



**The Institute of Materials, Minerals and Mining**

Schools  
Affiliates  
Scheme

Issue 20

Summer Term 2005

### **Another year comes to an end**

Well I really can't believe how time seems to be flying by and that this is the last newsletter for this academic year.

For me it has been a bumper year for visiting schools. Up to the end of March I had given 130 talks to over 4700 people, a mixture of pupils from year 7 to 13 and teachers. This term is proving to be just as manic. As usual you can find my diary on page 4, but you'll find that I am now pretty much fully booked for this term (except a few dates in July). I am already taking bookings for the Autumn Term so if you would like me to come out and see you please get in touch. People keep telling me that this is not an easy thing to do, which is probably true as I do spend a lot of time out of the office. However, if you send me an e-mail I will respond on my first day back in the office. Alternatively you can leave a message with Anita Horton, our new full-time administrator by calling 01302 380910.

As usual in this issue you will be able to find loads of information about courses and scholarships for you and your students, turn to pages 4, 5 and 6 for more details. We will once again be co-ordinating a series of Open Days in November, for more details see page 3 where you can also find a review of our MMM Day at the ASE meeting back in January.

Since the beginning of the year there have been changes in the Institute following our merger with the Institute of Packaging and you can read more about this on page 7. With the subject of packaging currently in our minds we have decided to create the 2006 SAS resource on this theme. If you have any views on this or know of any existing resources on the subject that you think we should know about, please get in touch.

Well all that remains is for me to wish you a relaxing summer break. I look forward to hearing from and meeting more of you in the Autumn. As usual thank you very much for your support throughout the year, especially to those schools that have made me feel very welcome during my visits. you.

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## Discover the World beneath your feet with a career in Geology

In the last few months I have made links with one of our local societies, MinSouth. They have a very enthusiastic Committee who are keen to promote Materials, Minerals and Mining in their area. One of the Council members has written a career profile and I'm sure you and your students will find it interesting.

Liv Carroll is 27 and is currently a Minerals Geologist on the Earth Sciences Team for Capita Symonds, a large UK-based consultancy firm. She studied Geology and Geography at A-level and says "I found that Geology was my vocation in life; I never cease to be amazed by the Earth, the processes involved and what the natural world produces."

After completing her undergraduate degree, a BSc in Geology at Durham University, Liv moved to London to study for her Masters in Mineral Deposit Evaluation and Mineral Project Appraisal at the Royal School of Mines, part of Imperial College.



*Delabole Slate Quarry,*

Liv explained that her current job varies from research work for government bodies, to work for private clients such as mineral operators. Her work involves meeting with people either in the office or out in the field. Every day is different and Liv enjoys the diversity of her job. She also says that she gets to meet and learn from a wide variety of interesting people and she feels that this gives her the chance to contribute to the bigger picture.

One of Liv's favourite projects was a couple of years ago when she spent two weeks travelling around the beautiful countryside of Northern Ireland visiting quarry sites and addressing the issue of the Aggregates Levy Sustainability Tax. The project combined geology with economics and because it involved looking at the impact of the tax on the industry there was a huge human element. The people at the quarries were being directly affected by the tax which is applied to each tonne of aggregate quarried and eventually the way the tax

was applied in Northern Ireland was changed. Liv says she feels she helped to get this outcome.

When asked why a career in her field might appeal to young people Liv answered: "There are endless opportunities and possibilities for jobs in the extractive industries all involving the processes and the products of the Earth. Just take a look around you and, like me, you may spend the rest of your life amazed."

## New Staff in Education

At the end of March our part-time administrator, Susan Longstaffe, retired after many years of working with the Institute. Susan's shoes were hard to fill but we have managed to find someone who we're sure will be able to do the trick.

Anita Horton is our new full-time administrator and she will be managing our Schools Affiliate Scheme database. Anita will be dealing with membership renewals and new members so if you have any queries about your membership she is the lady to call!



Anita is based here in our Doncaster office and can be contacted on 01302 380910 or by e-mail at [Anita.Horton@iom3.org](mailto:Anita.Horton@iom3.org). If I am not in the office I will put my phone through to Anita so if you can't contact me she will take a message and if it is urgent, contact me.

