A SUEVITE IN BLACK AND WHITE: SEM STUDY ON THE SAMPLES FROM THE EL'GYGYTGYN DRILL CORE. L. Pittarello[1] and C. Koeberl[1,2], [1]Department of Lithospheric Research, University of Vienna, Althanstrasse 14, 1090-Vienna, Austria (lidia.pittarello@univie.ac.at), [2]Natural History Museum, Burgring 7, 1010 Vienna, Austria (christian.koeberl@univie.ac.at).

Introduction: The El'gygytgyn impact structure, north-east Siberia (Russia), is a 3.6 Ma old depression 18 km in diameter from rim to rim, largely filled by a 12-km-diameter lake. The structure was recently drilled within the framework of a project sponsored by the scientific International Continental Drilling Program (ICDP) and several other funding organizations. The El'gygytgyn crater is excavated in Late Cretaceous volcanic rocks, mainly composed of rhyolitic-trachytic ignimbrites and tuffs, being the only impact crater on Earth in such a lithology [1 - 3].

The studied drill core, from 318 m to 517 m depth below the lake bottom (b.l.b.), has the following general stratigraphy: (i) ca. 10 m of breccia with lacustrine sediments as matrix, (ii) ca. 75 m of suevite and polymict lithic breccia, containing lake sediments in the matrix in the first 10 m, and blocks of shocked volcanic rocks throughout the whole length, (ii) ca. 30 m of highly altered and fractured volcanic rocks with some basaltic layers, and (iii) ca. 100 m of fractured and altered welded ignimbrite, with flattened pumice and a magmatic foliation, which is tilted of about 45° with respect the original deposition.

We present here a selection of characteristic features observed in the suevite, as observed by scanning electron microscopy.

Methods: Of the over 200 samples collected along the drill core, about half consist of suevite and impact breccia, including some blocks of impact/volcanic melts. Among them 38 thin sections (35 µm thick) were prepared for petrographic analysis, but only three have been selected for detailed electron microscope studies, performed with a FEI Inspect S50 electron microscope (10 mm WD, 10-15 kV, spot-size in the range 3.5-6), at the Department of Lithospheric Research of the University of Vienna. The three samples are: 98Q6 W7-11, 318 m b.l.b., 101Q6 W11-13, 326.7 m b.l.b., and 124Q2 W18-20, 387.2 m b.l.b.

Results:

Matrix and general aspect of the suevite. The crater suevite consists, accordingly to the definition [4], of a fallback breccia with melt and lithic particles, as well as shocked minerals. The El'gygytgyn suevite has a fine-grained cataclastic matrix, with fragments of melt and minerals, and locally some glass shards (Fig. 1a), preserved despite their very fragile shape.

Circular features, which might be vesicles or melt drops, are quite common (Fig. 1b): generally they are slightly flattened and filled by what appear to be secondary zeolites or quenched crystals. Fast crystallization of an unidentified K-bearing silicate, with cubic shape, occurs in Si-Al-rich but K-free melt (Fig. 1c), suggesting immiscibility reactions between melts of different composition.

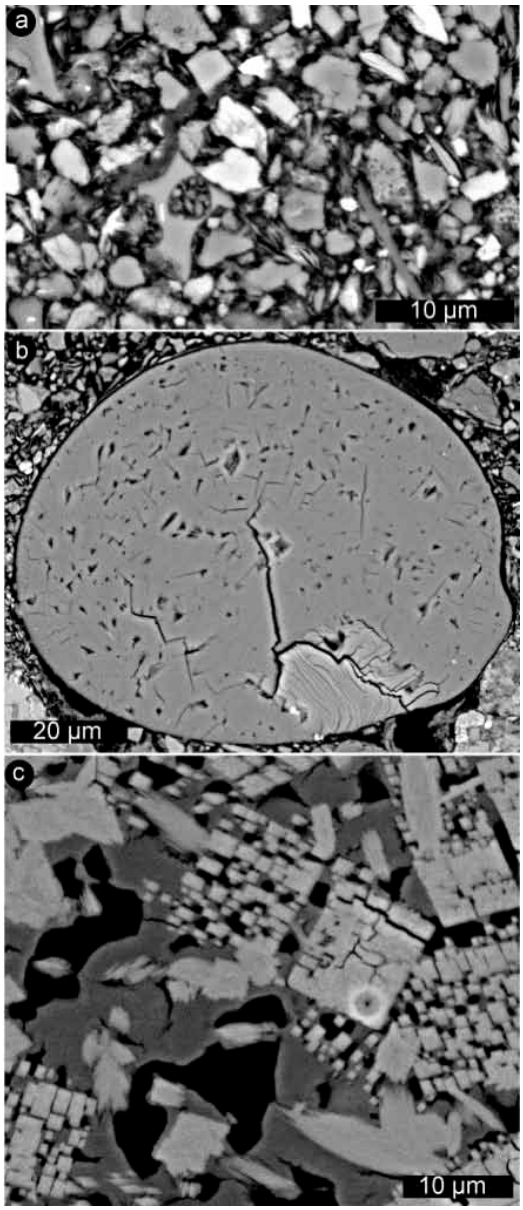

Fig. 1. *El'gygytgyn suevite in the drill core at 318 m b.l.b. (sample 98Q6 W7-11). a) The suevite clastic matrix with a preserved glass shard. b) Circular structure filled by secondary zeolites. c) Fast crystallization of K-rich silicates from a K-free melt. BSE-SEM images.*

