Understanding the formation of polytypism in natural moissanite with Laue microdiffraction

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Moissanite (SiC) is an uncommon terrestrial mineral that forms under highly reducing conditions. SiC can adopt over 300 crystal structures, mostly consisting of alternating Si and C layers, with stacking faults or shears distinguishing them from one another. Natural moissanite can adopt one of several specific types, namely a zincblende structure (3C-SiC), one of two wurtzite structures (4H-SiC and 6H-SiC), and a rhombohedral type (15R-SiC). We find a natural moissanite sample from an Israeli Miocene tuff, containing 3 SiC grains identified using Raman spectroscopy and Laue microdiffraction. One grain, SiC-2, is found to also contain native Si. We use synchrotron Laue microdiffraction at ALS 12.3.2 to map grain SiC-2 at 2-8 um step size. We are able to unambiguously assign the crystal structure to either 4H or 6H-SiC due to the significant difference in c-axis length between the two structures (~10 vs ~15 um, respectively). Data show that the sample contains multiple stacking faults, and large amounts of polycrystallinty in some cases. Based on the crystal structure of the aggregate and the composition of the mineral assemblage, we are able to make a reasonable guess at the mechanism of formation for this sample.