PETROLOGY AND RADIOISOTOPIC AGES OF ALLANITE IN THE PEAK RING OF THE CHICXULUB IMPACT CRATER.

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Introduction: The REE-rich epidote group mineral allanite $CaREEAl_2Fe^{2+}Si_3O_{11}O(OH)$ [1] occurs as an accessory mineral phase in the Chicxulub impact crater's lower peak ring section that was recovered in drill cores by IODP-ICDP Expedition 364 [2,3]. Allanite is a common accessory phase in igneous, metamorphic, metasomatic, and sedimentary rocks and can be used for radioisotopic dating [4].

We investigate allanite as a potential geochronometer for igneous and/or alteration events that affected Chicxulub's peak ring rocks.

Samples and Methods: We studied 5 samples of granite, and trachyte and phonotephrite dikes from the lower peak ring section in the Expedition 364 drill cores, spanning a depth range from 748 to 1325 meters below sea floor (mbsf; [3]). Using the electron microprobe and laser ablation inductively coupled plasma mass spectrometry at Arizona State University, we determined the petrographic context, compositions, and Th-Pb ages of allanite.

Results: Small, ~10 µm acicular allanite crystals that overgrow epidote and andradite occur in association with carbonate veins in samples from the hanging wall of the lower peak ring down to its basal part. These assemblages include apatite, andradite, Fe-rich epidote, titanite, fluorite, pyrite, rare Ca-sulfate, and phyllosilicates.

Nine 50 to 350 µm prismatic allanite grains with 0.2 to 2.7 wt% ThO_2 are associated with anhedral, Fe-rich epidote that replaces mafic phases in porphyritic trachyte dike C247_1159.99 mbsf and in granite breccia C266_1221.125 mbsf; these allanite grains are zoned, variably metamict and contain 5 to 15 µm thorite and zircon inclusions. Preliminary common lead-corrected Th/Pb ages from three spot analyses on allanite in a granite breccia are 215 ± 28, 229 ± 10, and 260.4 ± 9 Ma; three spot analyses on an allanite crystal hosted by a trachyte dike gave ages of 62.3 ± 3.3; 207.4 ±4.3; and 266 ± 13 Ma, respectively.

Discussion & Outlook: Xiao et al. [5] reported 304 to 341 Ma for zircon from five granite samples of the lower peak ring section in the Expedition 364 drill cores; and magmatic titanite in a lower peak ring granite sample from 887 mbsf gave a U-Pb concordia age of 341 ± 6 Ma [6].

Despite the caveat that allanite is susceptible to alteration due to its propensity to incorporate high concentrations of ThO_2 [1,4], the ages we calculated from the two allanite grains are significantly different from the igneous crystallization ages recorded by zircon. Thus, our data may record allanite growth in their host granite / trachyte during metamorphic, and/or alteration events. Widespread allanite mineralizations in alteration assemblages in the lower peak ring section is additional evidence for allanite recording alteration events in Chicxulub's peak ring. Pre-impact alteration episodes that affected the granitic peak ring rocks were the emplacement of trachyte, phonotephrite and basanite ("dolerite") dikes [3], and a greenschist facies overprint that is expected from regional metamorphism at the estimated depth of 8 to 10 km of these granitic rocks prior to the impact [2].

Moreover, the youngest age could record allanite growth from a hydrothermal system that was generated by the impact [7] and may have also caused the secondary growth of acicular allanite throughout the lower peak ring drill core section recovered by Expedition 364.

We will analyze additional allanite grains to refine their geochonologic records for the presentation at the meeting.

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