NEW INSIGHT INTO IMPACT GLASSES FROM THE EL'GYGYTGYN STRUCTURE, NORTHERN SIBERIA, RUSSIA. 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, 18 km in diameter and 3.6 Ma old, is located in the central part of the Chukotka Peninsula, Russia, centered at 67°30′N and 172°34′E, and provides the unique opportunity on Earth to study a meteorite impact in acidic volcanic rocks [1], [2]. The volcanic target includes lava, tuffs, and ignimbrites of rhyolites, dacites, andesites, and locally some basalts, of Late Cretaceous age [3], [4]. Although the ejecta blanket around the crater is completely eroded, bomb-shaped impact glasses, redeposited after the impact event, occur in lacustrine terraces within the crater [5]. Here we present a detailed petrographic description of 24 new samples of glasses, collected by C.K. through field survey during an ICDP supported drilling project in the impact crater, in spring 2009. Impact glasses from the El'gygytgyn were already described and analyzed in [5], here we present more detailed petrographic studies, focusing on the different types of glasses, on the shock features locally preserved in some relict clasts included in the melt, on some exsolution features indicating the impact origin of those glasses and on the development of microlites, which roughly constrain the cooling conditions of the melt.

Methods: The 24 samples were collected in an area of approximately 3 km^2, in the north-western part of the crater, along the lacustrine terraces, which bound the lake filling the depression. From each sample a polished thin section was cut and then studied under optical and electron microscopes. The used instruments are a FEI Inspect S50 with EDS detector (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, and a Jeol 3600 (37 mm WD, 15 kV) with EDS detector, at the Natural History Museum in Vienna.

Results: The samples can be macroscopically divided into two groups: type 1 glasses, which show alternating layers of black glass and a lithic breccia, and type 2 glasses, which consist only of homogeneous glass.

Type 1 glasses. The samples of this group contain some apparently unmelted portions with preserved mineral and lithic clasts (Fig. 1a). The matrix of these breccias is solidified melt, with flow fabric and local partial crystallization. The clasts include fragments of volcanic rocks, such as andesite, and angular fragments of mainly quartz and feldspar and rare biotite and hornblende, all with a chaotic orientation. Some quartz grains show shock features, such as PDFs, mosaicism, and partial isotropization (Fig. 1b). The feldspars are fractured and only locally partially isotropized. The glass layers are brownish in color under the optical microscope, and locally show *schlieren* marked by different intensity in color or by different amount of microlites, crystallized from the melt. The porosity is high, with rounded, circular to flattened vesicles. Most of the microlites have a pyroxene-like composition; the glass is silica rich, with high alkali content, and is especially enriched in Na. In the glass aggregates of exsolved Fe-oxides occur locally (Fig. 2), with arrangements similar to those described from impact spherules and meteorites [6].

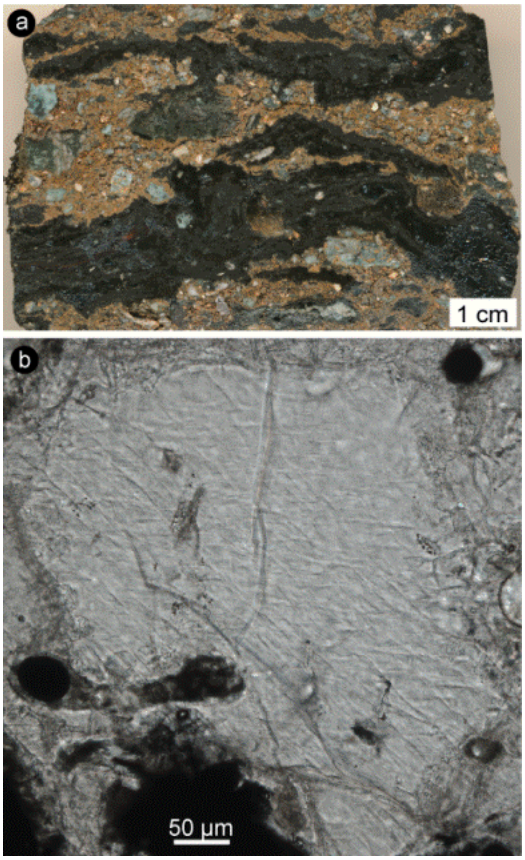

Fig. 1*. Type 1 glasses from El'gygytgyn. a) Hand sample showing the typical layering of glass and impact melt breccia with preserved fragments of minerals and lithics. b) Quartz grain showing some PDF sets. Under cross-polarized light the grain appears almost completely isotropic. Plane-polarized light.*

