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6. Soil in the digital era
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SPATIAL DISTRIBUTION OF ELEMENTS IN LATERITIC SOILS FROM A RARE SIDERITE CARBONATITE FORMATION IN THE BRAZILIAN AMAZON USING REMOTELY SENSED DATA AND TOPOGRAPHIC ATTRIBUTES

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Carbonatites are considered rare, their distribution in the crust is minimal at a global level and they have a high economic value. The Brazilian Amazon held the Morro dos Seis Lagos carbonatite complex, considered to be one of the largest known Nb deposit, with an estimated reserve around 2.9 billion tons of niobium. The occurrence of siderite carbonatite on highly weathered geomorphic surfaces has given rise to a thick lateritic crust, which hosts trace minerals containing elements with economic potential. The goal was to study the laterization process undergoing on a rare siderite carbonatite parent material by assessing the spatial distribution of Fe2O3, Nb, TiO2, and W using machine learning. Amont of 341 samples including soil, sediment, and rock material were gathered from the Geological Survey of Brazil (CPRM). Covariates included remotely sensed data collected from Sentinel-2 MSI, Sentinel-1A and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), and topographic attributes calculated from a 20-m digital elevation model (DEM). The modelling procedures were performed using the Multivariate Adaptive Regression Spline (MARS), Support Vector Machine with radial kernel (SVMRadial), and Random Forest (RF) algorithms. The optimal covariates for modeling were chosen using Recursive Feature Elimination (RFE). The most relevant covariates for the distribution of the elements contained in the laterites were evaluated using the RFE results. The models performed better in predicting W (R2 = 0.32), Fe2O3 (R2 = 0.24), TiO2 (R2 = 0.14) using the RF model, while the MARS models showed greater ability in predicting Nb (R2 = 0.10). Best results for MnO (R2 = 0.22) were found when using SVMRadial. The importance metric provided by the RFE indicated that terrain attributes exert a greater influence on the spatial distribution of the elements studied compared to remote sensing spectral indices, thus indicating that the relief may be one of the main drivers of the pedological processes responsible for the formation of laterites in the area.

Keywords: Pedogenesis,Laterite,Poorly-accessible areas,Pedometrics,Machine learning