

**ABSTRACT**

Four Ore samples were received for quantitative analysis of gold and of Rare Earth Elements. Fundamental parameter calculations were performed on the spectra received to calculate the elemental composition of the samples without using calibration standards.

**BACKGROUND**

EDXRF is a fast and non-destructive technique that can quantify any type of sample solid, powder or liquid from within a few minutes and can be the method of choice. Energy Dispersive X-ray Fluorescence (EDXRF) spectrometers can play an important role in assuring that consistent quality of samples is retained throughout a manufacturing process. Quantitative analysis without the need of special calibration standards is easily performed with a professional Fundamental Parameter software. The high power and very efficient X-ray excitation provided in the EX-6600 analyzer makes the analysis of the energetic Ka lines of the Rare Earth elements an easy task. The secondary target excitation provides an outstanding feature to analyze trace concentrations of different elements such as for example gold in ore samples

EDXRF is an ideal method for a quick and simple elemental analysis for industrial control purposes offering the following advantages: 1) Fast and minimal sample preparation, 2) An automated analysis process, 3) Limited or no exposure to corrosive reagents used by other analytical techniques, 4) Ease of use for operation by non-technical or non-specialized personnel.

**ANALYTICAL CONFIGURATION**

**Table 1:** Instrument Analytical configuration

<b>Instrument</b>	EX-6600SDD
<b>Anode</b>	Rh-Anode X-ray tube, 60kV, 330W
<b>Detector</b>	Silicon Drift Detector (SDD)
<b>Environment</b>	Air
<b>Type of analysis</b>	Fundamental parameter quantitative analysis
<b>Analysis time</b>	600 sec



**Figure 1: EX-6600SDD EDXRF analyzer**

**EXPERIMENTAL**

Four different ore powder samples were received. In two of them gold was the element of interest and in the other two the rare earth elements were of main interest. The samples were analyzed, as received, in fine powder in XRF sample cups with Prolene thin film support. No reference samples of similar matrix were available. To perform quantitative analysis a fundamental parameter software based on theoretical consideration was used. To improve on the results a NIST certified reference sample (70a) was used as a "type standard (to determine instrument sensitivity factors of some of the different elements in the ore samples). The quantitative results are presented in the Table 2 and Table 3 below. Typical spectra are shown in figure 2 and 3.

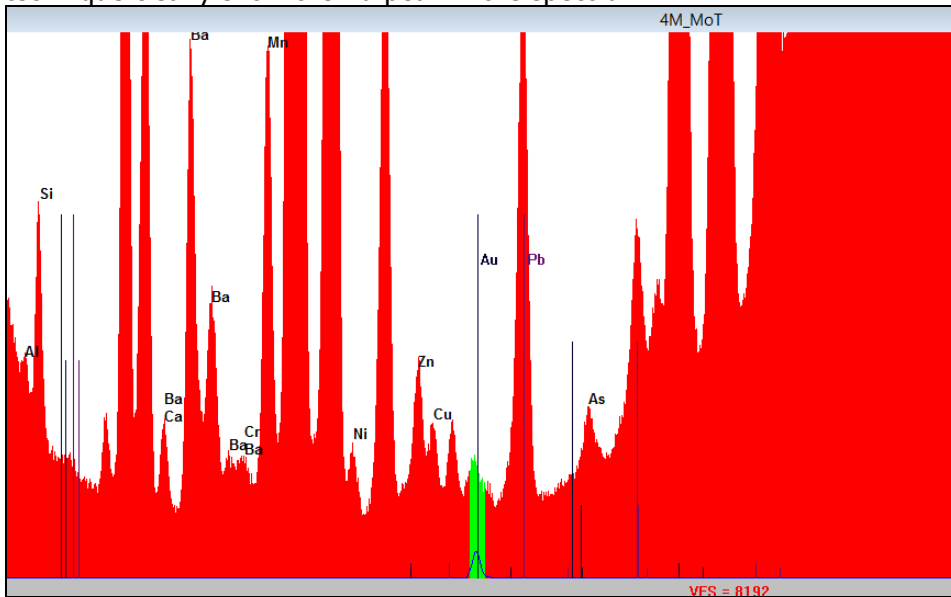
**Table 2: Gold containing Ore samples (w/w%)**

Elements	2-Akalbek	4-Mursumbek
Al2O3	22.867	9.997
SiO2	64.290	81.457
K2O	4.714	4.176
CaO	1.501	0.337
TiO2	0.287	0.128
MnO	0.049	0.053
Fe2O3	5.243	2.804
Ni	0.002	0.000
Cu	0.033	0.015
Zn	0.008	0.004
As	0.000	0.003
Rb	0.026	0.014
Sr	0.101	0.022
Y	0.002	0.001
Zr	0.008	0.019
Nb	0.000	0.001
BaO	0.341	0.452
<b>Au</b>	<b>0.002</b>	<b>0.007</b>
Pb	0.023	0.006
Th	0.001	0.002

