PAASSELKÄ - A NEW METEORITE IMPACT STRUCTURE IN EASTERN FINLAND. L. J. Pesonen[1], T. Kuivasaari[2], M. Lehtinen[3] and S. Elo[1], [1]Geological Survey of Finland, P.O. Box 96, FIN-02151 Espoo, Finland (e-mail:Lauri.Pesonen@gsf.fi); [2]Geological Survey of Finland, Regional Office for Mid-Finland, P.O. Box 1237, FIN-70211 Kuopio, Finland, [3]Finnish Museum for Natural History, P.O. Box 11, 00014 University of Helsinki, Finland.

Introduction. Lake Paasselkä with a diameter of ≥10 km, is an oval shaped deep (75 m) lake in south-eastern Finland. The local bedrock consists mainly of mica schists (~ 1.9 Ga) with smaller mafic intrusions. Numerous granitic and pegmatitic dykes occur around the lake and on the smaller islands near the shore. The structure is distinct due to its nearly circular shape in the satellite images and topographic maps. Airborne and ground magnetic data reveal a low magnetic relief over the lake with a negative anomaly (≤ 300 nT) near the center (Fig. 1). An elongated gravity minimum of - 8 mGal partly coincides with the lake [1]. Three alternative explanations for the origin of the structure have been thought of [1-3], but until now the evidence has been inconclusive.

Deep drilling. To study the origin of the Lake Paasselkä structure, the Geological Survey of Finland drilled a deep hole into the structure in the winter of 1999. The drilling site (62°8′45″N, 29°23′10.7″E) is located on top of the negative magnetic anomaly near the center of the structure. The drillcore analysis reveals that beneath the water (48 m) and Quaternary deposits (20 m), there exists a moderately fractured mica schist layer down to a depth of 252 m, where the drilling was terminated. Fractured pegmatitic veins cut the schist. Unlike some other Finnish impact structures, the Paasselkä appears to lack pre-impact or post-impact sediments. Unmetamorphosed pre-impact sediments occur sparsely as clasts in the breccia The brecciation is occasionally so strong that the target rock has been totally crushed into loose sandy-type layers of mica schist. When the drillcore is more solid, the rock is moderately or strongly brecciated consisting of mixed clasts of target rocks. The clasts in the breccias are sharp-edged and of different sizes. The matrix is medium to fine grained mica schist.

Petrophysical results. Preliminary laboratory measurements show that the breccias have, as expected, relatively low densitities (< 2280-2770 kgm^{-3}) and weak susceptibilities (< 400 x 10-6 SI). The intensity of NRM is also low. These observations explain the weak magnetic relief and the gravity low. The drilling did not reveal an impact melt layer, nor a central uplift, which could explain the magnetic anomaly near the center. However, at depths of 212-238 m, the drilling penetrated a layer rich in iron sulphides, black schists and graphites, with very low resistivities, high susceptibilities and high remanence intensitities with negative inclinations. Geophysical modelling suggests that these iron sulphides cause the observed negative magnetic anomaly.

Shock effects. Petrographic observations with optical microscope of the fine grained breccias from depths of 76 and 117 m, respectively, reveal unequivocal evidence of shock metamorphism. The first sample is an impact breccia with sharp-edged clasts of mica schist and granite. In thin sections, the biotite shows strong deformations and kink bands. The second breccia sample reveals quartz grains with sets of planar deformation features (PDF´s) in two to three orientations. The PDF´s prove that the rock has been shocked up to peak pressures over 10 GPa. A common feature of these breccias is a locally strong secondary alteration of feldspars to a claye material.

Conclusion. Based on petrographic observations, geophysical signatures and morphological appearance the Lake Paasselkä is a hypervelocity meteorite impact site. In the current data base of Finnish impact structures [2,3] Paasselkä is the ninth one.

References: [1] Elo, S. et al. (1984). Report of Investigation 64, Geological Survey of Finland: 1-24. [2] Henkel, H. and L.J. Pesonen (1992). Tectonophysics 216:32-40. [3] Pesonen, L.J. (1996). Earth, Moon and Planets 72: 377-393.

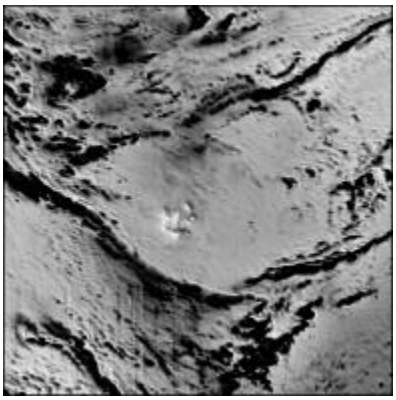

Fig. 1. Paasselkä aeromagnetic map, 20.6 km x 20.6 km. Intensity increases from light to dark. The drillhole is located on top of the negative magnetic anomaly (white spots) at the center of the map.