CL-SEM SPECTRAL CHARACTERISTICS OF QUARTZ AND FELDSPARS IN FRESH AND HYDROTHERMAL ALTERED VOLCANIC ROCKS (CABO DE GATA, ALMERIA, SPAIN). A. Aparicio[1] and M. A. Bustillo[2]
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Introduction: The volcanic rocks of the Cabo de Gata are lava flows and domes formed underwater or by air emissions, being sometimes piroclastics hydromagmatic deposits. In some areas, the volcanic rocks are transformed by hydrothermal alteration forming highly silicified and feldspatized rocks, or clay- rich rocks of economic interest. In this study, different samples from outcrops of fresh and altered volcanic rocks have been studied by optical microscopy and scanning electron microscope cathodoluminescence (CL-SEM), with the aim of knowing how the spectral characteristics of quartz and feldspar are modified by the hydrothermal alteration, and characterizing the spectral features of the neoformed minerals.

Metodology: Conventional transmitted-light microscopy data together with a study in scanning electron microscope cathodoluminescence (CL-SEM) was carried out on quartz and feldspar of both fresh and hydrothermal altered volcanic rocks. In the alterated rocks, inherited and neoformed minerals were defined by optical microscopy and were separately studied.

Scanning electron observations were made using a FEI QUANTA 200 microscope (SEM) equipped with an Analytical-Inca (Oxford Instruments) analysis system incorporating an energy dispersive [EDS] X-ray detector. The SEM-CL images and spectra were obtained with a MONOCL3 Gatan instrument to record CL spectra and panchromatic and monochromatic plots. The excitation for CL measurements was provided at 25-kV electron beam. The capability of combining CL with back-scattered electron (BSE) or secondary electron (SE) mode, or energy dispersive spectroscopy (EDS) microanalysis allows us to correlate important features as spectral patterns, growth textures, structural defects, incorporation of trace element…i.e.

Results:

Quartz. The quartz magmatic crystals, from volcanic rocks without alteration, show CL-spectrum with four emission bands at around 400, 430-440, and 480nm. Sometimes, in the hydrothermal altered volcanic rocks, the inherited quartz crystals are differentiated of primary magmatic quartz because they show numerous cracks and small fractures. The inherited quartz crystals show the same bands as the primary magmatic crystals (at 400, 430- 440 and 480 nm), and others at 640 and 775 nm, that are absent or are less intense in the magmatic quartz of the fresh volcanic rock. The inherited quartz crystals from Rodalquilar outcrop have emission bands at 390, 430-440, 475, 630 and 780 nm., showing slight differences and lower intensity, in relation to inherited quartz crystals of other outcrops. In this case, both magmatic and inherited quartz contain small amounts of Al, K and Na, under EDS.

Neoformed quartz shows two types of spectrum: 1) a emission band at 560-580 nm and others with less intensity at 400 and 460nm. Under EDS, these crystals also contain small amounts of Al and K, and 2) emission bands around 589, 400 and 460 , with a new band at 310nm. In this case the amount of trace elements is higher (Al, K, Ti, Na) than the other types of quartz.

Feldspars. Magmatic plagioclase shows quite uniform CL spectra with intense bands at 570, 340-350 nm., and others of lower intensity at 430, 480, 675-710 nm. In the altered volcanic rocks, the inherited plagioclase spectra are similar. The composition of the plagioclase from the fresh volcanic rock (bitownite, labrador) and from the altered volcanic rock (oligoclase, andesine) have no influence in the CL-spectrum, only the intensity of the bands is changing .

Neoformed anorthoclase is scarce founded in some samples of altered volcanic rocks, and their spectra have the same characteristics as those of the magmatic plagioclase with maxima peaks at 570 and 345 -360 nm.

Sanidine show differences in the CL spectra between magmatic and neoformed. The spectra of magmatic sanidine has intense bands at 425, 440 and 490 nm, while the low temperature sanidine has the intense bands at 310 and 570, and others smaller at 370 and 440-460 nm.

Conclusions: The studies by CL-SEM of the minerals that constitute fresh and hydrothermal altered calc-alkaline volcanic rocks show that the CL spectra denote the provenance and origin of the minerals. A magmatic, inherited or neoformed origin could be interpretable through their respective CL spectra.
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