

**Petrography of the impact breccias from the ICDP-El'gygytyn drill core, NE-Russia – a focus on melt particles.** U. Raschke<sup>1</sup>, W. U. Reimold<sup>1,2</sup>, and R. T. Schmitt<sup>1</sup>, <sup>1</sup>Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Invalidenstraße 43, 10115 Berlin, Germany; <sup>2</sup>Humboldt-Universität zu Berlin, Unter den Linden 6, 10099 Berlin, Germany (e-mail: uwe.reimold@mfn-berlin.de)

**Introduction:** El'gygytyn crater is a 18-km-diameter complex impact structure [1] of 3.6 Ma [2] age, located in the Ochotsk-Chukotsky Volcanic Belt of the Chukotka Peninsula (Northeast Russia) [3, 4]. Some of the mostly silica-rich volcanic rocks of the crater area yielded <sup>40</sup>Ar-<sup>39</sup>Ar - ages of 86-89 Ma [5]. In 2008/2009 an ICDP (International Continental Scientific Drilling Program) drilling campaign [6] obtained a ~520 m long drill core. Here, we present an overview of the ~200 m of impact rocks with a special focus on the nature of impact melt particles.

**Results:** A 520 m long core hole (D1c) was sunk through ~318 m lake sediments and ~202 m impactites [6]. We studied the different impact breccias with respect to their petrographic and geochemical character [7]. The 97 m long lower bedrock unit (520-423 m) consists of a welded ignimbrite that has been brecciated (monomict impact breccia). The overlying upper bedrock sequence (423–390 m) comprises a heterogeneous, dacitic ignimbrite and some intercalations of < 1 m wide mafic blocks. First shock metamorphic effects (Planar Deformation Features-PDF) were noted at 391.72 m below lake floor. From ~390 m to 328 m depth occurs a polymict impact breccia, so-called suevite. This consists of a very melt-poor clast-dominated matrix and rock fragments that represent the entire range of volcanic target rocks known from the El'gygytyn area and environs. All stages of shock metamorphism have been observed in lithic clasts and mineral fragments in this suevitic breccia, covering the shock pressure range from unshocked to highly shocked (> 50 GPa, impact melt clasts). The uppermost part (~10 m, 328-318 m depth) is considered a reworked suevite, with comparatively more, and, on average, stronger, shocked minerals than found in the main suevite body. This includes quartz crystals with three or more sets of PDF, mosaicism, and diaplectic glass. There is a distinct component of glass spherules likely derived from the impact produced vapor plume. These spherules are enriched in the depth interval from 318 to 322 m. We have been carrying out

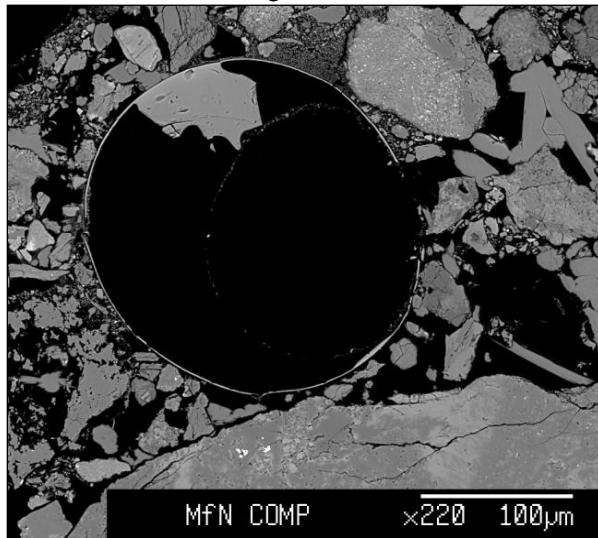
SEM and EMP studies of these spherules and the different melt and glass particles in the suevitic breccias. For the mainly hollow impact spherules we could identify a feldspathic composition of translucent glass rims. Small patches of glass may occur inside such rims and can be relatively enriched in SiO<sub>2</sub>, up to 89 vol. % (Fig. 1). Another type of spherules is completely filled with melt and then lacks a clear rim or quench margin. Sometimes the melt is devitrified and contains Mg-rich orthopyroxene or feldspar quench crystals (Fig. 2). Some spherules are partially replaced by secondary carbonate. Furthermore, we have found intricately banded melt particles in suevite that contain "schlieren" of lechatelierite or various feldspathic compositions, and of melts of combinations of different precursor components (Fig. 3). No melt after biotite or other mafic precursor components could be detected – instead these phases are still recognizable as remnants of original grains. Volcanic melt particles of the lower bedrock unit include in ignimbrite pumice fragments and rare accretionary lapilli, and in the upper bedrock unit of basaltic lava and pyroclastic glass shards of felsic to basaltic composition. These varieties also occur, together with clasts of all target lithologies, within suevite and reworked suevite. The brownish pumice fragments ("fiamme") consist of euhedral phenocrysts (mostly feldspars) in a crystalline to aphanitic groundmass. Ore minerals (Fe- and Ti-oxides) are widespread in the matrix. Pumice may include black glass shards. The upper bedrock contains rare accretionary lapilli, which were not noticed in impact breccias. No volcanic melt particles with micro-schlieren were observed.

