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# News

No 31 March 2004


# The Mackowsky Symposium

*Mackowsky at the 34th ICCP Meeting ,1981 Pau, France - Photo by Alan Cook*

inside this issue

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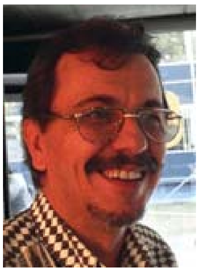

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# From the Editor

I am pleased to note another bumper issue of ICCP News. As promised in the last ICCP News, abstracts of the **Mackowsky Symposium** and the **poster papers** presented at Utrecht are included in this issue.

It is noteworthy that both the **Vice-president** and **General Secretary** have contributions in this issue to keep members informed of activities in these important posts. But do not forget that contributions from **all members** on any topic of interest are most welcome.

An invitation had been extended to the TSOP President to provide a regular column for ICCP News and we thank **Bob Finkleman** for his comments. This regular feature will keep ICCP members abreast of developments in our sister organisation.

Some members have requested to have available **old editions of ICCP News** on the website. This has commenced with issues 4, 6, 7, 8, 10, 11, 12 and 13 now available. They are in pdf format but are scanned images, so text is not searchable. However, you can certainly read them at your leisure or to ease the burden of point counting! The remaining issues will be scanned over the coming months and placed on the website.

Nominations are called for the new **Organic Petrology** and **Young Scientist awards** in this issue. For some of us, it will be too late to apply (due to age restrictions!), but I am sure that we all know suitable applicants who can be encouraged.

Finally, can members note that I have moved from my old job at James Cook University and started my own company based in Brisbane. My new contact details are :

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cheers and happy reading,

*Peter (ICCP Ed.)*

# From the President

In November 2003, two working groups of ISO TC27 met at Shoal Bay. This is a holiday resort located in NSW about 50 km north of Newcastle. The two working groups are WG18 (Classification of Coals) and WG19 (Petrographic analysis of Bituminous coal and Anthracite). I attended the meetings of both these WGs representing ICCP.

The two WGs were at markedly different stages of the procedure. Work on the Classification of Coals had largely been completed and a "final" draft of the proposal was circulated in 2002 - revised after receipt of some pages of written comments. This draft then ran into procedural difficulties with ISO. In summary, it appears that a magic time limit had expired and ISO wanted us to start again, even to the point of having to request that a group be formed to discuss the issue. This did not please those who have been active in the WG and it appears that Dr Pinheiro acting on behalf of the Secretariat for WG18 has got around that problem. So at Shoal Bay, the meeting had the circulated draft in front of it. The contents of this have been explained at a number of ICCP meetings. The proposal is that coals be classified on the basis of rank (three main categories based on vitrinite reflectance) type (four categories based on vitrinite content) and grade (five categories based on ash yield). Rather than get caught up in the history of the long existing rank terms such as bituminous, brown and anthracite, coals are classified as low, medium and high rank coals. As well as avoiding arguments about old boundaries, this has simplifying effects as the term "coal" now applies to coals of all ranks.

The convener of this WG is Dr Bob Durie and ICCP has had representation over many years from at least three Presidents. The basic concept for the classification owes much to Boris Alpern. Three other ICCP members (either members of WG18 or attending out of interest) were present and they were familiar with and supported the proposals. A number of representatives from North America (not petrologists) who had not made any concerns known in the course of the extensive written discussions that had followed circulation by Bob Durie of numerous versions of the draft, surprised most (or all) of the others wanting the title altered to "A petrographic classification of coals". It was pointed out that the aim was to produce a classification with generally validity and that, while two of the variables are petrographic, ash yield is not a petrographic variable and other categories of variables are unsatisfactory in global classifications for coals because of the difficulties of separating rank from type in bulk analyses. It was also noted that measurements made on maceral concentrates, while useful for rank assessment, are not a practical method for a general classification of coals.

The final decision was to accept the draft as tabled by Bob Durie and it is expected that it will be circulated for voting. Members will be advised when this happens and you will then be able to get access to the draft through your local standards association. Providing you agree with the classification, you should then urge your standards association to lodge a vote in favour of the proposal.

If the proposal for the classification of coals is accepted, it will mark a major advance in the acceptance of petrological data as a basis for understanding the variation in the properties of coals.

WG19 then convened with Harold Read in the chair to revise ISO standard 7404. Assuming that the WG18 proposal is accepted, major changes to terminology follow for WG19. For example, the title needs to be changed to Petrographic Analysis of Coals. The WG19 material is still at the stage of being circulated as drafts.

The simplifications flowing from the coal classification proposals have the potential to make the standard relating to coal maceral and reflectance analysis easier to understand. The only difficulty there is that although the classification emphasises the unity of coals, at present we still have a degree of dichotomy in the terminology for vitrinite at lower ranks if the term huminite is used at the maceral group level.

Most participants had travelled long distances, and it was disappointing that the two WG meetings were timetabled for a total of three hours. It is certainly true that meetings that run too long are generally counter-productive, but I thought that additional time for both of the WGs would have been useful.

Having these two WGs meet sequentially provided a timely reminder of how we need to undertake revisions having regard to their broader context. For WG18 and coal classification, we need to consider the wide applicability of data based on organic petrology techniques and in this the ICCP Accreditation Program has been invaluable. Indeed, without that program, it is unlikely that the present draft ISO system would ever have survived the scrutiny of the general "coal research community". For WG19 and standards for petrographic analysis, there is clearly an imperative to produce classifications that are as simple as possible consistent with the complexity of coals. The need for simplicity is especially apparent in trying to revise the nomenclature part of the standard. Having direct input to this process is also invaluable in ensuring that the standard is relevant to our own work, such as Accreditation.

