ELEMENT XR: Increased linear dynamic detection range sector field ICP-MS for geological applications

MEIKE HAMESTER, LOTHAR ROTTMANN AND JULIAN WILLS

Thermo Electron, Hanna-Kunath Str. 11, 28199 Bremen, Germany (Meike.Hamester@Thermo.com, Lothar.Rottmann@Thermo.com, Julian.Wills@Thermo.com)

With the Finnigan ELEMENT XR, Thermo Electron has introduced a new instrument specifically tailored for demanding geochemical applications. The detection system introduced in the ELEMENT XR consists of a dual mode, discrete dynode detector and a single faraday detector. This unique detection system provides the user with a linear dynamic range of over 12 orders of magnitude. This detection range allows the measurement of count rates from the very low 'background noise' of 0.2 cps to a maximum of more than 10^{12} cps. With the very high elemental sensitivities achievable with the ELEMENT XR (~$2*10^6$ cps per ng/g of a mid mass element, e.g. ^{59}Co), this count range corresponds to a measurable concentration range of sub fg/g (ppq) to over a 0.1% in solution mode.

With this extreme detectable range complimentary analysis techniques (e.g. AAS or ICP-AES) for the determination of major matrix elements can be replaced with a single instrument. Possible applications include:

- Determination of majors, traces and ultra-traces in survey analyses
- Use of the matrix element in laser ablation analysis:
  - Na in fluid inclusions.
  - Al in melt inclusions.
  - Ca in bone / corals / fish otoliths etc.
  - C in diamond analyses
- Concentration determination in minerals by laser ablation.
- Elemental ratios by laser ablation (e.g. Ca / Sr etc).

Mineral identification in basalts using automated mass spectral data analysis

B. YAN[1], T.R. MCJUNKIN[2], D.L. STONER[1] AND J.R. SCOTT[3]

[1]Department of Chemistry, University of Idaho, Idaho Falls, ID, 83402, USA (yanbz@if.uidaho.edu, stondl@if.uidaho.edu)
[2]Materials Technology Department, Idaho National Laboratory, Idaho Falls, ID, 83415 USA (mcjtur@inel.gov)
[3]Chemistry Department, Idaho National Laboratory, Idaho Falls, ID, 83415 USA (scotjr@inel.gov)

A newly developed technology, a Laser-Based Optical and Chemical Imager (LOCI) was used to analyze basalt samples collected from Idaho and from Hawaii [1-3]. Spatially-correlated spectra were obtained using a 2-dimensional raster protocol that used hundreds of individual laser-desorption mass spectrometric analyses to characterize ~1 mm^2 of the heterogeneous surface. An automatic Fuzzy Logic Inference Engine (FLIE) was developed and used to identify mineral phases within the basalt geomatrices. The rule base in the FLIE is based on mineral standards and separates. Identifications are made on the basis of the major elements and the relative abundances found in standards and separates (e.g.,plagioclase, olivine, augite). A statistical rule base generator (SRBG) was developed for *a priori* analyses and for situations in which mineral separates are not available. The rule bases in the SRBG are generated and unknowns identified by statistical pattern analysis of the LOCI mass spectra. Comparison of the standard-based and pattern-analysis approach showed a consistency among mineral identifications. When comparing the Idaho and Hawaiin basalts it was found that the relative concentrations of individual mineral types varied. The two independent methods consistently show that the major minerals in Idaho basalts are olivine, augite and some Ti-enriched minerals such as ilmenite, while Hawaii basalts consist mainly of olivine.

References

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