*American Mineralogist, Volume 95, pages 1389–1398, 2010*

# A new method for quantitative petrography based on image processing of chemical element maps: Part II. Semi-quantitative porosity maps superimposed on mineral maps

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## Abstract

Visualizing and quantifying the spatial heterogeneity of rock textures (i.e., mineral and porosity distributions) is of great interest in petrology or for understanding petrophysical properties. Spatial heterogeneities are not accurately revealed by usual techniques based on microscopy or bulk physical measurements. Detailed mineral mapping is already available from processing of chemical element maps acquired using an electron probe microanalyzer (Part I). The present paper is devoted to developing a new, coupled method for obtaining porosity maps from the same initial data. According to the difference between measured and theoretical sums of oxide weight percentages, a mean porosity is semi-quantitatively estimated for each pixel of the map (i.e., not fully absolute or accurate). All pores, including nanometer-size ones, are taken into account, whereas a sample area of several square millimeters is analyzed (spatial resolution of a few micrometers). The textural heterogeneities are thus visualized from the complementary maps of solids and voids. By superimposing these two maps, both the mean porosity and a porosity histogram associated with each rock-forming mineral are obtained. Such porosity measurements integrate the pore amounts within mono-crystals larger than the X-ray emission volume or between nanometer-size crystals of a matrix. When porosity changes are associated with a given mineral (various crystal arrangements, dissolution, etc.), pluri-modal distributions appear on porosity histograms. Thresholding each histogram mode then allows these processes to be localized. We used the MX80 bentonite to test this methodology, which represents a useful tool to study the local deformations and alteration of each rock-forming mineral, as well as to model transport properties.

**Keywords:** Chemical map, porosity map, software, texture, microstructure, electron microprobe, microanalysis, clay