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Magnetic and microscopic features of silicate-hosted Fe-oxide inclusions in an oceanic gabbro section

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The magnetic mineralogy of oceanic gabbros is typically dominated by magnetite, which occurs in several forms: as a cumulus or intercumulus phase, as a secondary phase formed through alteration, or as exsolved inclusions in plagioclase and pyroxene. This study characterizes the contribution of magnetic inclusions in plagioclase and pyroxene to the bulk rock remanence and examines changes in the distribution of remanence carriers with crustal depth. Selected samples were taken throughout a 1500-m-long section of drilled oceanic gabbro cores collected from the Oceanic Drilling Program Site 735B at Atlantis Bank on the Southwest Indian Ridge. Hysteresis parameters and curves of isothermal remanence acquisition were measured for plagioclase and clinopyroxene mineral separates and compared with whole rock measurements for samples from various depths to determine the relative contributions of each to the bulk sample remanence properties. In whole-rock samples, bulk saturation magnetization decreases and coercivity distributions become dominated by harder magnetic components with increasing depth. The changes in rock magnetic properties with depth are interpreted to result from variations in composition as well as cooling rates. Coercivity distributions in both plagioclase and pyroxene systematically shift to higher coercivities with increasing depth in the section, although the change is more pronounced in plagioclase, indicating that the size distributions of magnetic inclusions in plagioclase become progressively finer. First-order reversal curves for plagioclase separates provide a striking example of non-interacting single-domain particles. Variations in exsolution textures and compositions of the inclusions were also investigated by microanalysis and electron microscopy. Microscopic examination revealed unexpected complexity in the structure of exsolution features, with several oxide phases commonly present as inclusions in plagioclase and multiple generations of sub-exsolution present in pyroxene-hosted inclusions.