Anisotropy of magnetic susceptibility, rock magnetic, and paleomagnetic data from mafic dikes in the Espanola Basin, Rio Arriba County, New Mexico

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This study characterizes a suite of Miocene mafic dikes in the Española Basin, north-central NM using paleomagnetic, rock magnetic, and field observations. Paleomagnetic data provided constraints on potential components of vertical-axis rotation across structural blocks, between separate dikes, and along strike variations within individual dikes. Anisotropy of magnetic susceptibility (AMS) data and field observations provided information on magma flow patterns within each dike and discernment of any variation in magma flow patterns within the swarm. We tested the following hypotheses: 1) the mafic dikes experienced some degree of vertical axis rotation associated with Rio Grande rifting and 2) the magma flow pattern within the dikes reflects lateral emplacement with flow directed away from the magma ascent location.

Rock magnetic data provided constraints on the magnetic mineralogy responsible for carrying the AMS and the remanence directions. Low-field susceptibility versus temperature experiments yielded a spectrum of results reflecting a thermomagnetic behavior typical of intermediate composition titanomagnetite while others exhibited a more complex behavior with the presence of two or more magnetic phases. Curie point estimates ranged from ~ 100°C to 575°C indicating a range of moderate to low Ti- titanomagnetite compositions as well as the presence of a Fe-sulfide phase. Additional rock magnetic experiments included the Lowrie-Fuller test to estimate the magnetic domain state, acquisition of isothermal remanent magnetization (IRM), and backfield IRM experiments to verify the magnetic mineralogy, domain state, and the coercivity of the remanence. These experiments, as well as other data, indicated that the remanence is likely a primary thermoremanent magnetization acquired during cooling and is thus geologically stable.

The AMS fabric data reveal a combination of both prolate and oblate susceptibility ellipsoids. At several sites, the fabrics are oblate from paired dike margins and reveal a unique magma flow direction. The maximum susceptibility axis (K1) and the imbrications of the magnetic foliation (K1-K2) planes indicate both upward and downward sense of flow, as well as flow towards and away from the likely source region. Susceptibility values are high and consistent with a ferromagnetic phase. Preliminary results indicate that the group mean is discordant in a counter-clockwise sense to the expected Miocene field direction. Additional paleomagnetic experiments are underway and should help further constrain the emplacement of the dikes and tectonic evolution of the study area.

Keywords:
mafic dikes, igneous rocks, paleomagnetism, magnetic studies, Espanola Basin, structural geology

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