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Anisotropy of magnetic susceptibility (AMS) in the Siilinjärvi carbonatite complex, eastern Finland

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We present a set of AMS measurements on samples from the Siilinjärvi alkaline-carbonatite complex in eastern Finland. The complex has a tabular shape (ca. 16 km long, 1.5 km wide) that strikes north-south and is constrained within a steeply dipping N-S oriented deformation zone. It consists of a mixture of lithologies, including carbonatite, fenite and glimmerite (mica-rich rocks), which is hosted within a Precambrian granite and gneiss. After emplacement of the carbonatite, the complex was subsequently intruded by diabase dykes. Deformation has occurred in several episodes after dyke intrusions, and strain is heterogeneously distributed among the different lithologies. Strain localizes mainly within glimmerite and carbonatite, and at the contacts between dykes and glimmerite/carbonatite where shear zones develop locally. Structures provide indications for both simple (strike-slip) and pure shear components in the deformation history of the complex, although the former may dominate.

Thirty-six localities were sampled, providing 272 specimens for AMS measurements, within the southern and eastern parts of the Siilinjärvi open-pit mine (within the complex), mainly from diabase dykes, glimmerite and carbonatites; a smaller number of samples were collected from fenite. Sampling was carried out in order to investigate magnetic fabrics in relation to the emplacement of the dykes and their structural relationship to the glimmerite/carbonatite. Structural measurements were made to accompany the magnetic fabric study. The magnetic fabric shows a magnetic foliation plane that is oriented north-south, with sub-horizontal k3-axes oriented nearly east-west. Magnetic lineation (k1) clusters sub-vertically, but does show a tendency to spread along the north-south magnetic foliation great circle. The dataset can be further divided into two sub-sets based on the bulk susceptibility (km) and degree of anisotropy (P). The bulk of the data set (∼70 %), belonging to samples of diabase, is characterized by bulk susceptibility ranging from 1.26e-4 to 1.29e-3 [SI], and P <1.15 (i.e. <15 %). Glimmerites (and carbonatites) show considerably higher bulk susceptibility (4.27e-4 to 2.09e-1 [SI]) and P (up to 1.61), indicative of 1) a much higher magnetite content and 2) larger strain. The glimmerite/carbonatite shows a well-defined N-S magnetic lineation, with k1 and k2 dispersed along the foliation great circle. The diabase AMS shows greater scattering when considering the complete data set, which is likely tied to the individual orientations of dykes in the complex. Ongoing analysis focuses on the details of structural and AMS relationships, between dykes and glimmerite/carbonatite, in order to unravel their emplacement and subsequent deformation. This study was carried out within the ERA-MIN 1 StartGeoDelineation project sponsored by Vinnova (project number 2014-06238), SGU, Tekes, Nordic Iron Ore, and Yara.