

Identification of Possible Impact Glass in Ocean Sediment from South Atlantic

H. Ucar¹, G. Kletetschka^{1,2,3} ¹Faculty of Science, Charles University, Prague, Czech Republic (ucarh@natur.cuni.cz), ²Institute of Geology, Czech Academy of Sciences, Czech Republic, ³Geophysical Institute, University of Alaska Fairbanks, AK, USA (gunther.kletetschka@natur.cuni.cz)

Introduction: Published studies [1, 2, 3, 4, 5] showed micro-tektite level before the Matuyama-Brunhes transition as a glassy object formed by a meteorite impact. The Matuyama-Brunhes transition occurred 781 kyr ago [6] and is the last long-term magnetic reversal. The motivation of this study was to investigate the potential tektite deposition in ocean sediment from South Atlantic. This is a location where tektites have not yet been found.

The ocean sediments are from ODP Leg 175 expedition, which was carried out in 1997 [7, 8]. Hole 1082C (21°5.6690'S, 11°49.2342'E) was situated in the Walvis Basin, Namibia coast in the South Atlantic Ocean (Fig 1) [7, 8]. IODP Bremen Core Repository provided a 40 cm u-channel sample (2x2 cm) for investigation in the same clay sediment core as [8] between 81.4-81.8 mcd.

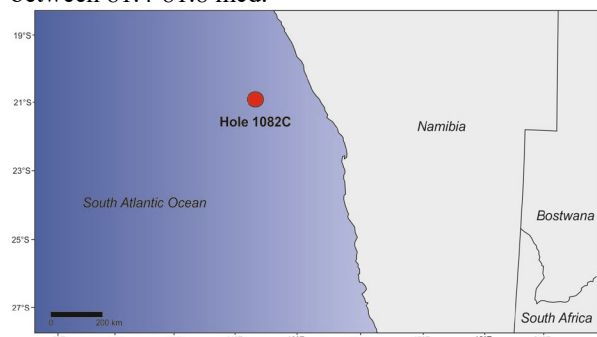


Fig 1: Location of the ODP Leg 175, Hole 1082C.

Methods and Results: 40 cm plastic u-channel sediment sample (2x2 cm) was sampled at 0.2 cm intervals by using a plastic tool for cutting the sediment (Fig 2a). Each sample was placed in a plastic cylinder container (2.5x2 cm) (Fig 2b). Containers were filled with distilled water and vibrated for 24 hours to have homogenous samples. Totally 196 samples were acquired.

The sieving method was done to search for possible tektite formation in the sediment. Sieving containers with grain sizes between 20-200 μm were used. The glassy objects found from the sieving were examined with an optical microscope and a Tescan Vega scanning electron microscope (SEM).

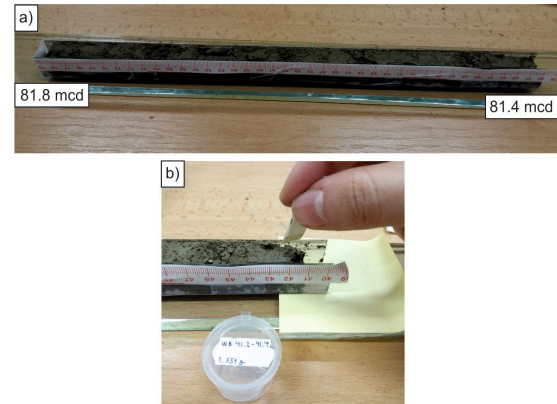


Fig 2: a) 40 cm u-channel sample between 81.4-81.8 mcd, b) sampling of the u-channel for sieving.

As a result of sieving, a total of 16 glass particles were found between 81.412-81.432 mcd (Fig 3). No glass particles were found between 81.40-81.42 mcd. The diameters of the objects are between 0.28-1.3 mm. The largest glass particle with a 1.3 mm diameter was found in 81.432 mcd (Fig 3). It has a rounded shape while other glass particles have an edgy shape.

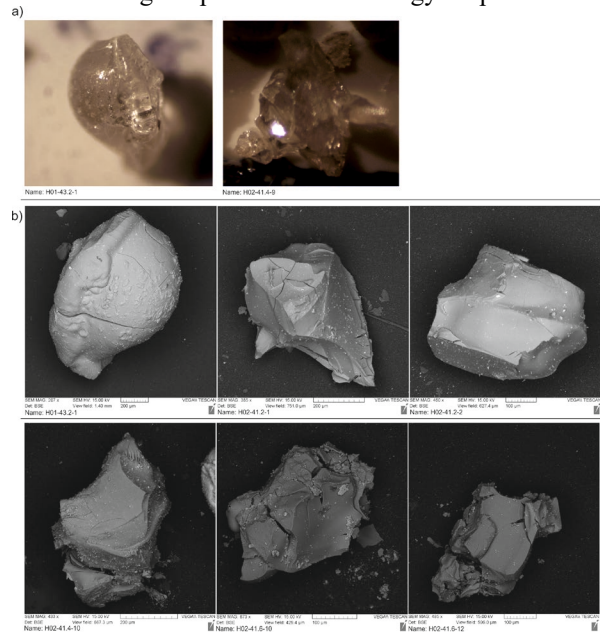


Fig 3: a) Optical microscope images of glass particles with rounded, edgy shapes and b) SEM images of the glass particles.

