AXAA
Australian X-ray Analytical Association
Newsletter Issue 2 2017

Vice President's Address

Dear AXAA Members and Friends,

Welcome to Winter!
Our President Nathan Webster is taking a break after the birth of his first child, for which the AXAA Council extend a heartfelt congratulations to him and wife Renee! This Newsletter welcome therefore comes from me as your past President and current Vice-President.
First up, while we are taking a break from our dedicated student seminar events this year, a reminder to keep an eye and ear out for our AXAA-sponsored seminars such as the "Not so Boring Boranes" presented by Dr Mark Paskevicius at Curtin University in late May (read on for more details).
Following the AXAA-2017 schools, conference, and exhibition, we have received feedback from attendees that we are using to shape future events. One of the major considerations for future events is the cost, and we are currently looking to scale down the exhibition portion of the event a little in conjunction with a more modest venue to vastly reduce registration fees. We welcome your thoughts on this and invite you to contact the National Council with these (see contact details at the end of the newsletter).
Finally, I hope you have enjoyed our "A Day in the Life of" series where we get to know our AXAA community members. I personally have found these of great interest, and if you would like to participate, or nominate someone, please contact us. Our thanks again to our Communications Editor Jessica Hamilton (Monash University) for getting this series going.
Stay warm and safe!

Vanessa Peterson
AXAA Vice President

AXAA sponsored seminar - Curtin University, WA.

On the 31st of May, Dr Mark Paskevicius presented an AXAA sponsored seminar titled "Not so Boring Boranes" at Curtin University. Dr Paskevicius entertained the sizeable audience with stories about his experiences working at Aarhus University in Denmark and trips to various synchrotrons around Europe.

He described in detail a range of methods for structure solution by diffraction methods and revealed how this information was used to understand material properties, particularly in terms of energy storage for battery applications. Dr Paskevicius has joined Curtin University as an ARC Future Fellow to continue his research on energy storage materials.

Will Rickard

AXAA National Gallery of Victoria (NGV) Conservation Department Visit Notes:

10th February 2017

12 delegates from the 2017 AXAA Innovation for Characterisation conference attended the National Gallery of Victoria (NGV) Conservation Department with John Payne on Friday afternoon 10th February 2017.
The Department is made up of several specialised Studios. Each in turn had prepared and put on a good show for us. Under John's guidance we visited the following Studios:

1. Objects Conservation with Marika Strohschnieder, focussing on the radiography and elemental analysis of Majolica ceramics. (John and Marika are in the left of the picture below)

2. Costumes and Textiles Conservation with Kate Douglas, looking in particular at X radiography of a stump-work panel from Tudor England.
3. Frames & Furniture Conservation with Suzi Shaw and the examination of Japanese armour through radiography.
4. Paper Conservation with Louise Wilson talking about Beta radiography of Watermarks in papers used by Albrecht Durer - now available as an NGV on-line resource.
5. Painting Conservation and the X radiography of paintings by J.M.W. Turner and Tom Roberts with John Payne.

Delegates on tour at the NGV.

All X-ray analysis was done with an Andrex Industrial transmission X-ray unit fitted with a Comet tube head. Element analysis was done by a hand held Bruker XRF.

For further information on what NGV Conservation does, check out their link: https://www.ngv.vic.gov.au/explore/collection/conservation/

Jorg Metz

Latest XRF Training Success for OTML Staff in Papua New Guinea through the Internet XRF Course

Three more staff from Ok Tedi Mining Limited (OTML) in Tabubil, which is situated the Western Province of Papua New Guinea (PNG), have completed Advanced Level certification for the Internet XRF Course directed by Dr Brian O'Connor of Perth. The Advanced Level course is designed for people capable of developing new XRF methods.

In addition to Brian O'Connor running the course via the internet, strong local mentoring support is provided by Hillary Turnamur, OTML Superintendent of Laboratory Services. Hillary had been one of the first staff completions in 2010 (see AXAA-NL 2011-4) when Brian Evans, OTML Development Chemist invited Brian O'Connor to customise the course for OTML use. The retirement of XRF luminary Brian Evans was reported in AXAA-NL 2012-3.

Gaining a course completion award for the Advanced Level course requires participants to gain a high mark in the assignments set for all 11 modules of the course. Those gaining a very high mark overall are awarded Advanced Level certification 'With Distinction'.

The latest awards were presented at Tabubil in May 2017. The OTML staff completing the course and their OTML mentors are shown in the photograph below with their certificates:

Hillary Turnamur (Superintendent Laboratory Services), Arnold Vai, Melvin Nome, Vuvu Ruing and Ivan Crnkovic (Manager Process Technical Services).

Arnold, Melvin and Vuvu received advanced level certificates, with Melvin and Vuvu gaining 'with distinction' certificates.

Brian O'Connor

Elemental and mineralogical mapping of fossils from the Talbragar Fish Bed, near Mudgee NSW

Fish, plant and insect fossils can be beautifully preserved in the Talbragar Fish Bed, near Mudgee in NSW. The ~150million year old fossils are preserved in shale with fabulous liesegang bands in places. The fossils present as white impressions with fine skeletal detail, and with black mineral overgrowths. The fossils fluoresce under ultraviolet, blue or green light in some places but not others, leading to questions about the elemental composition and mineralogy of the fragile white skeletal remains. We looked at whole fish and plant fossils using the Bruker M4 Tornado with 25 µm pixel resolution, with mineralogy inferred using AMICS software. The AMICS software compares XRF spectra from samples of known mineralogy to unknown samples, allowing a pixel by pixel determination of mineralogical distributions. The mineralogies were first constrained using a PANalytical X'Pert Pro MPD diffractometer to check that our mineralogical interpretations were correct. In all cases, measurements of these irreplaceable fossils were made non-destructively, with XRD performed on a multi-purpose sample stage on the fossils as received.

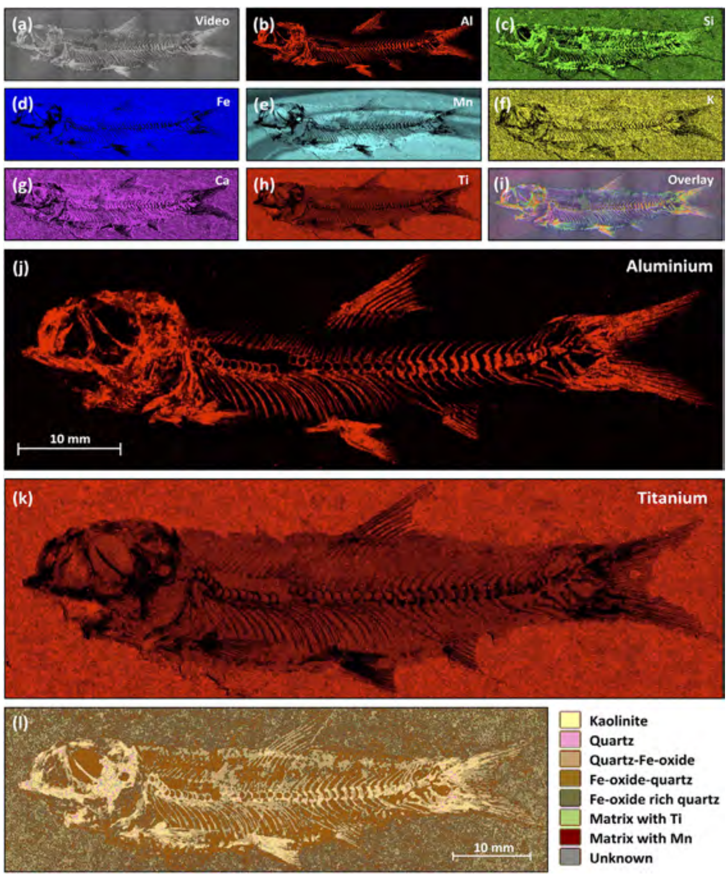

Figure 1. Elemental and mineralogical maps of a Cavenderichthys fish.