## 2005 Autumn Open Day Programme

This November we will be co-ordinating the fourth season of Open Days at Materials Departments across the UK. These events offer practical support and hands-on experience of the Materials topics in post-16 level courses and provide students with a greater understanding and appreciation of the importance of materials in our lives. Teachers will also gain valuable information which can be incorporated in to their teaching plans.

Typical activities include:

- Mechanical testing on metals, polymers, ceramics and composites with state of the art equipment and analysis techniques.
- Viewing materials from a macroscopic level to an atomic level using optical, electron and atomic force microscopes and X-ray analysis.
- Exploring new materials developments such as nano-scale materials, biomaterials, superconductors, lightweight composites and materials for fuel cells.

Schools visiting in previous years have given us very positive feedback. If you are not sure whether it is worthwhile you going, here are a few comments from previous schools:

“Students were interested and engaged in worthwhile activities”	Alsager School
“Broadened students experience of hands-on materials science”	St Paul’s Girls’ School
“Exceeded expectations”	Sutton Valence School
“Very appropriate to syllabus”	Skipton Girls’ High School
“Pupils were very engaged with the planned activities”	The Judd School
“Professionally delivered and informative”	St Joseph’s RC Comprehensive
“Every part was equally enjoyable and informative”	Brinsworth Comprehensive School
“Lots of different activities for the students to do”	Cheltenham College
“Staff were very understanding of the students needs”	Burton College

The Open Days will be taking place throughout November at venues across the UK. The events are free but the school must provide their own transport to and from the venue. Details of dates and venues are given below.

Venue	Date(s)	Time(s)
University of Birmingham	02, 09, 16, 23, 30	1330 to 1530
University of Cambridge	01, 08	1230 to 1600
Imperial College	02, 09, 16, 23, 30	1300 to 1530
University of Leeds	02, 09, 16, 23, 30	1230 to 1530
University of Liverpool	09, 16, 23	1230 to 1530
London Metropolitan University	02, 09, 16, 23, 30	1400 to 1700
Loughborough University	10	1000 to 1200 or 1400 to 1600
University of Manchester	16, 23	1400 to 1600
University of Newcastle	09, 16	1300 to 1530
University of Nottingham	09, 16	1000 to 1200 or 1300 to 1530
University of Oxford	04, 10, 16, 22	1000 to 1300
Queen Mary, University of London	02, 09, 16, 23, 30	1030 to 1230 or 1230 to 1530
University of Sheffield	02, 09, 16, 23	1300 to 1530
University of Wales, Swansea	02, 09, 16, 23, 30	1230 to 1500

Please note the times given are approximate and some flexibility may be arranged.

Flyers and booking forms will be coming out to schools shortly, however, if you would like to pre-register your interest in attending one of these events please get in touch with me at [diane.talbot@iom3.org](mailto:diane.talbot@iom3.org)

## DIANE'S DIARY

After a completely mad spring term, the summer one looks like it might be a bit easier... not!

- 31/03 St Thomas More School, Westcliffe on Sea
- 07/04 Brownedge St Mary's Catholic High School, nr Preston
- 14/04 Salters Chemistry Day, Bradford University
- 15/04 St John Fisher Catholic High School, Dewsbury
- 18/04 Blundell's School, Tiverton
- 19/04 Saltash School, nr Plymouth
- 20/04 Liskeard School
- 21/04 Helston School
- 22/04 Newquay Tretherras School
- 26-27/04 UCAS Convention, Newcastle
- 28/04 Burton College, Burton on Trent
- 04/05 Dulwich College, London
- 05/05 Ridgewood School, Doncaster
- 06/05 Bolton School (Boy's Division)
- 12/05 Kirkbie Kendal School
- 18/05 St Christophers School Letchworth
- 20/05 Uppingham School, Uppingham
- 24/05 Penketh High School, Warrington
- 26/05 Sacred Heart High School, Newcastle
- 27/05 Ogmores School, Bridgend
- 08/06 Gosforth East Middle School, Newcastle
- 09/06 Bungay High School, Suffolk
- 10/06 King James' School, Huddersfield
- 15/06 Ridgewood School, Doncaster
- 16/06 Dumpton School, nr Poole
- 17/06 St Martin's Ampleforth, nr York
- 20/06 Napier Polymer Study Tour
- 23/06 Salendine Nook School, Huddersfield
- 24/06 St Olave's School, York
- 27/06 London Metropolitan Polymer Study Tour
- 28-29/06 UCAS Convention Liverpool
- 30/06 Merchant Taylors Girls' School, Liverpool
- 01/07 Sussex Salters' Chemistry Camp
- 5-6/07 UCAS Convention Sheffield
- 07/07 Long Eaton School, Nottingham
- 08/07 UCAS Convention London Olympia
- 18/07 Samuel Whitbread College, Shefford
- 20/07 Kings of Wessex School, Cheddar

