Geophysical Research Abstracts
Vol. 13, EGU2011-1334-8, 2011
EGU General Assembly 2011

Concurrent ages of the Nördlinger Ries and the Steinheim Basin? - An extremely voluminous versus an inexistent isotopic data set for the two impact craters in Southern Germany

Elmar Buchner (1,2) and the *Ries-Steinheim Dating Team

(1) Institut für Planetologie, Universität Stuttgart, Germany (elmar.buchner@geologie.uni-stuttgart.de), (2) HNU – Neu-Ulm University, Germany

Among the ∼180 impact structures currently known on Earth, the ∼24 km Nördlinger Ries crater in southern Germany is unique in terms of the state of preservation of the crater shape and its impact ejecta blanket and offers a considerably wide age data set achieved by various types of material for isotopic dating and analytical methods [1]. The ∼3.8 km Steinheim Basin is a well-preserved, complex impact structure hosted by a sequence of Triassic to Upper Jurassic sedimentary rocks of the eastern Swabian Alb, SW Germany [2]. The specific alignment of the Steinheim Basin, the Nördlinger Ries crater, and the Central European tektite strewn field had led to the assumption that both impact structures formed simultaneously [3] during the 'Ries-Steinheim event' ∼14.59 Ma ago [1]. In contrast to the voluminous isotopic dataset for the Ries, however, no isotopic dating of rock or mineral samples from the Steinheim Basin has been carried out successfully and all efforts made did not yield reliable ages so far.
In addition to the extensive isotopic dataset, we recently performed the first $^{40}Ar/^{39}Ar$ dating of the Nördlinger Ries impact structure using monomineralic (recrystallized K-feldspar) melt separated from a shocked crystalline target rock clast (granite) in impact melt rocks. This $^{40}Ar/^{39}Ar$ step-heating analysis yielded a 14.37 ± 0.30 (0.32) Ma (2σ) age for the Nördlinger Ries supported by the age plateau characteristics, as well as the robust data set statistics and a concordant total fusion age. Therewith, we added a new age to the extensive isotopic age data set for this impact structure [1]. As a concept study on the well-studied Ries impact structure, we (U-Th)/He dated zircons from Aumühle quarry suevite samples and from Polsingen quarry impact melt rock yielding an age of 14.26 ± 0.31 Ma (2σ, n = 10) [4]. Among the recently discovered impact melt lithologies at Steinheim is a pebble of partially molten, fluidally-textured Middle Jurassic sandstone recovered from the central uplift ('Steinhirt') [2]. $^{40}Ar/^{39}Ar$ dating of white to reddish feldspathic cryptocrystalline to glassy domains of the partially molten sandstone failed to yield any statistically representative age but resulted in strongly scattered age data with individual steps ranging from ∼0 Ma to ∼600 Ma, inconsistent with the local Miocene crater lake biostratigraphy and earlier stratigraphic age estimates [5]. (U-Th)/He dated zircons extracted from Jurassic and Triassic sandstones that were drilled in the central uplift of the Steinheim Basin yielded ages that range from 226.14 ± 8.16 to 281.97 ± 9.36 Ma (2σ) [5], thus indicating that the He systematics in the clear zircon grains were not reset by the Steinheim Basin impact event.
The isotopic ages for the Nördlinger Ries impact of 14.37 ± 0.30 (0.32) Ma ($^{40}Ar/^{39}Ar$ step-heating) and of 14.26 ± 0.31 Ma ascertained by (U-Th)/He dated zircons are indistinguishable within error from the majority of the Nördlinger Ries ages obtained from suevite glasses and Ries tektites in recent years. However, we suggest a slightly older age of 14.59 ± 0.20 Ma (2σ) as best value for the Ries impact event, based on current decay constant values for $^{40}K/^{40}Ar$ and $^{40}Ar/^{39}Ar$ dating and 30 individual Ries ages obtained so far [1]. Thus, the ∼14.59 Ma impact age of the Nördlinger Ries crater can be regarded as well-established. In the case of the Steinheim Basin, (U-Th)/He dating failed to resolve a reasonable age for this impact event. On that account and also from an argon isotopic point of view, the Steinheim impact age still remains elusive. From a biostratigraphic point of view [6], it is likely that both craters (and their crater lake infill) formed simultaneously but it cannot be ruled out that the two impact structures are the products of two independent impact events in the Miocene. Therefore, the concurrency of the Ries and Steinheim impacts still remains to be confirmed by isotopic dating methods.

References: [1] Buchner et al. (2010) MAPS 45, 662-674. [2] Buchner and Schmieder (2010) MAPS 45, 1093-1107. [3] Stöffler et al. (2002) MAPS 37, 1893-1907. [4] van Soest et al. (2010) AGU abstract ID# P44B-08. [5] Schmieder et al. (2010) Paneth Kolloquium abstract no. 45. [5] Buchner et al. (2010) 41 LPSC abstract no. 2151. [6] Heizmann and Reiff (2002) Der Steinheimer Meteorkrater, Pfeil, Munich, 160 pp.

*Martin Schmieder, Francis J. Cooper, Kip V. Hodges, Fred Jourdan, Christian Köberl, Gisela Pösges, Uwe Reimold, Winfried H. Schwarz, Mario Trieloff, Matthijs C. van Soest and Jo-Anne Wartho