A copyright issue arose as a result of these ISO meetings. We should contribute the latest maceral classification to the Petrographic Analysis standard, if not to both standards. If we do this in an unqualified fashion, ISO will then copyright it. This can mean that we would be unable either to circulate it or to revise it without specific permission from ISO. There are ways in which some reservation of copyright can be effected, as we are now doing with Elsevier. A problem with doing this is that ICCP with its current informal status cannot assert copyright even over work we would think was our own. This is not being possessive over ICCP work, but expresses a concern to make sure other organizations do not interfere with what ICCP should see as its own work. For example, the Australian Standards organization has cheerfully asserted copyright over a couple of diagrams I use in my laboratory. Strictly, this means that I cannot alter my own diagrams without their permission! We don't want this to happen more generally to ICCP work.

At the Rio meeting I noted that oil prices were unusually high, we were then close to producing from "the second half" of the worlds oil reserves and that we might be entering a new era of energy prices. Most forecasters of oil prices since then have again and again predicted prices would fall below USD20 per barrel, but the prices are now challenging USD35 a barrel for WTI. Various warlike activities have presumably had some effect, but higher prices are beginning to look like a new price regime. In 1980 dollars, the current prices are much lower than those following the second oil shock (peak of USD78.19 for 1980 in 2002 prices), but they are massively above the USD13.11 (USD14.47 at 2002 prices) for 1998.

The prices for coking coals in contracts written in late 2003 for 2004 rose nearly 30% over those written for 2003 reaching about USD57 per tonne with a 2004 contract reported at USD62/t. Just over a month into 2004, spot prices for some coking coals are between USD80 and 110 per tonne. Coke prices have gone from about USD75 in mid-2002 to over USD400 for some Chinese coke in early 2004. Presumably these are short-term peaks, but the underlying contract levels are likely to be high by recent standards. We are also seeing buyers queuing up to buy LNG and gas prices in the US are about twice the level in Australia. Against these nominal prices must be set the decline in the value of the USD in many other currencies, so the numbers are not as spectacular when stated in some floating currencies such as the Euro, Rand and Australian dollar. Even so, most of these prices represent substantial real price increases since 1998. Prices for steam coals are also being affected although the effects are less dramatic but with low rank coking coal (the so-called semi-soft) from Newcastle NSW being sold at USD70/t they too may rise sharply.

If carbon sequestration is indeed taken seriously, end-use energy prices look set to rise considerably. Can we also look forward to research on fossil fuels being taken more seriously as it becomes a smaller fraction of the total costs, or will we find our fields of study being squeezed even more tightly to effect "economies" to offset higher unit costs of fuels? ICCP input to the ISO revisions of standards should assist petrology in having a more pivotal role in future studies on fossil fuels.

General references to oil prices, BP Statistical Review of World Energy June 2003 see http://www.bp.com/subsection.do?categoryId=95&contentId=2006480. Current coal prices, S Wyatt, The Australian Financial Review, February, 2004 available in the archives at http://afr.com/

*ACC 19 Feb 2004*

# From the General Secretary

Voting papers for the election of the Chair of Commission I were sent out in December 2003, with the candidates being Lila Gurba and Walter Pickel. The voting has now finished and I have been informed by Returning Officer, Harold Smith, that the successful candidate is Walter Pickel. The voting details are as follows:

Number eligible to vote: 149
Number of votes received: 87 (58%)
Candidate Lila Gurba received 20 votes: 23% of votes received
Candidate Walter Pickel received 66 votes: 76% of votes received
Abstention 1: 1% of votes received.

No elections are scheduled for 2004 and 2005.

From some communication with members it appears that not everybody is aware of his/her commission membership. Since the membership to a commission usually dates from the time of application, it can happen that members become active in a commission they did not apply for. Of course this does not affect their activities, but it does affect their eligibility to vote. As you know, all Associate and Full Members of the Commission elect Chair and Secretary of the commissions. So if you did not apply for a commission, you are not eligible to vote, although you may be active in this commission.

A new membership list will be published soon. Please check your details and inform me if you would like to extend your commission membership.

*Petra David*
*February 23, 2004*

# From the Vice-President

Dear All,

I had a message from the Editor, Peter Crosdale, “reminding” me that I have been elected Vice-President of the ICCP, and challenging me to present some contribution to the Newsletter. Although I didn't forget, he is absolutely right.

Going to the Statutes, nothing is written on the duties of the Council Members, except that there is an Executive Committee comprised by the President, the General Secretary and the Treasurer and that shall organize and administrate the organisation. I think that this situation should be solved.

When I wrote my manifesto to run for elections in 2003, I wrote then "The Vice-President must not be an 'ornamental' position inside the Council". And apparently, this is the only position inside the Council with an 'ornamental' role. Although the tasks are not clearly defined in the Statutes, President, Secretary General and Treasurer, belonging to the Executive Committee, have to carry out the day-to-day duties of the ICCP, and the

Editor has the job to publish the Newsletter.

I would like the Council to discuss this matter in a future meeting. Maybe having responsibilities and tasks well defined and clearly stated in the Statutes, matters will run more efficiently.

If we accept to introduce these duties in the Statutes, this means a need to change them. This is not a problem. Statutes are not static. They change and evolve according to the needs. And certainly there will be some more changes to make.

