DETRITAL SHOCKED MUSCOVITE FROM THE SANTA FE IMPACT STRUCTURE (USA).

D. Colón Lugo[1] and A. J. Cavosie[1,2]
Univ. Puerto Rico-Mayagüez (denyse.colon@upr.edu), [2]Univ. of Wisconsin-Madison

Introduction: Micas with kink bands (KB) remain a relatively understudied shocked mineral due to the formation of KB in both high strain (impact) and low strain (tectonic) regimes [1]. The discovery of shatter cones and shocked quartz near Santa Fe, New Mexico, led to the discovery and confirmation of the Santa Fe impact structure [2]. In addition to quartz, KB in muscovite were mentioned but not well-documented in the original discovery report. Here we report the occurrence of muscovite with KB (hereafter 'shocked muscovite') in modern colluvium collected near shatter cone outcrops. We report the results of a transmitted light and scanning electron microscopy (SEM) study of the kink bands, as well as electron microprobe analyses (EMPA) of the composition of the shocked muscovite grains in order to better document the shocked muscovite grains and to provide a basis for comparisons with other occurrences of shocked muscovite.

Shock metamorphism: Kink bands in mica result from glide and rotation mechanisms, and have been reported in mica as a product of regional metamorphism, meteoric impact, nuclear explosion, and laboratory experiment [3]. For our purposes, a kink band is defined as a microscale lense-like zone in which a pair of sub-parallel to parallel planes with opposite dislocations delimit the edges of a crystal domain deformed by gliding planes [4,5]. In muscovite, KB are readily visible features due to the deflection of cleavage orientation within the KB.

Samples: Sample 11NM03 is mixed colluvium/alluvium in a north-south drainage ~50m north of Hwy 475 [6]. A second colluvium sample, 11NM05, is from a shatter cone outcrop approximately 1 km further east on Hwy 475. Two thin sections were made from each sample and were analyzed using transmitted light (TL) imaging. SEM images of shock microstructures and muscovite EMPA data were collected for the same grains in thin section from both samples.

TL and SEM result: KB microstructures cross the c-axis in multiple orientations, and up to 3 orientations were observed in single grains. KB were divided into categories based on geometry of the microstructure: planar KB (Fig. 1), curviplanar KB, and serrate (saw-tooth) KB. In addition, kink band size and length are variable; we observe grain-scale KB, micro KB (~10 µm long, sometimes in arrays), thin KB (<5 µm thick), and wide KB (>5 µm thick) variations.

EMPA results: Muscovite compositions in each sample are similar: 11NM03-94 yielded a formula of: $(K_{2.066}, Na_{0.086})$ $(Al_{4.426}, Fe_{0.564}, Mg_{0.200}, Ti_{0.133})$ $(Al_{1.497}$ $Si_{6.503}$ $O_{20})$ $(OH)_4$ and 11NM05-52 yielded a formula of $(K_{2.026}, Na_{0.090})$ $(Al_{4.404}, Fe_{0.589}, Mg_{0.232}, Ti_{0.112})$ $(Al_{1.439}$ $Si_{6.561}$ $O_{20})$ $(OH)_4$. The presence of Na, Fe, and Mg indicates minor celadonite and paragonite solid solution. In general, the muscovite compositions are not anomalous.

Discussion: Shock microstructures in Santa Fe micas bear similarities and differences with other occurrences. In general, a wider range of variations was observed in our study than previously reported. Futher detailed investigation of KB microstructural variability may lead to identification of features that can be used to identify a high strain (impact) vs. low strain (tectonic) origin.

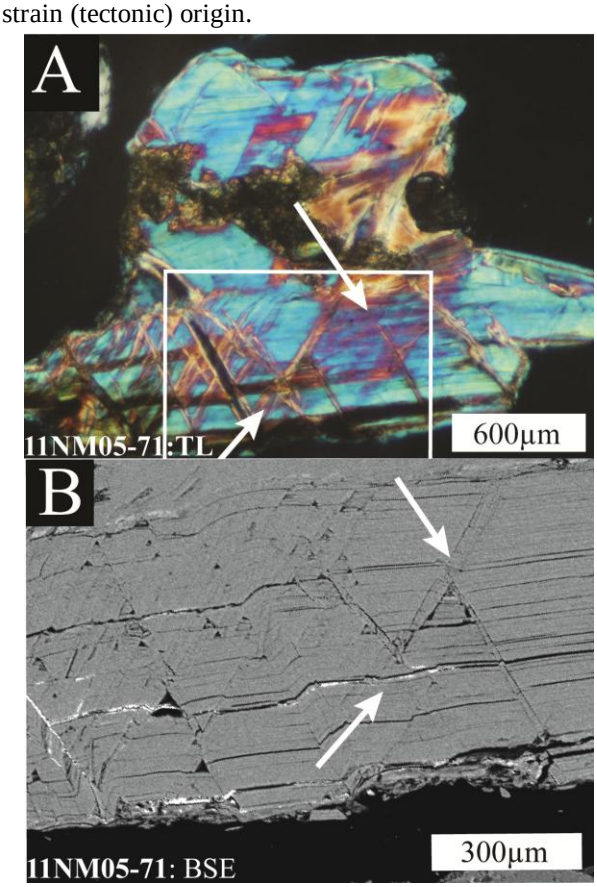

Figure 1. A) Transmitted light and B) BSE image of muscovite grain 11NM05-71 with two orientations of kind bands (arrows). Cleavage is roughly horizontal.

References: [1] French B. M. (1998) *LPI*. [2] Fackelman, S. P. et al. (2008) *EPSL*, *270*, 290-299. [3] Hörtz (1970) *JGR*. [4] Misra S. and Burg J. (2012) *Tectnophys*. [5] Starkey J. (1968) *Contr. Mineral. Petrol*. [6] Lugo et al. (2012) *LPSC*, Abstract #2014.