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Revisiting hysteresis analysis and representation

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It is essential in many palaeo-, environmental and rock magnetic studies to characterise the magnetic domain states of the magnetic minerals within samples, for example, to assess variations in grain size or to examine the fidelity of magnetic remanence. One of the most common methods used to determine the magnetic domain state is magnetic hysteresis. This usually involves the rapid measurement of the major magnetic hysteresis loop (combined with a backfield curve), but can also entail more time-consuming measurements such as the collection of multiple partial hysteresis curves, e.g., first order reversal curves, which can be used to construct detailed Preisach diagrams. Although frequently measured, the standard method to quantify major hysteresis loop data is often ineffective; from the hysteresis measurement and the backfield curve, four parameters are often combined and plotted on the "Day" plot. When geological data is depicted on Day plots, they are often grouped within a single region termed the pseudo-single domain (PSD) region, making it difficult to identify domain state variation within suites of samples. We believe (and are likely supported by others) that in its attempt to quantify hysteresis, the Day plot over-reduces the information contained within a hysteresis loop.

Continuing to use only the major hysteresis loop and backfield curve measurements, we show that by combining the parameters used in the Day plot with further published parameters, hysteresis loop data can be easily depicted in such a way as to discriminate more effectively than the Day plot, making clearer distinctions between single domain, PSD, multidomain and superparamagnetic behaviour.