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Unsupervised clustering of petrographic patterns of Mt. Vesuvius and Campi Flegrei volcanic rocks: preliminary results

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Techniques based on Artificial Intelligence (AI) are increasingly used to approach problems concerning the monitoring of natural hazards and geosciences. Recently, artificial neural networks have been used to study petrographic patterns of volcanic rocks, in particular products erupted in the recent activity of Mt. Etna. Here we present the preliminary results of a cluster analysis based on Self Organizing Map (SOM) to investigate possible relations between the products of different volcanic complexes in the Neapolitan area. The SOMs are unsupervised neural networks mainly suitable for large and high-dimensional dataset analyses. They are able to identify clusters using intrinsic similarity measures in the data. They use a bi-dimensional visual representation that is particularly understandable for users. Finally, being an unsupervised method, no a priori information about the data is necessary to obtain the final clusters. Our dataset consists of a series of petrographic analysis of the Neapolitan volcanic complex products: Somma Vesuvio and Campi Flegrei. Most of the samples are from well-known eruptions. For each sample we use 14 features (major bulk components, trace elements and Sr isotopic ratios) as input to the SOM. The dataset includes 298 samples. It is composed by three groups, namely Campi Flegrei (CF) with 190 samples, Effusive Somma Vesuvio (VF) with 57 samples and Explosive Somma Vesuvio (VX) with 51 samples. The resulting SOM map identifies three main clusters. The first one includes all the effusive products of the Vesuvius eruptions and some products of Campi Flegrei. The second one includes the products of the Avellino eruption (Somma Vesuvio; 3600 y.b.p) and some products of Campi Flegrei. Finally, the third cluster includes only products from Campi Flegrei. In conclusion, the obtained preliminary results are encouraging and can be consistent with the hypothesis that there might be a unique long-lived magma pool beneath the whole Neapolitan area.