

## Analysis of Calcium rich ores using Unisantis XMD-300 X-ray Diffractometer with X-Ray Polycapillary Optics technology

### Abstract

Rapid XRD mineralogical phase analysis is critical to the evaluation of ore quality during any geological, mineralogical or mine exploration work.

This study illustrates quick data acquisition and analysis of two unknown mine exploration samples supplied by a customer using the Unisantis XMD-300 Polycapillary Optic Parallel Beam X-ray Diffractometer.

The complete analysis and evaluation of each sample could be carried out successfully in less than 10 minutes.



### Introduction

X-ray diffraction is a unique tool for the identification and quantification of crystalline and amorphous phases present in any unknown sample. The peak/ line positions and relative intensities of the diffractogram are compared with reference 'fingerprint' patterns of known compounds available in the ICDD PDF database and the phases identified.

The demand for rapid analysis of mine exploration samples on-site has necessitated development of compact and easily transportable XRD's with small footprint and low installation requirements. Use of low power X-ray tubes and Position Sensitive Detectors (PSD's) has reduced the analysis time to a few minutes.

Low beam intensities from low wattage X-ray tubes however produce low quality diffractograms that adversely affects the outcome in applications like phase identification/ quantification, unit cell indexing and crystallite size analysis.

The high intensity resulting from the use of polycapillary collimating lens in the XMD-300 X-ray Diffractometer and high speed of data collection due to the Linear Position Sensitive Detector yield good quality diffraction data rapidly with a high signal to noise ratio which makes phase identification easy.

Table 1. System Configuration	
Unisantix XMD-300 Diffractometer	
X-Ray Tube	50 W; Air cooled; Cu anode
Incident Beam Optics	Polycapillary collimating lens
Tube Voltage	45 kV
Tube Current	0.8 mA
Detector	Position Sensitive Detector
Sample Stage	Standard sample stage with laser alignment

The complete scan was recorded by measuring 8 times a 10° interval during 60 seconds, which corresponds to the active length of the PSD. These measurements were subsequently concatenated.

The diffractogram was obtained for one of the powdered samples using the above instrumental configuration and a search-match conducted. Quantitative phase analysis was carried out using the RIR (Reference Intensity Ratio) method and the result is shown in Fig.1.

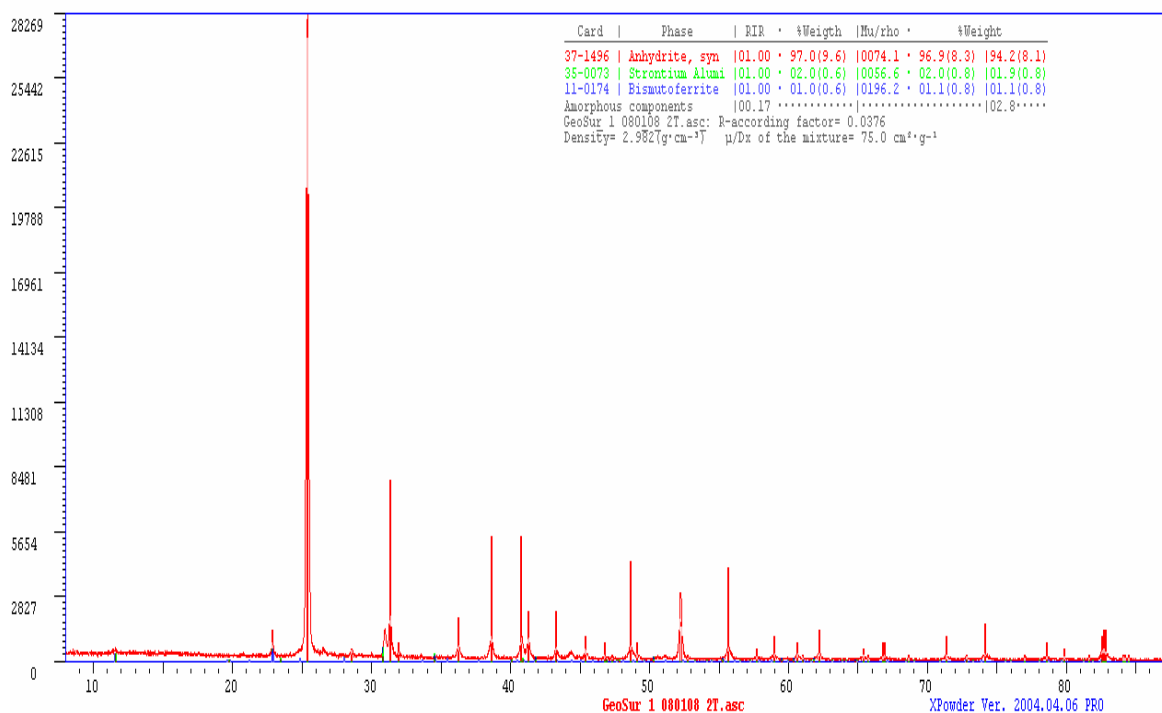


Fig.1. Mineral phases identified in the sample and Quantitative analysis results

Search-match was conducted on the diffractogram obtained for the second powdered sample followed by quantitative phase analysis using the RIR (Reference Intensity Ratio) method. The result is given in Fig.2.

