THE SUAVJARVI STRUCTURE: AN EARLY PROTEROZOIC IMPACT SITE ON THE FENNOSCANDIAN SHIELD.

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Due to special investigations carried out in the eastern part of Fennoscandian shield, 9 objects which possibly represent the deeply eroded ancient (pre-Vendian) impact structures were distinguished there. For the one of these, the Suavjarvi, the discovery of shock features, combined with cosmic imagery, gravity and magnetic evidences, and occurrence of specific polymict breccia, gave proofs of its impact origin. The structure which is transformed intensely by consequent regional metamorphism and erosion is about 16 km in diameter, and its age is estimated to be about 2.4 b.y.

Introduction. Although 10 Phanerozoic impact craters have been identified in the western part of the Fennoscandian shield (Sweden, Finland, and Norway) [1], the Janisjarvi astrobleme of Vendian age has remained the only structure of this kind known in the eastern part of the shield (Karelia and Kola regions in Russia). Therefore, special investigations of dozens of circular aerial photo patterns, geophysical anomalies, and sites where unusual breccia occur were undertaken to find impact features in this region. Among objects examined, the Suavjarvi is the sole one where reliable shock features have been identified [2].

Geological setting. The Suavjarvi structure, centred at 63°07′N, 33°23′E, has been distinguished in cosmic images as a distinctly circular photoanomaly of 16 km in diameter (*Fig.1*). It is located at 50 km northwest of the town of Medvejegorsk in Karelia Republic, Russia. The circular photoanomaly is superimposed with negative Bouger anomaly (with amplitude -10 mGal) and concentric weakly contrast (from -3 to +2 mE) magnetic field. On the present surface of the area of the structure, fractured granitized gneisses and shists of Archean intruded by plagiogranites and microcline granites of Early Proterozoic are exposed. Only in north-eastern and south-western domains of the structure, at the distance of 2-3 km from its borders, some erosional remnants of the polymict breccia occur fixing the scars of the annular depression (*Fig.2*). It contains blocks and boulders of both above-mentioned basement rocks and metavolcanites and fillites of Early Proterozoic from several centimeters to hundreds of meters in size; "gris" structures are common. The breccias as well as basement rocks were recrystallized during regional metamorphism in epidot-amphibolite facies so that the cement matter is transformed to albite-epidote-actinolite shist. A few of fragments which may be initially represent by impact glasses are characterized by relict fluidal structure and contain small rocks inclusions.

Shock features. Some large blocks composed the breccia display some deformation features in minerals: cleavage, blocking, deformation twins, deformation bands, and planar elements in quartz, microcline, and graphite. Individual quartz grains contain planar deformation features (*Fig.3*) following the crystallographic planes including $\{10\bar{1}9\}$, $\{10\bar{1}4\}$, $\{10\bar{1}3\}$, $\{10\bar{1}1\}$, $\{01\bar{1}1\}$, $\{21\bar{3}1\}$, $\{51\bar{6}1\}$, $\{10\bar{1}0\}$. Besides planar lamellae in microcline are recorded as many as four sets of lamellae per grain, with orientations corresponding to the $\{1\bar{1}1\}$, $\{11\bar{1}\}$, {001}, {010}, and {130} planes. The optical orientations of PDFs both in quartz (*Fig.4*) and in microcline represent reliable evidences of shock.

Age of impact. Since the Suavjarvi breccia is overlain by basal conglomerates of Jatulian formation, those age is evaluated to be about 2300 m.a., and the strong denudation occurred during pre-Jatulian time, we propose 2400 m.a. as a probable age of the impact. This evaluation attests the Suavjarvi as the oldest extraterrestrial impact scar known on the Earth.

THE SUAVJARVI IMPACT STRUCTURE: M.S.Mashchak & M.V.Naumov

Conclusions. The Suavjarvi structure is the remnant of an Early Proterozoic impact crater which was transformed intensely by both regional metamorphism and deep erosion. Therefore, shock features are obliterated and occur as relics only. Besides another 8 objects of this kind have been distinguished in Kola and Karelia regions; all these are the local areas of specific breccia resembling impact lithologies. Howewer, unquestionable shock features were not yet found there.

References: [1] Henkel H. & Pesonen L.J. (1992). *Tectonophysics 216, 31-40.* [2] Mashchak M.S. & Orlova J.V. (1986). *Meteoritika 45,137-141* (in Russian).

