

CHARACTERISATION OF HEAVY MINERAL SANDS BY PORTABLE X-RAY FLUORESCENCE (PXRF)

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Heavy mineral sands (HMS) are a potential resource of zircon, apatite and monazite, and therefore, of critical elements such as rare earth elements, Hf, and P. While major minerals of HMS can often be identified in the field, minor mineral components that host critical elements and the proportions of the various mineral groups are commonly more difficult to determine on-site. Hence, portable X-ray fluorescence (pXRF) analysers that yield geochemical information may improve identification and quantification of mineral constituents of HMS. In this study, we test the applicability of pXRF for the characterisation of garnet-magnetite HMS from the Namibian coastline.

Forty-six samples of HMS were collected from a c. 230 km long stretch of the northern Namibian coast in the Erongo and Kunene regions. The samples contain between a few and > 80 % heavy minerals, the major heavy constituents are garnet, Fe-oxides and Ti-minerals. Elements of interest (SiO₂, Ti, Mn, Fe, Zr, Th, Y, V and Hf) were measured by pXRF in powdered and unground HMS samples to test whether minimal sample preparation yields reliable results. Comparing pXRF to conventional laboratory analyses showed that pXRF results of unground sands scatter widely, likely due to sample preparation and resulting inhomogeneity. In contrast, homogenized powdered sands can be measured precisely and their systematic deviation from the conventional laboratory value can be corrected with simple linear regression equations.

To determine proportions of heavy mineral groups in the sands, HMS samples with various heavy mineral contents were selected to calibrate corrected pXRF element concentrations and XRD Rietveld data. Manganese, Fe, Ti and Zr concentrations were used to estimate the amounts of garnet, Fe-oxides, Ti-minerals and zircon in the samples, respectively. Geochemical and mineralogical data correlate well for garnet and moderately for Fe-oxides and Ti-minerals. While the presence of accessory minerals such as zircon, apatite and monazite is indicated by Zr, Hf and Th concentrations, a quantification is not possible with the current data set. Concluding, pXRF analysers are a useful tool for HMS characterisation and yield valuable information that may even be collected directly in the field.