As you can see this term is a bit packed too and I'm quite looking forward to a few days in the office over the summer. However, no rest for the popular so I am already taking bookings for next term. If you would like me to visit please get in touch as soon as possible as the diary fills up pretty quickly. Once again I will be generally be doing visits on Wednesdays, Thursday and Fridays, but I will be limiting my visits to three talks per day.

## SAS Resources

Unfortunately we have been experiencing difficulties in producing the SAS resource for 2005. Hopefully these will be sorted out very soon and the resource should be with you shortly. Just as a reminder, the new resource if the Second Edition of the Tomorrow's Materials booklet and will feature case studies on the use of materials in a wide ranging selection of applications.

It is at about this time of year that we start to think about the next resource and bearing in mind our recent merger we thought it would be good to produce a resource for 2006 based around the idea of packaging. If you have any suggestions of what you think the resource should include, it's format or you know of any other packaging resources that you think we should look at please get in touch.

### Armourers and Brasiers Corus Scholarships 2005

Just a quick reminder to let you know that your year 12 students should be getting in touch about these scholarships if they would like to apply for one of the 2005 awards. The scholarships are awarded to students interested in studying materials, at the beginning of year 13 and if they continue to read materials at one of the participating universities their award will continue for the duration of their degree. Ten awards of £350 will be made towards the end of the Autumn Term and the deadline for applications is September, which gives your students plenty of time to apply over the summer holidays.

For more information about the scholarships and an application form your students should contact Carolyn Green at [c.a.green@bham.ac.uk](mailto:c.a.green@bham.ac.uk) or phone 0121 414 5175.

## Aerogel

This is a material that I have been hearing a lot about in schools as many of your Advancing Physics students seem to have chosen it for their projects and asked me questions about it. So I thought it was about time I did a bit of research and being generous, I've decided to share it with you!



AEROGEL is a silica based material just like glass, sand and space shuttle tiles. However it has a very different structure to these and a conventional foam. Aerogel is 99.8% air by volume and is comprised of tiny silica particles, 2 to 5nm in diameter connected together with a dendrite-like network. The voids between the particles are typically 20nm in diameter. The material has an incredibly large surface area to volume ratio so if you took a cube of aerogel with 2.5cm sides and opened it out completely it would cover a football field. Since the material is mainly air it is essentially transparent with a hint of blue. It actually looks like a cloud of blue smoke with a regular shape! It appears blue due to Rayleigh scattering the same phenomenon that makes the sky look blue.

This material holds the Guinness World Record for the lightest solid ever made with a density of only  $3 \text{ kgm}^{-3}$ , however more typically it has a density of 5 to  $200 \text{ kgm}^{-3}$  (compare this to  $2300 \text{ kgm}^{-3}$  for silica glass). Despite its very low density it can support up to 4000 times its own weight, but if you do the sums you'll work out that this isn't that much! It is quite difficult to handle as it is very fragile and breaks quite easily. It behaves better under compression so is vacuum packed in plastic bags for transportation. It can be cut using a diamond saw to produce a variety of shapes.

The material is 39 times more insulating than fibreglass and was used on the Mars Pathfinder mission to insulate the Rover, not just from heat but from extremely low temperatures too, as the cold could damage the instrumentation. NASA are currently using the material in their STARDUST mission to capture fast moving comet particles so that they can be brought back to Earth for analysis.



