Identifying the post-sedimentary part of fission track length histograms with inherited tracks

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Abstract

Fission track length histograms from sedimentary samples may contain tracks generated before the time of deposition. They may originate from various source areas with their own thermal histories. After deposition they share thermal history. Inherited tracks, mainly represented by the shortest tracks, are mixed with the young post–sedimentary tracks due to anisotropic annealing, various grain chemistry and uncertainties of measure. Inherited tracks complicate calculating the thermal history. Deconvolution from time sequence analysis [1] is used to separate pre–and post–depositional tracks. Deconvolution reduces the length spread caused by the uncertainties. Hereby tracks are organized according to age, the short tracks being older than the long tracks.

Elimination of inherited tracks from fission track histograms

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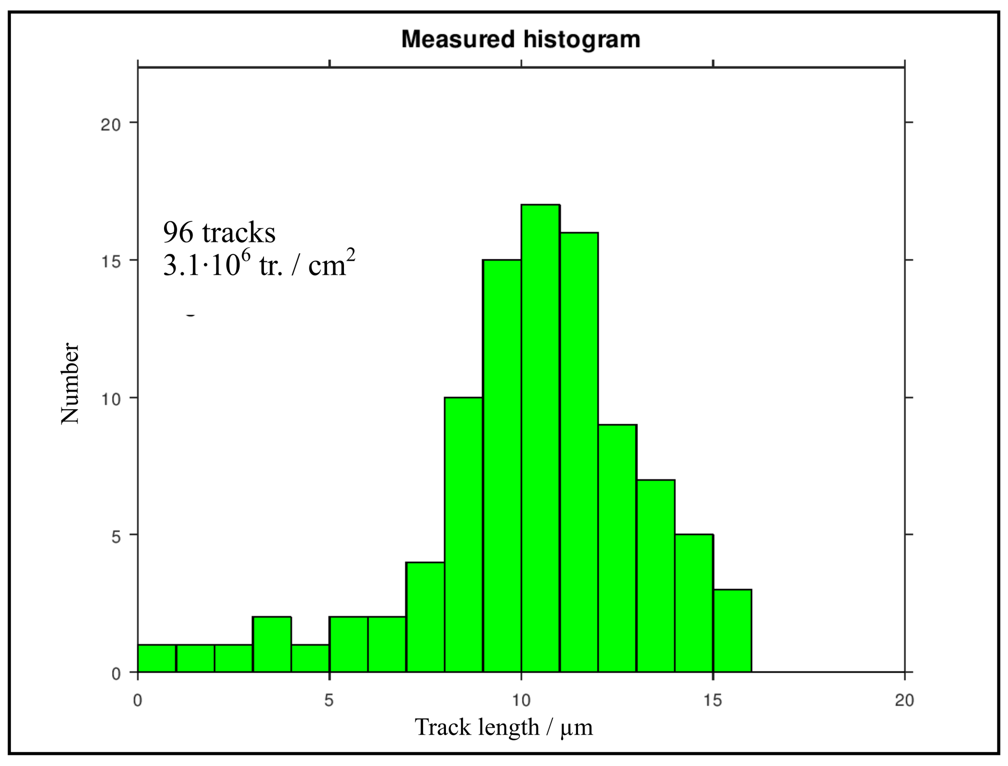
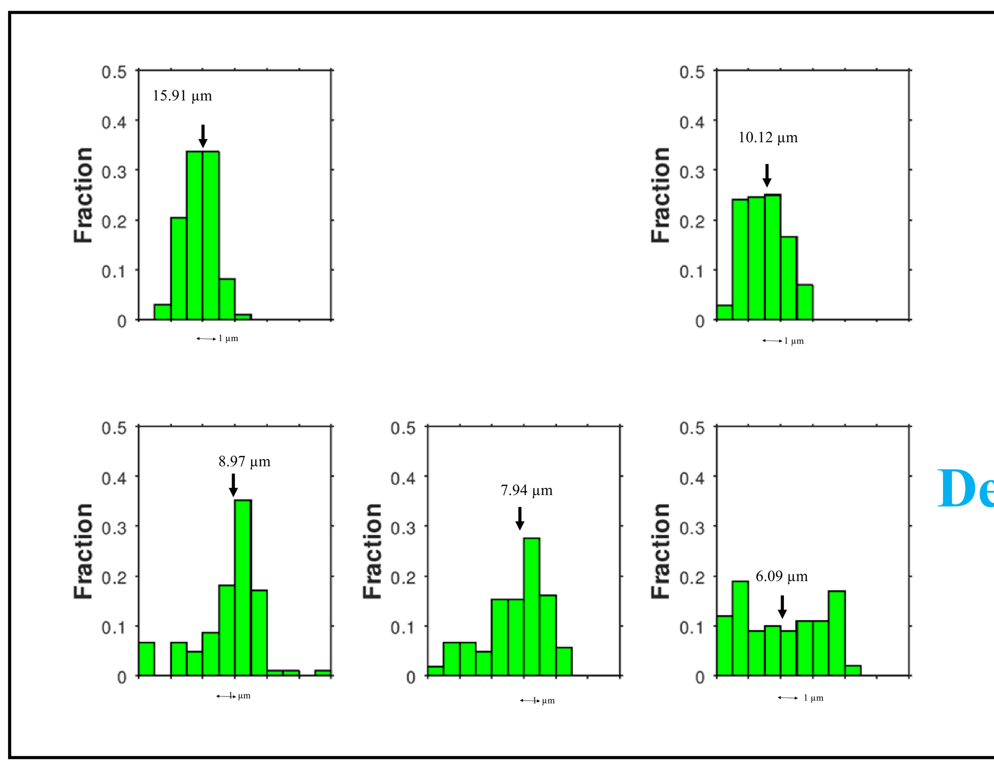
Introduction: Fission track length histograms from sedimentary samples may contain tracks generated before the time of deposition. They may originate from various source areas with their own thermal histories. After deposition they share thermal history. Inherited tracks, mainly represented by the shortest tracks, are mixed with the young post–sedimentary tracks due to anisotropic annealing, various grain chemistry and uncertainties of measure. Inherited tracks complicate calculating the thermal history.
Deconvolution from time sequence analysis [1] is used to separate pre–and post–depositional tracks. Deconvolution reduces the length spread caused by the uncertainties. Hereby tracks are organized according to age, the short tracks being older than the long tracks.