Shocked minerals. The shocked mineral abundance has strong local variations in the El'gygytgyn suevite. Due to the volcanic composition of the target, only preserved volcanic clasts with magmatic crystals of feldspars and quartz can contain recognizable shock features. The most common feature is multiple sets of PDFs in quartz grains (Fig. 2a) that preserve the magmatic ameboidal shape. In some crystals the PDFs depart from regular PF and form feather features in their incipient stages. Locally the PDF set seems deformed, with the separation of the lamellae and a slight kink (Fig. 2b). Rarely also albite grains show shock features, such as PDFs. Locally closely spaced fractures, originating from a major fracture or cleavage plane, resemble feather features in quartz (Fig. 2c) [5].

Discussion and conclusions: The El'gygytgyn suevite, as it appears from the drill core, contains melt drops, shocked minerals and unshocked lithic clasts in a fine-grained clastic matrix, consisting of mineral and glass fragments. Quartz is present in all the shock stages; some grains contain multiple sets of PDFs, which locally seem deformed. Such deformation might represent local shear zones within the crystals. Another possible explanation is that those areas were more affected by melting and alteration. Also some albite grains show shock features, such as PDFs and microfracturing.

Studies by scanning electron microscopy allowed us to better characterize the El'gygytgyn suevite, discovering some interesting microstructures, which could not be identified by optical microscopy. Further studies are necessary to clarify the origin of the observed unusual microstructures, but the exceptionality of the target composition of the El'gygytgyn impact structures provides a unique opportunity to improve our knowledge of shock metamorphism at the microscopic scale, which can investigated only with sophisticated techniques.

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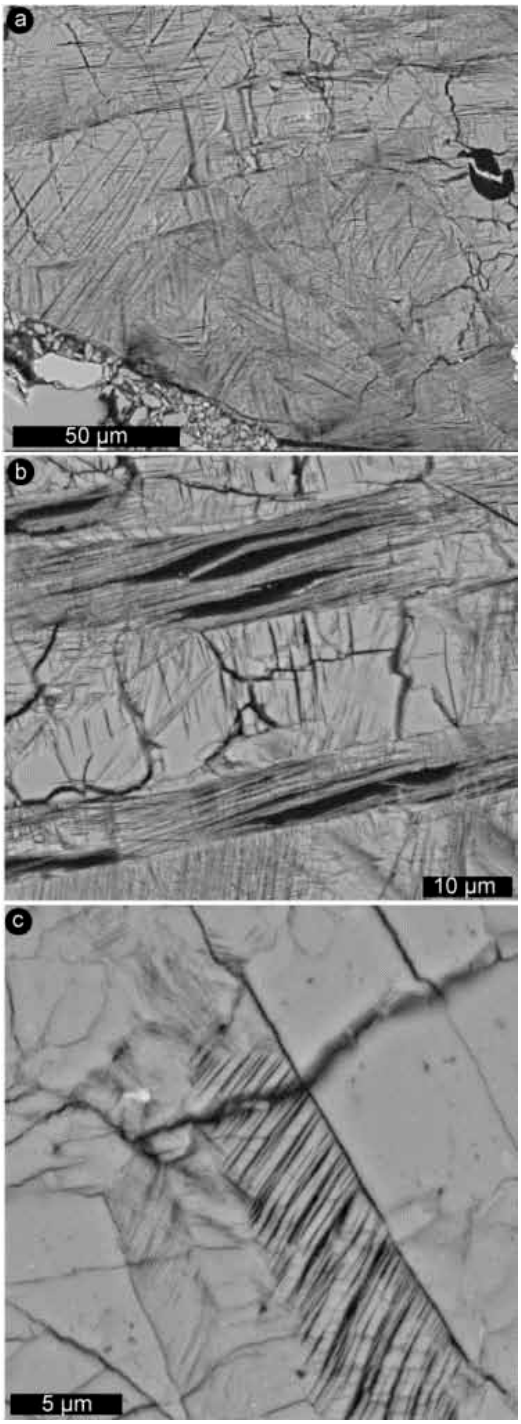

Fig. 2. *Shocked minerals in El'gygytgyn suevite. a) Quartz grain with multiple sets of PDFs. 101Q6 W11-13, 326.7 m b.l.b. b) From the same shocked quartz grain, apparently sheared lamellae separating PDF-poor domains. c) Incipient PDFs and feather feature-like microfractures in shocked albite. Notice the change in direction of the microfractures at the kink of the main fracture. 124Q2 W18-20, 387.2 m b.l.b.*