GEOTRACK

Review of Manuscript gchron 2021-8. " **Age distribution of horizontal fission tracks**" by Jensen and Hansen, submitted to Gchron.

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I have had real trouble trying to work through the ms under review. For much of the text it is hard to understand the real meaning and what the authors are trying to do. Much of the wording is vague. This is typified by the title. I have no real idea as to what the "age distribution of horizontal fission tracks" means. I assume this refers to horizontal CONFINED fission tracks, but I still don't know how to interpret the "age distribution".

In the first line of the abstract, we read " Equations for the distribution of age versus length of partially annealed horizontal fission tracks in apatite is presented." Again, I have no idea what this means.

Then in lines 26-27 we read: "The time of track generation can be derived from the observed track length distribution independent of any annealing law." followed by an integral. On the basis of my experience, I consider this meaningless. The annealing law fixes the rate of change of length with temperature, which will affect the final fission track age. The length distribution cannot be used to calculate the time of track generation in this way, because the relationship between the thermal history and the final measured track length distribution and fission track age is so complex, involving a number of factors including the annealing law

The basic premise of this paper, if I understand correctly, is that it is possible to "pick apart" the track length distribution of confined fission track lengths to assign a component of the fission track age to each track length "bin" on the basis that the shortest tracks are the oldest and the longest tracks are the youngest. The paper by Belton and Raab (2010) adopted a similar principle, but it is not correct. This approach is fundamentally flawed because of the natural spread of track lengths. Tracks are formed with a distribution of lengths characterised by a standard deviation of 1 μm, which means that they are typically spread over an interval of 4 μm. As tracks are heated, tracks get shorter and the spread increases. So a sample that is heated to say 80°C and then cools to say 20°C, the track length distribution can be considered as a mixture of two populations; one with a mean length of around 11.5μm with tracks dominantly between ~10 and 14 μm representing tracks formed between the start of the history and the point at which cooling began, and another with a mean length of 14.5 μm with lengths dominantly between 12 and 16 μm representing tracks formed after cooling began. There is thus considerable overlap between the two populations, with both contributing significantly to lengths between 12 and 14 μm. There is no way to distinguish between tracks belonging to these two populations, and so the approach is flawed. That is the simplest case. More complex histories produce more complex length distributions.

I must admit to not being equipped to follow the mathematical treatment which dominates the paper, but on the basis of the above, I cannot recommend acceptance of this ms for publication.

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