

A comparison of line scans and maps using EPMA, micro-XRF, and PIXE

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Electron probe microanalysis (EPMA), micro x-ray fluorescence (MXRF), and proton induced x-ray emission (PIXE) are microbeam techniques that produce a variety of emissions from the sample. Here we compare them as they are used to create line scans or maps, generally done by examining x-rays produced from inner-shell ionizations of the target atoms. All three techniques can analyze most of the periodic table although elements lighter than carbon are rarely analyzed because of detector sensitivities. EPMA, which generally uses wavelength dispersive spectrometers, is limited to x-ray emissions below about 10 keV, thus elements heavier than arsenic must be analyzed using L series lines, which are often more prone to interferences. While all three methods can produce fully quantitative data, the actual part of the specimen being analyzed varies widely among the three.

MXRF and PIXE, which penetrate the sample to a much greater degree, are more prone to miss or “smear” smaller details than EPMA although they can detect elements present at much lower levels.

| Values depend on operating condition and sample type | | | | |
|--|------------------------|---------------------------------------|------------------------------------|--------------------------------------|
| | Detection limits (ppm) | Excitation volume (μm^3) | Excitation depth (μm) | Spatial resolution (μm) |
| EPMA | 250 | 100 | 2 | 1-3 |
| MXRF | <1 | 3000 | 10-50 | 3-10 |
| PIXE | <1 | 500 | 30 | 1-10 |

When it comes to microbeam elemental analysis no one size fits all – it is up to the analyst to determine which technique is the best, or at least adequate, for the question at hand.