**Discussion:** Discrimination of volcanic and impact melt particles is highly complicated. At this time some trends are emerging for the distinction of different melt particles.

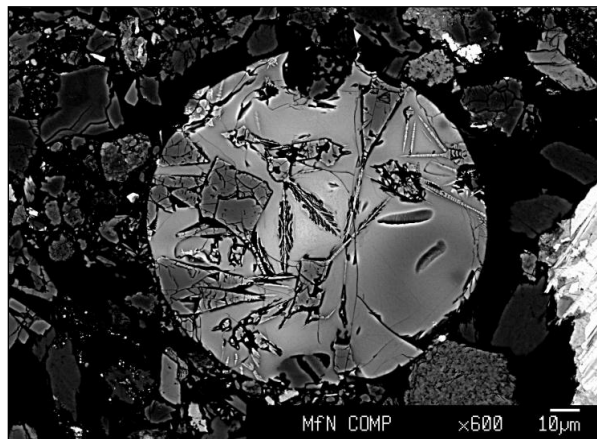
The volcanic melts have a finest-grained to aphanitic flow texture with a heterogeneous composition ranging from basaltic to rhyolitic, very similar to the respective host rock compositions. They include euhedral phenocrysts of feldspar,

quartz and accessory ore minerals. No intricate schlieren texture at the  $\mu\text{m}$ -scale was observed. Rare accretionary lapilli with radial growth structures occur in the upper bedrock.

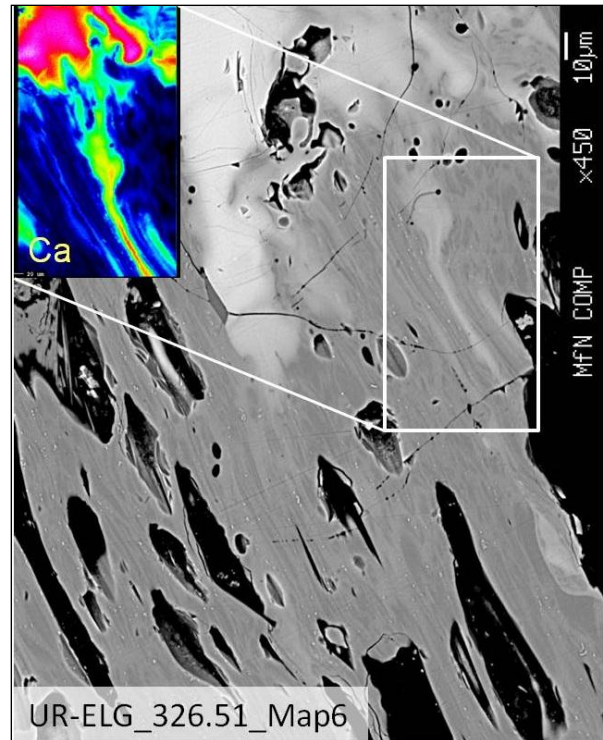
The impact melt particles show intricate schlieren structures with little evidence of devitrification. The heterogeneous chemical composition is silica- and/or feldspar dominated. No phenocrysts occur in the groundmass, but moderately to strongly shocked quartz grains may occur. Disseminated Fe, Mg, Ti-oxides appear only in brownish schlieren of feldspathic composition with small Fe and/or Mg contributions). At the conference, we will present further results of SEM and EMP investigations.



**Fig. 1: UR-ELG\_318.13 m (reworked suevite): Remnant of a glass spherule with a feldspathic rim and relic of  $\text{SiO}_2$ - rich glass fill.**



**Fig. 2: Glass spherule with feldspathic melt & pyroxene quench crystals (UR-ELG\_318.13).**



**Fig. 3: Element (Ca) map of intricately banded impact melt with “schlieren” of lechatelierite, various feldspathic compositions, and melts of combinations of these precursor components. Dark color = low concentration, green and red = high concentration**

**References:** [1] Gurov, E. P. et al. (2007), *Meteoritics & Planet. Sci.*, 42, 307–319; [2] Layer, P. (2000) *Meteoritics & Planet. Sci.*, 35, 591–599; [3] Gurov, E. P. et al., (1979), *LPS X*, 479–481; [4] Gurov, E. P. & Gurova, E. P. (1991), *Nauk. Dumka Press*, 160pp; [5] Stone, D. B. et al. (2009), *St. Mueller Spec. Pub. Ser., EGU-Copernicus Publ.*, 4, pp.243–260; Beliy, V. F. (1969), *Nauk. Dumka Press* 138pp; [6] Melles M., et al. (2012), *Science*, 337, 315–320 doi:10.1126/science. 1222135. [7] Raschke U. et al. (2012), *Meteorit. Planet. Sci.*, in press.

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