The M4 tornado revealed that the fish were beautifully imaged in aluminium and silicon, with the mineralogical maps revealing intergrown kaolinite and quartz (Figure 1). In hand specimen, these two white minerals were not readily distinguished but in some fossils they were clearly separated allowing easy identification of fine fossil parts. In places, superb liesegang banding was revealed in maps of Mn concentration (Figure 1). The plant fossils (Figure 2) were different, consisting only of quartz and the black mineral was revealed (as suspected) to be manganese oxides precipitating along the layers in the rock, in places either coating or replacing the quartz (Figure 2).

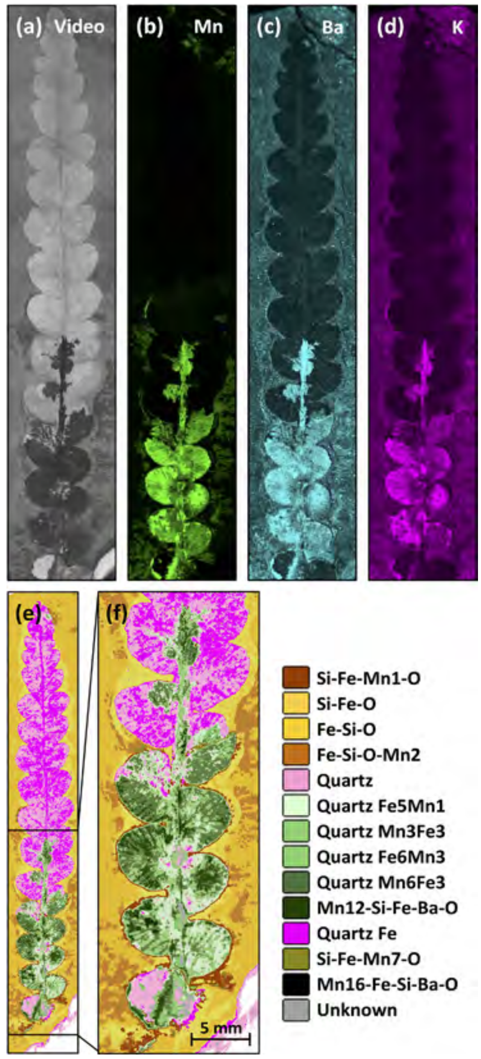

Figure 2. Elemental and mineralogical maps of a Rintoulia leaf.

This investigation hasn't answered all of the elemental and mineralogical questions about the fossils, and they retain some mystery still. However, the elemental and mineralogical determinations made on these materials show that they are not only scientifically interesting, but beautiful as well.

Michael Frese, Gerda Gloy, Rolf Oberprieler, Damian Gore. 2017. Imaging of Jurassic fossils from the Talbragar Fish Bed using fluorescence, photoluminescence, and elemental and mineralogical mapping. PLOSOne 12(6), e0179029.

The article is open access at:
https://doi.org/10.1371/journal.pone.0179029

First impressions count; using portable X-ray diffraction for environmental monitoring

Portable X-ray diffraction (XRD) instruments are creating interesting new opportunities in the geological and environmental sciences. Portable XRD is allowing for faster mineralogical analysis in the field, especially for samples that are hard or impossible to identify using hand specimens. At Monash University we have been using our portable XRD on various field trips to derelict mine sites. We have found that it is invaluable at providing a “first look” at the mineralogy of a field site without having to first take samples back to the university for analysis.[1, 2]

Example 1: The Ottery Arsenic-Tin Mine

The Ottery Arsenic-Tin mine in NSW, Australia, is a heritage listed derelict mine that now consists of piles of waste rock as well as a ruined condenser plant. In the condenser, arsenic rich mineral efflorescences were allowed to form on brick columns before they were scraped off and collected. Today, Ottery is the probable source of arsenic contamination in local waterways. We used the portable XRD to investigate the mineral efflorescences that can still be found on the condenser columns to see if we could determine the geochemical mechanisms that were contributing to the arsenic release.[1]

Qualitative X-ray diffraction analysis conducted in the field found that there was distinct mineralogical difference between efflorescent crusts that formed on exposed condenser columns or covered condenser columns. Condenser columns that were still protected by the remains of a roof contained the arsenic oxide polymorphs, claudetite and arsenolite [As_2O_3]. Meanwhile the columns that were more exposed to the elements did not have these arsenic oxides, instead they contained gypsum [$CaSO_4{\cdot}2H_2O$] and minor amounts of pharmacolite [$CaH(AsO_4){\cdot}2(H_2O)$] and haidingerite [$CaAsO_3{\cdot}(H_2O)$].

This mineralogical change could indicate a possible mechanism for arsenic release. Efflorescences that are still protected by the roof contain high amounts of arsenic. While those that are more exposed appear to have been replaced by non-arsenic bearing gypsum, potentially releasing arsenic into the local environment. Thus ensuring the remaining roof is stabilised could prevent further arsenic release over time.[1]

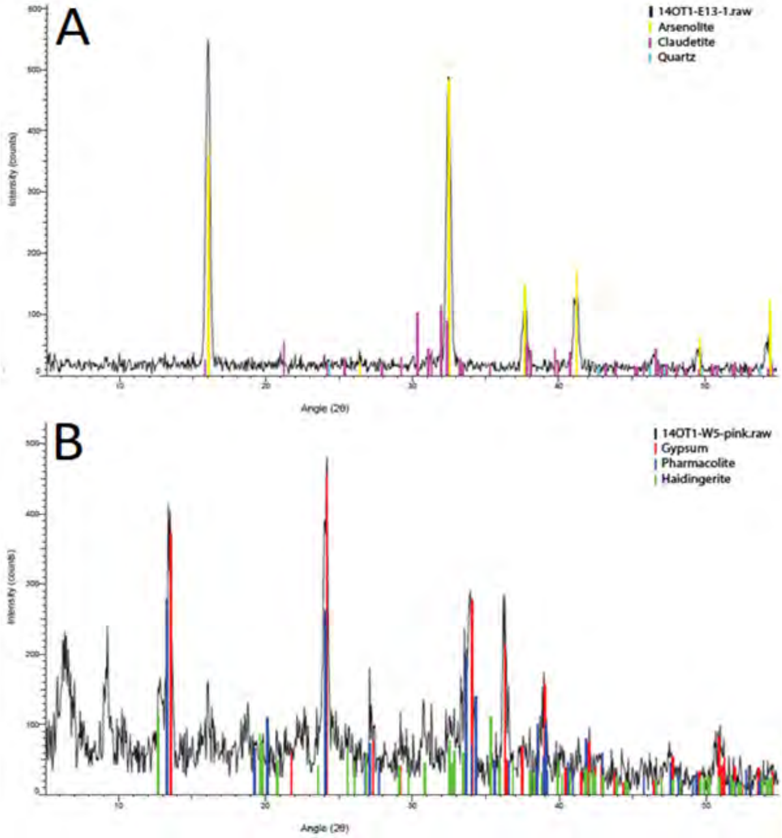

Figure 1: XRD patterns from an inXitu Terra portable diffractometer showing the mineralogical differences between efflorescences from covered (A) and exposed (B) condenser columns.

Example 2: The Woodsreef Chrysotile Mine

The Woodsreef Chrysotile Mine is located in New South Wales and was Australia’s largest tonnage chrysotile mine, producing 500,000 tons of chrysotile until its closure in 1983. It also produced 100 Mt of mineral wastes, including tailings and waste rock.[3,4] This waste material, especially the tailings, presents a health hazard to the local community, something that the state government is keen to prevent. Our involvement at the site was in looking at potential remediation strategies for Woodsreef, particularly investigating the potential for carbon sequestration in the tailings pile. The silicate minerals that dominate the tailings have the potential to act as a feedstock for carbonation reactions. These reactions can produce stable Mg-carbonate minerals that trap atmospheric CO_2.[5-7]

At Woodsreef we wanted to use our portable XRD to analyse the mineralogy of the tailings pile and identify any carbonate phases that may be forming thanks to interactions with the atmosphere. The tailings material consists mainly of the serpentine polymorphs chrysotile and lizardite and magnetite.

