OLDEST IMPACT STRUCTURES ON EARTH – THE CASE STUDY OF THE SUAVJÄRVI STRUCTURE (RUSSIA). M. S. Huber[1], J. Plado[2], and L. Ferrière[3], [1]University of Vienna, Vienna, Austria, (matthew.huber@univie.ac.at), [2]University of Tartu, Tartu, Estonia, [3]Natural History Museum, Vienna, Austria.

Introduction: The so-called Suavjärvi structure is considered to be the oldest confirmed impact structure on Earth [e.g., 1]. It is located in Karelia, Russia (63°07' N, 33°23' E) in a somewhat remote area. It was first described in 1986 [2], and more recently a publication written in English [3], somewhat expanded the previous arguments that were proposed earlier in [2]. A field expedition was organized to the Suavjärvi structure to revisit the previously described localities NE of the lake (and a few additional exposures), but we were unable to reproduce any of the field observations. No evidence of impact metamorphism was detected.

Background: The Suavjärvi structure has been described as an impact structure, with a target consisting of Archean crystalline basement rocks of the Svecofennian Shield and an infill of "megabreccia" overlain by Jatuli Formation conglomerates. These conglomerates were used to constrain the age of the structure to 2200-2700 Ma [3] (An age of 2400 Ma is given by [2]; age also listed in [1]; however, no justification for this age is provided). The structure is located around the ~3-km wide Lake Suavjärvi, with an "apparent diameter" of 16 km based on a poorly illustrated Landsat image [3]. However, no circular features appear on recent satellite imagery. Microphotographs of quartz grains described as "shocked quartz grains" are used by [2, 3] as an evidence of shock metamorphism.

Field Campaign: In July, 2012, we spent one week at the Suavjärvi structure. Prior to the field investigation, a map from an earlier expedition was obtained from M. Naumov (VSEGEI) that included the locations of outcrops. A large number of these outcrops were visited, in addition to traverses around the Lake Suavjärvi to any apparent outcrops that could be found. The area is wet, heavily vegetated, low-lying land, with relatively few outcrops.

The outcrops labeled on the map as "polymict impact breccia", and referred as being a "megabreccia" [2, 3], were found to consist primarily of granite and schist. Although the outcropping rocks had clearly undergone metamorphic deformation (folds and faults were clearly visible), they could not be described as a breccia, but rather entire outcrops consisting of massive granite or schist. The so-called "polymict impact breccia" and the "Archean basement" outcrops were indistinguishable in the field, and very few outcrops of Jatulian sediments were found.

Samples: Oriented rock samples were drilled from outcrops. So far, ten thin sections were prepared and carefully investigated for shock metamorphism. No shocked quartz grains were detected in these samples.

Interpretation: Neither evidence from our field campaign, nor evidence from our thin section investigations suggest an impact origin for the Suavjärvi structure. No "key point" of evidence reported by [2, 3] could be reproduced; There is no "megabreccia" or "polymict impact breccia" at the structure, and shocked quartz grains could not be found. We find no evidence to support the conclusion that the Suavjärvi structure was generated by a hypervelocity impact.

The structure, therefore, appears to be representative of the general geology of the region. Lake Suavjärvi is likely a post-glacial lake. The few "shocked quartz grain(s)" that were described in [2 & 3] are unconvincing as being shocked, and perhaps represent quartz grains with metamorphic deformation lamellae, which can sometimes be mistaken for shock lamellae [e.g., 4]. Thus, we recommend that the samples identified to contain "shocked quartz" be studied further. Based on our observations, we recommend the Suavjärvi structure not be considered an impact structure unless convincing evidence is provided.

Discussion: Accepted forms of evidence of impact structures are well established [e.g., 4]. Amongst the evidences that are accepted for demonstrating hypervelocity impact, shocked quartz are often taken as the most convincing. However, a number of studies, including [2, 3] and [5], provide photomicrographs of microstructures that are unlikely to be shocked quartz. We recommend that all impact structures be confirmed only if full details of the evidence of shock metamorphism are made available, including measurements of "shock lamellae" in quartz, complete with images of the grains, and preferably with techniques in addition to optical microscopy to confirm the interpretation.

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References: [1] Earth Impact Database. [2] Maschak M. S., Orlova J. V. (1986) *Meteoritika, 45*, 137–141. [3] Maschak M. S., Naumov M. V. (2012) *MAPS, 47*, 1644–1658. [4] French B. M., Koeberl C. (2010) *Earth-Sci. Rev., 98*, 123–170. [5] Garde et al. (2012) *EPSL, 337–338*, 197–210.