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Making Geology "Visible" for Geology Students with Visual Impairments

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In alignment with the UNESCO Education 2030 Agenda and Sustainable Development Goal 4 (inclusive and equitable quality education), this work reports a teaching experience involving a visually impaired student in several undergraduate geology disciplines (e.g., Igneous and Metamorphic Petrology, Field Geology and Geotectonics). The main objective was to overcome disability-related barriers and promote accessible, high-quality geology education for all students. Because much of the content in geology courses is essentially visual, the main challenge was to transform visual content into accessible formats. Tactile language proved to be the most effective approach. A wide range of didactic materials was developed and adapted with the support of visual assistance monitors. The creation of accessible materials involved the use of Braille printers, fusers, 3D printers, wood engraving (Fig. 1), Multiplan, Braille labelers, as well as manual resources (e.g., cardboard, hot glue, and relief paint) (Fig. 2). In theoretical classes, the content was described in greater detail and supported by tactile diagrams. In practical classes, hand samples and thin sections were explored through verbal descriptions provided by monitors, with the aid of tactile materials. Multiplan was widely used in both theoretical and practical classes to create diagrams, maps, and geological cross-sections, and proved fundamental to learning. The student also participated in all fieldwork. Fieldwork enabled observation of rocks, structures, and textures *in situ*, including features that could be explored through touch and, in some cases, auditory stimuli. Monitor support was essential for mobility, description of outcrops, handling of accessible materials, and ensuring both safety and quality during field activities. Teaching geology to a visually impaired student required multiple adaptations to create non-visual ways of "seeing" geology. Some strategies were fully successful, whereas others were only partially effective. Although theoretical content was learned with relatively few difficulties, practical activities, especially recognition of rock samples and thin sections, remained more limited. Overall, the adapted materials were effective in most cases, and continuous feedback from the student was essential for improving resources. These materials also benefited students without disabilities, demonstrating their broader value for more inclusive, accessible, and high-quality higher education.

Figure 1: Lithospheric plates - tactile wooden map

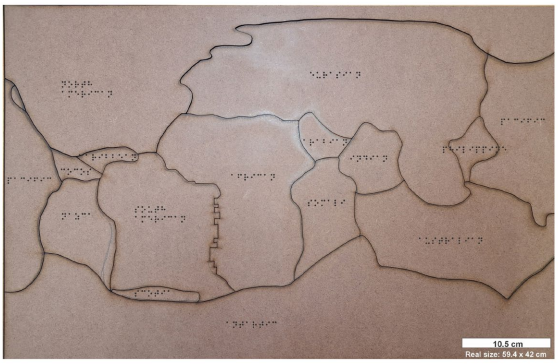
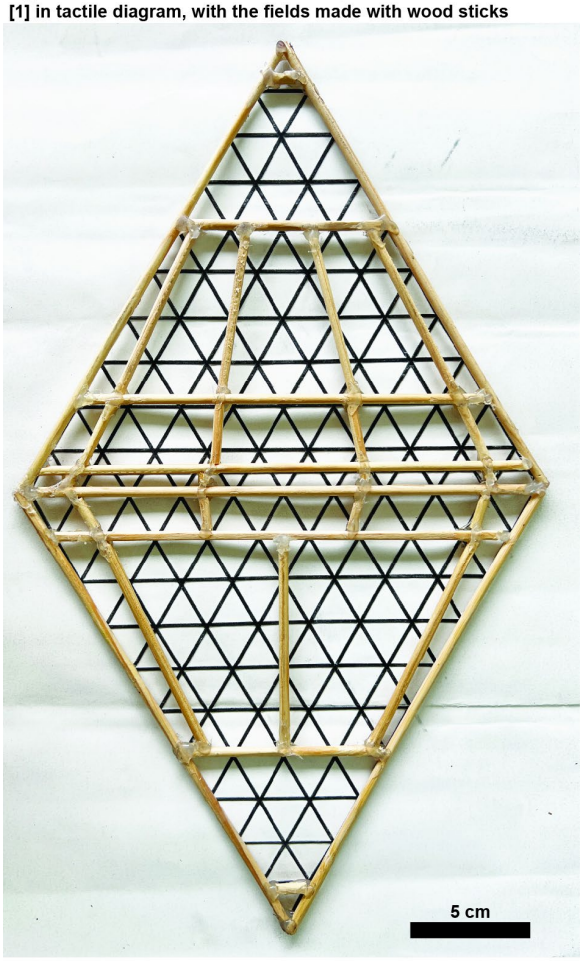


Figure 2: QAPF modal classification of plutonic and volcanic rocks [1] in tactile diagram, with the fields made with wood sticks



[1] Le Maitre, R. W., Streckeisen, A., Zanettin, B., Le Bas, M. J., Bonin, B., & Bateman, P. (Eds.). (2005). Igneous rocks: a classification and glossary of terms: recommendations of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks. Cambridge University Press.