Discrimination of sediment samples for forensic application using REE

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The geochemical signature of sediments is currently used as trace evidence in forensic investigations. In this research, geochemical studies have been carried out on Portuguese coastal sands aiming to ascertain its use for forensic purposes.

Rare Earth Elements (REE) concentrations were determined on samples collected on three coastal areas surrounded by different geological contexts, namely limestone, granite and metasediment. Eight sand samples were collected along transects perpendicular to the coastline, in beach and dune from each site. Each sample was manually collected with a plastic spade from the surface sediment, at a depth of approximately 0-5cm. From the sediment samples a standardized particle size fraction of <150 μm was obtained by dry sieving method and subsequently grinded to minimise the variation in the geochemical properties due to particle size.

The REE composition fraction was determined using four acid digestions ultratrace ICP-MS analysis at ACME labs (Canada), and concentrations calculated. Although the measured REEs concentrations can be compared directly for forensic purposes a normalisation reported to condrite meteorites was performed [1].

A REEs normalised concentration and a hierarchical cluster analyses were performed to obtain discrimination between samples. They reveal differences between samples associated with different geological context, and permitted the discrimination between samples surrounded by granite from samples surrounded by limestone and metasediments. It was also possible to discriminate some of the samples based on their REE concentration and profile.

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[1] Taylor & McLennan (1985) Blackwell Scientific Publications, 312p.

Geochemical signatures in detrital tourmalines as indicators for sediment provenance: The Baixo Alentejo Flysch Group, South Portuguese Zone

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Microprobe analyses were made to infer the source of detrital tourmalines from the Mid to Late Carboniferous turbiditic deposits of the Baixo Alentejo Flysch Group (BAFG) of the South Portuguese Zone. A representative group of greywacke samples covering the whole range of the BAFG ages was collected for this study. Tourmalines have brown to brownish gray colors and do not show any optical zonation. In the Fe-Mg-Al diagram, the tourmalines fall into the fields of Ca-poor metapelites, metapsammites and quartz-tourmaline rocks. Microprobe analyses revealed a range of values between schorl and dravite end members, being closer to the latter, with variable contents of X-site vacancies (0.05-0.255 apfu), Ca (0.078-0.2 apfu), Na (0.627-0.924 and Al (5.746-6.622 apfu). The Fe/(Fe+Mg) and Na/(Na+Ca) ratios range from 0.32-0.45 and 0.79-0.91, respectively.

The presence of well-rounded tourmaline grains suggests that they could have derived from a source located at a great distance from the sedimentary basin, or from reworked sedimentary rocks. The occurrence of few euhedral grains indicates minor contribution from first cycle sediments. Together, these data suggest that the detrital BAFG tourmalines derived from multiple sources with the predominance of rocks with a felsic composition.

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