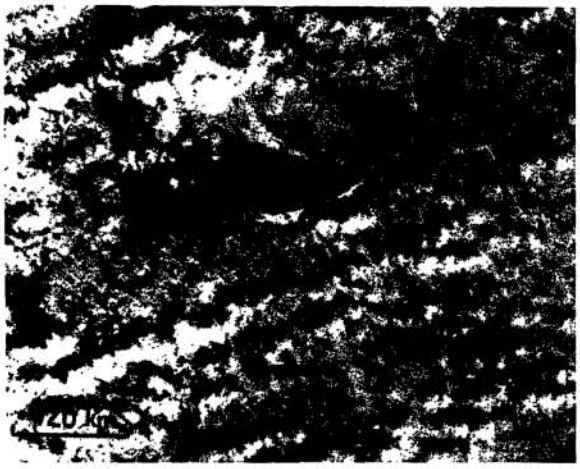


Fig.1. The Suavjarvi structure on NASA ERTS image

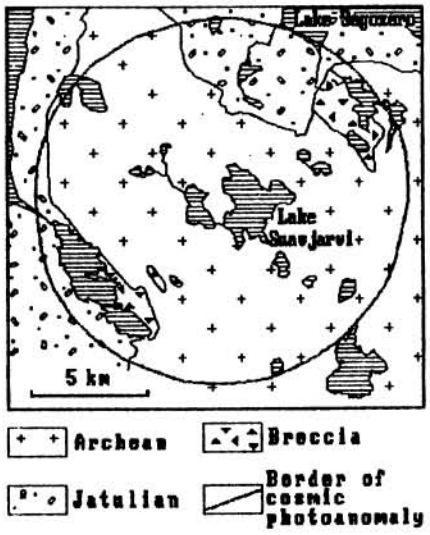
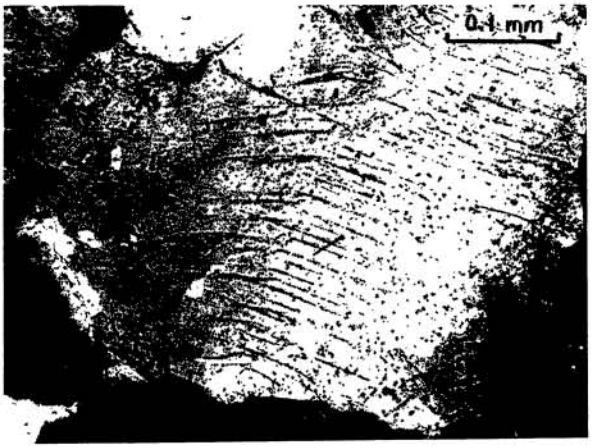


Fig.2. Geological scheme of the Suavjarvi structure



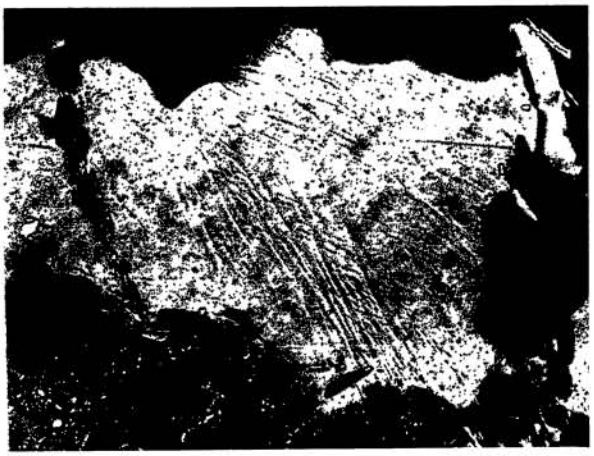


Fig.3 (a, b). Planar deformations in quartz from Suavjarvi breccia

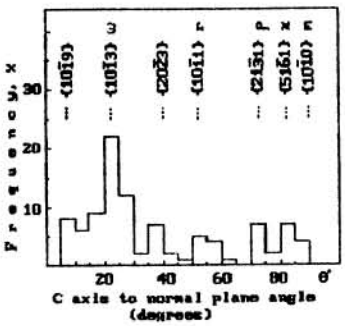


Fig.4. Histogram of optical orientations of planar deformation features in quartz grains