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Unsupervised machine learning driven Prospectivity analysis of REEs in NE India

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Traditional mineral prospectivity modelling for mineral exploration and targeting relies heavily on manual data filtering and processing to extract desirable geologic features based on expert knowledge. It involves the integration of geological predictor maps that are manually derived by time-consuming and labour-intensive pre-processing of primary geoscientific data to serve as spatial proxies of mineralisation processes. Moreover, the selection of these spatial proxies is guided by conceptual genetic modelling of the targeted deposit type, which may be biased by the subjective preference of an expert geologist. This study applies Self-Organising Maps (SOM), a neural network-based unsupervised machine learning clustering algorithm, to gridded geophysical and topographical datasets in order to identify and delineate regional-scale exploration targets for carbonatite-alkaline-complex-related REE deposits in northeast India. The study did not utilise interpreted and processed or manually generated data, such as surface or bed-rock geological maps, fault traces, etc., and relies on the algorithm to identify crucial features and delineate prospective areas. The obtained results were then compared with those obtained from a previous supervised knowledge-driven prospectivity analysis. The results were found to be comparable. Therefore, unsupervised machine learning algorithms are reliable tools to automate the manual process of mineral prospectivity modelling and are robust, time-saving alternatives to knowledge-driven or supervised data-driven prospectivity modelling. These methods would be instrumental in unexplored terrains for which there is little or no geological knowledge available.