Hard surface crusts found on the tailings additionally contain the carbonate minerals pyroaurite and hydromagnesite. This indicates that carbonation of the mineral tailings is ongoing throughout the pile.[2,6] Quantitative XRD analysis via Rietveld refinement was attempted using the portable XRD instrument and a laboratory based instrument, to compare the results of the portable instrument to those from a "typical" instrument. The PONKCS method for quantification of phases with poor or unknown crystal structures was used to overcome the issues associated with quantifying serpentine minerals, which suffer from turbostratic stacking disorder.[8] Quantitative XRD analysis found that the carbonate crusts typically contain 2.1 wt.% pyroaurite and 5.9 wt.% hydromagnesite. This is equivalent to every kg of carbonated tailings trapping 23.6 g of CO_2.[2]

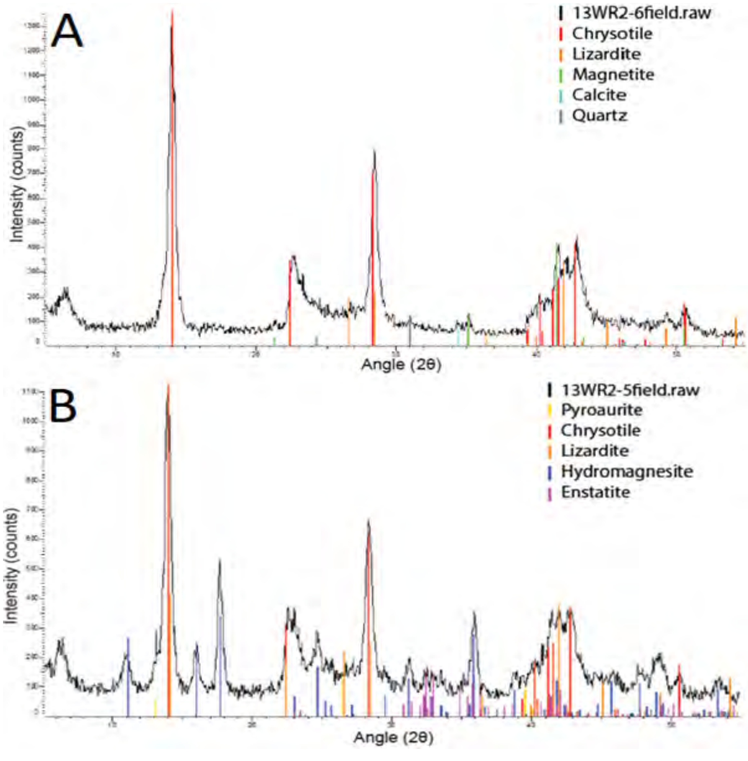

Figure 2: XRD patterns from an inXitu Terra portable diffractometer showing the mineralogical differences between the bulk woodsreef tailings (A) and hard surface crusts (B).

These examples demonstrate that portable XRD can be a powerful tool for quickly gaining an understanding of a derelict site, allowing us to Identify minerals in the field, rather than having to return to the laboratory. This "first look" can be used to inform further sampling decisions and can form the basis of larger studies or potential remediation strategies. At Ottery the initial data provided by the portable XRD informed a larger project investigating the best way to prevent further arsenic release into local waterways, while at Woodsreef the data was used as basis for further investigations into the total extent of carbonation at the site as well as experiments that aim to maximise the carbonation reactions using biotic and abiotic means.

1. Hebbard et al. (2017) Appl. Geochem.,79,91-106. 2. Turvey et al. (2017) Am. Mineral, 102 (6), 1302-1310. 3. Merril et al. (1980) Mining and Metallurgical Practices in Australasia. 10, 669-673. 4. Laughton et al. (2001). NSW mineral exploration and investment 2001 conference. 55-57. 5. Wilson et al. (2009) Appl. Geochem. 24(12), 2312-2331. 6. Oskierski et al. (2013) Chem. Geol. 358, 156-169. 7. Power et al. (2013) Elements, 9 (2), 115-121. 8. Scarlett et al. (2006) Powder Diffr., 21(4), 278-284.

Connor Turvey

The heat is on: how fire influences palaeosol mineralogy

Fraser Island is the world's largest sand island (122 km long) and is classified as a World Heritage Area based on its unique biological, geomorphological and hydrological features. Fraser Island and the Cooloola coast contain some of the best available archives of past climate change for the east coast of Australia, in the form of parabolic dune fields. These dunes are dominated by giant (>20m deep) podzol soil profiles, which contain characteristic soil horizons. The podzols found along the Cooloola coast and Fraser Island contain numerous deep, well-preserved soil B horizons. B horizons are 'illuvial' horizons, that is, they accumulate weathering products from the upper soil horizons. In the Fraser Island and Cooloola podzols, these weathering products include aluminium- and iron-organic complexes, and amorphous silica and alumina.

Giant podzol soil profile from the Cooloola coast, QLD.

Mineralogical and geochemical (including rare earth element [REE] distributions) properties of these B horizons can provide extensive information on the past weathering and environmental events that contributed to their formation.

Sampling of these B horizons has shown that they have persistent differences in consistency and appearance. Previous work has attributed the differences to their mode of formation and environmental setting. However, the role of post-erosional weathering (weathering after the removal of the overlying, poorly consolidated A and E horizons through aeolian erosion during periods of climate change) in altering these properties has not yet been explored. This needs to be addressed to accurately use B horizon properties (particularly rare earth element distributions) to infer past climate conditions. In this project, we have looked at the post-erosional effects of heating by fire on the B horizon sands.

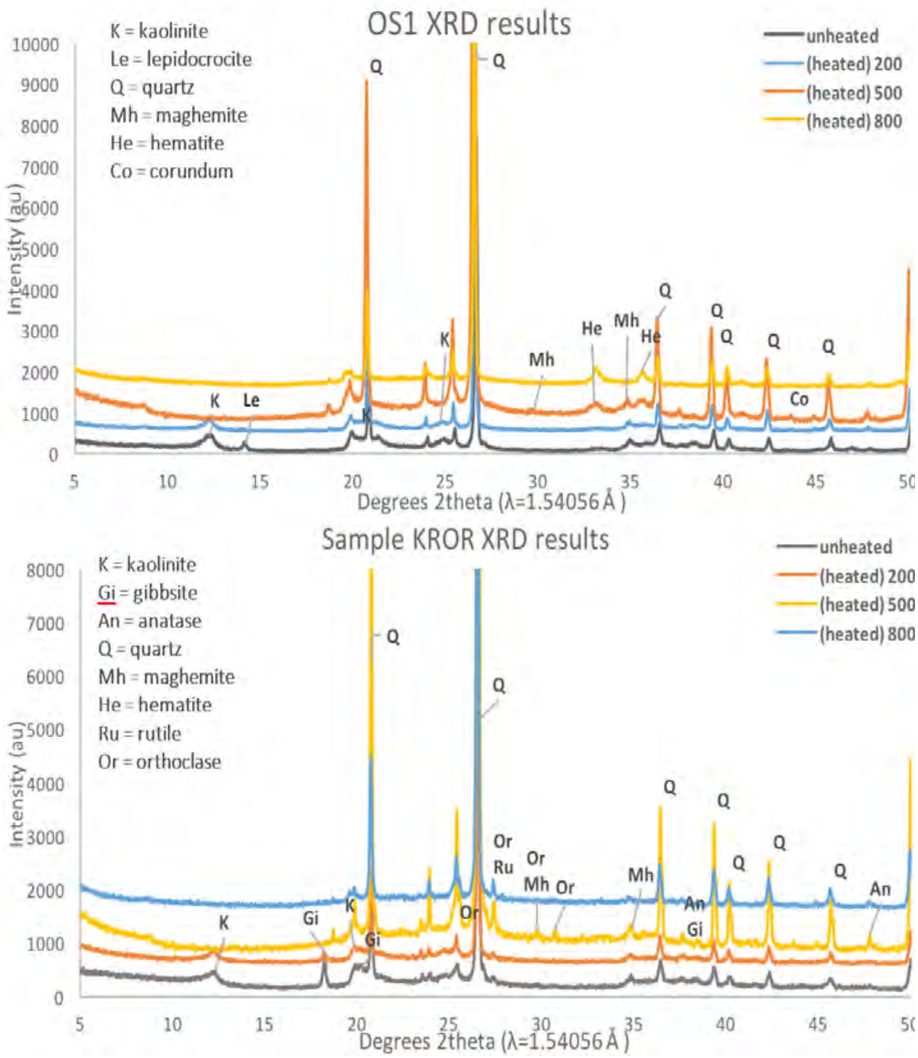

Figure 1. XRD patterns for two soil samples ('OS1' and 'KROR') unheated and after heat treatments show the effects of fire on the mineralogy of the B horizon coatings.

