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Dimensionality reduction techniques and computational intelligence models used to discriminate different petrogenetic models through lithogeochemical data

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The magmatism of the post-collisional stage on the Central Ribeira belt developed essentially in the Oriental Terrain. This magmatism is represented by granitic bodies with dimensions varying from stocks and veins to batholiths. For decades those granites were classified as type I and interpreted as the product of the interaction between magmas derived from the partial melting of the asthenosphere and magmas derived from the partial melting of the lower crust. Recent research demonstrated at least two distinct models of the post-collisional magmatism on the Central Ribeira belt. The Itaoca granite (~480 Ma) was interpreted as a product of partially melted rocks from the Rio Negro Magmatic Arc with some assimilation of rocks from the Upper crust. In addition, the Sana granite (~500 Ma) was interpreted as a product of the partial melting of metasedimentary rocks of the São Fidelis group, whose sediments originated in the magmatic arc in a proximal environment of a back-arc basin. The traditional models of geochemical discrimination, based mainly on the major oxides, could not accurately separate the Sana and Itaoca granites. Therefore, it was necessary to develop new models for granites in that crustal segment. To develop a model capable of discriminating between two types of lithogeochemical data, algorithms for reducing data dimensionality and classification techniques based on computational intelligence models were applied. Results of lithogeochemical analyses were used, comprising the principal oxides, the LILE, the HFSE, and the Rare Earth Elements. To reduce the dimensionality of the data, t-Distributed Stochastic Neighbor Embedding (t-SNE) was applied. As for classification models, the Support Vector Machine (SVM) model, the Random Forest model and a Recurrent Neural Network were tested. The models that presented the best results were two variations of the SVM, one with a RBF Kernel and the other, with a polynomial Kernel, both of which presented an accuracy of 87.5%, a relevant result considering that the Sana granite is the product of partial melting of metasedimentary rocks, and the Itaoca granite is the product of the melting of the magmatic arc with some assimilation of the same metasedimentary rocks.