SUMMANEN IMPACT STRUCTURE – New geological and preliminary geophysical studies. S. Hietala[1,2], T. Kreitsmann[2], J. Plado[2], J. Nenonen[1], J. Lerssi[1] and L. J. Pesonen[3], [1]Geological Survey of Finland, Kuopio, Finland, satu.hietala@gtk.fi, jari.nenonen@gtk.fi, [2]Department of Geology, University of Tartu, Estonia, timmu.kreitsmann@ut.ee, juri.plado@ut.ee, [3]Solid Earth Geophysics Laboratory, Physics Department, University of Helsinki, Finland, lauri.pesonen@helsinki.fi.

Introduction: Summanen meteorite impact structure (Fig. 1) is located within the Paleoproterozoic Central Finland Granite Belt in the Fennoscandian Shield. The structure owes its discovery to a primal low-altitude airborne geophysical data, which show circular ~2.6 km wide electromagnetic in-phase, and resistivity (Fig. 2), anomalies [1]. Several field campaigns and laboratory studies resulted in discovery of shatter cone and PDF-carrying boulders [2]. The boulders were found in south-eastern position of geophysical anomalies, hinting for their transport during the Weichselian glaciation.

Fig. 1. Location of the Summanen meteorite impact structure (62°39.00N, 25°22.50E) along with other Finnish craters.

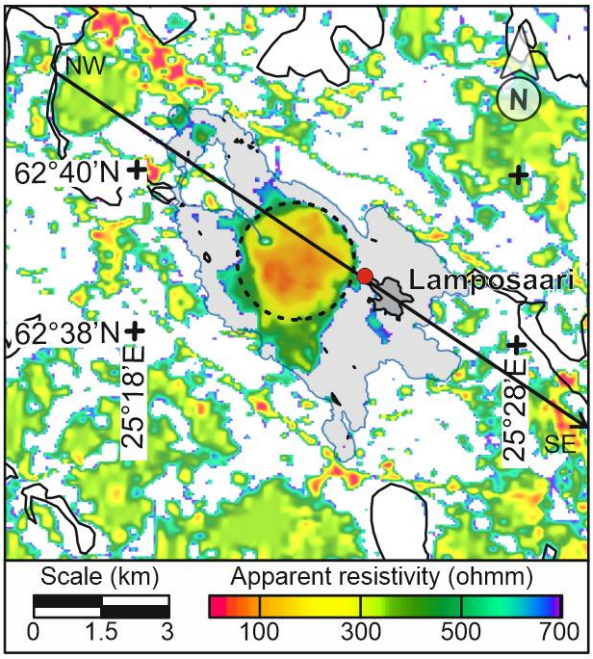

Fig. 2. Apparent resistivity anomaly map of the Lake Summanen (light grey) area. Lamposaari Island (dark grey) and location of shatter cone carrying outcrops (red dot) are shown. A dashed ring with diameter of ~2.6 km indicates the interpreted outline of the anomaly. Black line shows location of a gravity profile (Fig. 4).

Recent field-works in 2019 resulted in discovery of *in situ* shatter cones at three bedrock outcrops in Lamposaari Island. Shatter cones have been developed in K-feldspar porphyritic granitoid. Surfaces of the cones are curved, converging, and orientations of striations are variable (Fig. 3). In thin sections from shatter cone samples the quartz grains show rare PDFs (Fig. 4) and abundant PFs.

Fig. 3. Photo of in situ shatter cone in Lamposaari Island, Lake Summanen.