Now, I would like to congratulate Walter Pickel for his re-election to chair Commission I. I believe he will continue to lead this Commission with the interest and heart giving shown up to now, and will give all the efforts to improve its results and achievements. Alles Gute Walter!

To Maria Hamor-Vidó, my best wishes for a successful meeting. I am sure she and her organising committee will come up with a very interesting and successful event.

*Lopo Vasconcelos*
*ICCP VP*

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# Update on ICCP Membership

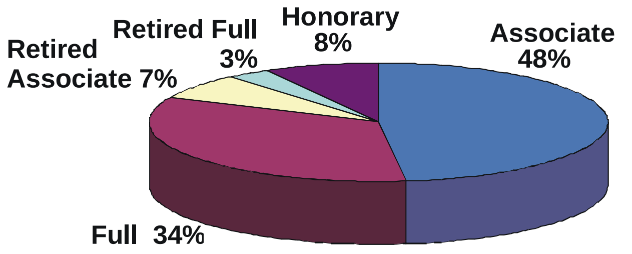
In order to calculate membership statistics, as outlined below, we have used the most recent membership list available (Master file of January, 2004). Pie charts are courtesy of David Pearson and Heath Mortimer (D.E. Pearson & Associates Ltd.).

**Membership by membership category**

The ICCP currently has 177 members. A breakdown of members by membership category is:

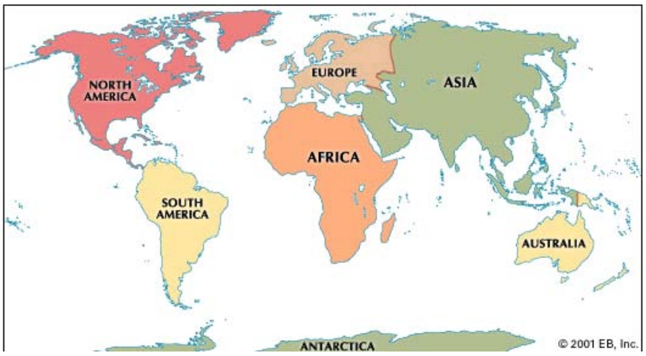
| Membership Category | Number |
|---|---:|
| Associate | 83 |
| Full | 60 |
| Retired Associate | 13 |
| Retired Full | 6 |
| Honorary | 15 |
| **TOTAL** | **177** |

**Distribution of Membership by Composition**




**Membership by continent**

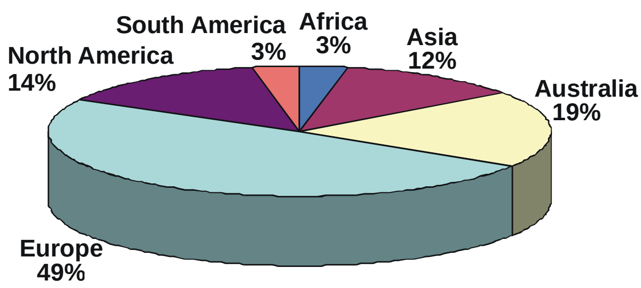
We have used the commonly accepted 7 continents as membership regions, namely, Africa, Antarctica, Asia, Australia, Europe, North America and South America, as the yardstick. The boundary used between Europe and Asia is the one depicted in Encyclopædia Britannica 2003 Student Edition CD-ROM (see below).




The proportion of members by continent is:

| Continent | Members |
|---|---:|
| Africa | 6 |
| Asia | 21 |
| Australia | 33 |
| Europe | 86 |
| North America | 25 |
| South America | 6 |
| **TOTAL** | **177** |

Distribution of Membership by Continents




**Membership by Commission**

These statistics are the least meaningful, but are included to indicate numbers of participants in each Commission. Obviously, some ICCP Members are members of only one Commission, some are members of two Commissions, with three permutations, and some are members of all three Commissions.

| Commission | Number |
|---|---:|
| Commission I | 145 |
| Commission II | 124 |
| Commission III | 117 |

*Aivars Depers*
*Rudolf Schwab*
*25/2/04*

# Corrections to ICCP News No. 30

## Commission I Minutes

The reflectance of the ICCP YAG is 0.90% and not 0.89%, as reported in the minutes of Commission I (ICCP News No 30, pages 20 and 22).

## Treasurer's Fax Numbers

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The last '500' of the first number was inadvertently omitted in ICCP News No 30 (page 46). Apologies for any inconvenience caused.

# Qualifying System for Reflectance Analysis W.G. - Results of the Round Robin 2003

A.G. Borrego, C.V. Araujo, B. Cardott, A. Cook, P. David, D. Flores, M. Hámor-Vidó, W. Hiltmann, W. Kalkreuth, K. Kommeren, B. Ligouis, M. Marques, J. G. Mendonça Jr., M. Misz, W. Pickel, K. Reimer, I. Suárez-Ruiz, A. Vieth

**Introduction**

Measurement of vitrinite reflectance in sedimentary rocks other than coal is often a difficult task due to a number of factors, amongst them: i) Vitrinite is very scarce in certain sedimentary basins resulting in low statistical significance of the data; ii) Particles are sometimes too small for a reliable measurement; iii) Surrounding minerals may affect the accuracy of the reflectance determination; iv) Polishing may be poor and this can be linked to sample lithology and v) Particles with suppressed reflectance or reworked particles may co-exist with the rank vitrinite population. With this scenario, a numeric label accompanying the reflectance measurement and informing about the reliability of the mean reflectance value would no doubt be extremely useful not only for computer based basin analysis (figures are easier to handle for computers) but also for any person having to deal with data of different quality.

