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Micromagnetics of mineral grains with irregular surfaces

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Micromagnetic calculations relevant to palaeomagnetism have generally focussed on ideal shapes such as spheres and octahedra. However, oxide grains that occur naturally in rocks often have irregular morphologies, sometimes very much so (e.g. the highly dendritic crystals commonly found in submarine basalts). To investigate such possibilities, we have initiated a series of calculations using a three-dimensional finite-element/boundary-element (3D-FEBE) micromagnetic model which is able to generate suitable morphologies unrestricted by the regular cell structure required by finite difference models. The irregular grains are constructed by adding bumps and hollows to an initially spherical grain. We find that the presence of irregularities on the grain surface generally lowers magnetic stability, probably because they act as nucleating centres for domain reversal. However, grains with only a few large irregularities show increased stability because the grain now possesses significant shape anisotropy.