MAGNETIZATION IN CRUSTAL AND UPPER MANTLE XENOLITHS

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By measuring the magnetic properties of the upper mantle and lower crustal xenoliths, we can gain insight into the magnetization of otherwise inaccessible regions. The identification of magnetic boundaries associated with magnetic mineral variations, in the crust, and the magnetic contrast between the crustal granulites and the upper mantle peridotites, are specific insights attainable via laboratory study of xenoliths. Routine measurements, which magnetically characterize the xenoliths, have been performed, and in addition measurements such as susceptibility vs temperature, and elevated temperature viscosity provide insight into magnetic behavior at increasing depth, recognizing the existence of the geothermal gradient. Xenoliths from different tectonic provinces (rift zones, continental intraplate regions, converging plate margins) have been evaluated.

Thermal demagnetization of the NRM in ilmenites from Monastery and Frank Smith, indicate blocking temperatures ranging from $\sim$200°C to $\sim$550°C. The ilmenite phase in the ilmenite-pyroxene intergrowths has an extremely fine exsolution pattern observable at high magnification. Peridotite xenoliths have weak levels of magnetization commensurate with complex chromite being the dominant oxide. Granulite grade xenoliths from South Africa, Australia, France, Japan and the USA have been studied in detail. Those from the Southern Rio Grande rift and Oki Dogo, Japan which presumably equilibrated in an anhydrous, high temperature regime where fO_2-T estimates indicate a relatively reducing environment, have Curie temperature <300°C. Granulites xenoliths from all other environments have 560-580°C Curie points indicative of magnetite. Thermal demagnetization of the natural remanence is utilized to evaluate whether the xenoliths have been altered at temperatures $\lesssim$550°C. No exotic mineralogies have been identified in any of the xenoliths studied. Chromite spinels and magnesian ilmenites dominate in peridotites from below the Moho and FeTi oxides dominate in crustal lithologies above the Moho. Certain granulite xenoliths from Bournac pipe and the Rio Grande rift exhibit magnetic self reversal properties, tentatively associated with the ilmenite mineralogy.

Studies of the xenoliths provide evidence: that the Moho may be a magnetic boundary, that mafic-ultramafic granulite grade rocks are the significant magnetic rocks in the crustal column, that the fO_2-T conditions at depth, in rift zones and converging plate margins where the geothermal gradient is steep and the environment anhydrous, is responsible for crystallizing oxide minerals with Curie points < 300°C.

Magnetic properties of xenoliths are used to infer the distribution of crustal magnetization.