Propagation of Dike and Sill Swarms in Basaltic Magmatic Sytems: The Cuillin Hills Volcano, Isle of Skye, Scotland

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The nature of magma transport in the crust is a first order problem in volcanology. It controls the growth of volcanoes and plays an important role in the modification of silicate melts by fractionation, assimilation and mixing. Establishing a technique to determine intrusive directions or more importantly, magma transport directions in dikes and/or sills is one of the most important steps forward in our understanding of magmatic plumbing systems. Understanding the emplacement behavior of dike swarms of Skye would be an important step forward in this direction. The bowels of a Tertiary (60 Ma old) volcano are superbly exposed on the Isle of Skye in the Scottish Highlands. Here all components of a volcano are exposed: lavas, feeder dikes and intrusive core. The deeply eroded gabbroic core of the Cuillin Hills Volcano, is cut by regional dike swarms and an intense localized cone-sheet swarm (the type example). Anisotropy of magnetic susceptibility (AMS) measured on profiles across selected dikes and sheets show that: (1) Kmin axes plot in a tight cluster near the normal to the intrusion plane(B), (2) Kmax axes plot in two areas (C,I) on either side of B corresponding with samples collected from opposite sides of the intrusion, interpreted to comprise and imbricate fabric; (3) the means for C and D are separated by 20 to 60° (twice the imbrication angle). The Kmax mean is interpreted to mark the magma-flow direction, and the imbrication yields the flow azimuth. Most measured intrusions yield an azimuth directed outward (from the volcanic center) and upward at 20 to 40°. Nosystematic difference is detected between dikes and cone-sheets, and sheets in general do not have up-dip direction. For some intrusions the flow azimuth for the central part (E) is significantly different from that from the outer part (C,D).