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Dyke emplacement at the incipient Namibian margin – Structural and anisotropy of magnetic susceptibility (AMS) studies in a dyke swarm

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Mafic dyke swarms are major components of the South Atlantic Large Igneous Province, which originated during the Cretaceous break up of Africa-South America. This contribution presents data on magnetic fabrics and its implications for magma flow from the major Henties Bay-Outjo dyke swarm (HOD) in coastal and inland NW Namibia at the African margin. The dykes were emplaced in the crust at the NE-SW trending, Neoproterozoic Damara mobile belt. The dominant NE-SW strike of the HOD indicates the influence of the Damara Belt structural grain at a regional scale, but locally the dykes crosscut basement foliations and lithologic contacts. Coast-parallel dyke trends are also common. Depending on dyke thickness (c. 0.1 m to >100 m), the rocks are variably fine- to medium grained with chilled margins. Main mineral phases are plagioclase, clinopyroxene, olivine, Fe-Ti oxides, and accessory apatite and sulphides. Detailed magnetic studies of 33 dykes in the area between Henties Bay at the coast and ca. 300 km inland are completed. Six to thirty standard cylinders were prepared at each sampled site. The samples were then studied microscopically (microstructure, opaque mineralogy) and magnetic properties were determined (bulk susceptibility, anisotropy of magnetic susceptibility, hysteresis, NRM). 21 dykes from adjacent areas have been sampled recently and are now being analysed.
Magnetic susceptibilities vary between 0.16 and 140 *10-3 SI units. Microscopic studies and kappa-T measurements identify magnetite and titanomagnetite as the dominant magnetic minerals. Anistropy is mostly low, with values between 1.01 and 1.15. Rare values of up to 1.33 point to a strong flow. The shape of the AMS ellipsoid ranges from prolate to neutral and oblate. Two main fabric types (normal and inverse) can be recognized, which are comparable to those reported earlier from mafic dykes of the Ponta Grossa dyke swarm in Brasil. At least the normal fabric type provides information on flow fabrics. Hysteresis measurements show that the domain states of the titanomagnetites are pseudo-single or a mixture of single and multi-domain. We attribute steep long axes of normal fabrics to vertical magma flow and shallow long axes to horizontal flow along the dyke planes. In places, oblate fabrics with flat-lying magnetic foliation are observed. This flat foliation is attributed to an obstruction of vertical flow due to subvertical stresses at the upper end of dykes. So far, both flat and steep magma flow directions have been observed in every area and there appears to be no pattern in flow directions regionally. We conclude that the dyke emplacement was a complex and localized process with multiple sites of vertical magma flow and lateral spreading. The analysis of the recently sampled dykes will allow a broader view and better-founded conclusion about magma flow directions and emplacement mechanisms in the dyke swarm.