Analysis of feldspar using Laser Induced Breakdown Spectroscopy

Florentine C. Zwillich[1], Kim Berlo[1], Nancy J. McMillan [2], Elske de Zeeuw-van Dalfsen [3]

[1] Department of Earth and Planetary Sciences, McGill University, Montreal, Canada
[2] Department of Geological Sciences, New Mexico State University, Las Cruces, USA
[3] R&D Department of Seismology and Acoustics, Royal Netherlands Meteorological Institute, De Bilt, The Netherlands

Zoned feldspar crystals are ubiquitous minerals in volcanic and plutonic rocks. They are useful indicator minerals because their chemical signatures reflect magmatic processes and ambient conditions during crystal growth. One rock sample can contain several crystal populations, with each population recording a different state in a magmatic system. To understand the evolution of a magmatic system over time, numerous rocks must be collected and crystals analyzed. Such intensive investigations routinely use analytical methods that are time-consuming (e.g. electron microprobe, LA-ICP-MS). Laser-Induced Breakdown Spectroscopy (LIBS) provides a full analysis of several hundreds of crystals in hours. This analytical technique produces a characteristic spectrum with every laser shot. We present the first approach to quantifying feldspar composition by setting up a model based on homogeneous feldspar crystals. The crystals are sampled by a 213 nm laser and analyzed by LIBS using a broadband 6-channel CCD detector. The model is formulated by correlating the LIBS spectra with electron microprobe analyses using Partial Least Square Regression (PLSR). This model can be applied to unknown zoned plagioclase crystals to quantify chemical compositions and investigate the evolution of a magmatic system over time.