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Tracking the Magmatic Flow in a Dyke-Sill Hybrid System using a Multi-Method Approach (AMS, SPO, X-ray micro-CT) for Petrofabrics Characterization (Lessines, Belgium)

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Understanding how magmas are transported and collected within the crust is crucial for constraining the dynamic of shallow plumbing volcanic systems and associated hydrothermal activity. This study focuses on the Lessines dioritic intrusion exposed in the SW margin of the Brabant Massif in Belgium. The kilometric subvolcanic body was emplaced around 419 Ma and is thought to result from the emplacement of multiple sills which intruded a lithostratigraphic discontinuity within Upper Ordovician sedimentary units. Our study aims to constrain how magmatic flow is recorded through different fabrics, how this flow varies across the solidified magmatic intrusion and how primary fabrics can be affected by subsequent hydrothermal overprint.

The petrofabric of 40 oriented diorite samples was investigated with a multi-methods approach: (i) Anisotropy of Magnetic Susceptibility (AMS) along with K-temperature curves determined using low field KLY-4S Kappabridge susceptibilimeter (at LIENS lab, University of La Rochelle, France), (ii) Shape Preferred Orientations (SPO) of melanocratic phenocrysts (pseudomorphosed amphibole and biotite) as well as leucocratic phenocrysts (quartz and sericitized felspars s.l.) determined by the Intercepts method applied on optical scans of three adjacent cut faces of each sample, (iii) X-ray micro-CT scanning of five selected samples using the HECTOR device at UGCT lab (Ghent University, Belgium).

AMS and melanocratic fabrics SPO are mainly marked by prolate shaped ellipsoids. Both subsets show similar and homogeneous orientation of their structures through the studied area, with E-W

striking foliations dipping 70° to the North to subvertical. Leucocratic petrofabric SPO shows more heterogeneous distribution with a similar E-W to N120-striking foliations but generally subhorizontal to low dipping structures (< 30°). This discrepancy is thought to be due to differential record of the subvolcanic phenocrysts during the ultimate emplacement and solidification of the Lessines magmatic body. These results combined to field observations (e.g., enclave orientations, columnar joints, borehole logs) suggest that the Lessines intrusion is a complex dyke-sill hybrid system, made of a main subvertical dyke-like structure that fed lateral sills bodies.