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# High-resolution and energy-filtered TEM of the interface between hematite and ilmenite exsolution lamellae: Relevance to the origin of lamellar magnetism

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## ABSTRACT

The interfaces between fine-scale exsolution lamellae of hematite and ilmenite from an igneous rock in Rogaland, Norway have been studied by conventional transmission electron microscopy (TEM), high-resolution TEM, and energy-filtered TEM (EFTEM), to investigate the lamellar magnetism hypothesis for the origin of the unusual magnetic properties of this rock. Very fine hematite and ilmenite lamellae, less than 50 nm in length and parallel to (001) of their host, were abundant throughout the hemo-ilmenite sample. Dark-field and EFTEM observations indicated the hematite and ilmenite have very sharp structural and compositional interfaces with their hosts. The interfaces between the coarse hematite and ilmenite lamellae (length >1 μm) and their hosts have some interface dislocations to relieve elastic coherency strain. On the other hand, very fine lamellae (length <50 nm) have no interface dislocations and are perfectly coherent. The interface dislocations for lamellae on the order of 100 nm in length are distributed heterogeneously, and more than 80% of the length of the interfaces seen by TEM is dislocation free. Thus, most of the interfaces in the sample are coherent. These results are in accord with the predictions of Monte Carlo simulations of the exsolution process (Harrison and Becker 2001) and with the hypothesis that coherent and sharp structural and compositional interfaces are the origin of lamellar magnetism (Robinson et al. 2002).