Example: Middle Jurassic sandstone with inherited tracks from Jameson Land, East Greenland.

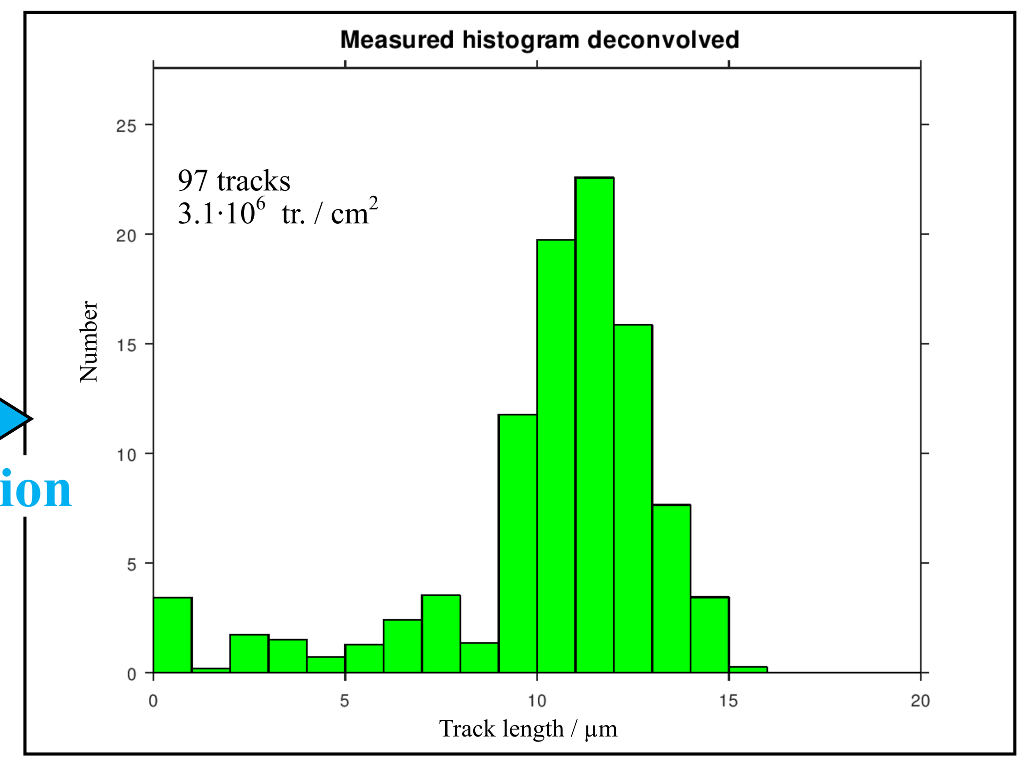


The measured fission track length histogram is considered as composed of induced track length distributions [2] after laboratory annealing [3] and [4], here called filters.

