Occurrence and origin of ring schlieren in the Halifax Pluton, South Mountain Batholith, Nova Scotia, Canada

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The Late Devonian Halifax Pluton (HP), which crops out along a coastal section of Halifax County, contains a biotite monzogranite unit (Peggys Cove lithological unit) that is host to a variety of schlieren structures, including more than 150 centimetre- to decametre-scale ring schlieren. Ring schlieren are alternating melanocratic and leucocratic bands in granitoid rocks, which form open to closed, nested, circular to elliptical, concentric to eccentric, prolate to oblate structures with cross-cutting relationships indicating a younging direction toward the centre. The purpose of this investigation is to develop a field-based model for the formation of ring schlieren in the HP.

Geographically, ring schlieren occur in clusters, with significant groups of structures occurring near Aspotogan Point (n = 7), near Peggys Cove (n = 61), near West Dover (n = 14), near Pennant Point (n = 41), and near Prospect (n = 8). Geometrically, the number of rings in a single structure and their shapes define three ring schlieren groups: 16 structures have one ring, 79 structures have two or more rings, and 58 structures have complex shapes including ladder dykes, snail-shaped rings, ladle-shaped rings, and convoluted rings. The local disruption of regional flow foliation in the host granitoid by the rings suggests that the rings are late magmatic structures, created when the degree of crystallinity of the magma was 55–75%, a condition permitting both deformation of the mush and retention of the deformed state. Rare three-dimensional exposures of ring schlieren reveal that these structures are vertical cylinders. As such, ring schlieren structures appear to represent vertical fossil pathways of solids descending from the roof of the pluton, or of the ascent of bubbles created by the late-stage degassing of magma at greater depth. Shear flow at the margin of descending xenoliths or ascending bubble (fluid) trains can produce flowage differentiation between silicate melt and solids of various sizes by the Bagnold effect, which can explain the particle sorting textures in ring schlieren structures. A miarolitic cavity in one multi-ring structure suggests a rising bubble train may have produced the rings. Natural (bubbling mudpits, volcano vapour rings) and synthetic (concrete, petroleum gel) analogue systems provide qualitative support for this model.

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