

## Mapping for microscopes: Automating apatite-image handling

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Geologists face several time-consuming tasks between the initial preparation of samples and their ultimate goal of identifying and measuring visual features within them, e.g., fission tracks within apatite grains. Those tasks include manually scanning the slide to determine promising regions to investigate, traversing focal depths to estimate the value and viability of a grain's features, all while maintaining a consistent coordinate system, sample-specific notes, and a record of all of the data and work involved. This project demonstrates the design, prototype, and possibilities of a system that automates the workflow of all of these preparatory tasks, allowing geologists to maximize the time they spend leveraging their expertise: geological judgment.

A "Google map of a microscope slide" captures the essence of this system's output. Starting from the prepared slide, the system (1) scans the entire slide at a geologist-chosen optical zoom, storing all of the raw images as it goes, (2) creates a single, in-focus image at each xy-location on the fly through analysis of each image stack, (3) computes a consistent, global coordinate system for all of those images captured, (4) uses those global coordinates to stitch together a very large single image, or "slide map," of the entire slide, and (5) provides a browser-based interface, deployed either locally or online, through which a geologist can navigate the slide map. Via Google-maps-like controls, a geologist explores the slide, zooms in and out, and annotates locations. Then, through its consistent, global coordinate system, the system can automatically return the microscope to a point the geologist clicked for a closer investigation on the live rig.

After building the slide map, additional algorithms in our proof-of-concept system (1) extract possible grains based on contrast and shape, (2) distinguish apatite from other materials present, and (3) suggest the most promising grains for further exploration by the geologist. The extensible *slide-map* system thus untethers the geologist from the microscope – while still retaining a geologist's scientific judgment as the central contribution of scope-based analysis.