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The sphene-centred ocellar texture: a powerful tool for understanding mingling processes.

Néstor Vegas (1), Javier Rodríguez (2), José Julián Esteban (1), Martin Feely (3), José María Tubía (1), and Julia Cuevas (1)

(1) Dpto. de Geodinámica, Universidad del País Vasco, Bilbao, Spain (nestor.vegas@ehu.es), (2) Dpto. Mineralogía y Petrología, Universidad del País Vasco, Bilbao, Spain (javier.rodrigueza@ehu.es), (3) Earth and Ocean Sciences, National University of Ireland, Galway, Ireland (martin.feely@nuigalway.ie)

The sphene-centred ocellar texture consists of leucocratic ocelli with sphene crystals at their centre, enclosed in a biotite-rich matrix. This texture, described in hybrid intermediate rocks, has been proposed as an indicator of magma mixing (Hibbard, 1991). A thorough study of this texture provides detailed information about the geochronology and rheological conditions prevailing at the end of crystallization of hybridised magmas.

Regarding the microstructural and rheological conditions, this texture reflects late stages of magma crystallization, when melt is below 20% and behaves as hyperdense suspensions (Vegas et al., 2011). Under these conditions, the magma subjected to deformation acts as a granular material entering the domain of grain-supported flow. Readjustments of the crystal framework give way to the onset of the Reynolds dilatancy, which promote the opening of transient voids. Residual melts percolate through the plagioclase- and biotite-rich crystalline framework and are finally concentrated in these transient voids where they crystallise as leucocratic ocelli. Preliminary estimations using the Zr-in-sphene thermometer yield a precise temperature range of 750-780 ºC for the crystallization of sphene in the residual melt (Rodriguez et al., 2009).
From the geochronological perspective, sphene in leucocratic ocelli offers an exceptional opportunity to date hybridised magmatic suites in which zircon is commonly affected by inheritance. Moreover, its crystal size and the mineral associations allow fast extraction for the analysis of single sphene grains/fragments (Vegas et al., 2011).

We have analysed the sphene-centred ocellar texture in two localities: the Variscan Ribadelago pluton in NW Spain and the Caledonian Galway batholith in W Ireland. In both locations, the appearance of this texture is linked with mingling processes induced by shearing, and affected by the viscosity contrast between the sphene-centred ocelli-bearing magma and the adjacent melts. In the Ribadelago pluton, the ocellar texture is found in tonalitic intrusions that form net-veining bands disrupting dioritic layers. This mode of occurrence represents initial stages of the texture formation in settings characterized by high proportions of mafic and intermediate magmas.
In contrast, a more evolved stage is observed in the Galway batholith, in which the ocellar texture is included in tonalitic enclaves surrounded by granodioritic magmas (Feely et al., 2006). Enclaves show a gradation from well-preserved bodies with chilled margins to enclaves displaying peeled-off rims and partially to totally disaggregated cores. In this latter case, the ocellar texture disappears due to mechanical hybridisation with the host. This process of enclave disaggregation is a consequence of prolonged shearing and is facilitated by low viscosity contrast between the enclaves and the granodioritic host.

All the recorded data reflects a protracted evolution of the sphene-centred ocellar texture, from its origin by dilatancy in highly crystallised magma mushes (Ribadelago pluton) to its subsequent vanishing by mechanical disintegration (Galway batholith). To summarise, this texture is an excellent marker of the evolutionary stage of mingling processes during the crystallization of magmatic systems.

Feely et al., 2006. Geol. Surv. Ireland, guide series, p 62.
Hibbard, 1991, in Didier & Barbarin, eds. Enclaves and Granite Petrology, 431-444.
Rodríguez et al., 2009. Geogaceta, 47, 121-124.
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