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Need to re-evaluate the age of Chesapeake Bay and Popigai Craters and their relevance for the Eocene/Oligocene boundary

Vera Assis Fernandes (1), Mario Trieloff (2), Natalia A. Artemieva (3), Joerg Fritz (4), and W. Uwe Reimold (4)

(1) University of Bern, Space Research & Planetary Sci., Berne, Switzerland (veraafernandes@yahoo.com), (2) Institut für Geowissenschaften, Univ. Heidelberg, Heidelberg, Germany, (3) Institute for Dynamics of Geospheres RAS, Moscow, Russia, (4) Museum für Naturkunde, Leibniz Institute, Humboldt Univ.-Berlin, Berlin, Germany

Introduction: Large impact craters distribute material globally, and their ejecta layers present important horizon markers allowing inter-correlation of sediments from different sites, e.g. for late Eocene sediments pre-dating the tipping point of Earth's climate at the Eocene/Oligocene boundary (boundary at33.9±0.1 Ma; [1]). The Global Stratotype Section and Point (GSSP) in Massignano, Italy [2] contains three iridium-rich ejecta layers covering a 2 Ma time interval, with two being attributed to the Chesapeake Bay (85 km Ø) and Popigai (100 km Ø) impact structures, respectively [3]. Coeval with these anomalies the flux of extraterrestrial 3He-rich particles (presumably dust-size) increased [3]. This increased 3He-burial flux into marine sediments may have resulted either from an asteroid shower onto the Earth-Moon system [4&5], or may have been due to a comet shower [3]. This intense shower of dust to km sized extraterrestrial objects onto Earth predates the Eocene/Oligocene boundary by ∼1.5 Ma, which marks the major global climatic change from the warm Eocene to the onset of glaciations in the Oligocene, i.e. hot house-ice house transition [6].

Age of the Chesapeake Bay crater: Current radiometric age determinations for the Chesapeake Bay crater are based on total fusion Ar ages of tektites (distal impact glasses; [7-10]). Our preliminary 40Ar-39Ar step heating measurements suggest that precise Ar ages on these tektites cannot be acquired by total fusion. These data, together with optical microscopy suggest a complex trapped component which cannot be deconvolved when performing total fusion Ar extraction experiments.

Age of the Popigai crater: Current radiometric age determination for the Popigai crater is based on 40Ar/39Ar step heating experiments carried out by [11] on several impact melt rocks. The reported age is 35.7± 0.2 Ma based on a single plateau as these authors argued that other Ar-Ar age spectra were likely affected by inherited 40Ar or perturbed by some mechanism which is not fully understood. More recently, [12] recalculated the weighted mean of all four plateaux and two "mini"-plateaux (displaying a disturbed age spectrum and a younger age for Popigai crater. The best age estimate of 36.42±0.81 Ma is based on the four plateaux showing ∼70% 39Ar release [12]. These authors concluded that there is a need to further extend the work on age determination on several samples to better evaluate the effects of inherited argon and other disturbances (e.g. weathering alteration) on Popigai impactites.

Conclusion: There is a need to acquire a variety of well preserved impactites that will permit the thorough characterization of the material as well as to enable hand-picking of the best suitable fragments for an extended 40Ar/39Ar study for precise age determinations of the Chesapeake and Popigai craters.

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