Data-driven estimation of material transfer from bulk compositions

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Material transfer of elements is the most important consequences of geological processes. However, it is difficult to estimate it, even if both compositional datasets of before and after are available. This is because the compositional data are not absolute data but relative ratio data. Isocon analysis has been widely applied as a simple and powerful standard tool for quantitative estimation of material transfer to various geoscientific problems. Despite its powerfulness, the method needs to assume the reference frame such as immobile elements or conservation of mass or volume, which relies on the researchers' intuition and experience. We propose a novel data-driven method which determines an appropriate reference frame from compositional data of multiple altered samples. In the proposed method, we use a mathematical framework, called sparse modeling, which can extract essential variables from high-dimensional datasets based on sparsity of the system. By optimizing the evaluation function, the least mobile elements are automatically selected. In this study, the effectiveness is validated and discussed using synthetic and natural sample data. The method seems to be a practical tool for estimate material transfer and it has the potential to be improved for particular problems due to its simple and flexible formulation.

Keywords: isocon, sparse modeling