The results of this working group are expected to be the basis for a future accreditation program on vitrinite reflectance measurements of dispersed organic matter (DOM) in sedimentary rocks.

The **qualifying system for reflectance analysis W.G.** was created at the Bucharest meeting in 1999, and is aimed at discussing and testing a qualifying system for vitrinite reflectance analysis, initially proposed by Joachim Koch. Since 2001 Angeles G. Borrego convened the activities of the group that performed a Round Robin exercise during the year 2002 based on CD images of vitrinite particles (193 images were classified). The results of this RR exercise can be summarised as follows:

- -The particles were classified with relatively low certainty since frequencies of modal values were low. Despite of this most participants classified the particles either as the mode or as a consecutive qualifier, except in the cases where concepts like oxidation or suppression were involved. No participant was alone in a given decision.

-The discussion at the Meeting in Africa focussed on i) the convenience of using a simplified system with only three qualifiers, ii) the significance of polishing, iii) vitrinite identification, iv) what to do with reworked, oxidised particles or particles with suppressed reflectance, v) name of the qualifiers, vi) difficulties with screen resolution, etc.

It was decided to run an additional exercise based on CD images using an improved system where genetic implications were removed and particularly the limits between Q3 and Q4 were better defined. During the year 2003 an additional exercise was performed and this is a summary of the results of the Round Robin exercise.

**Exercise Content**

The CD exercise contained 298 vitrinite images and from them 115 belonged to last year exercise including those classified with rather low level of agreement. The images comprised vitrinites of different maturity and rock type.

The classification system in which the exercise was based consists on 5 qualifiers defined as follows (in *italics* is marked the differences with the system applied in the previous year and the genetic concepts removed are also marked):

**1=*best quality*:** Bands, stripes, large detrinite particles (>3x the measuring field) exhibiting clean surfaces (free of pores, scratches or bright minerals) inside and outside the measuring field (minimum distance for defects =1 measuring field diameter. Pyrite needs more)

**2= *good quality*:** Bands, stripes, large detrinite particles (<3x the measuring field, but distinctly thicker) having clean surfaces under the measuring field but defects (pores, scratches) *in a distance of 1/2 measuring field diameter.*

**3= *medium quality*:** Clean surfaces in particles slightly larger than the measuring field *(~2x the measuring field).* Large particles with impurities at the edge of the measuring field. *Pyrite in a distance of >3x the measuring field.*

**4= *low quality*:** irregular surface within the measuring field (spots, granulated surface, microscratches). *Overall particles of low quality due to the aspect of the surface.*

**5= *lowest quality*:** Particles about the size of the measuring field or pyrite in a distance of one measuring field. *Overall particles of low quality due to their small size or to the closeness to highly reflecting minerals.* ~~Suspected weathered, altered or oxidised particles. Particles with suspected suppressed reflectance.~~

**Results**

The results shown in this report are based on the data provided by the authors (18). Most of the statistical considerations are based on modal values and the level of agreement of participants with these modal values. When participants doubted the assignment according to mode was considered. Figure 1 shows the comparison of last year and this year individual scores. The results have improved considerably since last year only two participants classified the surface according to mode in more than 70 % of the particles and 12 more did in more than 50 % of the particles, whereas this year 11 participants classified the particles according to mode in more than 80% of the particles. The poor score of participant L can be attributed to a different reason since many particles were left without label. **Overall excellent results.**

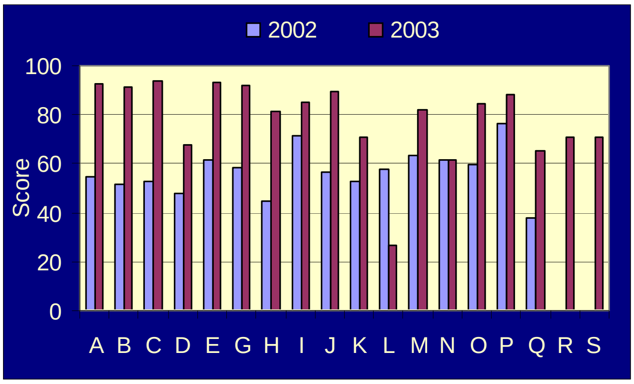


*Figure 1. Comparison of the percentage of particles classified according to modal values by individual participants in last year and this year exercise*

**Agreement in relation to quality of the surface**

The improvement of the results cannot be attributed to the fact that higher quality images were selected this year, since the amount of particles assigned to each qualifier were similar in both exercises. Figure 2 shows the distribution of particles according to participants decision in the two exercises and the corresponding level of agreement. The amount of particles agreed by more than 80% participants increased from 5% in 2002 to

26% in 2003 and the amount of particles agreed by 65-80% of participants increased from 18% to 32%. Overall the particles classified with low certainty decreased and at least 9 participants out of 18 had the same opinion about the quality of the surface in 84% of the particles. We have now high certainty in the classification of the particles.