For more information about this amazing stuff have a look at the following sites:

<http://www.jpl.nasa.gov/news/features.cfm?feature=490>, <http://stardust.jpl.nasa.gov/tech/aerogel.htm>,  
<http://homepages.cae.wisc.edu/~aerogel/aboutaerogel.html>, <http://eande.lbl.gov/ECS/aerogels/satoc.htm>

### Rolls-Royce Science Prize

Over the years Rolls-Royce has supported a wide range of national and local science activities. However they have now launched a major long-term initiative to support and develop science teaching in the UK and Republic of Ireland. The Rolls-Royce Science Prize is an innovative awards programme with three principle objectives. Namely to recognise and reward excellence in science teaching in all its forms, to promote inspiring and sustainable strategies for teaching science and to contribute to teachers CPD. The Prize is an annual awards programme in which teams of people working in science education are invited to put together a proposal for delivering an aspect of excellence in science teaching in their own school or college. Short-listed teams will be awarded financial support (£5000) to implement their winning proposals. At the end of an implementation phase the Rolls-Royce Science Prize will be made to the team that is judged to have been most effective in implementing their proposal. They will be awarded £15,000 to invest in their school or colleges science education programme. A runner-up prize of £10,000 will also be made. The programme of awards for 2005-2006 was launched in May and teams are invited to submit their proposals before the deadline of February 2006.

I know it sounds like quite a complicated procedure, but the rewards really are worthwhile. If you would like to find out more please have a look at the Rolls-Royce web-site, [www.rolls-royce.com](http://www.rolls-royce.com).

## **Courses for you and your students – a round-up of what's going on**

It's that time of year again when I am inundated with information about courses available for you and your students so here is a round-up of some of the things that are on offer this summer and Autumn.

### **Polymer Study Tours**

These highly popular and successful courses will be running again in late June and early July this year. The courses are open to science and technology teachers and provide an interesting insight in to the polymer industry. Over the three days of the course delegates will attend lectures, carry out laboratory experiments and visits companies working on polymers. The courses are heavily sponsored and so only cost £75 to attend, which covers administration. This year the courses will be held at Napier University (Edinburgh), 19 to 22 June, London Metropolitan University 26 to 29 June and Manchester Metropolitan University 29 June to 2 July. Further information can be found on the enclosed booking form or at [www.horners.org.uk](http://www.horners.org.uk)

### **Materials Master Class**

Once again this year Rolls Royce will be running a Master Class in Materials for science and technology teachers in two parts. The first part is a two day residential course in the Materials Department and the University of Birmingham on the 22<sup>nd</sup> and 23<sup>rd</sup> September. The course covers a wealth of topics including mechanical testing and structures of materials, magnetic materials, fibre optics, shape memory alloys and materials for aerospace and sports equipment. All meals and accommodation are included. The second part of the course on 11<sup>th</sup> October is at Rolls Royce plc in Derby where delegates will have the chance to see engines during construction and look at how they are tested and monitored. I have been on this tour and can highly recommend it, its fascinating! There is a small charge of £30 to attend the course which contributes towards the cost of meals and accommodation. If you would like to find out more or book a place on the course please contact Erica Tyson by writing to her at Rolls Royce plc, PO Box 31, Derby, DE24 8BJ or e-mail her at [erica.tyson@rolls-royce.com](mailto:erica.tyson@rolls-royce.com)

### **Headstart courses**

These residential courses for students at the end of year 12 are co-ordinated by the Royal Academy of Engineering and run at a number of universities across the UK. The general courses give students a taste of a number of engineering disciplines, but this year they are also running courses focussed on particular aspects of engineering. In particular there will be a course focussed on Materials at Oxford (24 to 28 July) and one on Natural Sciences at Cambridge (17 to 21 July). To find out more about the courses and apply to go on one visit [www.headstartcourses.org.uk](http://www.headstartcourses.org.uk)

### **Insight courses**

These are very similar to the Headstart programme, but these are specifically aimed at girls. Again they are run at a number of venues around the UK and give a taster in a number of engineering disciplines along with industrial visits. Materials will feature in the courses at Birmingham, Brunel, Nottingham, Salford and Strathclyde (though the latter two do not offer materials undergraduate courses). Although the deadline for applications has passed there may still be places available, to find out you can ring 0800 282 167.

