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Mineralogical and geochronological study of a relict monazite inclusion in a Muong Nong Tektite from Indochina.

ANNE-MAGALI SEYDOUX-GUILLAUME[1], PIERRE ROCHETTE[2], PIERRE-MARIE ZANETTA[1] AND BILLY P. GLASS[3]

[1]LGL-TPE, CNRS, UJM
[2]Aix-Marseille Université
[3]University of Delaware

Presenting Author: anne.magali.seydoux@univ-st-etienne.fr

Tektites are terrestrial impact-generated glasses distributed over regions of Earth 'surface with ejection distance up to ten thousand km. The Australasian tektite strewn field is the largest and the youngest (788 ka). In this study we focused our attention on a monazite inclusion in a Muong Nong tektite from Indochina first reported by Glass [1]. He identified this unique inclusion (~30x40 μm) as monazite based on an x-ray diffraction pattern. Here the sample is re-investigated down to the atomic scale using Scanning Electron Microscope, Electron Microprobe and Transmission Electron Microscope techniques. The objectives are first to characterize both structure and composition of monazite down to nanometer scale and second, to investigate the resetting of the U-(Th)-Pb systems in the monazite and implications in response to impact.

The monazite inclusion is quite rounded as a whole (no visible crystallographic face) with a sharp glass-crystal interface. At the micrometer scale, a primary zonation and a high concentration of pores (< 1 μm in size) are observed. This chemical zonation results in Th enrichment (8.6 wt% ThO_2 vs 3.9 wt%) on one half of the inclusion. Surprisingly, at the nanometer scale we see that the monazite inclusion is polycrystalline with significant nanoporosity (~40 – 500 nm) visible at the boundaries of individual grains. Bubble walls and glass are also trapped within these nanopores. The monazite polycrystals are free of radiation damage, which prove the recent annealing of the crystals, in agreement with the 0.8 Ma high temperature impact event [2]. The presence of high density of dislocations and low-angle boundaries, as well as the trapping of bubble walls and glass in the porosity imply rapid kinetic of re-crystallization into monazite polycrystals shortly after impact. We suggest that a partial resetting of the U-Pb system occurred at the time of the impact and Pb-diffusion is enhanced thanks to the formation of grain boundaries. The validity of preimpact crystallization age estimate will be discussed.

[1] Glass, B.P. (1972). EPSL, 16, 23-26
[2] Jourdan, F. et al. (2019). MAPS, 54, 2573-2591