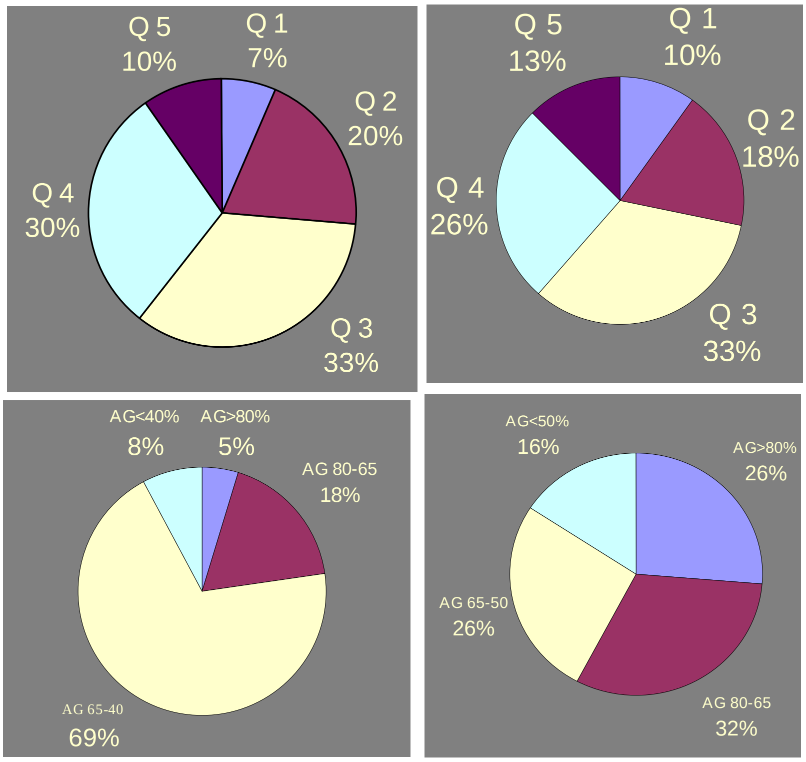


*Figure 2. Amount of particles assigned to each qualifier and level of agreement achieved. Left 2002 exercise, right 2003 exercise.*

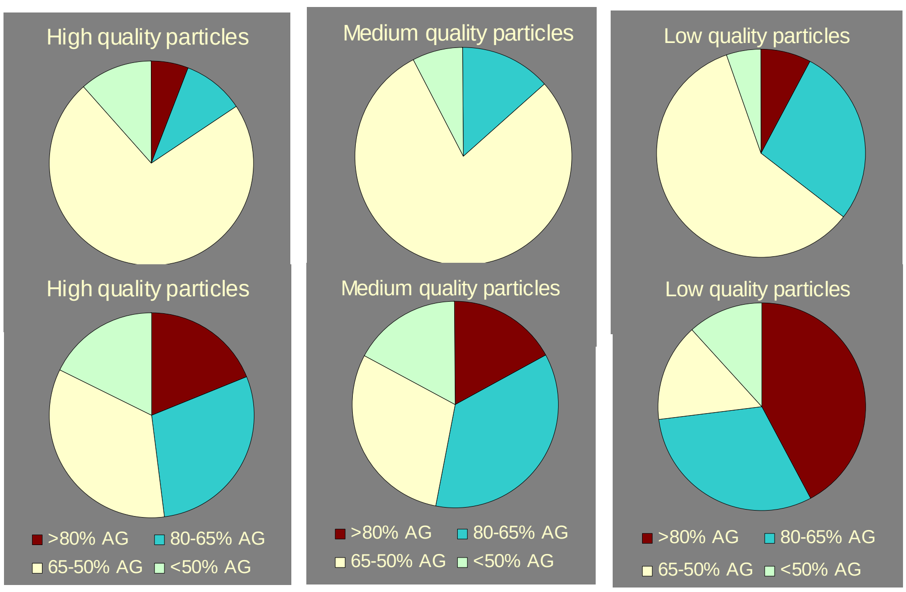


*Figure 3. Level of agreement in relation to the quality of the surface. Top results of the 2002 exercise, bottom results of the 2003 exercise*

The level of agreement can be related to the quality of the surface (higher agreement within the high quality surfaces than within the low quality surfaces or vice versa; Figure 3). The certainty in the classification of particles was roughly equally low for the high, medium or low quality particles in the 2002 exercise. The situation changed drastically this year. Both high, medium and low quality particles were classified with higher certainty and the improvement was significant between the medium (Q3) and low quality (Q4 + Q5) particles. This is particularly important for the utility of the system since particles classified as Q4 and Q5 can be regarded unsuitable for reliable reflectance measurements.

**Agreement in the re-classified particles**

As mentioned in the introduction 115 particles classified with low agreement in last year exercise were also included in the set of images to be classified this year. A quick inspection of the classification systems might indicate that the differences between last year and this year systems were rather subtle. Despite of this the modifications have a large impact in the classification of the surfaces.

Figure 4 shows that most of the re-classified particles were assigned last year to a given qualifier with low level of agreement (50-65% of participants agreed). The certainty in the assignment increased in half of these particles using the 2003 system.

The modifications introduced in the classification system did not have the same impact on all participants. Figure 5 shows the amount of particles that were assigned to a different qualifier using the 2003 system. All participants changed their mind at least in 40 % of the particles. As consequence frequency of mode in the assignments increased in 78 % of the particles and from them 31 % of the particles changed the identification.

