IMPACTITES OF THE PAASSELKÄ AND SUVASVESI SOUTH CRATERS, FINLAND. T. Öhman[1], D. Badjukov[2], J. Raitala[1], T. Petrova[3], and H. Stehlik[4] [1]Geosciences, Univ. Oulu, Finland, (teemu.ohman@oulu.fi); [2]Vernadsky Institute, Moscow, Russia, (badyukov@geokhi.ru); [3]Physics, Univ. of Oulu, Finland, [4]119110, Moscow, Russia; [5]Hagedornweg 2/12, A-1220, Vienna, Austria

Introduction: The Paasselkä and Suvasvesi South circular structures were proposed as impact craters 10 years ago but mineralogical evidences of their impact origin were found only 3 and 1 years ago, respectively [1,2]. It is noteworthy that all but a few of the impact craters in Finland are old, deeply eroded and occupied by lakes. This is the reason for absence of impactite exposures at these craters (only the Lappajarvi crater has impactite outcrops). However, impactite boulders and pebbles can be found usually in Quarternary glacifluvial deposits in vicinities of craters. Here we report the discovery of new types of impact rocks found in sandy pits located close to the proven Paasselkä and the probable Suvasvesi South craters. The impactites provide further definitive evidences of impact origin of these structures.

The **Paasselkä** impact crater (62°9’ N, 29°23’E) is the second largest crater in Finland with a diameter of about 10 km. The crater is well expressed in gravity and magnetic data. The drill core taken from the center of the crater in 1999 contains mica schist - granite breccia with shocked quartz grains and strongly fractured mica schist [1]. Samples of impacted rocks were collected close to the shore of the Paasselkä lake, NE from Pahatsunlahti, 62° 06' N, 29° 30' E by one of the author (HS). This impact breccia (probably impact melt breccia) consists of clasts of shocked granite, mica schist and well-sorted sandstone. Breccia matrix is not visible; it may have been destroyed by alteration or has been originally absent. It seems that clasts of mica schist were impregnated in sandstone along cracks and the sandstone clasts were at the time in viscose state - probably in partially molten state. Heavy alteration and re-crystallisation of the breccia prevent exact recognition of the degree of shock features in the clasts. However, there are quartz grains that display sets of closely spaced and sometimes indistinct decorated PDFs. The PDFs crystallographic orientations and their relative frequencies (Fig. 1) correspond well with the ones obtained for shocked quartz from various craters [e.g. 3]. Other shock effects include mosaicism and planar cleavage in quartz and strong biotite kinking, melted areas in mica shist clasts were encountered too. The rock is strongly altered. Most of the felsic mineral grains and all glass are totally re-crystallised with preservation of the grain shapes and a flow texture in glasses. Rare quartz grains with PDFs display incipient re-crystallization along cleavage planes. Sandstone matrices, as well as biotite in schist, are substituted by chlorite-feldspar groundmass. Also former biotite grains contain ilmenite. We suppose that clasts in the rock were shocked up to 25 GPa and higher with formation of diaplectic quartz glass and melt glass areas in most of these clasts.

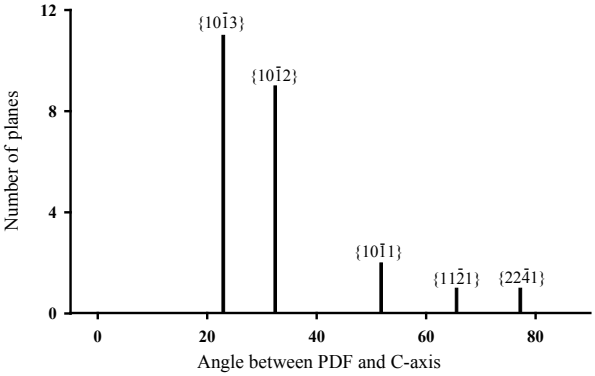

Fig. 1. Crystallographic orientation of PDFs in quartz from Paasselkä impactite measured by a standard U-stage method

The followed relatively high-temperature event caused re-crystallization of diaplectic and melt glasses. The event was connected to either post-impact hydrothermal activity in the crater or to weak regional metamorphism. The presence of impact-metamorphosed sandstones in the breccia constrains a lower limit for the age of the structure age during the formation of first sediments on the Fennoscandian shield.

The **Suvasvesi South** structure (62° 35’N, 28° 14’E) has a diameter of 3.8 km. It causes a strong aeromagnetic anomaly. The structure was formed in Proterozoic gneiss and granitoids. Collected samples are from the Lusikkaniemi area , 62° 35N', 28° 17'E. The impactites are classified as allogenic breccia containing rare altered melt and glass inclusions. The rock clasts are derived from target granite. Quartz grains and rock clasts display various levels of shock metamorphism, most of them were shocked in 15-25 GPa range. Decorated PDFs in quartz (Fig. 3) are well expressed and show typical crystallographic orientations (Fig. 4). PDFs in oligoclase are oriented along (201) and (101) planes. Kink bands can be very often found in biotite. Apatite in a shocked (about 25 GPa) granite clast shows mosaicism and regular planar fractures but is without PDFs and does not have a lowered birefringence. Former impact melt inclusions have lapilli-like

shapes and are totally converted to chlorite and Na-Al silicate aggregates.