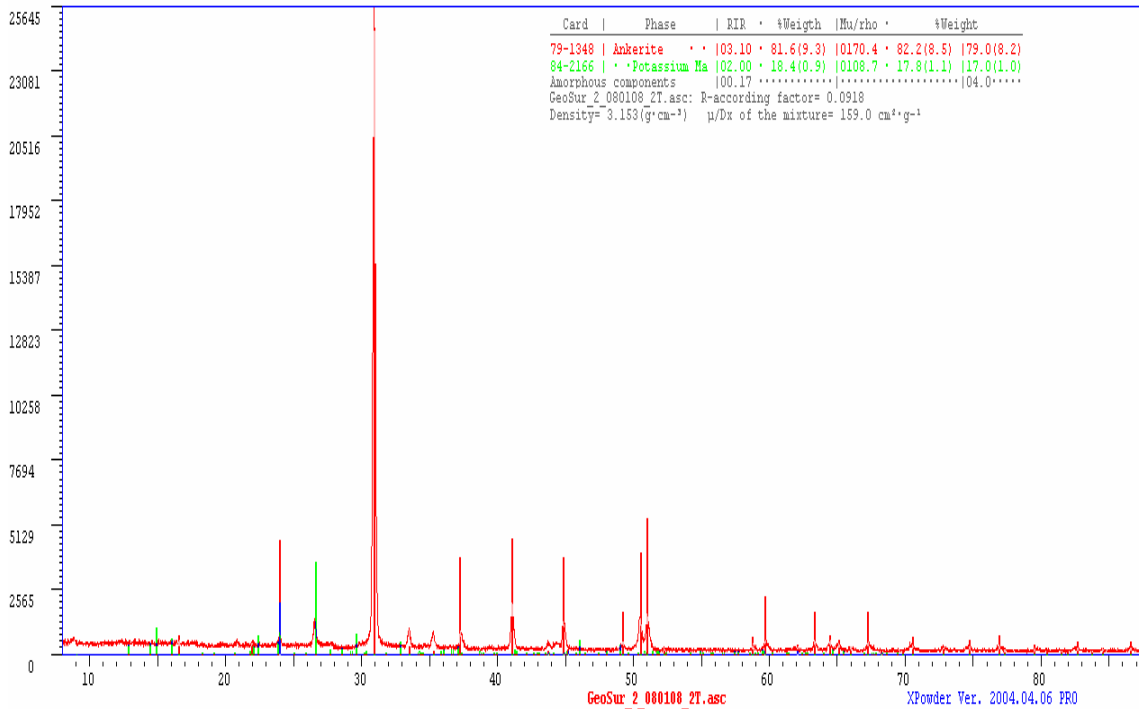


Fig.2. Phases identified in the second sample and Quantitative analysis results

## Results

Analysis was carried out on the raw diffraction pattern for both the samples.

The first sample was found to be rich in Anhydrite. Also detected were two minor phases identified as Strontium Aluminium Silicate and Bismutoferrite. The ICDD PDF stick patterns for the best search-match results are shown along with the quantitative analysis results.

It was possible to quantify the minor phases also and the minimum detection limit was observed to be 1.1% for this sample.

The second sample was found to be rich in Ankerite with another mineralogical phase present. This phase was identified as Potassium Manganese Vanadium Oxide. The ICDD PDF stick patterns for the phases are shown with the quantitative analysis results.

It may be noted that the XRD data for each sample, covering the entire 2Theta range, was collected in only 8 mins with high intensity and excellent signal to noise ratio.

## Conclusions

The present study demonstrates that Unisantis XMD 300 Polycapillary Optic X-ray Diffractometer provides rapid and reliable data that is highly suitable for all X-ray diffraction studies such as phase identification, phase quantification, crystallite size measurement and unit cell indexing.

The quality of diffraction data obtained using a low power tube is exceptionally good considering the fact that the data has not been corrected for any of the errors known to be generally associated with powder diffraction experiments

It may be noted that due to its parallel beam geometry the data provided by XMD is without any instrumental errors known to be associated with conventional powder diffractometers such as sample displacement error, sample transparency errors, etc.

## Company profile

Unisantis Europe GmbH is a global leader in development and manufacturing of innovative X-Ray analytical instrumentation, complete solutions and software for structure and elemental analysis using proprietary Polycapillary optics known for best beam collimation. Success in research has enabled Unisantis Europe GmbH to develop new cutting-edge X-ray technology, applications and products for the market. Our products have particular applications in material characterization, life science and industrial analysis.

Unisantis instruments incorporate a new range of user benefits, including transportability and multifunctionality all comprised in compact, bench top, user friendly, environmentally safe and low energy consumption equipment.

## Unisantis Headquarter

**Unisantis Europe GmbH**  
Werner-von-Siemens-Strasse 31  
49124 Georgsmarienhütte  
Germany  
Tel: + 49 5401 3681 40  
Fax: + 49 5401 3681 50  
E: [sales@unisantis.com](mailto:sales@unisantis.com)

**Unisantis FZE**  
P.O Box: 17667  
Dubai, United Arab Emirates  
Tel: + 971 4 808 44 44  
Fax: + 971 4 881 98 98  
E: [info-me@unisantis.com](mailto:info-me@unisantis.com)

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**unisantis**

[sales@unisantis.com](mailto:sales@unisantis.com)  
[www.unisantis.com](http://www.unisantis.com)