

# Sample analysis using elemental mapping at low power

## ARL PERFORM'X 1500-watt Advanced WDXRF Spectrometer

### Introduction

The Thermo Scientific™ 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 spectrometer as uniform and homogeneously prepared samples.

With the ARL PERFORM'X Spectrometer, sample analysis is now possible with sample surface mapping. The mapping capability enables analyses of inhomogeneity, contamination, gradient, segregation, and inclusion.

The ARL PERFORM'X Spectrometer can construct detailed composite maps of elemental distribution within a sample. The cartography control and overlay have a fine resolution of 0.1 mm 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 scanning electron microscopy (SEM).

### Instrument

The 1500-watt ARL PERFORM'X system was used for these tests. This system is configured as standard with 6 primary beam filters, 4 collimators, up to 9 crystals, 2 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 1.5 mm and 0.5 mm areas.

**Figure 1: ARL PERFORM'X XRF Spectrometer.**

## 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 increasing the 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 with a simple click of a button. The first display is as a 2-dimensional representation, as shown in Figure 2. Here, the highest intensities of the elemental distribution are shown to have the brightest colors.

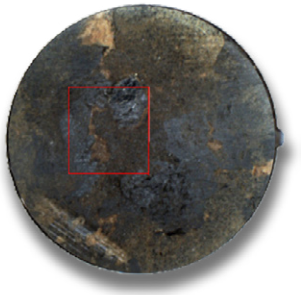

**Figure 2: 2D representation of elemental mapped biotite rock.**

### Analysis conditions of mapped elements

| 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, as 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 understanding the mineral ore body in the sample.

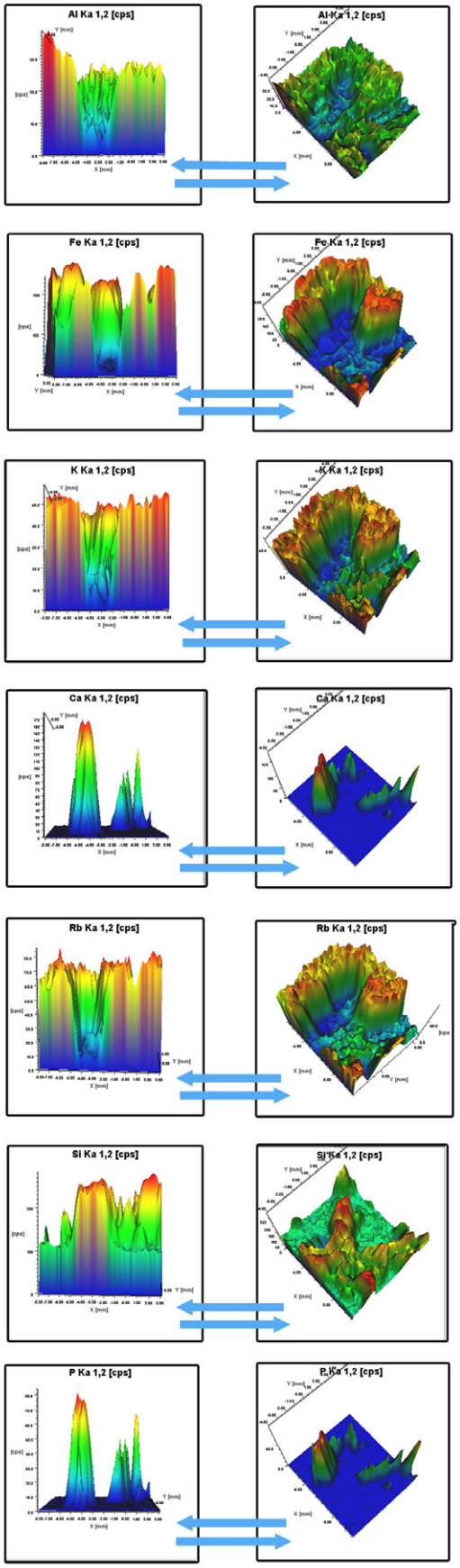


**Figure 3: 3-D mapping of elements.**

Thus, to create an easy distinguished relationship, a colored overlay has been applied. These overlays are seen in Figure 4 and 5. The overlays can be separated into individual elements or displayed 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 worlds of process control, research and development, and nature.