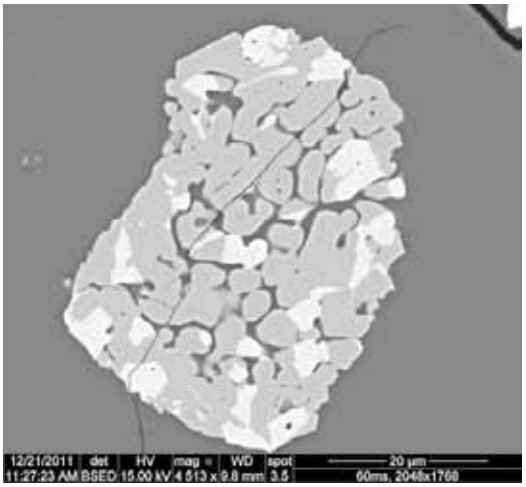

Fig.2*. Type 1 glass from El'gygytgyn. Exsolution aggregates of Fe-oxides in Si-rich glass. BSE-SEM image.*

Type 2 glasses. These consist either of black aerodynamically shaped bombs (Fig. 3a) or whitish pumice-like glasses. The bombs show folded *schlieren* with different color intensity, corresponding to different amount of iron in the glass and thus immiscibility between different melts. Such *schlieren* mark also the flow fabric, locally causing pressure shadows around vesicles or rare relict clasts. The porosity is generally low, and the vesicles are well rounded, circular to ellipsoidal along the flow direction. Rare clasts of quartz are unmelted but completely isotropized. Darker portions of the glass consist of fine aggregates of microlites, arranged in spherulitic or bow-tie shape (Fig. 3b), locally developing from heterogeneities used as nucleation points, generally consisting of vesicles or tiny mineral fragments. Most of the microlites have a pyroxene or biotite-like composition, but rare plagioclase microlites occur locally. The pumice-like samples are homogeneous in color and composition; no clasts are preserved. The porosity is high and the vesicles have ameboidal shapes that are generally elongated in the flow direction.

Discussion and conclusions: The studied samples of El'gygytgyn impact glasses show a variety of shapes, and some of them contain relict clast of unmelted portions of the volcanic target. Although the glasses were classified as shock stage IV [5], the unmelted portions contain shocked minerals and rock fragments comparable to those of shock stages I and II. The occurrence of low-shock fragments in the impact glasses might suggest that those fragments were formed during the early stages of the impact event and then included in the impact melt and deposited with the ejecta.

The occurrence of microlites is well documented in volcanic glasses and related to the cooling rate. The occurrence of pyroxene microlites in rhyolitic glasses suggests a crystallization temperature higher then 900°C [7] The composition of the Fe-Mg bearing microlites, comprising pyroxene and biotite members, might suggest local variation in water content in the glass. Further studies are necessary to better constrain the formation history of such glasses during the impact process.

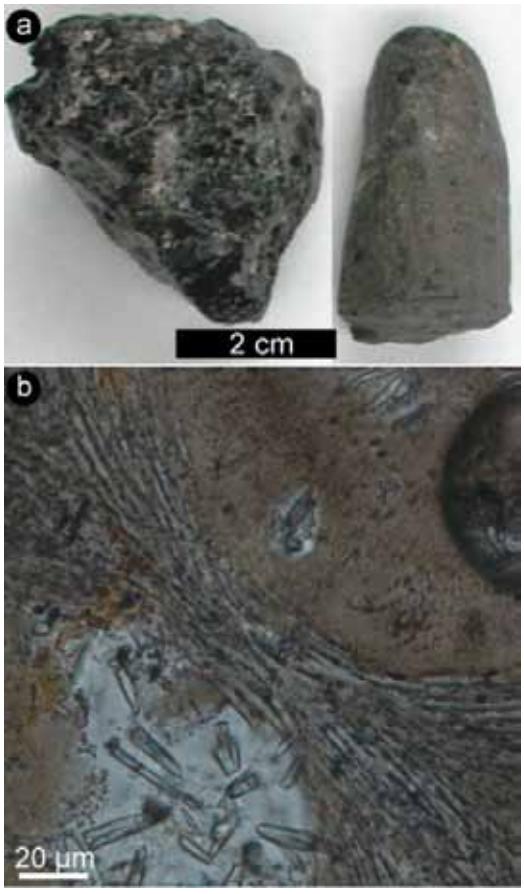

Fig. 3. *Type 2 glasses from El'gygytgyn. a) Hand samples of aerodynamically shaped black glass bombs. b) Bow-tie aggregate of microlites in the glass. Plane-polarized light.*

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