Application Note 41674

Sample Analysis Using Elemental Mapping at Low Power with Thermo Scientific ARL PERFORM'X 1500 W Advanced WDXRF Spectrometer

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Key Words

ARL PERFORM'X, XRF, WDXRF, mapping

Goal

To show that elemental mapping and small spot analysis create new dimensions of investigation in process control, research and development, even at low power with the Thermo Scientific™ ARL™ PERFORM'X WDXRF analyzer 1500 Watt.

Introduction

The ARL PERFORM'X sequential XRF spectrometer is typically used for quantitative elemental analysis of many material types ranging from petrochemical, geochemical, metals, glass and ceramics, mining and cement. These samples are normally presented to the XRF as uniform and homogenously prepared samples.

With the introduction of the ARL PERFORM'X spectrometer, a new dimension of sample analysis is now possible with sample surface mapping. The mapping capability enables in homogeneity, contamination, gradient, segregation and inclusion analyses.

The ARL PERFORM'X mapping can construct detailed composite maps of elemental distribution within a sample. The cartography control and overlay has a fine resolution of 0.1mm steps providing superior analysis for process improvement and problem solving applications.

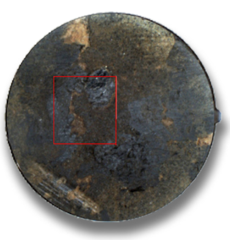
This ability bridges the gap between traditional bulk analysis and standard micro-analysis using microscopic techniques such as SEM.

Instrument

The ARL PERFORM'X spectrometer used for these tests is a 1500 watt system. This system is configured as standard with 6 primary beam filters, 4 collimators, up to nine crystals, two detectors, and our 5 GN Rh X-ray tube for ultra light element analysis.

The ARL PERFORM'X analyzer features mapping and small spot analysis allowing for 1.5mm and 0.5mm areas.

Elemental mapping



Elemental mapping using a WDXRF spectrometer can be an incredibly powerful analytical tool for segregation, inhomogeneity, inclusion, or contamination determinations. This information aids in giving an overall picture of not only routine samples but moreover in discovery or root cause failure analysis. Normally, the feature of small spot and mapping are utilized with high power XRF. Higher powers enable faster analysis and lower limits of detection, but high power is not an essential requirement for these determinations. The sample applications can be performed at excitation conditions as low as 1500 watts instead of 4200 watts by sampling increasing elemental analysis times.

As an example, a biotite rock was elemental mapped for the following elements: Al, Ca, K, P, Fe, Rb and Si. The results are presented in a variety of styles and can be switched at any time by a simple click of a button. The first display is as a 2 dimensional representation shown in figure 2. Here, the highest intensities of the elemental distribution are shown to have the brightest colors.

Analysis conditions

Elements	Crystal	Detector	kV	mA
Al	PET	FPC	21	70
Ca	LiF200	FPC	30	50
K	LiF200	FPC	30	50
P	Ge111	FPC	21	70
Si	InSb	FPC	21	70
Fe	LiF200	FPC	37	40
Rb	LiF200	SC	40	37

For a more elaborate depiction of the intensity variations, the results can be displayed in a 3 dimensional orientation. and are shown in figure 3. The largest peaks represent the areas with the greatest intensities. The distribution of elemental components in relationship to the surface aids in the understanding of mineral ore body in the sample. Thus to create an easy distinguished relationship, a colored overlay has been applied. These overlays are seen in figure 4 and 5 below. The overlays can be separated into individual elements or as a total composite.

Conclusion

WDXRF technique is primarily employed for routine elemental quantification using homogenous samples. However, the added benefits of features such as elemental mapping and small spot analysis create new dimensions of investigation in the imperfect world of process control, research and development and nature.

