

S4 PIONEER & GEO-QUANT ENHANCED TRACE ANALYSIS OF GEOLOGICAL MATERIALS

Introduction

Traces in geological material have long been of strong interest for mineralogical research and geochemical landmapping programs. Like a finger-print traces answer the questions about an origin or the class of a geological material.

Today due to new legislation for environmental protection the knowledge about the trace concentrations are even more important, like mapping for contaminated soils, or monitoring of old mining areas. But also raw materials for industrial use have to be analyzed for traces to get more information about the suitability of these materials.

Wavelength dispersive X-ray fluorescence spectrometry (WD-XRF) is the most powerful analytical tool to satisfy the needs regarding high sample throughput, in combination with an easy and quick sample preparation for monitoring work. It provides reliable results for elements in major, minor or trace concentration levels, no matter if light or heavier elements have to be determined.

This report shows the excellent performance of the high power, high sample throughput S4 PIONEER in combination with the calibrated solution GEO-QUANT, for the trace analysis of geological materials.

Sample Preparation

The sample preparation has to be very easy and quick to ensure a high sample throughput. GEO-QUANT provides a standard procedure for the preparation of pressed pellet, grinding 10 g of the sample for 3 minutes and pressing it with a pressure of 20 tons. As binder and grinding aid 4 "POLYSIUS" tablets are used for each sample.



Figure 1: Typical geological material
- before sample preparation

Measurement and Results

The measurements were performed on the S4 PIONEER with 4 kW excitation and standard configuration, plus the analyser crystal LiF 220 for high resolution. The measurement method and calibration are provided from GEO-QUANT, the unique solution for the quantification of traces in geological samples. GEO-QUANT evaluates the concentrations of 21 elements at trace level, with a typical measurement time of less than 30 minutes.

Element Compound	LLD [100s, 3 σ] [ppm]	Upper Calibration range [ppm]	Analysis Time [s]
Sc	1.5	100	40
TiO ₂	0.001%	2.6%	6
V	1.6	500	60
Cr	2.8	300	40
MnO	0.001%	1%	6
Fe ₂ O ₃	0.001%	20%	4
Ni	1.6	2500	30
Cu	2.1	1000	30
Zn	1.6	3000	30
As	2.3	350	100
Rb	0.8	3500	20
Sr	0.8	1500	20
Y	0.9	150	20
Zr	1.4	1000	20
Nb	0.9	1000	20
Mo	0.7	150	20
Ba	4.9	2500	60
La	3.5	350	60
Ce	4.6	2500	60
Pb	1.4	2500	100
Th	1.2	1000	100
U	1.1	600	100

Table 1: LLD, Calibration range and measurement times of GEO-QUANT

Optimised measurement parameters, carefully selected predefined peak and background positions as well as automatic matrix correction, makes the analysis of traces a job for daily routine. The analytical performance is specified in table 1.

To demonstrate the accuracy of GEO-QUANT with the S4 PIONEER, two international geological reference samples have been prepared and measured. The results are shown in table 2 and 3 in comparison to the certified values.

Element Compound	Cert. Conc. [ppm]	XRF Conc. [ppm]
Sc	1	< 1
TiO ₂	0.090%	0,092%
V	2	2
Cr	12	20
MnO	0.021%	0.012%
Fe ₂ O ₃	2.02%	1,89%
Ni	8	5
Cu	12	7
Zn	50	51
As	15	11
Rb	320	327
Sr	3	9
Y	143	139
Zr	300	284
Nb	53	53
Mo	3	1
Ba	120	112
La	109	104
Ce	195	211
Pb	40	39
Th	51	51
U	15	20

Table 2: Result of Granite MINTEK NIM-G

Element Compound	Cert. Conc. [ppm]	XRF Conc. [ppm]
Sc	5	6
TiO ₂	0.100%	0.111%
V	T	6
Cr	2	4
MnO	0.103%	0.100%
Fe ₂ O ₃	0.96%	0.94%
Ni	1	2
Cu	1	< 1
Zn	30	28
As	16	15
Rb	257	260
Sr	30	28
Y	45	49
Zr	101	105
Nb	16	16
Mo	T	3
Ba	40	49
La	20	26
Ce	47	52
Pb	19	21
Th	27	27
U	19	10

Table 3: Result of Rhyolite JR-1

The S4 PIONEER provides high intensity due to the high excitation power of 4 kW in combination with the optimized beam path and the close coupling of the X-ray tube, sample and detector.

The high level of accuracy for traces obtained with GEO-QUANT is clearly based on the powerful matrix correction of the “variable alpha” correction model, provided in the software package SPECTRA plus. This accuracy can therefore even be achieved with samples of a very different composition.

Conclusions

This labreport clearly demonstrates the outstanding analytical performance of the S4 PIONEER in combination with the calibrated solution GEO-QUANT for the trace analysis in geological applications.

With GEO-QUANT the S4 PIONEER is ready to start for the trace analysis. Quality, check and drift correction samples are included as standard ensuring the same excellent analytical performance day after day – over years.

Trace analysis has now become an easy analytical job for daily routine with GEO-QUANT and the S4 PIONEER.

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