XMapTools: a MATLAB©-based program for petrology (treatment of X-ray images, chemical and thermobarometric studies)

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Metamorphic rocks are made up of a mosaic of local thermodynamic equilibria, but frequently involving mineral phases that grew at different equilibrium conditions of Pressure (P), Temperature (T), pH and fO_2. The identification of relationships between microstructures and metamorphic conditions requires continuous P-T estimates in at least two dimensions (P-T maps). These maps can be derived from standardized X-ray images and superimposed to the observed deformation structures and assemblages.

To this end, we present XMapTools (freely available online at http://www.xmaptools.com), a MATLAB©-based graphical user interface program for processing electron microprobe X-ray images. XMapTools provides a convenient and efficient method to standardize X-ray images (raw intensities) into maps of oxide weight percent compositions using Castaing's approach, employing internal standards. The different minerals phases and other parts of the maps such as fractures or mineral boundaries are automatically separated using a K-means clustering approach. A set of ~50 additional functions is provided in the XMapTools package (1) to calculate structural formulas for common minerals from the standardized analyses, and (2) to estimate the P-T conditions of growth or equilibration, with the geothermobarometry functions using multi-equilibrium thermobarometry and empirical thermobarometers from the literature. The program XMapTools can easily be coupled with forward (i.e. pseudosection) and inverse (i.e. multi-equilibrium) modelling calculations to estimate the P-T conditions of crystallization at the microscale using a semi-empirical approach. In addition, two graphical user interface modules Chem2D and TriPlot3D can be used to plot the mineral compositions into binary and ternary diagrams.

This presentation introduces XMapTools and includes typical examples of its functionality.