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Application of remote sensing in surveying for REE-rich carbonatites in Tamil Nadu (Southern India)

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Carbonatites, which are rocks with exotic chemical composition, are globally among the most prospective for hosting deposits of REE and other rare metals. During the last few decades, remote sensing methods, particularly, the analyses of multi-spectral images are being increasingly applied in geological surveys. The vegetation cover unfortunately limits these methods. Within a framework of the project "Role of carbonatites for HFSE and HSE budgets in the Earth´s mantle" (supported by the Czech Science Foundation project 15-08583S), a suite of Neoproterozoic carbonatites and related alkaline rocks in an arid area of Tamil Nadu (southern India) was sampled.

To support fieldwork and sample collection, multispectral images were obtained for the sampling area clearly delimiting the geometry of the carbonatite intrusions. Spectra from selected pixels with field-confirmed carbonatite exposures were compared with hyperspectral data obtained in the laboratory for the collected rock samples (image hyperspectral data were acquired with HySPEX VNIR 1600/SWIR320m-e, spectral libraries were acquired with SR-2500 Portable Spectroradiometer). The spectral data were further compared with the results of chemical analyses carried out using an ICPMS housed at the Czech Geological Survey. The larger of the two investigated carbonatite bodies (Samalpatti) shows significantly lower Rare Earth Elements (REE) concentrations (ΣREE = 20–270 ppm) with flat to moderately fractionated REE patterns (CI chondrite-normalized [1] La_N/Yb_N = 3–25); highly elevated Cr and Ni concentrations (up to 1800 ppm Cr and 150 ppm Ni). In contrast, the smaller carbonatite body of Sevattur (IC10, IC11, IC16), located to the NE of the Samalpatti complex is characterized by high abundances of REE (ΣREE = 1450–2830 ppm) with steep light-REE enriched patterns (La_N/Yb_N = 20–55), and high Sr and Ba contents (up to 8700 and 3700 ppm, respectively), but lower Cr and Ni contents (cf. Samalpatti).

The ICPMS analytical results have been used to calibrate the spectroscopic data. In addition to delineating the aerial extent of the carbonate bodies, multispectral data can also be used to identify rocks with high REE abundances. We note that a great challenge for this technique is its application in humid areas with vegetation cover. At present, we are testing it on carbonatite intrusions in Eastern Uganda.

References:
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