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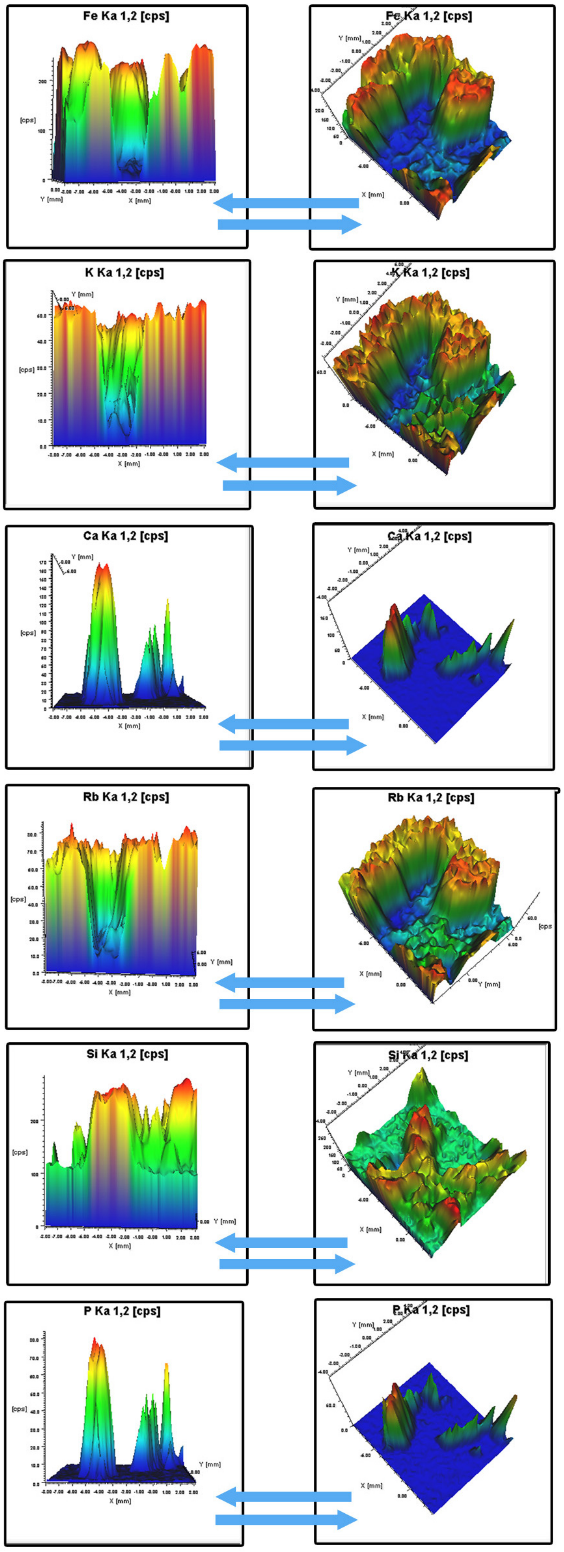

Figure 3: 3-D mapping of elements

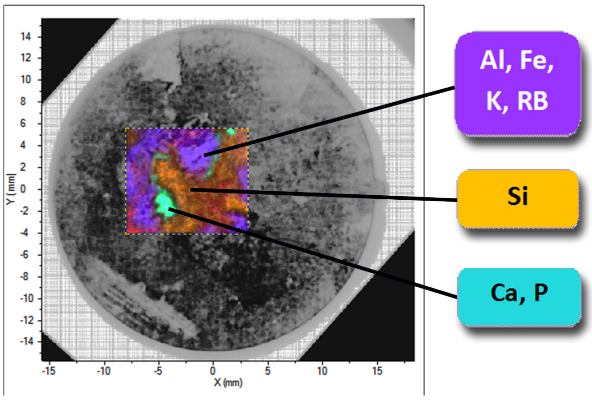

Figure 4: Elemental distribution overlay

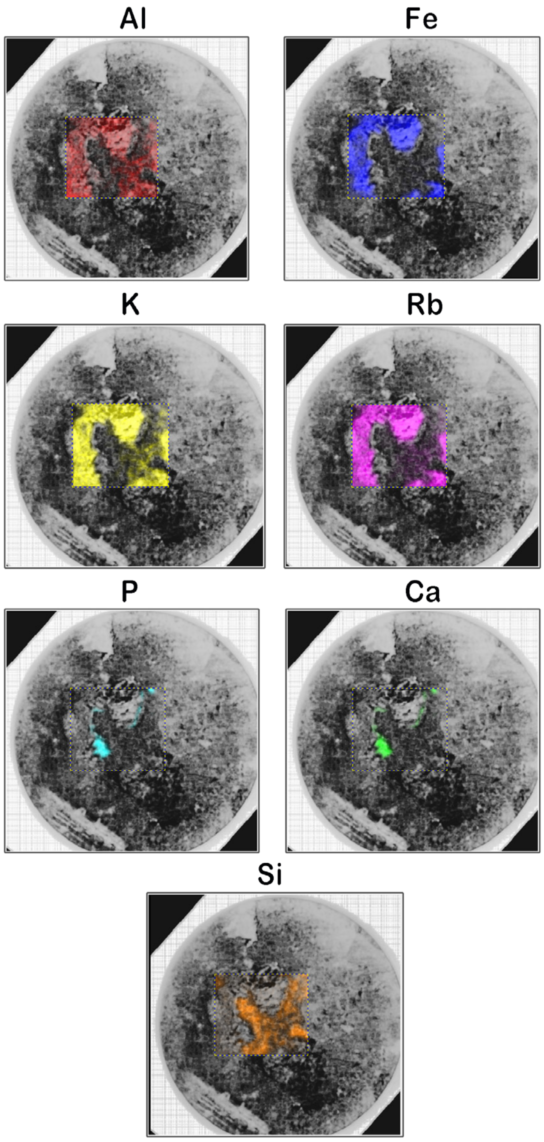

Figure 5: Single elemental distribution

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