurring garnet, kimzeyite, $Ca_3(Zr,Ti)_2(Si,Al,Fe)_3O_{12}$, can contain ~30wt% Zr. An understanding of the radiation tolerance of these materials is crucial to their potential use in nuclear waste immobilization. In this study two synthetic analogues of kimzeyite of composition $Ca_3Zr_2FeAlSiO_{12}$ and $Ca_3Hf_2FeAlSiO_{12}$ were monitored in situ during irradiation with 1.0 MeV Kr ions using the intermediate voltage electron microscope-tandem user facility (IVEM) at Argonne National Laboratory. The structure of these materials was previously determined by neutron diffraction and ^{57}Fe Mössbauer spectroscopy. $Ca_3Zr_2FeAlSiO_{12}$ and $Ca_3Hf_2FeAlSiO_{12}$ have very similar structural properties with cubic Ia3d symmetry, the only significant difference being the presence of Zr and Hf, respectively, on the 6 coordinated B sites.