THE DEPARTMENT OF GEOLOGICAL SCIENCES
UNIVERSITY OF CAPE TOWN

will be hosting a course on

UNDERSTANDING XRF SPECTROMETRY

16 - 27 January, 2017

Introduction

The Department of Geological Sciences will host a summer course for industry, research, and academia on the theory and practice of XRF Spectrometry from 16 to 27 January 2017. Initiated by Emeritus Prof James Willis, and now organized hosted by UCT in association with PANalytical B.V., this course presents the principles and practice of XRFS analysis. The emphasis will be on the application of the technique to geological materials, but applications in the cement, metals, and other industries and in environmental analysis will also be discussed.

Lectures will be given mostly by Dr B.A.R. Vrebos on both wavelength and energy dispersive XRF spectrometry. There will be practical exercises that will include an introduction to modern wavelength and energy dispersive XRF spectrometers, and a practical introduction to the various procedures necessary for successful major and trace element calibrations and data reduction for both techniques. Participants will carry out tutorial calculations on test data sets to familiarize themselves with the procedures involved. They will receive a comprehensive set of course materials, including "Understanding XRF Spectrometry" (a two-volume book by James Willis and Andrew Duncan published in 2008 by PANalytical B.V.) together with lecture handouts, notes, and other useful documentation. **As always, the contents of the course and its presentation will be vendor neutral**. It is NOT a course on the instrumentation or software of any particular vendor.

Participants completing the course should be in a strong position to successfully carry out XRFS analysis on any vendor's machine. A certificate of attendance will be issued.

Course Structure

The course is divided into two distinct parts:
The **first week** comprises an introduction to the fundamentals of XRFS, qualitative analysis, selection and setting of instrumental parameters, matrix effects and how to deal with them, counting statistics, sampling procedures, sample preparation, and an introduction to quantitative XRFS analysis;
The **second week** covers in detail quantitative analysis for both major and trace elements, background and spectral overlap corrections, standardisation, absorption and enhancement problems and corrections, influence (alpha) coefficient corrections, commercial and manufacturer's software for correcting for inter-element matrix effects, special sample preparation techniques, analysis of small samples and solutions, and different applications of XRFS.

Each week can be attended separately, BUT persons attending the second week on quantitative analysis MUST have attended previously the introductory first week, although not necessarily in the same year. This is a very full, very intensive course containing an enormous amount of detail and building very rapidly on itself. For participants with little theoretical or practical knowledge of XRFS, it is strongly recommended that only the introductory week be attended in the first year. After gaining a year's experience in the laboratory and building on the knowledge gained from the first week, such participants will be in a much stronger position to extract the maximum advantage from the second week of the course. *It is strongly recommended that in their second year, such participants*

should attend the full two-week course in order to reinforce their basic knowledge and thus gain the greatest benefit from the full course. All previous participants who have adopted this approach have found it to be extremely valuable and beneficial.

There will be two morning sessions each day commencing at 08h15. Sessions will last from 08h15 to 10h15 and from 10h45 to 12h30 with a break for tea/coffee. Lunch will be taken from 12h30 to 13h30. Afternoon sessions will last from 13h30 to 15h10 and from 15h30 to 17h00 with a tea break in-between. There will be short open-book 15 minute revision tests each day, starting on day 2, and a 1-hour test on the last day of Week 1. The same will apply to Week 2. **The first week of the course ends at ~16h30 on Friday 20nd January and the second week at ~15h00 on Friday 27th January 2017.** Participants should try to avoid booking return flights leaving Cape Town before 18h00!!

Each participant receives course materials in full colour amounting to more than 500 pages per week. **Leave space in your luggage to carry it all (up to 5 kg for two weeks!).**

Course Fee

The fee for the full two-week course is ZAR 18,000.00, and ZAR 10,400.00 for one week only, **excluding accommodation and meals**, **PAYMENT IN ADVANCE.**
ALL cancellations received after 2 December 2016 will be liable to a cancellation fee of ZAR3400.00 to defray expenses and to cover costs of course materials ordered earlier from overseas.
Members of staff or registered full-time students from any South African or SADEC educational institution can apply for a reduction in the course fee.
Members of SASS or SACI will get a 5% discount on the course fees; this is not cumulative with other reductions in course fee.

Accommodation

Most hotels close to the university have now closed. The City Lodge (on the N2 near Pinelands) and the Breakwater Lodge (Waterfront) are cheaper than most. However, all the hotels are expensive in January as it is the height of the tourist season, and a car would be required to get to the University, adding to the hotel cost. There are many B&Bs available relatively close to UCT. Try Google using "Cape+Town+accommodation".
Lunch is available on campus. An evening meal at a very reasonable price will be available at the UCT Club on the upper campus. Alternatively, there is a very wide choice of restaurants located close by and all over the peninsula.

Participants are responsible for making their own arrangements, and paying separately, for accommodation.