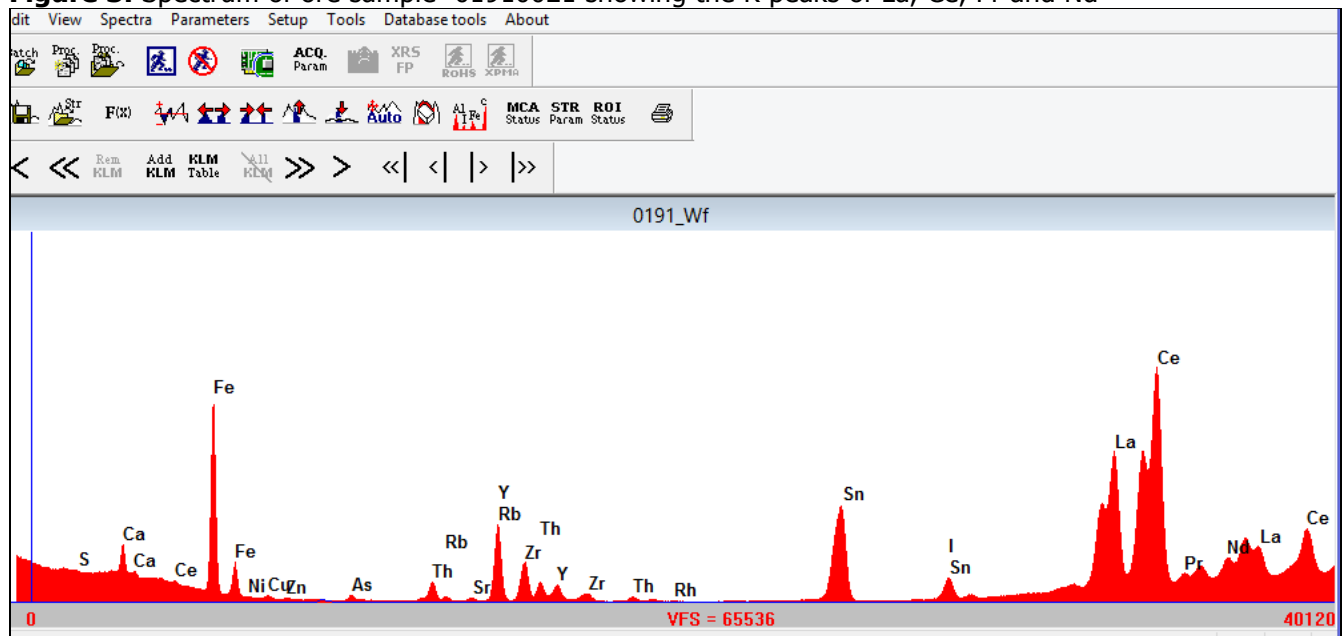
**Table 3: REE containing Ore samples (w/w%)**

Elements	01910021	01810004
Al2O3	18.386	22.441
SiO2	47.611	64.634
K2O	1.835	2.528
CaO	7.028	1.022
TiO2	0.335	0.573
MnO	0.104	0.047
Fe2O3	17.324	7.375
Ni	0.004	0.003
Cu	0.084	0.005
Zn	0.030	0.012
As	0.018	0.000
Rb2O	0.027	0.024
Sr	0.015	0.005
Y	0.348	0.112
Zr	0.139	0.041
Mo	0.013	0.280
Sn	0.542	0.009
Sb	0.012	0.004
BaO	0.029	0.027
Pb	0.099	0.015
<b>La</b>	<b>1.164</b>	<b>0.074</b>
<b>Ce</b>	<b>3.204</b>	<b>0.222</b>
<b>Pr</b>	<b>0.132</b>	<b>0.013</b>
<b>Nd</b>	<b>0.816</b>	<b>0.034</b>
Th	0.202	0.001

**Figure 2:** Ore samples 4-Mursumbek excited with Mo secondary target. Using Fit intensity extraction technique clearly show the Au peak in the spectrum.



**Figure 3:** Spectrum of ore sample 01910021 showing the K peaks of La, Ce, Pr and Nd



**Precision performances**

To show the instrument stability the 4-Mursumbek samples was excited 10 times repeatedly without moving the sample in between . The results of Au content was 66ppm±6ppm, rsd=9.0%.

A similar investigation was performed on ore sample 01910021and the results for the REE elements were:  
 La 1.148%±0.008%, rsd=0.65%;  
 Ce 3.222%±0.012%, rsd=0.38%;  
 Pr 0.130%±0.003%, rsd=2.41%;  
 Nd 0.758%±0.021%, rsd=2.78%.

## **CONCLUSION**

This short application report show the simplicity to use EX-6600SDD for Ore analysis. In short time and without any complicated sample preparation, reliable composition results on ore samples with good precision can be obtained using Xenemetrix EDXRF analyzer EX-6600SDD.

The high power of EX-6600SDD provides the base for simple analysis of the energetic Ka lines of the REE elements.

The secondary target excitation that efficiently reduces the background and thereby promoting analysis at low concentrations such as for example gold in ore