Western Nanofabrication Facility

Western Science

An Accurate Determination of Shock Level in Feldspar Group Minerals

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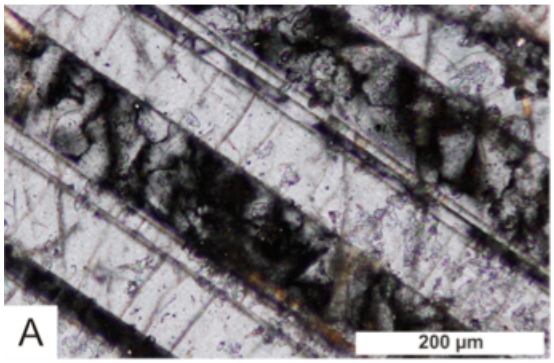
Meteorite impact craters are the dominant surface feature on most terrestrial planetary bodies and provide important information about planetary evolution [1]. As the shockwave from impact excavates a crater, rocks and minerals of the target material undergo pressure-dependent micro-structural solid-state deformation, termed shock metamorphism [1]. Studies of shock metamorphism in feldspars have been limited thus far, resulting in a purely qualitative shock classification scale for them.

This project aims to develop a more quantitative scale of shock deformation in feldspar group minerals in order to expand the utility of feldspar for determining shock level in quartz-limited systems (e.g. anorthosite, syenites, ultramafic rocks, and meteorites).

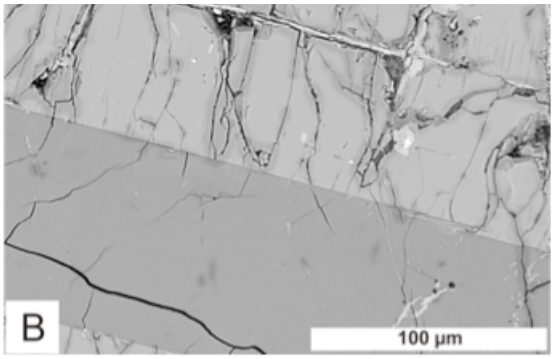
A suite of polished thin sections containing shocked feldspar from multiple locations, including the Mistastin (Kamestastin) Lake impact structure, Labrador, Canada, and the Apollo landing sites have been examined. Initial optical observations have been carried out using petrographic microscopes with follow-on in-depth studies using the LEO (Zeiss) 1540XB scanning electron microscope at the Western Nanofabrication Facility. These investigations revealed visible shock metamorphic effects, such as planar features in the crystal structure, diaplectic glass, and a unique plumose texture related to the ambiguous formation of maskelynite (fig. 1).

Understanding shock in feldspars on Earth, will set the groundwork for future studies of samples returned from the Moon, Mars, and asteroids thus increasing the scientific return of sample return missions – which is a primary goal of space agencies the world over.

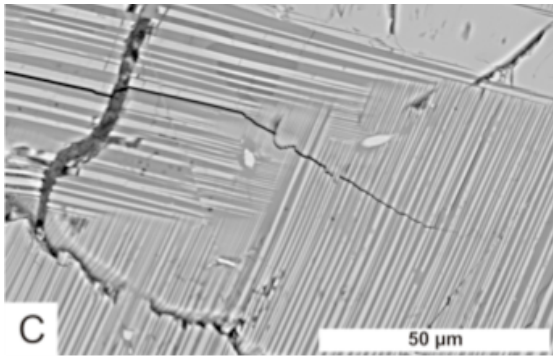
[1] French B.M., and Koeberl C. 2010. *Earth-Science Reviews* 98:123-170.



A. Plumose extinction displayed in alternate twins of feldspar, reminiscent of the manner in which maskelynite sometimes forms in only alternate twins. Cross-polarized transmitted light.



B. Plumose twin/regular twin boundary. Note change in tone and texture across boundary. BSE image.



C. Planar features in two directions in one twin. BSE image.

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