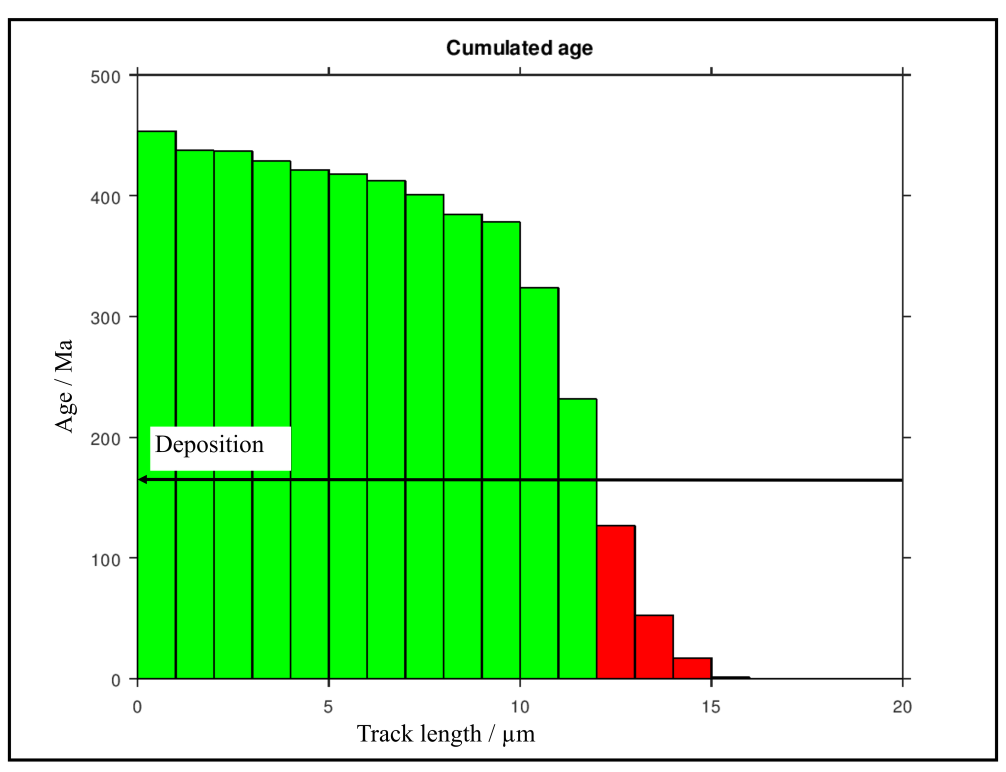


A filter is placed with its center on each bin of the measured histogram. The filters are scaled so their sum matches the measured histogram.

