State of the art micro-XRF applied to geological samples

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X-ray fluorescence analysis (XRF) usually needs only little sample preparation and is in general considered to be non-destructive. These advantages make it a technique widely applied for example for geological studies. The respective samples are usually inhomogeneous and sometimes structures well down into the micrometer range need to be spatially resolved. The method of choice for this is scanning electron microscopy (SEM) and electron induced energy-dispersive X-ray spectroscopy (EDX). For large samples, however, this approach can be very slow and very time consuming, if feasible at all due to volume restrictions of the sample chamber.

Micro-XRF combines both the minimal sample preparation and a good spatial resolution. State of the art micro-XRF instruments make use of polycapillary optics to focus primary X-rays into excitation spots of diameters below 25 µm still achieving detected count rates of several 100,000 kcps. Thus, very short measurement times can be achieved only limited by the sample stage speed and the software data acquisition and processing capabilities.

Using micro-XRF it is possible to pre-examine geological samples in a very reasonable time frame and identify areas which successively could be studied in further detail in the SEM. As an example an array of 6 x 3 thin sections, capturing an area of roughly 170 mm x 150 mm, can be scanned in steps of 50 µm with 15 min scanning time per individual thin section. The distribution of elements with Z > 10 can be studied and making use of different data mining tools, phase analysis or the identification of heavy element mineral phases is rendered feasible.

Also larger samples such as drill cores and other hand specimen can be examined in high resolution. Numerical algorithms allow for fast spectrum deconvolution of each of the several million individual pixel spectra to reliably discriminate elements with overlapping characteristic lines, like Fe-Kβ and Co-Kα, or the Ti-K lines and the Ba-L series.