

SEG 2024 Conference: Sustainable Mineral Exploration and Development

Unidirectional Solidification Textures and Magmatic Silica Caps; What Do They Tell Us?

Douglas J. Kirwin¹, Axel Müller²

1. Consultant, Makati, Philippines, 2. Natural History Museum, University of Oslo, Oslo, Norway

Unidirectional Solidification Textures (USTs) are primary magmatic textures which comprise parallel to sub-parallel bands of crystals, commonly quartz with oriented c-axis terminations. The UST zones are products of rhythmic precipitation of quartz and quartz plus feldspar (or other rock-forming minerals) during periods of fluctuating overpressuring of volatiles and fluids within relatively small cupolas. They occur in a wide variety of intrusion-related mineral deposits and display several textural types. The exsolution of a magmatic vapor phase accompanying or following UST formation may serve as an important marker for magmatic-hydrothermal transition processes and the beginning of peak ore precipitation. Magmatic silica caps comprising massive milky to cloudy mottled quartz have been observed in a number of cupolas associated with mineralized felsic intrusions. Furthermore, those silica-enriched zones may transition to an underlying comb quartz UST horizon reflecting magma quench processes due to undercooling and oscillatory crystallization of excess silica during the magmatic to hydrothermal transition. Silica caps normally occur at the cupola contact with the host wall rocks and may vary considerably in terms of lateral extent and thickness from several meters to hundreds of meters. In many cases, they are well mineralized, particularly in highly evolved porphyry stocks hosting copper-gold-molybdenum mineralization, subject to the timing and conditions of the magmatic to hydrothermal transition. There are also many barren examples of USTs and magmatic silica caps which, at a district scale, represent pre-mineral magmatic accumulations, and as such, are vectors for proximal fertile mineralized intrusion-related ore deposits.