These tools simply aid in your laboratory's capabilities and techniques, allowing for even more valuable services for your clients and associates. Operation is made easy through the advanced Thermo Scientific™ OXSAS™ Software which is able to operate with the latest Windows® operating system.

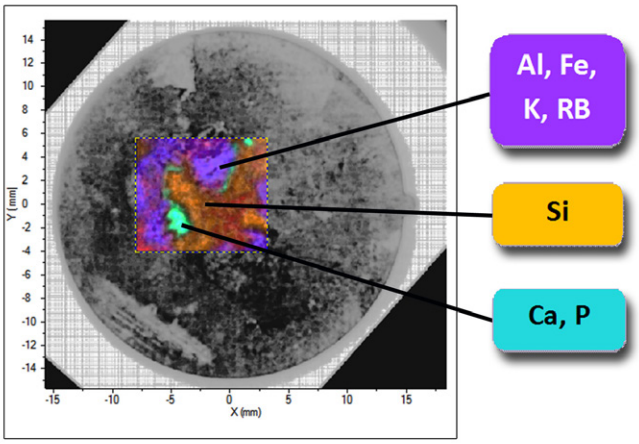


**Figure 4: Elemental distribution overlay.**

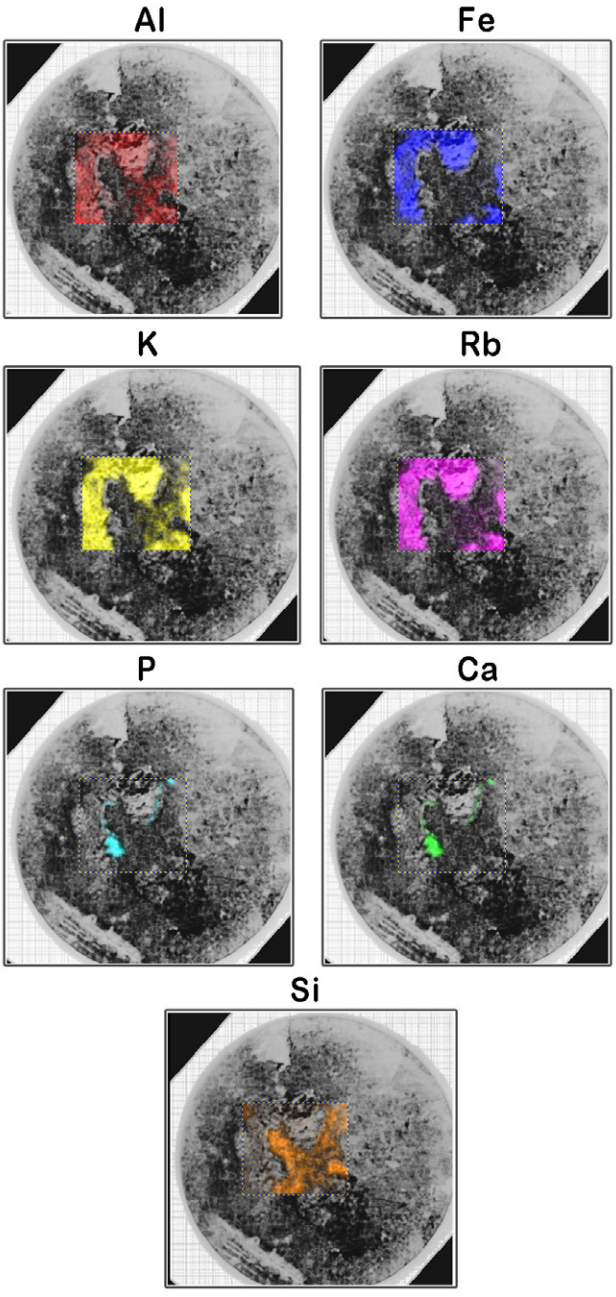


**Figure 5: Single elemental distribution.**