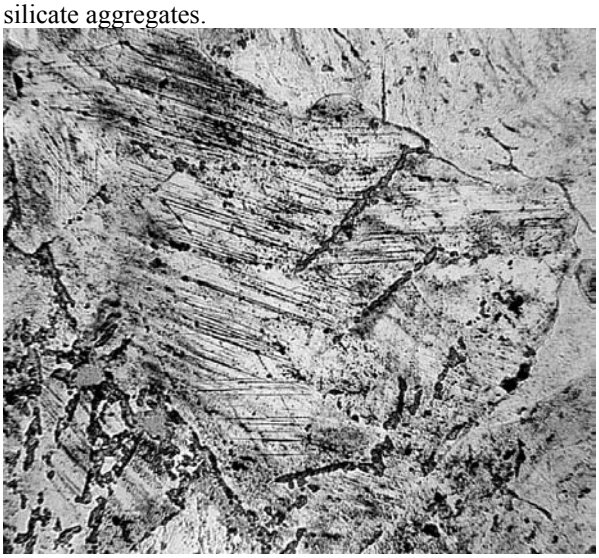

Fig. 3. Suvasvesi South quartz grain with 3 sets of PDFs. Transmitted light, parallel polarizers, field of view is 0.25 mm.

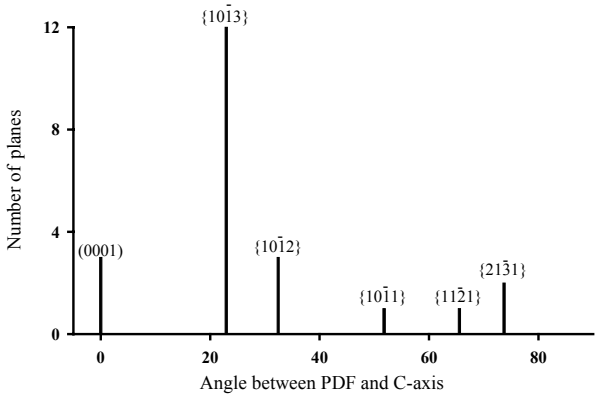

Fig.4. Crystallographic orientation of PDFs in quartz from Suvasvesi South breccia measured by a standard U-stage method.

A fraction of the inclusions contains numerous small (10 – 100 мм) grains with cubic or tetrahedron shapes (Fig. 5). The grains do not consist of a single phase as a rule. Often they have a core of Ni-Co containing pyrite (bravoite) surrounded by a Fe-oxide rim, sometimes with Ni and silicate admixture. The highest observed Ni and Co concentrations (wt%) are 2.5 and 1, respectively. Because of the Ni and Co enrichment and the association of the grains with an impact melt we propose that Ni and Co originate from a projectile matter and that the allogenic breccia should be strongly enriched in PGE.

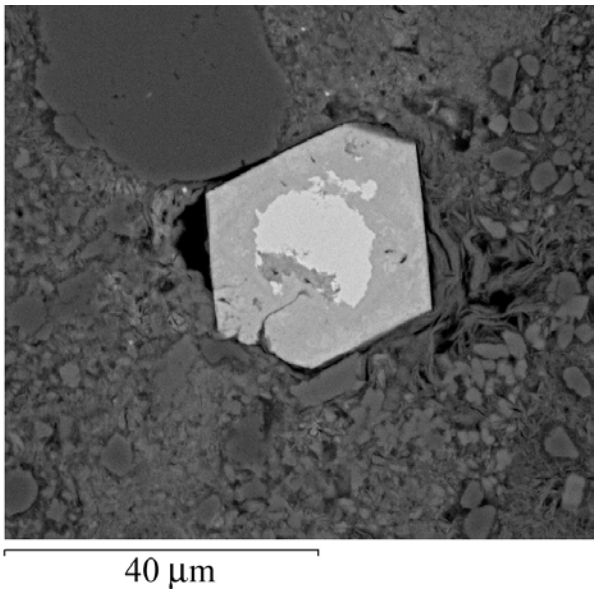

Fig. 5. BSE image of grain consisting of Ni-containing pyrite (white) and oxide (gray). The grain is embedded in a recrystallized impact melt inclusion.

Conclusions: The discovery of the impactites in the vicinities of the studied craters provides conclusive evidence of the impact origin of the two structures. The impact breccia sample from Paasselkд constrains a lower age limit of the crater and might be of use for dating the crater in a case that the alteration is due to post-impact hydrothermal activity. Occurrence of pyrite rich in Ni and Co in the Suvasvesi allogenic breccia demonstrates a possibility to find traces of projectile matter contamination in the rock. The study is in progress.

References: [1] L. J. Pesonen,; T. Kuivasaari,; M. Lehtinen, and S. Elo (1999) *Meteoritics & Planet. Sci., 34*, A90; [2] M. Lehtinen, L.J. Pesonen, H. Stehlik, and M. Kuulusa (2002) *LPS XXXIII,* Abstract #1188; [3] R. A. F. Grieve, F. Langenhorst, and D. Stoffler (1996) *Meteoritics & Planet. Sci., 31,* 6-35