Discussion and Conclusion: About 788 kyr ago [10], an asteroid or comet impacted somewhere in Asia, producing glassy objects, tektites and

microtektites, and impact debris which were found over more than 10% of the Earth's surface, including much of Australia and surrounding oceans. There is a general consensus to locate their parent impact crater in Indochina, within or close to densest occurrence of the Australasian tektites, but [11] argued against it and suggested a crater in the desert area of Northwest China (Fig 4). Positions of the Australasian microtektite layer in the deep-sea sediments are close to the beginning of the Matuyama-Brunhes magnetic reversal [12, 13, 14]. Published studies [1, 2, 3, 4, 5] showed microtektite level before the M/B transition.

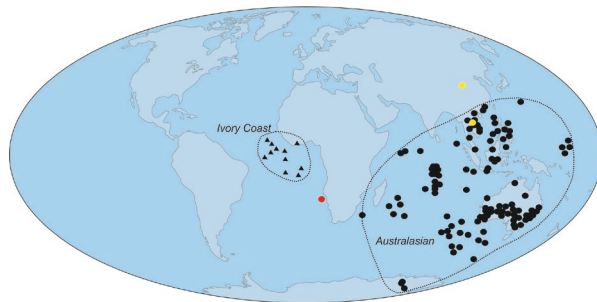


Fig 4: The Australasian and Ivory Coast tektite strewnfields (dashed lines) (modified after [9]). Triangles show the Ivory Coast tektite sites and black dots show the Australasian tektite sites. The red dot shows the location of ODP Leg 175, Hole 1082C. The yellow dots show the hypothetical locations of the parent impact crater for Australasian tektites – the conventional one in Indochina [15] and the alternative one in the Northwest China [11].

The location of the ODP Hole 1082C is between Australasian and the Ivory Coast strewnfields (Fig 4). However, the suggested age for the Ivory Coast tektites is 1.07 Ma [16] which does not correspond to the age of the sediment. [8] gave the age for 81.6 mcd as 795 kyr according to their sedimentation rate (10 cm/kyr). Our preliminary investigation and the suggested age of the sediment shows that the glass objects were caused by the meteorite impact before the Matuyama-Brunhes reversal. Further investigation is needed to find out which strewnfield the glass particles belong to. Geochemical analysis is underway. Supporting association of the recovered glass particles with the Australasian tektites would be a great achievement. This would extend the borders of the Australasian strewn field significantly in the western direction, which may, among others, testify for the effect of the Earth rotation during tektite flight [17, 18].

Acknowledgements: We thank IODP Bremen Core Repository (BCR) and Holger Kuhlmann for providing the marine sediments from ODP Leg 175, Hole 1082C. We thank Eva Svecova for helping with

the sample preparation. Support for GK came from the Czech Science Foundation 20-08294S, Ministry of Education, Youth and Sports LTAUSA 19141, and institutional support RVO 67985831.

References: [1] Hyodo M. et al. (2011) *Proceedings of the National Academy of Sciences*, 108(49), 19563-19568, doi/10.1073/pnas.1113106108 [2] Suganuma, Y. et al. (2011) *Earth and Planetary Science Letters*, 311(1-2), 39-52 [3] Valet, J.P. et al. (2014) *Earth and Planetary Science Letters*, 397, 67-79 [4] Valet, J.P. et al. (2019) *Earth and Planetary Science Letters*, 506, 323-331 [5] Mark, D.F. et al. (2017) *Quaternary Geochronology*, 39, 1-23 [6] Gradstein, F.M. et al. (2004) *Episodes*, 27(2), 83-100 [7] Wefer, G. et al. (1998) *Proceedings of the Ocean Drilling Program, Initial Reports*, Vol. 175 [8] Yamazaki T. and Oda H. (2001) *Earth, planets and space*, 53(8), 817-827, doi/10.1186/BF03351679 [9] Glass, B.P. and Simonson, B.M. (2013) In *Distal Impact Ejecta Layers*, 137-243 [10] Jourdan, F. et al. (2019) *Meteoritics & Planetary Science*, 54, 2573-2591, doi /10.1111/maps.13305 [11] Mizera, J. et al. (2016) *Earth-Science Reviews*, 154, 123-137, doi/10.1016/j.earscirev.2015.12.004 [12] Glass, B.P. (1967) *Nature*, 214, 372-374 [13] Cassidy, W.A. et al. (1969) *Journal of Geophysical Research*, 74, 1008-1025, doi/10.1029/JB074i004p01008 [14] Gentner, W. (1970) *Science*, 168, 359-361 [15] Sieh et al. (2020) *Proceedings of the National Academy of Sciences*, 117, 1346-1353 [16] Koeberl, C. et al. (1997) *Geochimica et Cosmochimica Acta*, 61, 1745-1772. [17] Dobrovolskis, A. (1981) *Icarus*, 47, 203-219, doi/10.1016/0019-1035(81)90167-6. [18] Alvarez, W. et al. (1995), *Science* 269, 930-935.