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Semi automated Phase Segmentation of volcanic rocks from energy-dispersive X-ray spectroscopy images using foundation segmentation model

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The semi-automated identification of mineral phases, e.g. from Energy-dispersive X-ray spectroscopy (EDS) images, is often a starting point for the direct evaluation of volcanological samples or to provide machine learning (ML) methods with reference data for training and evaluation. The semi-automated process identifies segments with similar properties and allows the user to assign semantic meaning to the whole segments instead of single pixels which allows faster and unified processing of data. The amount of data that can be processed is limited by the human interaction in the semi-automated process. To increase the output of the process, the pre-segmentation step has to be improved. In this contribution we consider the possibility of using the novel Segment Anything Model (SAM) to enable easier processing of larger datasets.

SAM is a foundation semantic segmentation model which is training on tremendous amount of data and can be applied to different tasks. In our case the main challenge is the fact that SAM is designed to process three channel RGB images but EDS provides multi channel spectral data. To overcome this problem we apply Principal Component Analysis (PCA) to the EDS images and reduce it to three channels (so-called "Pseudo-RGB"). An example of the outcome of this procedure, when applied to a volcanic rock composed of phenocrysts and groundmass, is shown in the upper part of **Figure 1** where olivine and plagioclase are visualized in light green color and red color, respectively. Finally the SAM model is applied to the Pseudo-RGB image to acquire the segmentation. An example of the results of the segmentation is shown in the lower part of **Figure1**. In most cases, the identified segments closely follow the shape of the crystals. In some cases a problem of over-segmentation can be noted when crystals are affected by cracks.

The ongoing work is focused on automatically identify clusters of similar segments to allow fast processing of large amounts of data.

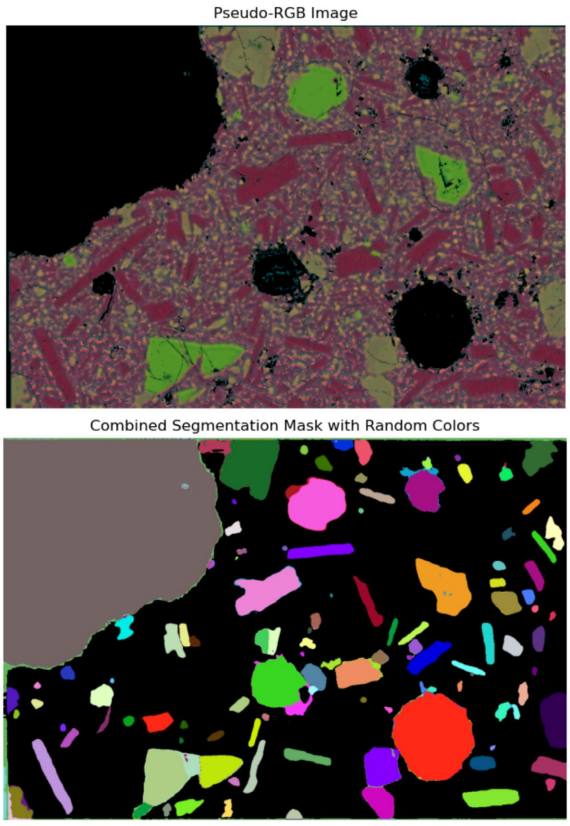

Figure 1: Upper part shows Pseudo-RGB image created from EDS images using PCA to reduce the number of channels to three. Lower part shows segments identified by SAM in the Pseudo-RGB Image.