

Origin of “quartz eyes” and fluid inclusions in mineralized porphyries

O.V. VASYUKOVA¹, V.S. KAMENETSKY¹ AND
K. GÖMANN²

¹CODES, University of Tasmania, Hobart 7001, Australia
(olgav@utas.edu.au)

²CSL, University of Tasmania, Hobart 7001, Australia
(karsten.goemann@utas.edu.au)

Formation of porphyry-style ore deposits starts with the metal extraction from magmas at so-called magmatic-hydrothermal transition (MHT). The processes and compositions at MHT are difficult to study as the record of them is poorly preserved. As the MHT is characterized by massive crystallization of quartz, including quartz “eyes” and veins, their study can elucidate questions related to metal transport and deposition. Quartz grains from the porphyry deposits all over the world (Antapaccay, Peru; Batu Hijao, Indonesia; Climax, USA; Panguna, PNG; Far Southeast porphyry, Philippines; Rio Blanco, Chile; Omsukchan, Russia) were studied by optical, SEM-CL and BSE microscopy, electron microprobe and LA ICPMS.

Quartz grains, even within each sample, have different shapes (rounded, egg-shaped, amoeboid or euhedral) and cathodoluminescence (CL) patterns (shape, number and width of bands in CL images). The outer layers of quartz are markedly different, which is unexpected if the grains had formed in the same conditions. The zones that are dark and bright in CL have different area proportions in grains occurring next to each other. The CL pattern is sometimes extremely irregular. CL layers in many cases mimic grain boundaries. According to microprobe and LA ICPMS data the CL intensity depends on the concentration of the impurities Al, Ti, Fe and Li. Different CL layers are different in structure - the brighter bands are more crystallographic and brighter grains are more euhedral. Inflections and blurring of CL bands are often structurally associated with fractures.

The data show that the quartz “eyes” could not crystallize from a silicate melt as normal phenocrysts. It is very likely that *in situ* segregation of residual SiO₂- and H₂O-rich liquid and its solidification followed by coagulation (e.g. formation of silica-gel globules) took place in the magma (crystal mush) during MHT. Such globules could remain in a plastic state for a long time even at rather low temperatures. The solidification of globules occurred after bands of different composition had formed and led to fracturing of solidified and inflection of unconsolidated layers. All fluids (liquid and vapour) released from the original silica-gel during solidification were trapped as inclusions (aqueous, salt-rich and sulphide).

Geochemical and microbial controls of the decomposition and dispersion of depleted Uranium in the environment: Experimental studies

D.J. VAUGHAN^{1,2*}, R. ALVAREZ^{1,2,3}, N. BRYAN^{1,3},
M. FOMINA⁴, G.M. GADD⁴, S. HANDLEY-SIDHU⁵,
M.J. KEITH-ROACH⁵, F.R. LIVENS^{1,2,3} AND J.R. LLOYD^{1,2}

¹Williamson Research Centre for Molecular Environmental Science, University of Manchester, Manchester M13 9PL, UK (*correspondence: david.vaughan@manchester.ac.uk)

²School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester M13 9PL, UK

³Centre for Radiochemistry Research, School of Chemistry, University of Manchester, Manchester M13 9PL, UK

⁴College of Life Sciences, University of Dundee, Dundee DD1 5EH, UK

⁵School of Earth, Ocean and Environmental Sciences, University of Plymouth, Plymouth PL4 8AA, UK

Depleted uranium (DU) is now commonly utilised in armour piercing munitions. The majority of DU entering the environment does so as large pieces of DU alloy. After impact, DU deposits on the ground and other surfaces, generally in the form of partly oxidised fragments. Penetrators which hit soft targets such as sand or soil can penetrate to depths of >50cm and stay intact for long periods. Largely intact penetrators may end up in the sea or in bodies of freshwater. The environmental fate of DU fragments is still not well known, and there are obvious concerns regarding potential contamination of soils or groundwaters.

Currently we are involved in a multidisciplinary study of laboratory model systems aimed at providing a predictive understanding of the processes involved in DU decomposition and dispersion. The role of bacteria and fungi in DU decomposition (and, in turn, the impact of DU on bacterial and fungal communities) in addition to (geo)chemical factors are being studied. Model systems representative of a considerable range of natural environments (loamy, sandy or cementitious soils, estuarine sediments of differing salinities) and specific conditions (aerobic, anaerobic, abiotic or with fungi or bacteria present) have been studied and shown to exhibit important differences in breakdown behaviour and hence uranium mobility. For example, under conditions representative of a loamy soil, anaerobes may inhibit DU corrosion whereas pitting corrosion occurs under biotic aerobic conditions. DU appears initially to corrode to U⁴⁺ oxide and subsequently form secondary U compounds via dissolution and reprecipitation.