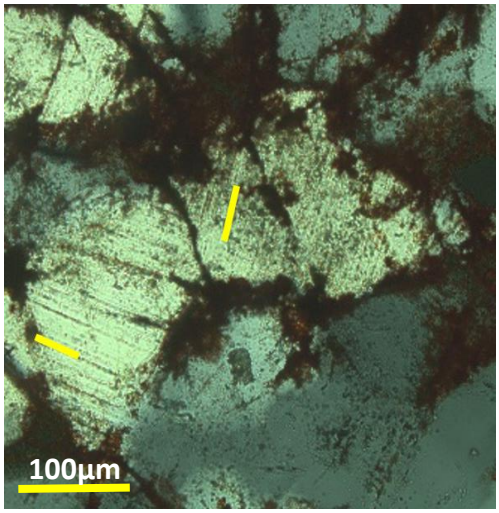

Fig. 4. One set of decorated PDFs in two quartz grains, Lamposaari Island outcrop sample SHHI-2019-9. Crossed polars.

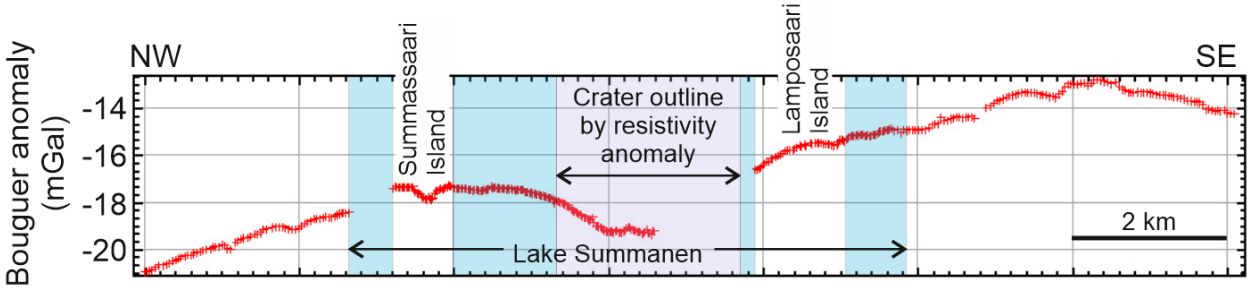

Fig 5. Preliminary gravity profile in NE-SW direction crossing the Summanen structure in its NW side (Fig. 1). One can assume presence of ~3 mGal negative gravity anomaly in a center of crater.

This new finding provided a solid proof of a meteorite impact origin of the Summanen structure in addition to [2], but arose a question about its diameter as according to interpreted size of the crater and geophysical anomalies (2.6 km-in-D) the new findings are located beyond the rim of the Summanen crater at ~1.6 km from its center. Considering that shatter cones do not favor to develop at rim areas of craters [3] one can suggest that the Summanen impact crater could be larger than previously thought and represents a complex structure.

To determine size of the structure and presence of a possible bigger structure, Geological Survey of Finland initiated a gravity study in March 2020. Two perpendicular to each other profiles were run across the crater. Because of unfavorable ice conditions, the profiles were not finalized and have caps at the lake area. Thus, here we illustrate one, the most completed, of the profiles only, running ~550 m NE from a supposed center of the Summanen crater (Fig. 2). This profile from NW to SE (Fig. 5) illustrates significant regional gradient (potential field increase towards SE by ~0.65 mGal/km) and a local ~3 km wide minimum of ~2.5 mGal in a location of earlier discovered resistivity anomaly. No hints for wider disturbances are seen suggesting presence of a simple structure with shatter cone features at its rim area.

Shatter cones at the rim area are not common, although in some Finnish craters *in situ* shatter cones are found at the edge or beyond the topographic depression or geophysical feature e.g nearby Karikkoselkä (2.4 km-in-D) impact structure [4].

References: [1] Lerssi J. et al. 2007. Geological Survey of Finland report Q19/2243, 2244/2007/1. [2] Plado J. et al. 2018. *Meteoritics & Planet. Sci.*, 53, 2413-2426. [3] Osinski G. R. and Ferrière, L. *Science Advance*, 2, e1600616. [4] Pesonen, L. J. et al. 1999, *in* Dressler, B. O., and Sharpton, V. L., eds., *Large Meteorite Impacts and Planetary Evolution II: Boulder*, Colorado, GSA, Spec Paper 339.