Fission-Track Dating using Object-Based Image Analysis

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Geological dating with the help of fission track analysis is based on a time-consuming counting of the spontaneous and induced tracks in the minerals. Fission tracks are damage trails in minerals caused by fast charged particles, released in nuclear fission. In this study the ζ-method is used for fission-track dating. In order to determine the age, spontaneous tracks in the apatite and induced tracks in the muscovite external detector have to be counted. The automatic extraction and identification would not only improve the speed of track counting and eliminate the personal factor. Pixel values alone are not enough to distinguish between tracks and background. Traditional pixel-based approaches are therefore inefficient for fission track counting. Image analysis based on objects, which include shape, texture and contextual information is a more promising method. A procedure for automatic object - based classification is used to extract the track objects. Resolving the individual tracks in a multi-track object is based on morphological operations. The individual track objects are skeletonised and the number of individual tracks in the object is counted by processing the skeletons. To give the right fission track age, there has to be a calibration of every single user manually counting the tracks. We calibrate the automatic approach for counting in the same way. Durango apatite standard samples are used to determine the ζ- and Z-calibration factor. The automatic approach is useful for counting tracks in apatite standards and induced tracks in muscovite external detectors where the quality and quantities of the etched tracks is high. Muscovite detectors irradiated against glasses can also be used to determine the thermal neutron fluence, which is necessary to determine an absolute age. These images are of high quality and free of disturbing background irregularities. Here the automatic approach is a practical alternative. However for natural samples of small grain size, low track-numbers and background irregularities, the implementation is questionable. The algorithm for the automatic extraction and counting of fission tracks in standard samples of Durango Apatite and muscovite external detectors is shown to be self-consistent.