Evolving thermal histories with fission track data using an evolutionary optimization algorithm

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The potential of apatite fission-track thermochronology for the deciphering of the thermal history of rocks since their last cooling below ~150°C is continuously growing and received particular attention by many workers. This paper presents an inverse method for the optimization of apatite thermal histories. The method is based on a genetic algorithm (GA) which determines the best fitting t-T paths to the experimental (fission-track age, confined track lengths distribution) data.

Taking into account problem-specific knowledge, the investigated t-T space and the GA parameters are adjusted to provide a remarkable speed up for the GA and constitute a further way of guiding the search of best solutions. Practical optimization problems often require the location of multiple solutions. Since in classical GA, the population of individuals converges over time to a single optimum, even within a multimodal domain, the proposed approach uses a niching method, such as the sharing heuristic, that enables a GA to locate multiple optima.

The re-examination of some samples studied earlier reveal the effect of multi-modal solutions. The proposed method shows a behavior similar to that of the Gallagher (1995) model and suggests new possible solutions, which allows to take a final decision when the available geologic informations are considered.