IMPACT CRATERING RECORD OF FENNOSCANDIA. L. J. Pesonen[1] and H. Henkel[2], [1]Laboratory for Paleomagnetism, Geophysics Department, Geological Survey of Finland, Espoo, Finland, [2]Department of Photogrammetry, Royal Institute of Technology, Stockholm, Sweden.

A compilation (Fig. 1) of circular topographic, morphological, or geophysical structures in Fennoscandia and adjacent areas reveals 62 craterform structures of which 15 (class A or a) appear to be of extraterrestrial origin due to meteorite impact. The majority of the structures are probable (class B, 9) and possible (class C, 34) impact craters for which there is not yet sufficient proof for impact origin.

Four of the proven impact craters (Lappäjarvi, No. 31, ~77 Ma old; Dellen, No. 5, ~90 Ma old; Mien, No. 20, ~120 Ma old; and Jänisjärvi, No. 36, ~700 Ma old) contain large volumes of impact melt and many other features of intense shock metamorphism. The age of the recognized impact craters vary from prehistoric (3500 B.C., No. 38, Kaali) to late Precambrian (~1210 Ma, No. 11, Björkö). The histogram of the ages (although the number of proven impact craters is still very small) shows two possible peaks (Fig. 1, inset): one group consisting of impact craters less than 150 Ma old and the second one with ages between 350 and 600 Ma. There is so far a deficiency of impact craters in Fennoscandia with ages between 200 and 350 Ma. The majority of the proven impact craters have rim diameters between 5 and 20 km; the largest meteorite impact crater in Fennoscandia, the Siljan (No. 6, age ~360 Ma), has a diameter of 55 km. The impact cratering rate for Fennoscandia in the region where craters occur is 2.4×10^{-14} km^{-2} a^{-1} and includes 12 proven impact craters with diameters from 3 to 55 km. This amounts to 2 events per every 100 Ma during the last 700 Ma.

There is increasing evidence that some (3, class E) of the large circular geological, morphological, or geophysical features [the Uppland (No. 45), the Nunjes (No. 46), and the Marras (No. 55) structures, Fig. 1] represent deeply eroded scars of Early Proterozoic impact craters, but impact-generated rocks or fall-out ejecta layers have not yet been identified with these structures.

No craterform structures of Archean age have so far been discovered in Fennoscandia although, statistically, remnants of Archean cratering events should be found in the Fennoscandian Shield. New ways of searching for these craters are proposed and discussed. In addition to changes in the petrophysical properties of rocks, such as density, magnetization, and electrical conductivity, redistribution of large volumes of rocks are associated with large impacts. Such changes in structures and rock properties may be identified by integrated interpretations of regional high-resolution geophysical data.

The Siljan impact case shows, however, that the impact overprinting can be very slight in comparison to geophysical anomalies caused by preimpact lithological and structural variations.

We review the Fennoscandian impact cratering record giving examples of geophysical signatures of impact craters.

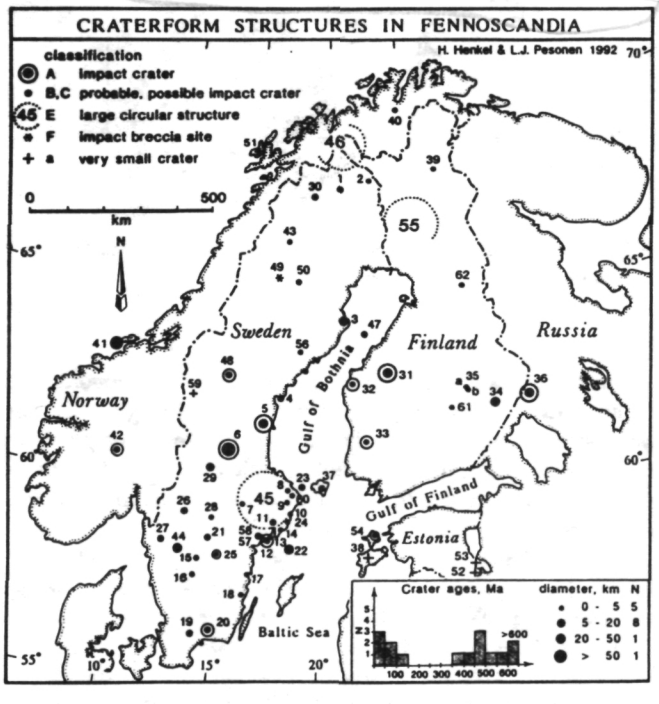

Fig. 1. Impact craters and other craterform structures in Fennoscandia and adjacent areas. Encircled structures refer to proven impact craters (class A); the others refer to class B (probable) and class C (possible) impact craters respectively. The very large circular patterns refer to class E structures for which impact origin is not yet proven. The class F sites represent locations of breccia occurrences without known crater structure. The very small Quaternary craters (class a) are denoted with a plus sign. (Inset) Ages and diameters of the proven (classes A and a) impact craters.

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Test of the impact hypothesis [1] for the origin of the circular, 260-km-diameter structure of the Bohemian Massif (Fig. 1) led to the discovery of glasses and breccias in the Upper Proterozoic sequence that can be compared to autogeneous breccias [2] of larger craters. The black recrystallized glass contains small exsolution

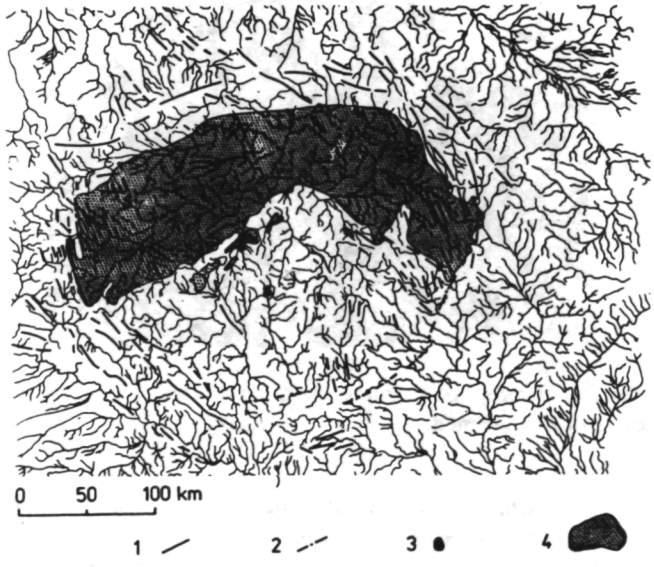

Fig. 1. Circular structure of the Bohemian Massif; 1—topographical features, 2—important faults with geological contacts of units differing in mobility in Variscan orogenesis, 3—outcrops of autogeneous breccias, 4—extent of the Upper Proterozoic series.