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Unmixing magnetic remanence curves without a priori knowledge

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Many of the natural materials studied in rock and environmental magnetism contain a mixed assemblage of mineral grains with a variety of different origins. Mathematical decomposition of the bulk magnetic mineral assemblage into populations with different properties can therefore be a source of useful environmental information. Previous investigations have shown that such unmixing into component parts can provide insights concerning source materials, transport processes, diagenetic alteration, authigenic mineral growth and a number of other processes. A new approach will be presented that performs a linear unmixing of remanence data into coercivity-based end-members using only a minimal number of assumptions. The remanence data is unmixed using a parts-based representation obtained by a recently developed method of nonnegative matrix factorisation (NMF). Using NMF the shape of the end-members and their abundances are based solely on the variation in the measured data set and there is no requirement for mathematical functions or type curves to represent individual components. Therefore, in contrast to previous approaches that aimed to unmix curves into components corresponding to individual minerals and domain states, NMF produces a genetically more meaningful decomposition showing how a data set can be represented as a linear sum of invariant parts. It has been found that the NMF algorithm performs well for both absolute and normalized remanence curves, with the capacity to process thousands of measured data points rapidly.