

**UPDATING THE FINNISH IMPACT CRATERING RECORD.** M. Schmieder<sup>1</sup>, E. Buchner<sup>1,2</sup>, F. Jourdan<sup>3</sup>, W. H. Schwarz<sup>4</sup>, M. Trieloff<sup>4</sup>, M. C. van Soest<sup>5</sup>, J.-A. Wartho<sup>5</sup>, K. V. Hodges<sup>5</sup>, J. Moilanen<sup>6</sup>, S. Hietala<sup>7</sup> and T. Öhman<sup>8</sup>, <sup>1</sup>Institut für Planetologie, Universität Stuttgart, Herdweg 51, D-70174 Stuttgart, Germany, martin.schmieder@geologie.uni-stuttgart.de, <sup>2</sup>HNU Neu-Ulm University, Wileystrasse 1, D-89231 Neu-Ulm, Germany, <sup>3</sup>Western Australian Argon Isotope Facility, Applied Geology & JdL-CMS, Curtin University of Technology, GPO Box U1987, Perth WA 6845, Australia, <sup>4</sup>Institut für Geowissenschaften, Universität Heidelberg, Im Neuenheimer Feld 234-236, D-69120 Heidelberg, Germany, <sup>5</sup>School of Earth and Space Exploration, Arizona State University, PO Box 871404, Tempe, AZ 85287, USA, <sup>6</sup>Pinkelikatu 6 B 48, FI-90520 Oulu, Finland, <sup>7</sup>Asematie 1 B 8, FI-61300 Kurikka, Finland, <sup>8</sup>Department of Geosciences, P.O. Box 3000, FI-90014 University of Oulu, Finland.

**Introduction:** Eleven impact structures have so far been confirmed in Finland: Iso-Naakkima (3 km), Karikkoselkä (1.5 km), Keurusselkä (~30 km), Lappajärvi (23 km), Lumparn (9 km), Paasselkä (10 km), Sääksjärvi (6 km), Saarijärvi (1.5 km), Söderfjärden (6.6 km), Suvasvesi North (4 km), and Suvasvesi South (4 km) [1]. Apart from some U/Pb and <sup>40</sup>Ar/<sup>39</sup>Ar ages available for Lappajärvi [2;3] and Sääksjärvi [4;5], most of the Finnish impact structures are still poorly dated. We have recently obtained new <sup>40</sup>Ar/<sup>39</sup>Ar data for the Keurusselkä, Paasselkä, and Suvasvesi South impact structures, as well as a first set of (U-Th)/He data for the Karikkoselkä crater, all of which are hosted by Paleoproterozoic (~1.88 Ga) crystalline rocks of the Baltic Shield.

**Samples and Isotopic Dating:** Impactites used as material for dating were collected in the field by two of the authors (J.M. and S.H.). <sup>40</sup>Ar/<sup>39</sup>Ar step-heating dating was done at the Western Australian Argon Isotope Facility, Perth, Australia (Keurusselkä) and the University of Heidelberg, Germany (Paasselkä and Suvasvesi South). (U-Th)/He dating was carried out at the Arizona State University, Tempe, AZ, USA (Karikkoselkä).

#### Results and Interpretation:

**Keurusselkä.** The discovery of a pseudotachylitic breccia dike in the central part of the deeply eroded ~30 km Keurusselkä impact structure [6;7] provided the first known melt lithologies from this impact structure. <sup>40</sup>Ar/<sup>39</sup>Ar dating of clast-poor and virtually fresh domains of the dike rock gave a Mesoproterozoic plateau age of  $1144 \pm 10$  Ma ( $2\sigma$ ;  $n=5$ ; MSWD=0.11;  $P=0.98$ ; ~90% of <sup>39</sup>Ar released) [8], in accordance with a weighted mean age of  $1152 \pm 4$  Ma ( $2\sigma$ ; combination of the plateau age and four mini-plateau ages that include more than 50% of <sup>39</sup>Ar released, respectively; MSWD=1.06;  $P=0.37$ ).

**Paasselkä.** <sup>40</sup>Ar/<sup>39</sup>Ar dating of optically fresh recrystallized feldspar glass particles separated from impact melt rocks from the eroded ~10 km Paasselkä impact structure [9-11] yielded a Middle to Late Triassic pseudo-plateau age of  $229 \pm 3$  Ma ( $2\sigma$ ;  $n=9$ ;

MSWD=1.01;  $P=0.42$ ; ~47% of <sup>39</sup>Ar released) and a concordant  $229 \pm 4$  Ma ( $2\sigma$ , MSWD=0.79) isochron age [12], which makes Paasselkä the first known Triassic impact structure dated by isotopic methods on the Baltic Shield.

**Suvasvesi South.** <sup>40</sup>Ar/<sup>39</sup>Ar dating of clast-poor domains within allochthonous impact melt rocks from the eroded ~4 km Suvasvesi South impact structure [10;13] yielded no plateau within a disturbed (hump-shaped) age spectrum. The age spectrum suggests a Proterozoic age of >700 Ma for the impact [14].

**Karikkoselkä.** (U-Th)/He dating of euhedral apatite and zircon crystals [15] recovered from the granitic lithic impact breccia of the ~1.5 km simple Karikkoselkä impact structure [16] devoid of impact melt lithologies yielded a wide range of ages from ~873 Ma for a single apatite grain and ~151 Ma to ~9 Ma for 5 zircons. Possible explanations for the strong scatter of ages and apparently young zircon age values are discussed.

**References:** [1] Dypvik H. et al. (2008) *Episodes*, 31, 107-114. [2] Jessberger E. K. and Reimold W. U. (1977) *J. Geophys.*, 48, 57-59. [3] Mänttari I. and Koivisto M. (2004) *Meteoritics & Planet. Sci.*, 36, 1087-1095. [4] Müller N. et al. (1990) *Meteoritics*, 25, 1-10. [5] Mänttari I. et al. (2004) *IGC 32*, Abstract #1434. [6] Hietala S. and Moilanen J. (2004) *LPS XXXV*, Abstract #1619. [7] Hietala S. and Moilanen J. (2007) *LPS XXXVIII*, Abstract #1762. [8] Schmieder M. et al. (2009) *LPS XL*, Abstract #1028. [9] Pesonen L. J. et al. (1999) *Meteoritics & Planet. Sci.*, 34, A90. [10] Öhman T. et al. (2003) *LPS XXXIV*, Abstract #1571. [11] Schmieder M. et al. (2008) *Meteoritics & Planet. Sci.*, 43, 1189-1200. [12] Schmieder M. et al. (2009) *Meteoritics Planet. Sci.*, 44, A187. [13] Donadini F. et al. (2006) In: Cockell C. et al. (eds.) *Biological Processes Associated with Impact Events*, Springer, Berlin, Heidelberg, p. 287-307. [14] Buchner E. et al. (2009) *Meteoritics & Planet. Sci.*, 44, A44. [15] van Soest M. C. et al. (2009) *LPS XL*, Abstract #2041. [16] Pesonen L. J. et al. (1999) *GSA Spec. Pap.*, 339, 131-147.