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The age of the Lappajärvi impact structure

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The Lappajärvi crater is a ∼23 km impact structure located in western central Finland [1]. Impact lithologies comprise autochthonous impact breccias and massive impact melt rocks at the central island of Lake Lappajärvi, as well as reworked impact ejecta in glacial till some kilometers south of the lake.

A late Cretaceous (Campanian) age has been previously established for the Lappajärvi impact but a precise and accurate absolute age is currently lacking. Previous 40Ar/39Ar attempt on multi-grain aliquot of melt rock (using several tens of milligrams of material per experiment) yielded a series of somewhat perturbed age spectra [2]. Apparent ages derived from these data range from 76.6 ± 0.6 to 78.6 ± 1.8 Ma (2σ, using decay constant of [3]). Based on this dataset, a mean age of 77.3 ± 0.8 Ma has been proposed for this impact but a MSWD value of 5.1 (P<0.0001) clearly shows that this apparent age is largely compromised by the scatter of the data. More recently, ion probe U/Pb dating of melt-grown zircons suggested an indistinguishable, albeit imprecise, lower discordia age of 73.3 ± 5.3 Ma [3], although we note that this apparent age is also derived from a scattered dataset (MSWD = 3.3; P<0.0003) [4].

In this study, we reinvestigated the age of Lappajärvi impact by applying the 40Ar/39Ar technique to carefully selected single-grain aliquots of (1) K-feldspar melt particles separated from impact-metamorphosed granite and (2) optically fresh, clast-poor impact melt rock. Furthermore, the ages have been calculated using the latest revised decay constants and standard ages that are directly comparable to the U/Pb system [5]. Each of the K-feldspar melt particles produced an excellent plateau age but altogether yielded a range of discordant ages ranging from 73.9 ± 0.4 to 76.1 ± 0.4 Ma. We suggest that the age spread of ∼2 Ma might monitor the overprint by impact-induced, post-shock hydrothermal activity occurring in the target rock. Furthermore, the range of age warns against the use of single 40Ar/39Ar analysis of K-feldspar to derive the age of an impact and we recommend that, if this approach is to be used successfully, several single-grain analyses need be carry out [6].

The melt rock samples, on the other hand, gave a series of concordant plateau ages ranging from 74.9 ± 1.8 to 76.8 ± 0.9 Ma (mean age of 76.37 ± 0.46 Ma; P=0.36). The melt rock results combined with the oldest, syn-impact K-feldspar age yielded a weighted mean age of 76.20 ± 0.27 [± 0.50-all error] Ma (MSWD = 1.02, p = 0.41) considered as representing the most accurate and precise age currently available for the Lappajärvi impact.

[1] Reimold (1982) GCA 46, 1203-1225.
[2] Jessberger & Reimold (1980) J. Geophys. 48, 57-59.
[3] Steiger & Jäger (1977) EPSL 36, 359-362.
[4] Mänttäri & Koivisto (2001) MAPS 36, 1087-1095.
[5] Renne et al. (2010) GCA 74, 5349-5367.
[6] Schmieder et al. (2010) MAPS 45, 1225-1242.