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Accessibility to thin section analysis: Improvements and new low-cost tools.

ALEXANDER SCHEINOST[1,2], MAURICIO TORREBLANCA-GAYMER[1] AND MAURICIO RIVERA[1]

[1]Millennium Institute on Volcanic Risk Research – Ckelar Volcanoes

[2]Programa de doctorado en ciencias mención geología

Presenting Author: asc021@alumnos.ucn.cl

Thin section analysis is critical for studying geological materials, providing insight into their mineralogy, textures, and microstructures. In the last years, many tools have emerged in this area, mainly focused on calculating vesicles, minerals, or machine learning mineral recognition. In this study, we present new advances in the application of thin section analysis in microscopy, new Python code, graphical user interface, and calibration techniques that enhance the capabilities of the PiAutoStage [1].

We work with a Raspberry Pi and Pi Camera, a low-cost real-time image acquisition and sharing bundle/system. We present a new code and graphical user interface, which allows taking individual pictures and displaying previews from the microscope; it also is configured to run the PiAutoStage code with our improvements and modifications. The code includes advanced image processing techniques that enable more precise thin-section scrolling and single-frame preview functions. There are several possible outcomes from this low-cost technique. First, it can help to reuse old microscopes for thin-section analysis. Also, it can help as a teaching tool for in-class and e-learning. At the same time, it can support other specialized techniques (i.e., electron microprobe, SEM) as a complete image map browser. Finally, it helps with statistical and descriptive analysis (i.e., the initial fraction of phenocrysts, quantifying mineral phases, and petrographic descriptions). These advances would enable researchers to obtain highly accurate and consistent data from their geological thin sections, revolutionizing how these materials are analyzed, studied, and taught.

Our study presents new advances in the accessibility of thin section analysis, a new Python code, and a graphical user interface. Our findings show implications for several research fields, such as petrology, mineralogy, and sedimentology, and represent a major step forward in the analysis of geological materials, bringing these tools to users who do not have the financial capability to perform this analysis rather than expensive equipment.

[1] Steiner, R. A., & Rooney, T. O. (2021). PiAutoStage: An Open–Source 3D Printed Tool for the Automatic Collection of High–Resolution Microscope Imagery. *Geochemistry, Geophysics, Geosystems*, 22, e2021GC009693.