

Heterogeneous distribution of water in wet mantle plume beneath Changbaishan, NE China: constraints from machine learning

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The genesis of the Cenozoic intraplate basalts in Changbaishan area is considered to be related to a low-velocity zone in the underlying mantle. Previous studies suggested that this low-velocity zone corresponds to a wet mantle plume which originated from mantle transition zone. However, the origin and distribution of water in the wet mantle plume still remain unclear. In this study, the new approach of machine learning is used to provide a perspective on this issue. The major and trace element compositions of island arc basalts (IABs) and ocean island basalts (OIBs) are collated from GEOROC as training data. Based on the support vector machine (SVM) model, a hyperplane in high-dimensional space for binary classification is established. The signed distance of each sample to the hyperplane (i.e. the greater the distance is, the more similar the sample is to each class), is taken as the output value of the model. Positive values represent a similarity to IABs, and vice versa. Then we apply the trained SVM model to basalts in Changbaishan area. The predicted values of samples are close to IABs, indicating that the water in the mantle source of basalts in Changbaishan area is probably from the subducted Pacific slab. More importantly, the predicted values of samples display a negative relationship with their distances to the center of Changbaishan. That is to say, the water content in the mantle source of basalts is decreasing from the center of Changbaishan area to the edge. This finding further confirms the existence of the wet mantle plume beneath Changbaishan and indicates the geographical characteristics of water distribution in the wet mantle plume.