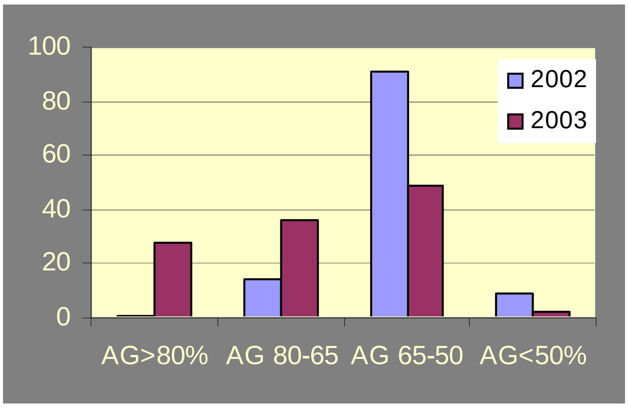


*Figure 4. Level of agreement in particles included in both exercises applying the 2002 and 2003 classification systems*

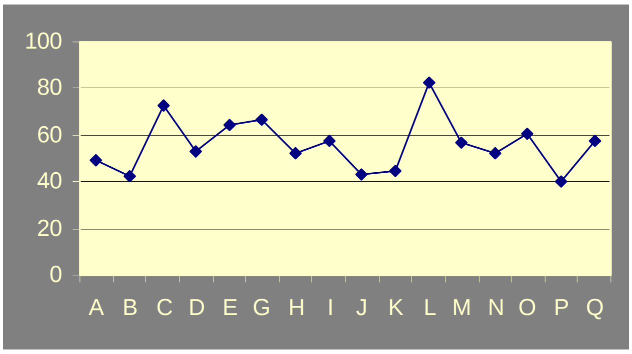


*Figure 5. Amount of particles assigned by each participant to a different qualifier using 2002 and 2003 systems.*

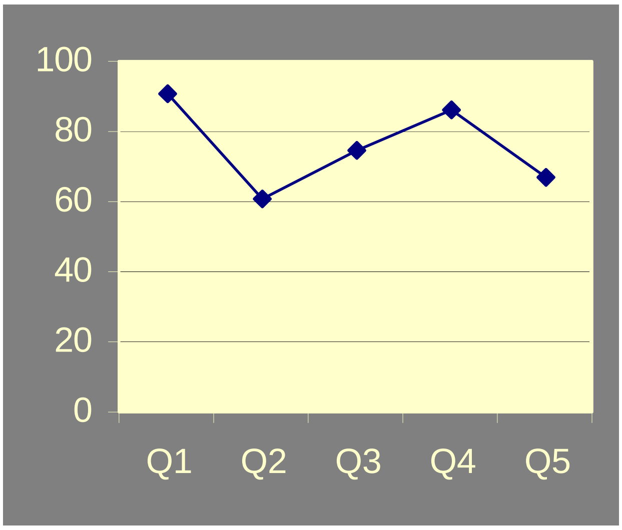


*Figure 6. Percentage of particles assigned to each qualifier where agreement increased using 2003 system.*

The improvements in the level of agreement were significant and affected all qualifiers as shown in Figure 6 where it is plotted the percentage of particles assigned to each category where the agreement increased.

All the data discussed up to this point indicate that we were able to define a sound system with limits rather well-established and applicable.

**Suggestions for an improved system**

Some of the difficulties we have faced in the CD exercises will be no longer relevant when analysing microscopy samples, among them it can be mentioned i) particles were selected by a single person and identifications might be wrong, ii) the measuring field makes difficult to see surface below, particularly in small particles, iii) different screens might yield variable quality displays, iv) some camera-screen interferences result in wavy images or colour variation. No doubt that all these points have contributed to decrease the level of agreement but despite of these our results were excellent. As mentioned by participants in their comments there is still some room for improvement among them.

- Complains about the relative quality of Q4 and Q5 were received since the criterion to assign a particle to Q5 was mainly a question of size and very often particles classified as Q5 had a nice and smooth surface that could yield reliable measurements only decreasing the size of the measuring field, whereas particles classified as Q4 will never yield a reliable measurement.
- We should introduce in the system also some indication about the size and brightness of pyrite since large, massive and bright pyrites will not have the same effect on measurement as small or disseminated framboids.
- Most participants would like a 3 classes system: good quality (Q1+Q2), medium quality (Q3), low quality (Q4+Q5). Alternatively: Excellent (Q1), good (Q2+Q3), low quality (Q4+Q5).

**Conclusions**

*The results of this year exercise were excellent and we are ready to apply our system in real samples at the microscope.*

**Proposal for a simplified system to be applied with microscopy samples**

After discussion at the meeting in Utrecht the system to be applied in 2004 exercise on microscopy samples reads as follow: It is assumed a field diaphragm 3 times larger than the measuring field the three qualifiers dealing with the quality of the surface might be defined as follow:

**1= Excellent quality:** Bands, stripes, large detrinite particles exhibiting clean surfaces (free of pores, scratches or bright minerals) under the measuring field and inside the field diaphragm.

**2= good quality:** Bands, stripes, large detrinite particles, distinctly thicker than the measuring field, but smaller than the field diaphragm. Clean surfaces under the measuring field but defects (pores, scratches) within the field diaphragm. Free of large pyrite particles within the field diaphragm.

**3= low quality:** Clean surfaces in particles about the size of the measuring field. Large particles with impurities within the measuring field (spots, granulated surface, microscratches). Large and/or bright pyrite within the field diaphragm.

**4= Unsuitable:** Suspected weathered, altered or oxidised particles. Particles of uncertain origin.

**Forthcoming work**

For this year the system will be tested on microscopy samples. Four samples will be analysed belonging to different kerogen types. Participants will be asked to measure the reflectance and assign the measurement to one of the qualifyiers. Anyone willing to participate in the exercise is welcome to joint us. Please contact the convenor to get the samples.