### **Other Taster courses**

The Material Department at the University of Birmingham will be running a residential taster course in Materials between the 19<sup>th</sup> and 21<sup>st</sup> July during which delegates will be able to design and build a model snowboard. There are 20 places available and there is a small cost of £30 to attend. For more information contact Carolyn Green at [c.a.green@bham.ac.uk](mailto:c.a.green@bham.ac.uk), or phone 0121 414 5175.

All of the universities with materials engineering and minerals and mining engineering departments will be having general open days later this year. These are the ideal chance for your students to find out more about courses and university life. You can find out more at the universities web-sites.

## **The Institute of Materials, Minerals and Mining merges with the Institute of Packaging**

Back in early January the Institute of Materials, Minerals and Mining merged with the Institute of Packaging. Our name will remain the same (though the prospect of being IMMMPs was quite appealing!) and the packaging aspects associated with the Institute of Packaging will be recognised by the creation of a new packaging division, which will retain the IoP name. For those of you who have not heard of this IoP before, or not read about the merger in the last few issues of Materials World the Institute of Packaging has a number of activities, the most relevant to education being the annual StarPack awards. There are different classes in this competition, one of which is open to schools, but the aim is for students to design innovative packaging solutions to a number of different design briefs, using a variety of materials. Details of the winning entries for the 2005 competition can be found at [www.pi2.org.uk](http://www.pi2.org.uk).

### **ASE Meeting: What we did and what we're planning**

We had a great time at the ASE meeting in Leeds in January and it was lovely to catch up with so many of you at the exhibition. Our materials, minerals and mining theme day was successful though we were a little disappointed with the numbers attending the lectures and workshops. Our evening reception at the Royal Armouries went really well, with delegates getting the chance to have a go at building a mini trebuchet!

The 2006 ASE Meeting will be returning to Reading and once again we are planning to host a number of special events in addition to our exhibition stand. More details to follow in the Autumn Newsletter.

### **Design & Technology with ICT Show**

After the experience we had at the Design and Technology with ICT show in 2004 we have decided to go again this year. The show will be taking place at NEC near Birmingham between the 17<sup>th</sup> and 19<sup>th</sup> of November and we will be having a stand for the duration of the exhibition.

If you are planning to visit please come along and say hello. You will also have the chance to discuss my visits in schools and perhaps book me to come in and talk to your students as I will have my diary with me!

More details will appear in the next newsletter.

### **Science Learning Centres – everything you needed to know**

The Science Learning Centres are a national network for professional development in science teaching and there are nine Regional Centres around England and a National Centre which serves the whole of the UK. The Centres provide courses for all involved in science teaching and assist teachers to develop their skills by offering courses about contemporary science and effective teaching techniques. The courses cover all aspects of science across all key stages and at 16+ and they underpin the scientific knowledge used by related subjects such as technology and maths, and vocational courses. The aims of the centres are to improve science teaching and raise moral in the profession and through these to inspire pupils. Each centre is equipped with ICT resources, labs and seminar facilities which allow them to run advanced training sessions. Most of the courses offered are run during the day in term time, however some are available at the weekend, after school or during the holidays and virtual courses will be available on-line.

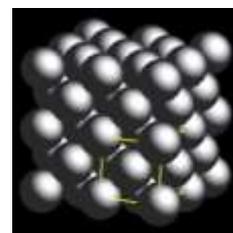
The nine regional centres (SLCs) are located at the University of Durham (SLC North East), Manchester Metropolitan University (SLC North West), Sheffield Hallam University (SLC Yorkshire and Humber), University of Leicester (SLC East Midlands), Keele University (SLC West Midlands), University of Hertfordshire (SLC East of England), University of London Institute of Education (SLC London), University of Southampton (SLC South East) and At Bristol (SLC South West). The National Centre is based at the University of York.

