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Combined PGAA and in-beam NAA measurements on mineral

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Heavy mineral separates from Hungarian sand samples were measured by instrumental NAA at the Budapest Research Reactor (BRR), but the amounts and weights of them were way too small to also analyze them effectively at the PGAA station of the BNC. Combined PGAA and in-beam NAA experiments were made on the samples at FRM-II to study their possibilities.
First, the mineral separates were irradiated at the PGAA station with an elliptically focused neutron beam (Φth: 4x1010 cm-2s-1) and the emitted decay gammas were measured for 15 minutes in situ. Then, the samples were moved to a low-background counting chamber for longer decay gamma counting. After the short-time and high-flux irradiations for in-beam NAA measurements, long irradiations followed by decay counting were run at the PGAA.
Compared to the INAA results, we detected 12-14 more elements and their precise mass fractions by PGAA and in-beam NAA at FRM-II. The analyses based on the decay spectra acquired at PGAA yield only few elements (e.g. Eu, Dy, and Br), which can be better detected in the low-background chamber. The decay measurement at the irradiation position seems to be reasonable for short-lived nuclides only.
PGAA and INAA complement each other; their combination offers a panoramic analysis for a much broader circle of elements. Their unique opportunities must be further investigated at the two European PGAA-INAA facilities (MLZ and BNC) to enhance the quality assurance and control.

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