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Orthogonal AMS and SPO fabrics in the MORB-like Rooi-Rand dyke swarm (South Africa)

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The use of anisotropy of magnetic susceptibility (AMS) and grain shape preferred orientation (SPO) to find magma flow direction was applied to 23 dykes of the Rooi-Rand dyke swarm (RRDS) in South Africa and Swaziland. This N-S trending sheeted dyke swarm, of MORB-like composition, intruded Karoo sedimentary rocks and overlying Letaba River Formation basalts along the eastern margin of the N-S trending Lebombo faulted monocline at ∼174 Ma. The AMS of the measured samples is provided by fine grained, Ti-poor magnetites, which in 20 dykes defines fabric sub-parallel to the dyke plane. The magnetite, most likely an exsolution product, defines a weakly anisotropic ($1.004 < P' < 1.091$) and dominantly oblate fabric (60%>T= 0). From a total of 10 dykes studied for plagioclase SPO, 8 have a dyke parallel foliation. The lineation (L1) is almost always steeper than K1 found in the AMS study. The plagioclase grains measured (n=2.1×10^5) range in size from 0.015mm to 1.25mm and define a weakly anisotropic, oblate fabric (P'= 1.121, T = -0.187). This fabric is indicative of being magmatic in origin and in 8 dykes is also coaxial with the AMS fabric. However, in 50% of the dykes, the fabric defined by the SPO of opaque grains (n= 0.52×10^5) is non-coaxial with AMS and is at a high angle to the dyke (>50°) and is steeply dipping. The opaque grains measured during SPO analysis (0.0025mm to 0.154mm) are similarly anisotropic (P'= 1.178) to plagioclase (P'= 1.121) and is also oblate (T= -0.269). The detection of orthogonal and dyke parallel SPO fabrics, and only one type of AMS fabric supports the notion that AMS detects very fine grains which are not detectable microscopically. Furthermore, the non-coaxial AMS and SPO fabric, coupled with the orthogonal plagioclase and opaque SPO fabrics suggests that late stage lateral flow of relatively high viscosity magma has occurred, and results in a fabric which most workers would regard as “inverse” and/or non-magmatic.