The quartz sands from the B-horizons contain aluminium-, iron-, and organic-rich coatings which were removed for analysis. These coatings were subjected to various heat treatments (200, 500, 800 °C) to simulate fire conditions and were analysed for changes in their geochemistry, mineralogy and micromorphology. Qualitative XRD was used to determine the mineralogical changes exhibited by the samples. The main crystalline compounds observed within the B horizon coatings were quartz, kaolinite, gibbsite, hematite and maghemite. After heating, samples containing gibbsite and kaolinite showed decreases in peak intensity, indicating the minerals were partly dehydroxylated. Kaolinite dehydroxylates to form metakaolinite at a temperature of ~500 °C and gibbsite likely alters to amorphous alumina or boehmite after 200 °C. The formation of hematite from lepidocrocite was also observed in more iron rich samples. The lepidocrocite peaks disappear during heating to 200 °C and the formation of hematite is noted at 500 °C. Free aluminium lost from organic matter upon heating is hypothesised to be incorporated into Al-substituted maghemite.

The B horizon coatings were also analysed for different forms of extractable iron, aluminium and silica using three extraction methods, as well as for total carbon and nitrogen. Extractable Fe-organic and Al-organic complexes were seen to decrease after heating, indicating a loss of organic matter. This was also supported by the total carbon data, which showed almost complete loss of carbon after 500°C, reflecting a loss of organic matter through volatilisation at 400-500 °C. In some samples, an increase in the Fe-extractable crystalline material was noted after heating. This is hypothesised to represent the formation of hematite from ferrihydrite during the heat treatment. These changes are significant as they are irreversible, and likely alter how REEs are hosted within the soil profile and therefore the utility of REE fractionation as markers of climate and environmental history. Investigations into REE fractionation within these podzols are ongoing.

After results are finalised, an indicator matrix will be developed to identify B horizons in the Cooloola and Fraser Island podzols likely to have been exposed to fire, and the effects of these transformations on REE retention and hosting will be quantified. Thus, the role of palaeoclimate in driving differences between the B horizons from various locations can be more accurately constrained by accounting for possible post-erosional weathering. This will allow other researchers to improve the accuracy with which they can use the properties of the B horizons to infer climatic events experienced by the upper soil horizons during soil development. This research is contributing to the development of a palaeoclimate model that will be produced for eastern Australia as part of a larger, ARC Discovery research project involving geomorphic and vegetation mapping, soil sampling and mapping, optically stimulated luminescence dating, and stable isotope analysis of vegetation.

Acknowledgements: This research was supported by ARC Discovery Project DP150101513, with Jamie Shulmeister (University of Queensland), Patrick Hesp and Graziela Miot da Silva (Flinders University), Kevin Welsh and Talitha Santini (University of Queensland), Allen Gontz (San Diego State University), and Tammy Rittenour (Utah State University) as the investigator team.

Grace Scullett-Dean

First Asia Oceania Forum (AOF) Synchrotron Radiation School held at Australian Synchrotron for Asia-Oceania participants (May 28th to June 2nd, 2017)

A compilation of student accounts from the school.

The Synchrotron school was chock-full of lectures from Synchrotron experts including Professor Mike James, Head of Science, and Dr Richard Garett, Senior Advisor at the Australian Synchrotron, as well as an army of scientists who are regular users of the Synchrotron facilities. Some of the speakers were Synchrotron beamline scientists, while others were research fellows from Australian and international universities, the CSIRO or ANSTO.

The Synchrotron School was made up of a very diverse range of students, including Masters and PhD students, as well as beamline scientists at other synchrotrons. As such, we ranged from complete synchrotron novices (such as myself) to experienced users. The lectures were excellent because they contained a lot of theory and background information, as well as covering the applications of each beamline and detailed case studies.

We started with an introduction to the Australian Synchrotron, learning exactly how it produces light which is a billion times brighter than sunlight. Light source basics were covered, as well as next-generation synchrotrons and future light sources. We got a crash course in crystallography and moved on to beamline basics, which covered how to optimise the beam source, signal and background, and everything we needed to know about detectors.

Synchrotron imaging is well-renowned for its superior intensity and brightness and we learned how it can produce excellent phase contrast and even 3D CT images. We then delved into a myriad of material characterisation synchrotron techniques, including (but not limited to) photoemission spectroscopy, soft X-ray microscopy, powder X-ray diffraction, X-ray absorption spectroscopy, small angle X-ray scattering and coherent diffractive imaging. We learned about the applications of synchrotron light to cultural materials studies, where we saw how X-ray fluorescence microscopy has been used to find a hidden painting under Edgar Degas' Portrait of a Woman. We also had two medical-themed lectures: medical imaging and medical therapy, which can be carried out using synchrotron radiotherapy. It was certainly a lot of information to digest but the interesting subject matter meant we avoided information overload, even on the day we had eight lectures!

Finally, we had a special lecture from Dr Gail Iles, who shared some of her experiences in condensed matter physics, astronaut instruction and parabolic flight experiments, making us all a bit envious (and slightly dizzy).

One of the highlights of the School was that we were able to get practical experience on a beamline of our choice. I was part of the small angle X-ray scattering (SAXS) team, supervised by beamline scientists Dr Stephen Mudie and Dr Adrian Hawley. We got some practice setting up the beamline (using liquid protein and leather samples), collecting the data and analysing it using Scatterbrain software (developed by Stephen himself). With the help of SAXS experts Stephen and Adrian, we got the rundown on how to use beamline time effectively (although we didn't experience 12 hour-shift, middle-of-the-night experimental conditions…what a shame.)

Larissa Fedunik-Hofman (University of Newcastle)

Techniques for corrosion scientists and industry, discussion from the 1st AOF school

Application of synchrotron powder diffraction is an essential technique for corrosion science, allowing us to investigate phases produced by corrosion processes as they evolve. Conventional lab based XRD offers poor signal to noise compared to synchrotron XRD, which has several advantages such as good signal to noise ratio, high speed data acquisition, high brightness, high intensity, high collimation, high polarization and low emittance. Because of the high resolution data collection, this technique can also be used for stress and strain analysis, which was highlighted during the lectures in the AOF school. Corrosion is one of the biggest industrial problems, especially for the oil and gas industries, and carbon steel is the most common material which is being used for pipelines and various other applications. However, the examination of carbon steel corrosion, and corrosion inhibition through the application of corrosion inhibitors, is considered a challenging job because of the surface roughness association with film formation on the carbon steel. In addition, the internal morphology of carbon steel is a mixture of various phases such as pearlite (Fe(BCC)+Fe_3C) and ferrite (Fe (BCC iron)), which also creates significantly high inherent roughness, therefore corrosion scientists are increasingly turning to synchrotron XRD analysis. It is worth mentioning that the application of parallel beam X- ray could help in eliminating high angle peak broadening which is useful for corrosion scientists, specifically for characterizing corrosion resistive films such as corrosion inhibitors and corrosion coatings, and investigating strain associated with the film. Both in-situ and ex-situ experiments are possible at Australian synchrotron, and may include analysis of a corroding substrate's texture, and phase evolution kinetics, which are very important for understanding corrosion processes. Since metals and alloys undergo corrosion product formation within a short timeframe, synchrotron XRD (PD beam line) can be very useful to predict the corrosion kinetics. Experiments to investigate high temperature oxidation can also be performed using a heating furnace apparatus. It is possible to mimic various in-situ conditions, such as simulating oil and pipe line corrosion, and setting specific atmospheric conditions. There are various detectors available at the PD (powder diffraction) beam line such as strip detector, area detector etc. making it versatile to provide insights into corrosion phenomenon which can be further correlated with the electrochemical performance of the system. It is worthwhile for experiments to be conducted with lab based XRD first, and it is important to think about the kinetics of corrosion product evolution because synchrotron beam time is precious and if the corrosion product formation rate is too slow, it is advisable to apply potential to increase corrosion rate. During the school it was highlighted that for a good synchrotron proposal, it is always good to include the initial lab based experimental results, a clear experimental plan (including experimental requirements), and most importantly before submitting a proposal, talk to the beam line scientists who are always happy to help researchers.

