A COMPARATIVE STUDY OF IMPACT DIAMONDS FROM THE POPIGAI, RIES, SUDBURY, AND LAPPAJÄRVI CRATERS. F. Langenhorst¹, G. Shafranovsky², and V. L. Masaitis², ¹Bayerisches Geoinstitut, University of Bayreuth, D-95440 Bayreuth, Germany (Falko.Langenhorst@uni-bayreuth.de), ²Karpinsky All-Russian Geological Research Institute (VSGEI), Sredny prospekt 74, 199106 St. Petersburg, Russia.

Our knowledge about the formation of diamonds by impact dates back to the first shock synthesis by [1]. In the light of this discovery diamonds in iron meteorites (e.g., Canyon Diablo) and ureilites have been (re-) interpreted to be of impact origin. After the first discovery of impact diamonds at a terrestrial impact site, the Popigai crater [2], diamonds have been detected in numerous Ukrainian and Russian craters (e.g. Zapadnaya, Puchezh Katunki), the Nördlinger Ries [3], and the KT boundary. New finds of diamonds in the Sudbury and Lappajärvi craters have been recently reported [4,5]. We have undertaken a combined X-ray, SEM, and TEM study of impact diamonds from Popigai, Ries, Sudbury, and Lappajärvi in order to better understand the transformation mechanism and resulting characteristics.

Diamonds have been extracted from the typical suevites and impact melt rocks occurring at Popigai, Ries, and Lappajärvi, and, in case of Sudbury, from the C-bearing Black Onaping formation, which is interpreted as reworked suevite breccia. X-ray diffraction reveals the polycrystalline nature of diamonds, the presence of graphite, and up to 30% lonsdaleite, the hexagonal high-pressure polymorph of C. Popigai, Ries, and Lappajärvi diamonds have a tabular shape, which is inherited from the precursor mineral graphite. Distinct surface striations indicate additionally the inheritance of primary twins of graphite. On the other hand, Sudbury diamonds are blocky in morphology and surfaces are corroded and pitted. Untransformed graphite from the same formation shows similar morphological characteristics. In contrast to the compact Popigai, Ries, and Lappajärvi diamonds, Sudbury diamonds are relatively fragile and can be disaggregated by light pressing. The TEM study reveals similar microstructural characteristics of the diamonds from all four craters. The polycrystalline aggregates are composed of numerous diamond crystallites with typical grain sizes between 100 nm and 1 µm. The crystallites show preferred orientations and are sometimes arranged in bands, which might be due to the transformation.

Altogether, the investigations confirm that impact diamonds form by solid-state transformation of graphite. The characteristics of the precursor graphite exert an important control on the resulting characteristics of diamonds. The new discoveries of impact diamonds at Sudbury and Lappajärvi provide further unequivocal evidence on the impact origin of these geological structures.