Origin of quartz-eyes from porphyry-type deposits

O.V. VASYUKOVA[1]*, K. GÖMANN[2], C.M. MACRAE[3] AND V.S. KAMENETSKY[1]

[1]CODES, University of Tasmania, Hobart 7001, Australia (*correspondence: olgav@utas.edu.au)
[2]CSL, University of Tasmania, Hobart 7001, Australia (karsten.goemann@utas.edu.au)
[3]Microbeam Laboratory, CSIRO Process Science and Engineering, Clayton, Victoria 3168, Australia (colin.macrae@csiro.au)

Formation of quartz eyes is a ubiquitous phenomenon of porphyry-style mineralization attributed to prolonged crystallization during magma convection, ascent and emplacement. To investigate the quartz eyes we have used spectral cathodoluminescence (CL) to examined two porphyry deposits (Climax, USA and Rio Blanco, Chile) which revealed significant inconsistency with crystallization of quartz as phenocrysts. Hyperspectral mapping showed three principal contributions to CL emission: 1.93, 2.05 and 2.72 eV peaks. The 1.9 eV emission is related to non-bridging oxygen hole centre defects with O–Si or O–M (M is an alkali ion) bonds as precursors. Infrared spectroscopy showed negative correlation between ~1.9 eV intensities and OH content, thus an OH bond is unlikely to be a precursor. The 2.05 eV emission is probably related to oxygen vacancies. The 2.72 eV peak is attributed to the alkali compensated paramagnetic [TiO_4/M+] centre with M being possibly Li+.

Quartz cores are usually of low 2.72 eV band intensity (low Ti content) but often have sector zoning determined by variations in Ti content. Sector zoning has never been observed in magmatic phenocrysts but it is a common feature in hydrothermal quartz, where it is usually caused by different Al uptake along different faces induced by their different surface structure. Moreover, both cores and rims have oscillatory zoning determined by 2.72 eV band intensity. It is likely, this is caused by a self-organized diffusion-controlled mechanism, which can operate only within still magma. Finally, quartz crystal clusters are ubiquitous within the samples, and attached grains have identical CL patterns indicating that they were attached during their growth, rather than attaching after crystallization in different environments.

The spectral CL data therefore indicates that quartz eyes have features of both magmatic and hydrothermal origin and are likely to crystallize *in situ* after emplacement rather than in a magma chamber or during magma ascent and convection.

Evidence of internal mixing of African dust and biomass burning particles by individual particle analysis using electron beam techniques

D.J. VAUGHAN[1], V.L. HAND[1], G. CAPES[2], P. FORMENTI[3], J.M. HAYWOOD[4] AND H. COE[2]

[1]Williamson Research Centre for Molecular Environmental Science, and School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester M13 9PL, UK (david.vaughan@manchester.ac.uk)
[2]Centre for Atmospheric Sciences, School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester M13 9PL, UK
[3]LISA, Universités Paris 12 et Paris 7, CNRS, Créteil, France
[4]UK Met Office, Exeter, UK

The interaction between aerosols derived from biomass burning and (largely mineral) dust aerosols is the focus of interest of our investigation. Using an environmental scanning electron microscope equipped with both an energy dispersive analysis and an image analysis system, we have examined the morphology and chemical composition of dust and biomass burning aerosol particles sampled on airborne filters. Employing these techniques, we were able to study both mineral dust and biomass burning particles in samples containing significant amounts of both biomass burning and dust aerosol, compared to samples dominated by biomass burning aerosol and a sample dominated by dust aerosol. Thirteen particle types were identified in the samples. Aluminosilicates were the dominant particle type in the sample dominated by dust aerosol. Many more particles were found to be rich in S, Na and K in the sample dominated by biomass burning aerosols, and particles in these samples were also found to be completely devoid of Cl due to aging of the aerosol and chemical conversion during atmospheric transport.

We suggest that biomass burning particles containing all three characteristic elements are internal mixtures. Particle imaging showed that up to a third of soot particles were internally mixed with mineral dust particles in samples containing significant numbers of both biomass burning and mineral dust particles. This internal mixing would significantly change the optical properties of the particle ensemble and, hence, the direct radiative forcing caused by biomass burning.