HOW TO INTERPRET WIDELY SCATTERED SINGLE-GRAIN (U-Th)/He AGES FROM UNSHOCKED METEORITES? EXAMPLES WITH ELEPHANT MORaine 14074 AND THIEL MOUNTAINS 07012 ACAPULCOITeS. K. Min¹, C. Anderkin¹, J. Grigsby¹ and D. Sheikh¹, ¹Department of Geological Sciences, University of Florida, Gainesville, FL 32611. kmin@ufl.edu.

Introduction: Single-grain (U-Th)/He ages from meteorites are commonly scattered, making it difficult to extract meaningful information from the data. The unresolved question is how the samples from a single meteorite rock chip, typically less than 1-2 cm in linear dimensions, yielded scattered ages even though they are expected to have experienced the same thermal history. In this study, we present single-grain (U-Th)/He ages from two acapulcoites of EET14074 and TIL07012, and attempt to interpret the resulting ages using a simple He diffusion model combined with morphological characteristics of the samples.

Results: For EET14074, the alpha recoil-uncorrected (U-Th)/He ages obtained from 37 phosphate aggregates are widely scattered from 116.8 Ma ± 145.7 (1σ) Ma to 4212 Ma ± 1089 Ma (Fig. 1). Two batches of the same size samples, analyzed to check the reproducibility, yielded indistinguishable results.

TIL07012 also yielded very scattered (U-Th)/He ages in the range of 35.4 ± 8.9 Ma to 5769 ± 1506 Ma (n=45). The phosphate aggregates from TIL07012 were divided into two groups (150-180 µm, 180-250 µm) based on the sieve size used during the separation. The larger aggregates (180-250 µm; red solid circles in Fig. 2) yielded generally older ages with an average of 3055 Ma compared to the smaller aggregates (150-180 µm; blue solid rectangles in Fig. 2; average = 1343 Ma). Note that the surface areas and the converted radii of phosphates (x-axis in Fig. 2) are indistinguishable for these two groups. These observations confirm the previous suggestion that the phosphate aggregates with thicker layers of attached phases can more efficiently shield alpha recoil ejection, therefore yielding older (more pristine) apparent ages, compared to the phosphates with thinner attached phases [1]. The large age scatter within each group can be explained by differential extents of alpha recoil loss. The areal relationship...
between phosphate and the attached phases is examined using SEM on the 2-D surface of the aggregate, but the spatial relationship along the vertical direction cannot be examined using SEM, hampering precise determination of alpha recoil correction factor (F T). Another complication comes from the He diffusion profile in the original phosphate grain because the individual phosphates in the aggregates used for analysis correspond to fractions of originally larger phosphate grains. Without knowing the morphological relationship between the phosphates used in the analysis and their original grains, it is difficult to determine the true (U-Th)/He age. Both of these effects (alpha recoil and fragmentation) cause the apparent ages to be younger than the true age, yielding scattered apparent ages depending on the extent of these effects. Therefore, we suggest that the oldest apparent ages, rather than the weighted mean of all measured ages, are expected to be close to the true (U-Th)/He age of the unshocked meteorites.

**Modeling:** To explain the observed age-radius relationships (dashed curves in Figs. 1 and 2), a simple diffusion modeling was performed. The dashed curves in Figs. 1 and 2 represent the age-radius relationship when the samples of different radii experienced an identical isothermal heating event at present. For EET14074, the modeling was performed to fit the three oldest ages. The modeling results correspond to fractional He loss of 14.8 % for a grain with a radius of 120 µm, assuming that the true cooling age is 4538 ± 32 Ma (1σ) constrained from the Acapulco meteorite [2]. For TIL07012, the five oldest ages are used to model the age-radius relationship, and yielded He fractional loss of 6.4 % at a radius of 60 µm. The given data suggest that these two meteorites experienced thermal disturbance relatively recently, after the primary cooling in their parent body. The nature of the later-stage thermal event(s) that caused the diffusive He loss is still unclear, but it was most likely caused by a short-term, high-T event such as compressional heating during their passage in Earth’s atmosphere or solar heating after the meteoroids were exposed to cosmic rays. The observed He fractional loss can be explained by recent isothermal heating at ~500-600 °C (heating duration = 1 min) for EET14076, and ~400-500 °C for TIL07012.