Evidence for radiation damage control on apatite He ages from the Grand Canyon region, Colorado Plateau

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Individual detrital apatites from three sedimentary units in the Grand Canyon region of the Colorado Plateau yield a span of (U-Th)/He dates that are positively correlated with radiogenic ^{4}He and effective U (*eU*) concentrations. All dates are younger than the depositional ages of the sandstone units, indicating partial to complete ^{4}He loss in the analyzed apatites following deposition. Recent refinements in our understanding of He diffusion based on laboratory experiments suggest that radiation damage impedes He mobility in apatite [1]. Forward models that incorporate the effect of evolving He diffusivities indicate that this behavior will be most strongly manifested by suites of apatites containing a range of *eU* concentrations that cooled and were partially reset. Detrital apatite grains from sedimentary units in the Grand Canyon region fit these criteria when 1) compositionally variable apatites were deposited, and 2) underwent burial heating, partial ^{4}He loss, and subsequent exhumation. Using geologically reasonable thermal histories, our simulations can reproduce our distributions of detrital apatite dates. The youngest dates are obtained for the lowest *eU* apatites that underwent the greatest ^{4}He loss during burial, and impose the strongest constraint on the exhumation timing. The results also predict that the correlations between age and ^{4}He and *eU* concentrations are sensitive to the thermal history, such that it may be possible to extract additional details regarding temperature-time paths from these relationships.

References

[1] Shuster et al., (2006) GCA (This volume), Goldschmidt 2006