The time and effort of J.R. Montes at INCAR for sample preparation and polishing is gratefully acknowledged an also the co-operation of L. Stasiuk for providing samples from Gething coaly and Lower Mannville Formations to expand the sample set.

Evamarie Wolff-Fischer delivers her address at the Mackowsky Symposium. *Photo: Peter Crosdale*

# News from Commission I

In the working group section of Commission I, Kimon Christanis circulated the first round robin exercise of the *Peat WG* in February. To quote Kimon about the objectives of the Working Group: The aim of this WG is:

- a. to bring together petrographers that deal with the petrographical and petrological features of peat, but also scientists from other disciplines that have an interest in "peat science",
- b. to examine the applicability of the existent maceral terminology (huminites, inertinites and liptinites), in accomplishing the desirable targets,
- c. to assess the necessity of a new/revised(?) nomenclature scheme for the micro-petrographical constituent of peat, and to which directions this scheme should be feasible to apply for. Some preliminary directions can include:

  coal science (i.e. as maceral precursors)
  - ★ soil science (i.e. considering peat as organic-rich soil - histosols)
  - ★ organic-rich sediments science (i.e. dispersed organic matter)
  - ★ material science (i.e. applications in industry, environment protection etc.)

  botanic (i.e. phytogenic approach).
- d. to propose a terminology that will accomplish the specifications for a comprehensive description of peat microscopic constituents.'

Anybody interested in joining this working group, please contact Kimon Christanis.

Peter Crosdale sent in the following note on the *Working Group to Investigate the Status of Degradinite*: 'Samples containing suitable material were examined during the microscopy session at the Utrecht meeting by both members and non-members of the WG. A wide variety of opinions were expressed but no consensus was reached. More samples are being sought to look at a wider variety of similar material and samples of Kimmeridge Clay have been obtained for comparison with bituminite.'

The *Standardization WG* is shortly going to send out a set of two or three lignite samples to check on the applicability of the new Huminte Classification System. Samples were kindly sent in from Kimon Christanis and a set of German samples is also available.

The *Sample Preparation WG*, though formally resting after the presentation of the 'Lucite Method' at the Utrecht Meeting, is still active. Dave Pearson presented the method at the ISO Meeting in Shoal Bay last November and it is likely to be included in the new ISO 7404_2. Samples of various ranks and composition were in the meantime tested in Australia on possible heat effects of this preparation method. It is clear by now that bituminous coals are not affected. Low rank coals seem to be partly affected to different degrees. Further testing is currently done.

No response was received from the R*eview of New Methodologies and Techniques in Organic Petrology WG*.

The *Temporal Variation of Coal WG* is busily collecting data and would welcome any additional input of regional data. Please contact Lopo Vasconcelos if you are able to supply petrographic data.

In the service section, the *Accreditation Programme* concluded another successful year. Please find Aivars Deper's report following. The review process of the accreditation is still in progress and a final report is expected to be presented at the following ICCP Meeting. All members of commission I were invited to contribute with their comments to this review. Please send these to Walter Pickel.

The service to calibrate standards against the *ICCP Reflectance Standards* is available from Dave Pearson and Walter Pickel. In the minutes of the Utrecht Meeting, the reflectance of the ICCP master standard was erroneously reported to be 0.89%, it is 0.90%.

On the editorial side, 'Graphite, Semi-Graphite, Natural Coke, and Natural Char Classification - ICCP System, by Kwiecinska & Petersen, has been published in the most recent issue of the Int. J. of Coal Geology (vol. 57, 2) and you should find a copy of this article attached to this volume of the ICCP-Newsletter.

Walter Pickel / Deolinda Flores
Sydney / Porto, Feb. 26, 2004.

# Accreditation Programme Update

The 2003 Exercise was conducted last year. This was a trial exercise, where new petrographers were permitted to participate, but were not charged the normal registration fees. The exercise proved to be well supported and 13 people took part. Eight participants were new petrographers. Accreditation certificates were posted out to successful petrographers in mid-January, 2004 and the Accreditation website has been updated recently ( http://www.iccop.org/acredit_accredited.htm ). Two petrographers were denied accreditation and one withdrew due to work commitments.

The Accreditation Committee is proud to announce that the following people have gained ICCP Accreditation:-

Kathy. E. BENFELL
Peter J. CROSDALE
Alfonso DELA CRUZ
Zeba IMAM
Jhumjhumi MAITRA
Hrusi K. MISHRA
Donna M. O'CONNOR
Daniel RIGG
Pravin K. SHARAN
Loraine WATSON

The 2004 Exercise has commenced and has been very well supported. To date, 49 petrographers from 29 laboratories have indicated that they will participate. If you would like to participate, then please contact the organiser, Aivars Depers ( mailto:iccpap@ozemail.com.au ) as soon as possible. New petrographers are most welcome to join, but the current fee structure will apply. Please refer to the Accreditation page at the ICCP website ( http://www.iccop.org/acredit_general.htm ) for details.

If you have not been contacted by the organiser and invited to participate in the 2004 Exercise, then this means that there are still some outstanding issues remaining from either the 2002 Exercise or the 2003 Exercise. These issues need to be finalised before an invitation to the 2004 Exercise is sent out. Please contact the organiser, as a matter of urgency, if you have previously been accredited, but have not been contacted recently.

*Aivars Depers*
*Deolinda Flores Fonseca*
*Rosa Menéndez*
*Walter Pickel (Chairperson)*
Accreditation Committee, 5/2/04

# News from Commission II

Summary of activities currently running under Commission II. Those interested in participating, please contact the convenors.