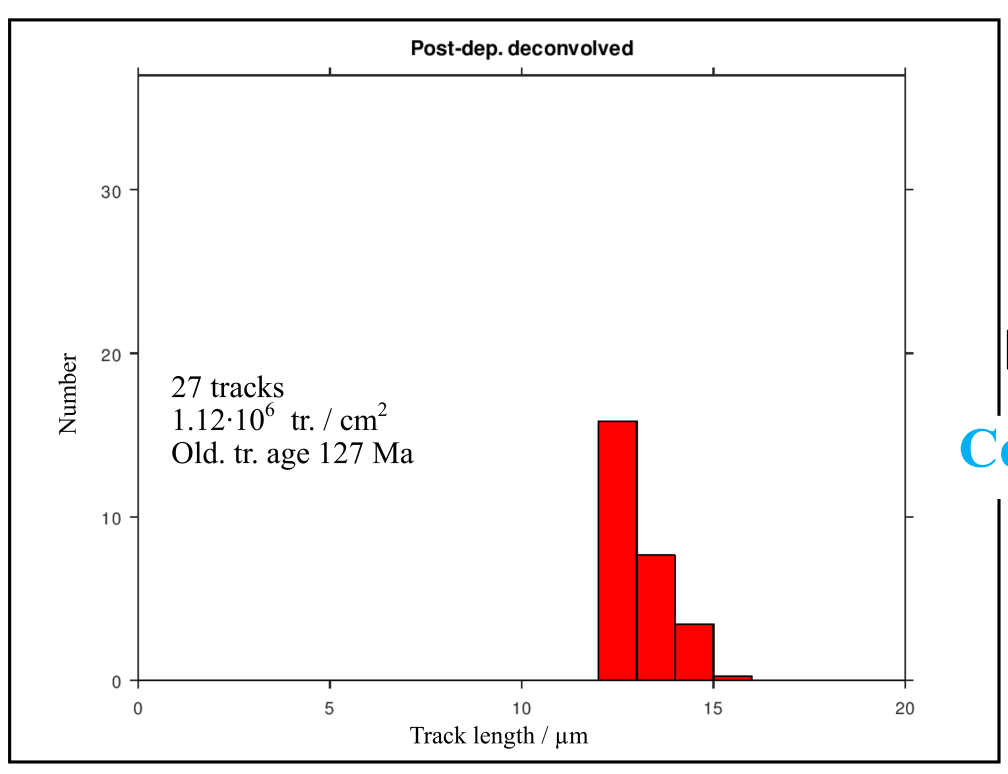
Deconvolution



The tracks in the histogram of scaling factors are organized chronologically, short tracks being older than long tracks. Shortening increases by annealing.

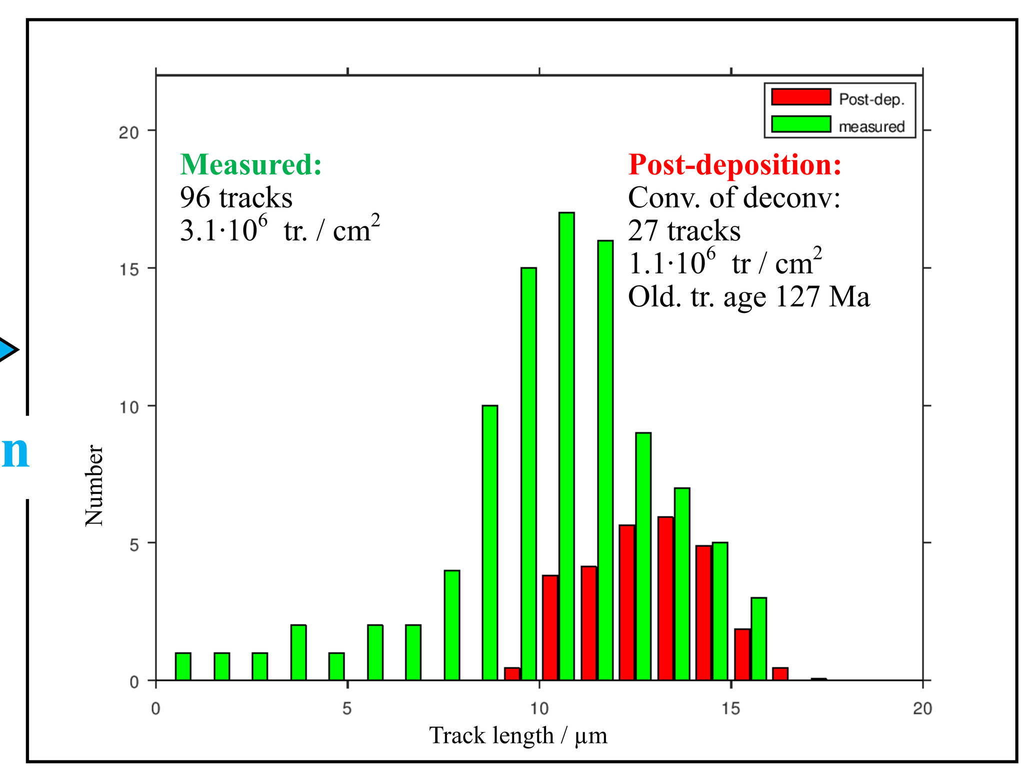


Cumulation of track ages of the deconvolved histogram from long to short tracks. Ages are calculated using a diagram [5] relating mean track length to surface track density. Tracks younger than the deposition age are identified.



The post–depositional tracks extracted from the deconvolved histogram depleted of inherited tracks. Biases and uncertainties are reinstated by convolution to obtain a histogram similar to a measured histogram. In this process the filters are used again.

Convolution



The convolved post–depositional histogram shown with the measured histogram. Convolution broadens the deconvolved histogram.

Conclusion: Inherited tracks can be eliminated from sedimentary track length histograms by deconvolution. This leaves histograms enabling us to calculate the last part of the post–depositional thermal history.
Note: In this presentation wholly included horizontal tracks parallel or near parallel to prismatic faces are measured.

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