

### Identification and Measurement of Minerals on Thin Sections of Intrusive Igneous Rocks Using Deep Learning

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Artificial Intelligence has gone beyond theory, and it is used in everyday life, including politics, economics, medicine, social networks, web browsers, academic research, etc., and some consider it as the Fourth Industrial Revolution. Since the beginning of the 21st century, research on deep learning has been applied to different branches of the Earth Sciences. On this research I used the Facebook AI Research's Detectron2-v0.6 model to identify eight minerals of intrusive igneous rocks on thin sections, and the image processing library scikit-image to obtain quantitative measurements of each identified mineral.

For this task, the starting point is the workflow used in the development of AI models. 400 images were obtained from the British Geological Survey and The Open University database, and 62178 labels were prepared in the Roboflow platform. This was used to generate four datasets for training and validation, along with an external evaluation dataset of 20 images for the Detectron2-v0.6 model. This process was carried out in Google Colab.

The best result was obtained in the XPL-10X image dataset, achieving a total loss of 1.15, an average precision (AP, IoU = 0.5-0.95) of 15.7% and an average recall (AR, IoU = 0.5-0.95) of 26.3%. Scikit-image was also evaluated, and the relative error results were between 0-3%, which is appropriate for this task.

An application was designed and implemented, available in Google Colab and Hugging Face-Streamlit. This mineral identification and measurement tool allows the user to upload their own images and generate a PDF report useful in the geological field, which includes the results of mineral segmentation and identification, mineralogical analysis, and crystal size distribution analysis.

AI models show great potential for automating petrographic analysis, accelerating processes that have traditionally been manual and highly specialized. Their adaptability makes them valuable for the microscopic analysis of ore minerals.