Machine learning applied to finding and characterizing the tips of etched fission tracks

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Stacks of digital images (AVIs) of etched surface fission tracks (SFTs) and confined fission tracks (CFTs) in apatite (Ap) were collected for standard U-FT analysis: one AVI for reflected light; one AVI for transmitted light; both AVIs spanning 30 μm in X and Y directions at 24 pixel $\cdot$ μm^{-1} resolution; 33 frames separated by uniform 0.3 μm; 8 frames above Ap, frame with Ap surface in focus, 24 frames below Ap surface and within Ap volume.

The goal of this study is to explore a machine learning approach to the automated finding and characterizing of the tips of SFTs and especially CFTs. This approach included the following steps:

Starting with a set of AVIs and an untrained machine learning model:

1) Load imagery

2)Process imagery to extract potential CFT/SFT tips

3)Identify true tips with machine learning model (skip if model is untrained)

4)Correct the model's predictions, add CFT/SFT tips to library

5)Train machine learning model on tip library

6)Goto step 1

The algorithm returns a trained machine learning model, which can be used to accurately identify SFT and CFT tips in an unseen image.

Results of this analysis are encouraging. The success rate for finding SFT and CFT tips improves significantly with increasing number of patterns used to train the algorithm. This machine learning strategy to automate the finding and characterizing of SFTs and CFTs in apatite deserves further study. An important component of this approach is the substantial and efficient use of human expertise to aid the training of the automation algorithm.