



Better undelete the pseudo-single domain concept

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Most quantitative theories in rock magnetism describe the behavior of isolated single-domain (SD) particles. Experimental observations of remanence carriers in rocks indicate that in natural samples the magnetic particles are typically either strongly interacting, or have more complex internal magnetization structures than single-domain particles. The astonishing observation, that predictions based on the too simple SD concept are still quantitatively useful, led Frank Stacey to coin the notion of pseudo-single domain (PSD) particles for remanence carriers that are not SD but behave very much like SD. A breakthrough in popularity for this notion came for the wrong reason—namely through the wide use of the Day plot for hysteresis parameters, that introduced a PSD field, which contains the overwhelming majority of all measured natural samples, and especially those which contain mixtures of SD and multidomain remanence carriers. Based on advances in micromagnetic modeling and experimental technique the whole concept of pseudo-single domain states has recently been questioned, and it was suggested to subsume it under the theoretically and experimentally better defined concept of the micromagnetic vortex state. Here it is argued that what seems to be a helpful clarification was also done for the wrong reason: By identifying PSD with vortex states one rather obfuscates the clear concept of a vortex state than clarifies the experimental variety of PSD phenomena. Several PSD properties, like LT memory effects, also occur in hard magnetic materials and thus cannot be explained in terms of vortex states which are the hallmark of soft magnetic materials only. On the other hand, experimental observations that are easily explained by the presence of vortex states, like closed flux loops in electron holography images, or off-diagonal distributions in FORC diagrams, can just as well occur for other reasons and do not uniquely prove the presence of micromagnetic vortex states in the remanence carriers. By simply equating the two concepts, the physical problems will not vanish but become even more confusing. In very soft magnetic materials, one will have vortex states that behave like multi-domain particles, but more seriously, one also will have to state observations as: “the vortex state in sample X is not carried by vortex states” instead of “the PSD state in sample X is not carried by vortex states”. This is a semantic mess. Better undelete the PSD concept!