

SEA NO.4 DEC.1989

Unknown Sample Analysis

1. Overview

In the analysis of geological surveys or artifacts, a lot of time is required for qualitative analysis of the many elements included in each individual sample, and because densities vary greatly. It would be nice to have a non-destructive method that can analyze a sample in its original shape.

The SEA2001 is an energy dispersion fluorescent X-ray analyzer that can non-destructively and simultaneously analyze all elements from Na11 to U92. Even samples with complex shapes can be rapidly analyzed without modification. Non-standard quantitative analysis is performed using the Fundamental Parameter Method (a theoretical calculation method).

An example of analysis is shown below.

2. Analysis Conditions

Analysis conditions are listed in Table 1.

Table 1

Item	Sample A	Sample B	Sample C	Bronze
Beam size (mm)	3	10	10	3
Tube current (μ A)	15	50	15	50
Tube voltage (kV)	250	7	29	8
Target	Mo	Rh	Rh	Rh
Atmosphere	vacuum	vacuum	vacuum	air
Mylar	no	yes	yes	yes
Meas. Time (sec)	200	3600	3600	300

3. Quantitative Method

Fundamental Parameters Method (Theoretical Calculation Method)

4. Analysis Results

Table 2 Unknown Sample Analysis

Components	Sample A		Sample B		Sample C	
	Chem Ana	SEA	Chem Ana	SEA	Chem Ana	SEA
Al ₂ O ₃	33.9	36.3	15.3	14.8	14.5	14.6
SiO ₂	56.7	53.8	69.2	69.3	52.2	50.9
P ₂ O ₅			0.14	0.37	0.26	0.20
K ₂ O	2.62	2.91	4.51	5.03	1.46	1.41
CaO	0.33	0.10	1.99	2.31	9.23	8.46
TiO ₂	1.48	1.84	0.53	0.64	1.30	1.40
MnO	< 0.02	0.04	0.04	0.04	0.15	0.20
FeO ₃	3.50	3.99	2.77	3.58	9.10	12.3
Na ₂ O	1.30		4.94		10.5	
MgO						

Units: %

Note: Quantitative is non-standard (FP Method).

Na₂O and MgO are input as fixed elements.

Table 3 Bronze Mirror Analysis

Element	Cu	Sn	As	Pb	Ni	Fe	Co	Sb	Ag
Conc.	72.23	22.10	0.66	4.31	0.27	0.11	0.12	0.16	0.04

Units: %

5. Summary

The results of this analysis show error between the measured value and chemical analysis without a standard sample (in case a standard sample such as ore cannot be obtained) to be less than $\pm 3\%$. Also, an archeological artifact of unknown composition, such as a bronze mirror, can be quickly and non-destructively analyzed.

Na₂O and MgO were input as fixed elements due to the large variation at a measurement time of 300 seconds, but Na₂O and MgO can be quantitatively measured by increasing measurement time.

Even unknown samples that contain many elements can be rapidly analyzed both qualitatively and quantitatively.