Deepak Dwivedi (Curtin University)

Practical Workshop on the Soft X-ray Beamline - 1st AOF School

During the Australian Synchrotron School, I was able to take part in a hands-on workshop at the Soft X-ray Beamline, which is primarily used to probe electronic transitions within materials. The energies associated with these transitions can then be used to determine various characteristics of a given material, from elemental composition to electronic structure, while causing minimal beam damage to a sample. This beamline is particularly useful for my area of research, which is focused on semiconducting organic materials such as polymers and small molecules, which are particularly susceptible to beam damage.

The workshop focused on two principle techniques: X-ray photoelectron spectroscopy (XPS) and Near Edge X-ray Absorption Fine Structure (NEXAFS). Using XPS, we were able to determine the composition of an unknown material given to us by a beamline scientist. Because electron transitions are associated with specific energies for each element, a comparison between observed transitions with known elemental spectra make this a fairly simple but useful technique. Additionally, we were able to measure the NEXAFS of highly ordered pyrolytic graphite (HOPG), which can be used to determine both the electronic band structure and molecular orientation at the surface of a material.

Although soft x-rays are primarily used for surface-sensitive characterization, they are still extremely useful in polymer research.

Charge transport in semiconducting organic materials is most efficient along the conjugated backbone of the material, meaning the molecular orientation plays an important role in both charge mobility and extraction in electronic devices such as field effect transistors and solar cells. Understanding the principles of NEXAFS has given me a better appreciation for the complexity in determining molecular orientation in my materials as well as deeper knowledge of the mechanisms behind electrical transitions in very complex organic semiconducting materials.

Kira Rundel (Monash University)

Excursion to Healsville Sanctuary - 1st AOF School

A highlight of this school was the excursion to Healesville Sanctuary, a zoo specializing in native Australian animals like wallabies, wombats, dingoes, kangaroos, platypus, Tasmanian devil, reptiles and over 200 native birds. At the "Spirits of the Sky" show, we saw predator and prey birds showing off their skills and learned that we are responsible for protecting their habitats. After spending almost half a day at the Sanctuary, we were all off to a charming nearby winery. We all had a great time with a nice glass of red or white with a few exceptions of beer, and amazing cuisine.

I would like to thank Richard and Mike for their support and inspiring us with their knowledge and experience about the Australian Synchrotron and its capabilities. I would also like to thank the Australian Synchrotron scientists and staff for hosting such an amazing event and I am enthusiastic about the next school in Pohang, South Korea housing an impressive 32 beamlines.

Varun Prasath (RMIT)

New 'Wavelength' Newsletter:

A new quarterly newsletter has been founded by staff at Curtin University's X-ray Characterisation facilities. Find previous newsletters at at their website or contact the Curtin team to subscribe to the mailing list.

Upcoming Events

Denver X-ray Conference

31 July - 4 August 2017
Big Sky Resort, Big Sky, Montana, USA

The world's largest X-ray conference will take place this year at Big Sky in Montana, USA from the 31st of July to the 4th August.

Website: http://www.dxcicdd.com

ISEB23

24 - 29 September 2017
Palm Cove, Tropical North Queensland, Australia

The International Society of Environmental Biogeochemistry's 23rd Symposium (ISEB23) will take place in Australia for the first time in 2017.

Poster Abstract submission closing date: **25th August 2017**
Email: iseb23@pco.com.au
Website: http://www.iseb23.info

Crystal 31

3 - 7 December 2017
Pullman Bunker Bay, Western Australia, Australia

Crystal31 is the 31st Biennial Conference of the Society of Crystallographers in Australia and New Zealand (SCANZ) (http://scanz.iucr.org/).

Registration opens: **7th August 2017**
Abstracts due: **9th October 2017**
Website: http://crystal31.com/

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Please visit our website, www.axaa.org, for further information, or follow us on Twitter @axaa_org.

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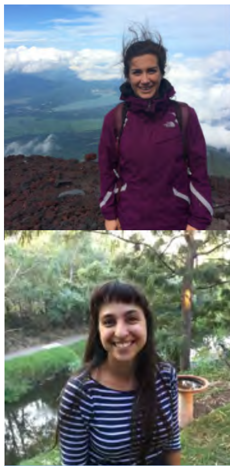
William Rickard (Curtin University, WA)

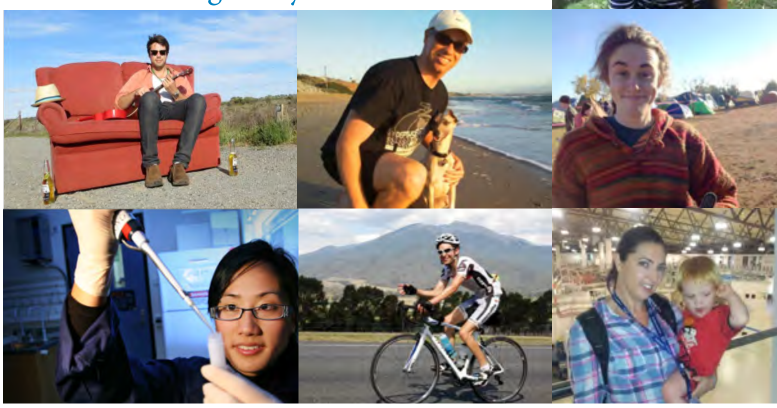
AXAA Membership

All registered participants of the AXAA-2017 conference are automatically granted AXAA membership for 3 years. Alternatively, new memberships can be obtained free of charge, by making an application to the National Council. Candidates should provide their CV and a short statement about how they intend to contribute to the organisation. Please send these to the National Council Secretary Mark Styles.

A Day in the Life of an X-ray / Neutron Scientist



In 2016, AXAA started a blog series as a new way to get to know our members. Our 'Day in the Life' posts take a peek behind the scenes of different workplaces to find out the fun bits, the challenging bits, and why you do what you do.
We are currently seeking posts so if you'd like to contribute, or know someone who might be interested, please contact National Council Communications Editor Jessica Hamilton.
W: www.axaa.org/a-day-in-the-life.html



Resource Centre

There are a range of resources available on the AXAA website, including video recordings of the two Public Lectures at AXAA-2017, tips for Rietveld Analysis, Clay Analysis, XRF tips, and more.
We welcome further contributions to our Resource Centre.

The next issue of the AXAA Newsletter will be distributed in December 2017. Please feel free to send contributions for the newsletter to Jessica Hamilton at any time. Any comments or feedback about the Newsletter are welcome.

Malvern PANalytical
X'press Updates

Launch of benchtop XRF for small spot analysis, Epsilon 1 Meso

This new member of the Epsilon 1 family has been designed for small spot analysis, and is the most powerful benchtop spectrometer in its class. It provides a compact and cost-effective 'out-of-the-box' solution, ready for the analysis of small objects or small inclusions in rocks, electronic appliances, toys, jewelry or finished products.

