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On the connected porosity of mineral aggregates in crystalline rocks

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ABSTRACT

The ^{14}C-PMMA impregnation of rock samples and mineral staining methods provide the connected porosity map and the spatial distribution of mineral aggregates, respectively. Combined image analysis of mineral and porosity maps allows quantification of the connected porosity distribution in rock-forming mineral aggregates. After the two maps have been superimposed numerically, the ^{14}C-PMMA method provides an indication of the extent of pore connectivity for each pixel in the analyzed area, which can be used to obtain the porosity distribution as a function of modal mineralogy.

When applied to undeformed and deformed Kivetty granodiorite samples from Finland, the method allows for a detailed analysis of the rock porosity. Porosity distributions related to the undeformed rock are unimodal and approximately identical to each other. On the other hand, porosity distributions of the deformed granodiorite are multimodal and vary significantly. Constituent porosity sets of the deformed samples were albite crystals free of alkali feldspar patches and alkali feldspar phenocrysts (average porosity, $\overline{\Phi} = 0.21\%$), albite containing alkali feldspar patches ($\overline{\Phi} = 0.59\%$), rapakivi albitic mantles ($\overline{\Phi} = 1.15\%$), quartz ($\overline{\Phi} = 0.39\%$) and mafic minerals ($\overline{\Phi} = 5.8\%$). Moreover, the analysis indicates that the numerous micropores observed under SEM within alkali feldspar phenocrysts and albite crystals free of alkali feldspar patches are unconnected in 3D.

Keywords: Petrography, connected porosity, new technique, ^{14}C-PMMA method, image analysis, igneous petrology, granite