For more information and details of courses visit [www.sciencelearningcentres.org.uk](http://www.sciencelearningcentres.org.uk)

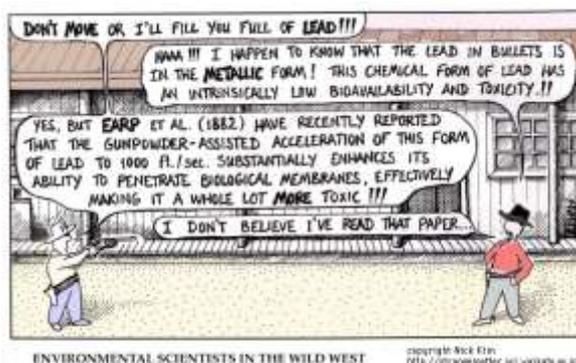
# LEAD



- Lead is a bluish-white metallic solid. It is lustrous and very malleable and ductile. It is resistant to corrosion but does tarnish in air. It is a poor electrical conductor.
- Lead has atomic number 82 and atomic mass 207.2. There are four main naturally occurring isotopes:  $^{204}\text{Pb}$  (1.4%),  $^{206}\text{Pb}$  (24.1%),  $^{207}\text{Pb}$  (22.1%) and  $^{208}\text{Pb}$  (52.4%).
- Lead isotopes are the end products of each of the three series of naturally occurring radioactive elements.  $^{206}\text{Pb}$  is at the end of the uranium series,  $^{207}\text{Pb}$  is at the end of the actinium series and  $^{208}\text{Pb}$  results from the decay of thorium.
- Lead has a density of  $11350\text{kgm}^{-3}$ . It melts at  $327.5^\circ\text{C}$  and boils at  $1749^\circ\text{C}$ .
- Lead has been known since ancient times. The chemical symbol, Pb, originates from the Latin *plumbum* meaning liquid silver, though the word lead is Anglo-Saxon.
- Alchemists spent a great deal of time trying to convert lead in to gold, without success. It is the first and oldest of the alchemical metals (gold, silver, mercury, copper, lead, iron and tin).
- The metal is found sparingly in its native form. The ores include are *galena* ( $\text{PbS}$ ), *anglesite* ( $\text{PbSO}_4$ ), *minim* ( $\text{Pb}_3\text{O}_4$ ) and *cerusite* ( $\text{PbCO}_3$ ). Galena is the most important ore.
- Lead is extracted by roasting the galena ore. Today, 40% of the UK's supply of lead comes from recycling scrap, mainly batteries and pipes.
- Many of the applications of lead draw from the ease with which it can be worked. The ductility and malleability of the material arises from its face centred cubic crystal structure. The Romans used lead for plumbing, and indeed some Roman plumbing is still in use today.



- Lead has been used for centuries in making stained glass windows. Soft lead can be shaped to fit around complex shaped panels to fasten them together.
- Lead oxide has been added to glass to produce a material with a high refractive index, for example lead crystal.
- The metal and its oxide are used in batteries such as those for cars which are rechargeable.
- Lead is used as a sound absorber and radiation shield for both X-rays and nuclear radiation.
- Lead has also been used in ammunition for many years and for small castings such as toys.
- Lead is toxic to humans for ingestion and inhalation, it affects the gut, central nervous system and causes anaemia. Lead is a cumulative poison and its compounds can lead to cancer and birth defects.
- Lead compounds are no longer added to fuel as an anti-knocking agent, since it has been suggested that they can cause brain retardation.
- Lead is also no longer used in paint, due to its toxicity. Lead compounds could be used to produce a variety of colours: white lead ( $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$ ), yellow chrome ( $\text{PbCrO}_4$ ) and red lead ( $\text{P}_3\text{O}_4$ ). Lead silicate has been used as a white glaze for ceramics and for fireproofing fabrics.
- The main alloying elements for lead are tin, antimony, arsenic and calcium. These additions are made to make the lead alloys harder and stronger than lead alone.
- Lead-tin alloys are widely used as solders. Lead with 20% tin is known as plumbers solder and has a mushy state between liquid and solid, allowing it to be worked. Lead with 62% tin is used as an electrical solder and solidifies at  $183^\circ\text{C}$ .



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