The instrument can handle a large variety of sample types, from small objects to larger final products. They can all be placed directly in the spectrometer without the need of any sample preparation. The integrated color camera allows straightforward positioning of the sample directly in front of the small measurement spot. The small footprint and self-contained design make the Epsilon 1 an ideal solution for elemental analysis and can be placed close to the sample location, like production facilities, exploration sites, at a shop's counter or even taken to crime scenes for forensic investigation.

The performance of the spectrometer meets the standard test methods required by different directives and regulations in various industry markets, like RoHS-2, WEEE and ELV for electronics and CPSIA for consumer goods. The Epsilon 1 is specifically designed to analyze a wide range of samples in accordance to these regulations, and meets the performance required by international test methods like ASTM F2617 for RoHS-2.

"Epsilon 1 for small spot analysis provides you with flexible and robust spot-on elemental analysis. The combination of hardware and software delivers results with peace of mind", according to Dr. Lieven Kempenaers, benchtop product manager at Malvern PANalytical.

Newer and bigger premise for Malvern PANalytical in Perth

From August 2017, the Perth team will move into their new office location in Canning Vale. The new office provides much needed space for the growing team.

It will also be able to cater to a dedicated training centre for customers. Customers will be able to receive classroom and hands-on training by our Application Specialists on using our instruments and software. Training includes XRF at the Workplace, fusion sample preparation, SuperQ XRF software and more. Stay tuned for more information.

Get real time analysis & better process control for your mine

A holistic solution by Malvern PANalytical

With the combined analytical technology of both Malvern and PANalytical, you now have easy access to a holistic range of analytical solutions. Plus the experts to advise you on tailored solutions at each step of your mining process. Learn how your mine can benefit.

Exploration
with portable analytical instruments

Epsilon 1 Meso XRF
For small spot analysis of inclusions in rocks

TerraSpec Halo handheld NIR
for easy point & click on-site analysis of drilling samples

Grade control
with direct, real time analysis and safe detection:

CNA³ high-frequency real time elemental analysis
of the bulk material on the belt

Process control and research

Minerals edition of Zetium XRF
for high throughput elemental analysis

Claisse LeNeo
fusion sample preparation for a homogenous sample and more accurate sample analysis

Aeris Minerals edition XRD
for quantification of the mineralogical phase composition

Other value added services:

Mastersizer 3000 laser diffraction
monitoring particle size distribution for better grinding and instant detection of a process upset

Automation
analytical solutions tailored for your laboratory

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Bruker Launches the S8 TIGER™ Series 2 WDXRF System for Elemental Analysis in Industrial and Academic Research and Materials Quality Control

Bruker announces the launch of its new *S8 TIGER™ Series 2*, the next-generation Wavelength Dispersive X-Ray Fluorescence (WDXRF) spectrometer. The *S8 TIGER Series 2* is the most versatile WDXRF tool available for advanced quantitative elemental analysis in industrial and academic materials research, as well as in industrial quality control (QC) of materials.

The new *S8 TIGER Series 2* introduces novel *HighSense™* technology which offers an exceptional linear dynamic range, thus enabling higher precision levels for process and quality control in cement, minerals, mining, metals, glass and ceramics applications. In addition, measurement times are significantly reduced, sample throughput is increased, and time-to-result is improved, typically by 25%.

The *S8 TIGER Series 2* also features *XRF²* small spot mapping for detailed maps of elemental distributions in materials. With a 300μm spot size, *XRF²* offers the highest spatial resolution available in WDXRF. This makes the *S8 TIGER Series 2* an excellent system for both industrial QC labs as well as for industrial and academic research and methods development laboratories.

In addition, the *S8 TIGER Series 2* new *HighSense* X-ray optics improves both sensitivity and spectral resolution. This benefits a wide range of applications including recognition of foreign particles, optimization of mineral beneficiation processes in mining, analysis of material properties in metals, semiconductors, and nanotechnology.

The *S8 TIGER Series 2* offers intuitive and robust operation with a new multilingual *TouchControl™* interface. The *S8 TIGER Series 2* is designed for high sample throughput and easy integration into automated analytical laboratories. Optimal instrument uptime and low cost of operation are ensured with the unique *SampleCare™* feature that protects system components while running liquid petrochemical samples, or powders.

Dr. Kai Behrens, the Bruker AXS Head of XRF Product Management, commented: "The *S8 TIGER Series 2* combines unequalled robustness and reliability with highest analytical performance, flexibility and application range in WDXRF. Its new *HighSense* technology allows tighter quality and process control, while the new *XRF²* mapping tool benefits both R&D of new materials, as well as the optimization of industrial processes."

For more information about the *S8 TIGER Series 2*, please visit www.bruker.com/s8tiger

PRESS RELEASE

SOLUTIONS FOR SCIENCE AND INDUSTRY | MATERIALS SCIENCE | LIFE SCIENCE | MINING | NDT |

Rigaku Launch 6th Generation MiniFlex Benchtop XRD

X-ray scientific, analytical and industrial instrumentation manufacturer Rigaku Corporation has announced the new 6th generation Rigaku MiniFlex benchtop XRD (X-ray diffraction) instrument.

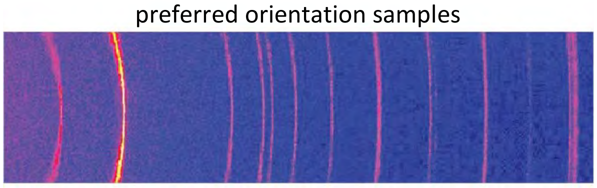
The new MiniFlex X-ray diffractometer is a multipurpose analytical instrument that can determine:

- Phase identification and quantification
- Per cent (%) crystallinity
- Crystallite size and strain
- Lattice parameter refinement
- Rietveld refinement
- Molecular structure

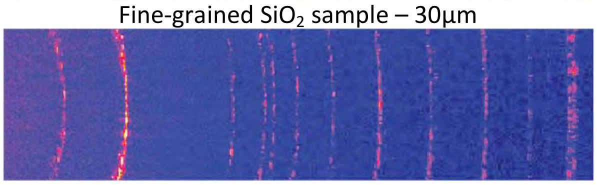
It is widely used in research field especially in material science and chemistry and also in industry for research and quality control. It is the newest addition to MiniFlex series of benchtop X-ray diffraction analysers from Rigaku, which began with the introduction of the original MiniFlex system decades ago.

Rigaku MiniFlex is historically significant in that it was the first commercial benchtop (tabletop) X-ray diffraction (XRD) instrument. When introduced in 1973, the original Miniflex was about one-tenth the size, and dramatically less expensive, than conventional X-ray diffraction equipment of the period. The original instrument (Gen 1), and its successor that was introduced in 1976 (Gen 2), employed a horizontal goniometer with data output provided by an internal strip chart recorder. The third generation (Gen 3) instrument, introduced in 1995, was called Miniflex+. It provided a dramatic advance in X-ray power to 450 watts (by operating at 30kV and 15mA) and Windows® PC computer control. Both the Miniflex+ and the succeeding generation products employ a vertical goniometer and allow the use of an automatic sample changer. Fourth generation (Gen 4) Miniflex II was introduced in 2006 and offered the advance of a monochromatic X-ray source and D/teX Ultra 1D silicon strip detector. The fifth generation (Gen5) MiniFlex600 system, introduced in 2012, built upon this legacy with 600W of available power and new PDXL powder diffraction software.

HPAD detectors cater for coarse-grained and preferred orientation samples



Fine-grained SiO_2 sample – 30µm



Coarse-grained SiO_2 sample – 100µm

The new MiniFlex system delivers speed and sensitivity through innovative technology advances, including the Hypix- 400 2D Hybrid Pixel Array Detector (HPAD) together with an available 600W X-ray source and new 8-position automatic sample changer. This new direct photon counting detector enables high speed, low noise data collection and may be operated in 0D and 1D modes for conventional XRD analysis and 2D mode for samples with coarse grain size and/or preferred orientation.