Registration for Course

If you would like to attend the course, please complete the registration form attached to this notice and return it as soon as possible by email, fax or post to the address below. The form is available electronically via email. Submission of the form need not be accompanied by the registration fee and places you under no obligation to attend. It does allow us to assess probable attendance at the course. Your registration for the course will be confirmed by letter at the end of November, at which time we would expect a final decision from you and you will be invoiced for the registration fee, **WHICH MUST BE PAID BEFORE THE COURSE BEGINS.**

REGISTRATIONS SHOULD BE SUBMITTED ON OR BEFORE 25 NOVEMBER 2016 TO PROVIDE ADEQUATE TIME FOR COURSE MATERIALS TO BE ORDERED AND DELIVERED FROM OVERSEAS.

Participants from outside South Africa who may require visas should be sure to apply well in advance.

COURSE SYLLABUS

FIRST WEEK LECTURES

** Properties of X-rays.
** Excitation of X-rays; scattering of X-rays.
** Dispersion of X-rays; spectrometers.
** Detectors; dead time losses.
** Counting chain electronics, pulse height analysis, sin-θ amplifiers, pulse shifts and distortions.
** Energy dispersive spectrometry.
** Matrix effects: absorption, enhancement, particle size effects, mineralogical effects, chemical effects, surface effects. Mass attenuation coefficients. Critical thickness.
** Introduction to quantitative major and trace XRF analysis; counting statistics.
** Sampling; major and trace element sample preparation: crushing, grinding, binders, fluxes and fusions.
** Selection of instrumental parameters.

FIRST WEEK PRACTICAL SESSIONS

** Introduction to WDXRF spectrometers; running wavelength scans.
** Introduction to EDXRF spectrometers.
** Qualitative analysis using wavelength and energy dispersive spectrometers.
** Demonstration of setting up a WDXRF spectrometer for quantitative analysis; running blanks and standards; setting up applications for major, minor and trace elements.
** Setting detector voltages, determination of detector resolution, setting of pulse height selector.
** Determination of mass attenuation coefficients by calculation from major element composition, and by Compton peak measurements.
** Introduction to the calculation and application of influence coefficients; quantitative analysis.

SECOND WEEK LECTURES

** Quantitative major and trace element analysis: choice of angle/counting positions, determination of background intensity, spectral interferences on analyte line and associated background positions, X-ray tube line interferences, use of Compton peak MACs. Standards and standardization.
** Choice of analysing crystals for determination of low atomic number elements, crystal fluorescence problems, and their solution.
** Calculation of theoretical intensities.
** Influence (alpha) coefficients: empirical and theoretical; fundamental parameters; different influence coefficient algorithms for correcting for inter-element matrix effects.
** Special sample preparation techniques; quality of data; applications of XRFS in industry; comparison of XRFS, and other instrumental techniques.

SECOND WEEK PRACTICAL SESSIONS

** Major and Trace element data reduction: methods for determining background intensity at peak positions; corrections for peak-on-peak and peak-on-background interferences; determination of, and correction for, X-ray tube line interferences; iterative cross-tail correction procedures; standardization; calculation of concentration using MACs for matrix correction, counting error, and lower limit of detection.
** Applications of mass attenuation coefficients; absorption edge problems; techniques for crossing ("jumping") major element absorption edges.
** Derivation, calculation and application of influence (alpha) coefficients.
** Application of different influence coefficient models/equations/algorithms.
** Practical demonstration of the use of different models for the correction of inter-element matrix effects in setting up calibrations.
** Explanation and application of software for major and trace element data reduction.

REGISTRATION FORM

UNDERSTANDING XRF SPECTROMETRY

16 – 27 January, 2017

DEPARTMENT OF GEOLOGICAL SCIENCES

UNIVERSITY OF CAPE TOWN

Title: (Prof/Dr/Mr/Mrs/Ms) .....

First name, initials, and surname, *e.g. James, JP, Willis*: .....

Employer: .....

Position or occupation: .....

Company address: Your address (at which you can be contacted):

....

....

....

Tel no.: (Cell) ..... Fax no.: .....

(W) ..... **Email:** .....

Business sector: ..... (*e.g.* Commercial, Government, Academic, Individual)

Industry type: ..... (*e.g.* Electronics, Education, Steel, Non-ferrous metals, Cement)

XRF spectrometer, make and model: .....

For invoice purposes: Include a company letterhead to ensure we have the correct postal address

Name of contact person ..... **Email address**: ……

Position in company ..... **Tel. no.**: ……..

Signature ……

I plan to attend the course on **Understanding XRF Spectrometry** in January 2017.

Delete below options NOT required

BOTH weeks	YES
First week ONLY	YES
Second week ONLY*	YES

(*Only possible if you have previously attended the first week of the course)

Please advise when known Arrival Date ..... Departure Date .....

Return completed form to:

Prof. Dr. Chris Harris
Department of Geological Sciences
Private Bag X3
Rondebosch, 7701 South Africa
Fax: +27 21 650 3783
Tel: +27 21 650 2921 or +27 21 650 2931 or +27 21 650 3275
Email: contact nicholas.laidler@uct.ac.za and chris.harris@uct.ac.za