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Establishing Background REE Geochemistry in the Lori Province of Armenia (Stage I: La, Ce, and Y)

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This study provides the first geochemical insights into La, Ce, and Y in the soils of the Lori province (Armenia). As one of Armenia's mining centers, the Lori province is well known for its mineral resources. The aim of this study is to investigate the contents and spatial distribution patterns of La, Ce, and Y in Lori soils, as well as to identify their potential sources and relationships with other elements (Fe, Mn, Al, Si, Ti, Zr, Sr, Rb, Pb, Zn, Cu). The contents of La, Ce, and Y in 158 soil samples were determined using X-ray fluorescence spectroscopy (Rigaku NEX DE) in Helium mode, with a measurement time of 100 seconds at three voltages: 6.5 kV, 35 kV, and 60 kV. Quality assurance and quality control procedures included the analysis of six certified reference materials and duplicate samples. Compositional data analysis combined with geospatial mapping was applied to reveal hidden distribution patterns of the studied elements. La was detected in 38.0% of samples, Ce in 78.5%, and Y in all samples. La ranged from 21.7-42.6 mg/kg (mean 30.5), Ce from 25.3-78.5 mg/kg (mean 49.2), and Y from 12.1-45.6 mg/kg (mean 29.2). The mean Y content was 1.3 times higher, while Ce was lower than the corresponding upper continental crust values. Relatively high contents of the elements studied were mainly found in the northwestern part of the province, with Y also showing high levels in the northeast. Anomalous values were linked with ore deposits and aligned with the province's polymetallic ore zones. For all studied elements, the highest positive significant ($p < 0.01$) correlations of La, Ce, and Y were observed with Zr. After a detailed inspection of distribution patterns and the elimination of anomalous values, in the resulting subdataset the correlations of La, Ce, and Y with Zr increased to 0.835, 0.761, and 0.573, respectively. These patterns suggest that Zr plays a key role in the distribution of La, Ce, and Y across the soils of the province.