A variety of X-ray tube anodes – along with range of sample rotation and positioning accessories together with a variety of temperature attachments – are offered to ensure that the MiniFlex system is versatile enough to perform challenging qualitative and quantitative analysis of a broad range of samples, whether performing research or routine quality control. The new (Gen6) MiniFlex embodies Rigaku's philosophy of "Leading with Innovation" by offering the world's most advanced benchtop XRD.

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PRESS RELEASE

SOLUTIONS FOR SCIENCE AND INDUSTRY | MATERIALS SCIENCE | LIFE SCIENCE | MINING | NDT |

AXT Brings Sigray's Revolutionary X-Ray Technology to Australia & New Zealand

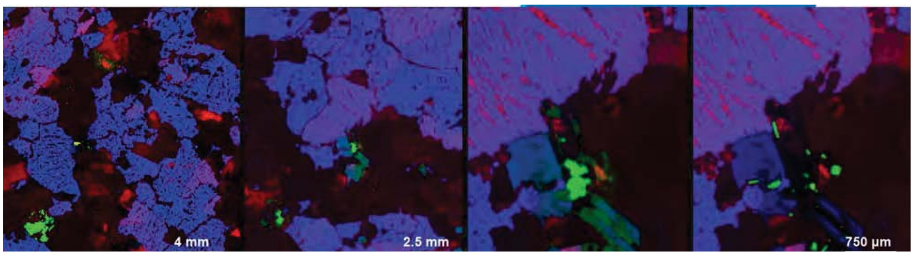
AXT is committed to bringing new technologies to Australia and New Zealand to ensure that our researchers have access to the latest technologies. To this end, AXT has just signed a distribution agreement with Sigray Inc., developers of disruptive X-ray technology that promises to revolutionise some analytical X-ray techniques.

To date, Sigray has already patented several devices and components with many more patents pending. One such device is the FAAST-Micro™ X-ray source that incorporates micron-scale metal X-ray emitters that are embedded into a diamond substrate. This design results in far superior cooling and the anode is no longer limited by the melting point of the substrate. The FAAST-Micro™ X-ray source produces an electron power density 4X greater than a conventional source and results in an ultra-high flux home lab instrument. It also has numerous other advantages over more conventional sources such as multi-wavelength anodes .

Sigray's AttoMap microXRF instrument utilises the new source which is mated to SigRay's highly optimised optic. This combination produces an industry-leading 8µm spot size and an X-ray intensity brightness more than 50 times that of more conventional polycapillary systems. This provides the AttoMap with class-leading levels of performance, i.e. the highest resolution sub-ppm X-ray mapping with results obtained in less than a second. This makes it the ultimate tool for geology, biology, forensics and materials science researchers.

Dr. Wenbing Yung, President and CEO of US-based Sigray is a key figure in the field of X-ray optics. He was also the founder of Xradia, which manufactured X-ray microscopes and was acquired by Carl Zeiss. His technical prowess has also been recognised by election to a Fellow of the Optical Society of America and four prestigious R&D 100 Awards. Dr. Yung said of the new agreement with AXT, "we are excited to re-establish our relationship with AXT who we worked with in the Xradia days as they have a proven track record when it comes to introducing new technologies. We have numerous new products under development and look forward to working with AXT to bring these to Australia."

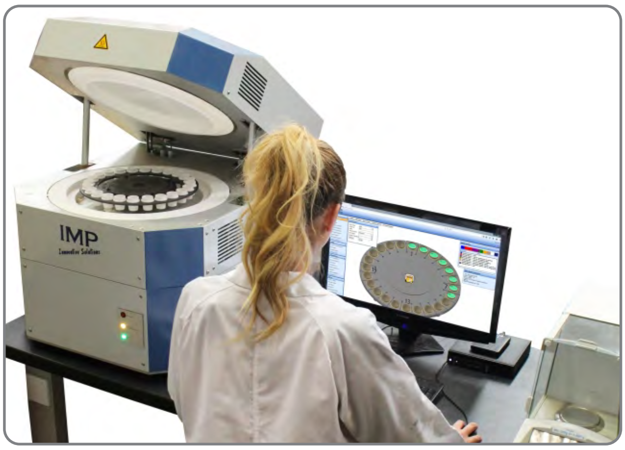
AXT's Managing Director Richard Trett commented, "this new arrangement is consistent with our strategy of sourcing the latest and most advanced technologies and making them available to local researchers. As a nation which will survive based on technical superiority, access to the most cutting edge solutions like Sigray's AttoMap are essential to maintaining our competitive edge."



Elemental mapping of a geological quartz sample at increasing resolutions, showing K (Blue), Zn (Red), Co (Green), and P (Green in last image) inclusions.

Sigray's products join a host of other X-ray-related and analytical instruments in the AXT product portfolio. If you are looking for analytical instruments that will give you an edge or an unfair advantage, please visit www.axt.com.au.

Posted June 14, 2017



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RRM Range of Premium Iron Ore Certified Reference Materials

RRM is proud to release a range of Premium Iron Ore Certified Reference Materials, with 21 products of Australian (Pilbara) origin and 3 products of South African (Northern Cape) origin.

Separate certification exercises have been conducted based on laboratory moisture determination procedure. Certain laboratories determine the dry weight according to ISO 2596:2006 correction for hygroscopic moisture, with other laboratories preparing samples for analysis according to ISO7764:2006.

For both methods; certified values are provided for measured and calculated Iron, multi-element, as well as total and intermediate LOI values.

Both, Iron concentration as determined quantitively from the measurement process (direct assay method) via fused bead XRF analysis (as per ISO 9516-1) and Calculated Iron derived from the "difference" method (as per ISO procedure 2597-3) have been reported and certified.

To further characterize each material, additional information is provided, which includes the following:

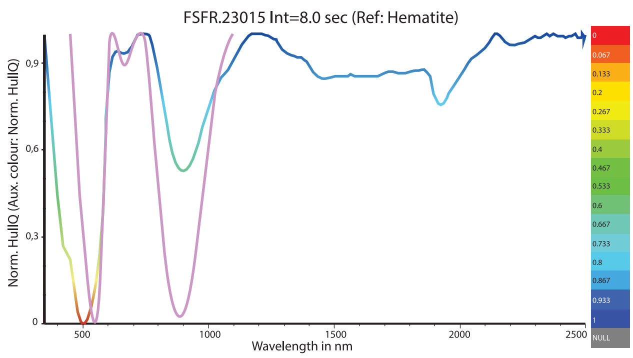
- Particle Size Analysis Data
- Quantitative X-Ray Diffraction Analysis
- FTIR, SWIR and VNIR Spectral Data
- Sorption Testing Data, illustrating the potential effect of hygroscopic moisture on the quality of the chemical analysis results

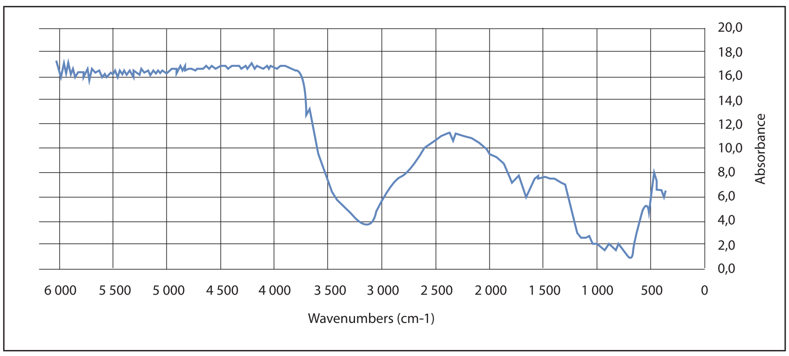
To ensure the best possible quality the CRMs are painstakingly rotary divided to the final aliquot sizes required by individual clients.

RRM is highly focused on producing the highest quality Premium certified reference materials possible, for both internal and external laboratory performance management.

