Sparse modeling based feature selection of magmatic tectonic settings

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Understanding the magma generation processes and characteristic end-members in various tectonic settings is fundamental to understand the material circulation and compositional evolution of the solid Earth. Recent studies based on a machine learning approach revealed that volcanic rocks formed in different tectonic settings have unique geochemical signatures, indicating that both volcanic rock geochemistry and magma generation processes are closely connected to the tectonic setting. We present a result of a feature selection where sparse modeling approach is used. Sparse modeling is an approach in which automatically selects the smallest number of essential variables from high-dimensional data and constructs a succinct model. We used 24 elements and five isotopic ratios of igneous rocks formed in eight different tectonic settings for the feature selection of the settings. In addition to the major and trace element concentrations and isotopic ratios, we also considered combinations of elements, i.e., sum or ratio between two different elements, for the feature selection. This study uses sparse multinomial regression (SMR) approaches for feature selection. Multinomial regression is the classical linear discrimination method. Using the multinomial regression with the sparse modeling approach, a small number of essential geochemical information of tectonic settings are extracted. Based on the automatically selected features, we will discuss the geodynamical and geochemical process to derive various magmas and tectonics.

Keywords: Machine learning, Magma generation, Tectonic setting, Geochemical data

