

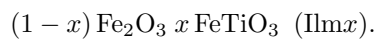


Clusters and holes: Exchange networks in hematite-ilmenite solid solutions

K. Fabian, S. A. McEnroe, and P. Robinson

NGU, Geological Survey of Norway, Trondheim, Norway (karl.fabian@ngu.no)

Holes and clusters of exchange networks dominate the low-temperature, metastable phase diagram of the system



By our measurements we have probed and extended the phase diagram of Ishikawa *et al.* (1985) in the light of magnetic influences of the random exchange links, which originate either by replacing random pairs of Fe^{2+} and Ti^{4+} ions in the ordered ilmenite lattice by two Fe^{3+} ions (ordered $\text{Ilm}x$ phase), or by randomly replacing two Fe^{3+} ions in the hematite lattice by a pair of Fe^{2+} and Ti^{4+} ions (disordered $\text{Ilm}x$ phase). Now a large dataset is available from these measurements, and we propose several new ideas to interpret the sometimes unexpected results. By refining a method of Ishikawa (1967), we analyze the PM' region of the phase diagram in terms of a mean field theory of interacting clusters. This allows to determine cluster sizes and interaction field distribution by inverting hysteresis measurements of $\text{Ilm}92$ and $\text{Ilm}97$. To understand the relation between ordered and disordered phases we design a mean field theory to determine Neel and Curie temperatures of both. An especially interesting finding is that the experimentally observed intersection of PM-PM' crossover with the AF phase boundary close to $\text{Ilm}97$ can be explained by analyzing average exchange interaction strengths.