What we do:

- Custom produced CRMs from your materials
- Industry relevant RRM sourced Iron Ore CRMs
- Coarse (-2mm) standards available on request
- Laboratory performance evaluation–through our Iron Ore Proficiency Testing Scheme





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www.resourcereferencematerials.com

Product	Fe (%)	Fe calc (%)	SiO_2 (%)	Al_2O_3 (%)	TiO_2 (%)	MgO (%)	Mn (%)	P (%)	S (%)	LOI				Method
										371°C	425°C	650°C	Total	
Fe-117	42,02	42,09	16,28	11,39	1,07	0,271	0,447	0,028	0,066	6,95	7,74	9,23	9,62	*
Goethite/Hematite	41,81	41,86	16,17	11,22	1,06	0,274	0,443	0,028	0,063	7,38	8,21	9,65	10,2	**
Fe-115	43,83	43,21	17,29	9,88	0,909	0,239	0,399	0,031	0,064	6,60	7,24	8,68	8,75	*
Goethite/Hematite	43,34	43,06	17,10	9,74	0,900	0,241	0,393	0,032	0,062	7,03	7,66	9,07	9,23	**
Fe-116	45,28	45,37	14,14	10,02	0,948	0,236	0,415	0,031	0,057	6,40	7,05	8,18	8,60	*
Goethite/Hematite	45,01	45,02	14,06	9,88	0,941	0,240	0,411	0,031	0,053	6,93	7,51	8,70	9,13	**
Fe-107	49,43	48,80	22,32	2,06	0,102	0,081	0,080	0,057	0,046	4,45	4,64	4,99	5,05	*
Goethite/Hematite	49,21	48,84	22,11	2,03	0,104	0,077	0,081	0,057	0,043	4,63	4,80	5,22	5,25	**
Fe-108	52,78	52,75	11,99	3,09	0,193	0,175	0,134	0,042	0,021	7,52	7,79	8,38	8,55	*
Goethite/Hematite	52,66	52,63	11,82	3,05	0,194	0,172	0,133	0,043	0,021	7,81	8,14	8,67	8,82	**
Fe-121	54,55	54,61	12,64	2,32	0,075	0,059	0,154	0,056	0,020	5,34	5,56	6,07	6,30	*
Goethite/Hematite	54,41	54,47	12,62	2,30	0,078	0,044	0,152	0,057	0,019	5,50	5,77	6,24	6,56	**
Fe-109	56,38	56,53	8,59	2,30	0,093	0,111	0,734	0,050	0,036	5,66	5,89	6,43	6,69	*
Goethite/Hematite	56,36	56,38	8,55	2,28	0,094	0,105	0,735	0,051	0,034	5,88	6,09	6,65	6,95	**
Fe-105	56,77	56,82	6,39	2,80	0,129	0,094	0,957	0,047	0,039	6,56	6,79	7,33	7,62	*
Goethite/Hematite	56,53	56,61	6,35	2,77	0,130	0,094	0,950	0,047	0,037	6,87	7,11	7,63	7,95	**
Fe-110	56,77	56,73	8,55	2,15	0,086	0,116	0,809	0,053	0,040	5,46	5,67	6,19	6,45	*
Goethite/Hematite	56,56	56,56	8,52	2,14	0,087	0,122	0,802	0,053	0,039	5,69	5,90	6,42	6,68	**
Fe-111	56,91	56,85	8,42	2,20	0,079	0,104	0,816	0,051	0,033	5,50	5,72	6,21	6,45	*
Goethite/Hematite	56,76	56,72	8,30	2,16	0,079	0,096	0,815	0,052	0,032	5,75	5,95	6,47	6,77	**
Fe-113	56,89	56,66	7,12	2,87	0,097	0,108	0,322	0,047	0,032	6,89	7,18	7,71	8,00	*
Goethite/Hematite	56,53	56,55	7,04	2,83	0,097	0,104	0,322	0,048	0,030	7,11	7,38	7,92	8,21	**
Fe-102	57,07	57,11	6,20	2,75	0,101	0,167	0,590	0,048	0,037	6,77	6,98	7,50	7,76	*
Goethite/Hematite	56,91	56,96	6,16	2,74	0,102	0,172	0,588	0,048	0,034	6,95	7,22	7,73	8,05	**
Fe-103	57,19	57,24	5,86	2,76	0,115	0,092	0,863	0,047	0,037	6,67	6,90	7,48	7,77	*
Goethite/Hematite	57,06	56,98	5,83	2,73	0,116	0,086	0,861	0,048	0,036	6,89	7,14	7,70	8,01	**
Fe-120	57,26	57,18	6,20	5,20	0,359	0,038	0,021	0,075	0,022	4,77	5,16	5,91	6,10	*
Hematite/Goethite	56,97	56,95	6,14	5,17	0,361	0,034	0,024	0,077	0,019	5,03	5,45	6,17	6,48	**
Fe-104	57,31	57,39	5,67	2,78	0,113	0,096	0,839	0,040	0,039	6,65	6,89	7,45	7,76	*
Goethite/Hematite	57,12	57,17	5,65	2,75	0,114	0,104	0,835	0,040	0,036	6,89	7,17	7,71	8,03	**
Fe-106	57,33	57,20	5,90	3,08	0,171	0,105	0,572	0,047	0,034	6,54	6,80	7,42	7,69	*
Goethite/Hematite	57,11	57,12	5,86	3,05	0,174	0,103	0,571	0,047	0,032	6,76	7,02	7,64	7,93	**
Fe-114	57,51	57,57	5,17	2,97	0,102	0,087	0,296	0,043	0,033	7,52	7,77	8,34	8,62	*
Goethite/Hematite	57,32	57,41	5,15	2,95	0,101	0,091	0,293	0,044	0,032	7,76	8,06	8,58	8,85	**
Fe-112	57,83	57,86	4,67	2,96	0,099	0,077	0,228	0,043	0,034	7,73	8,02	8,58	8,83	*
Goethite/Hematite	57,64	57,60	4,63	2,93	0,099	0,094	0,229	0,043	0,034	7,97	8,26	8,81	9,18	**
Fe-101	58,18	58,10	5,54	2,45	0,094	0,106	0,495	0,049	0,033	6,66	6,87	7,39	7,66	*
Goethite/Hematite	57,94	57,97	5,51	2,42	0,095	0,101	0,493	0,049	0,031	6,85	7,09	7,62	7,89	**
Fe-119	60,06	60,07	6,23	2,64	0,220	0,045	0,023	0,077	0,021	3,72	3,92	4,35	4,58	*
Hematite/Goethite	59,83	59,95	6,22	2,62	0,219	0,042	0,023	0,077	0,021	3,94	4,10	4,54	4,76	**
Fe-118	61,04	60,89	4,68	4,44	0,577	0,057	0,055	0,049	0,024	1,96	2,17	2,54	2,74	*
Hematite/Goethite	60,71	60,06	4,66	4,40	0,581	0,057	0,055	0,049	0,021	2,20	2,37	2,78	3,01	**
Fe-123	63,22	63,15	5,93	1,77	0,095	0,105	0,037	0,058	0,013	0,270	0,319	0,688	0,816	*
Hematite	63,22	63,12	5,94	1,77	0,097	0,103	0,036	0,059	0,011	0,339	0,384	0,749	0,897	**
Fe-122	63,66	63,50	5,19	2,07	0,113	0,032	0,153	0,042	0,017	0,477	0,556	0,823	0,973	*
Hematite	63,54	63,47	5,19	2,04	0,115	0,030	0,153	0,043	0,015	0,563	0,591	0,885	1,040	**
Fe-124	63,99	63,82	5,18	1,83	0,098	0,036	0,172	0,041	0,012	0,254	0,331	0,561	0,705	*
Hematite	63,98	63,82	5,16	1,81	0,099	0,027	0,174	0,041	0,010	0,336	0,417	0,638	0,804	**

*ISO2596:2006
**ISO7764:2006

To download a complete list of certified element certificates, please visit our website (https://www.resourcereferencematerials.com)

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