Numerical Evaluation of geochemical discrimination of tsunami deposits by HCA(Hierarchical Clustering Analysis)

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Several methods have been proposed for discriminating historical tsunami deposits, including methods using particle size distribution and the presence of marine microfossils, but most of them are for sand deposits. It is necessary to identify mud tsunami deposits for identification of more accurate inundation area, but the method of discrimination for mud tsunami deposits has not been established yet. On the other hand, there is a study that mud tsunami deposits have less temporal change of marine ions than sand tsunami deposits. Therefore, geochemical methods may be an effective method for judging mud tsunami deposits. As a previous study, there is a method of discrimination of mud tsunami deposits by machine learning, but it is difficult to define training data for non-tsunami deposits, and adaptation to unknown samples has not yet been performed. In this presentation, we examined the discrimination by applying unsupervised learning using the chemical composition (major component + trace component) of tsunami deposits without data of non-tsunami deposits. We also applied unknown samples and tried to discover unknown tsunami deposits. I verified the usefulness of this method for discriminating tsunami sediments by classifying tsunami deposits caused by the Great East Japan Earthquake and Pliocene marine sediments widely distributed in northeastern Japan(Tatsunokuchi Formation) using whole-rock chemical composition as feature values by hierarchical clustering analysis(HCA). To discuss the accuracy quantitatively, we classified the cluster results into clusters dominated by tsunami deposits and clusters dominated by non-tsunami deposits and calculated the accuracy rate. In addition, we attempted to extract unknown tsunami deposits by applying the same method to unknown samples collected in East-Matsushima City. As a result, tsunami deposits and non-tsunami deposits were correctly classified with an accuracy of 96.6%. In addition, as a result of applying this method to unknown samples collected in East-Matsushima City, the possibility of unknown tsunami deposits could be pointed out. Compared to the conventional discrimination method using machine learning, this method does not require teacher data of non-tsunami deposits, so there is a possibility that tsunami deposits can be discriminated more easily.

Keywords: Tsunami deposits, machine learning, Hierarchical Clustering Analysis