**Environmental Applications of Organic Petrology Working Group** *Convenor: M. Mastalerz*

The activity of the Group focus on building an atlas of anthropogenic particles. The structure of the atlas consists of two main groups, in which anthropogenic particles are classified in relation to source (combustion, carbonization, manufacture, etc), and with respect to site of deposition (atmosphere, soil, water, etc). The atlas is in an advanced stage but input of images classified regarding the site of deposition will be welcomed.

**Thermal Indices Working Group** *Convenor: C. Araujo*

The Thermal indices WG has been working over the last years on matters related with i) results on different thermal indices, ii) spectral fluorescence analysis and, iii) on the geochemical characterization of Type I kerogen samples. The full report based on these results is available in the ICCP web page. The consistency between most data provided by the laboratories involved in this round robin exercise was very good but additional work is needed to check the deviations of maturity parameters in marine type II (marine facies) and type III (coaly) kerogens.

An exercise is running in which a Type II kerogen sample (Irati shale) will be analysed.

**Coalbed Methane/$CO_2$ sequestration.** *Convenors: P. Crosdale and L. Gurba*

The W.G. has enlarged the scope initially based on coalbed methane to embrace items related to $CO_2$ sequestration. A white paper is under preparation to identify coal properties relevant to the subject.

**The Atlas on Dispersed Organic Matter Project.** *Convenor: W. Kalkreuth*

This WG was created with the aim of producing an Atlas on dispersed organic matter with didactic purposes. Some contributions related to sample preparation, analytical methods, liptinite, inertinite, vitrinite and zooclast occurrences, reflectance assessment and DOM classification are being updated to be grouped in an special volume for publication.

**Classification of DOM**. *Convenors: L. Stasiuk, J. Burgess, A. Hutton*

The classification of DOM is the product of a joint effort with TSOP to find an agreement on organic component classification in sedimentary rocks. The Atlas is in an advanced stage and contains images of components taken under different illumination conditions. A progress report is available in the ICCP web site and a final version will be presented at the meeting in Budapest.

**Qualifying system for reflectance analysis.** *Convenor: Angeles G. Borrego*

The WG. is aimed at discussing and testing a qualifying system for vitrinite reflectance analysis. After a couple of exercises based on CD images with excellent results, the system will be tested this year on microscopy samples.

**Isolation of Organic Matter.** *Convenor: Werner Hiltmann*

During the Meeting in Utrecht it was noted that the objectives of the isolation of organic matter WG were not fully accomplished and that there is still scope for further activities. A review of the material and results from former activities is under development and future activities will be discussed in Budapest.

**Coal facies Working Group**. *Convenor: María Hamor Vidó*

The WG. has accomplished its objectives and at the present summarized result of compilations are under publication at the International Journal of Coal Geology. Corrected proof articles are now available online via ScienceDirect in the "Articles in Press" section.

# ICCP Services

## ★ ICCP Reflectance Standard
## ★ Accreditation Programme

For more information contact the Commission I chair:

Dr. Walter Pickel
mailto:pickel@bigpond.net.au
mailto:walter.pickel@ozemail.com.au

## Mackowsky Symposium

**in the scope of the 55th ICCP meeting**
Wednesday 13 August 2003

The following programme was presented:

9.00 - 9.15 *M.J. Lemos de Sousa* - Introduction
9.15 - 9.30 *E. Wolf-Fisher and C. Diessel* - In memoriam Prof. Dr. rer. nat. habil. Marie-Therese Mackowsky.
9.30 - 9.45 *C. Diessel* - My Doctor Mother Marie-Therese.
9.45 - 10.15 *M. Steller, Arendt, P. and Kühl, H.* - Development of the applied coal petrology at the Bergbau-Forschung/DMT during the last 50 years.
10.15 - 10.45 *J.C. Hower, K.W. Kuehn and B.K. Parekh* - Petrographic response to oil agglomeration of coal.
10.45 - 11.15 Coffee Break
11.15 - 11.45 *D. Murchison* - The influence of heating rate in laboratory and natural environments.
11.45 - 12.15 *C. Diessel* - On the Petrography of an unusual Coal Seam in the Sydney Basin, Australia.
12.15 - 12.45 *A. Cook, R. Wright and G. Benstead* - Production of high quality metallurgical cokes from high inertinite coals in non-recovery coke ovens.
12.45 - 13.45 Lunch
13.45 - 14.15 *K.J. Kruszewska and V.M. du Cann* - A simple and effective evaluation of reactive inertinite: A new approach.
14.15- 14.45 *B. Valentim, M.J. Lemos de Sousa, P. Abelha, D. Boavida and I. Gulyurtlu* - Coal and char petrography, NO and $N_2O$ emissions from fluidised bed combustion: A case study.
14.45 - 15.15 *A. Depers* - International Accreditation in Organic Petrography: Past efforts, present status and future developments.
15.15 - 15.45 Coffee break
15.45 - 16.15 *Suarez-Ruiz, D. Flores, M.M. Marques, M.R. Martinez-Tarazona, J.J. Pis and F. Rubiera* - Geochemistry and Mineralogy of Coals from Rio Maior (Portugal) and Peñarroya - Belmez - Espiel (Spain): Technological implications.
16.15 - 16.30 *M.J. Lemos de Sousa and others* - Conclusion

## ABSTRACTS

### Production of High Quality Metallurgical Cokes from High Inertinite Coals in non-recovery Coke Ovens

Alan C. Cook[1], Rex Wright[2] and Glenn Benstead[2]
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[2]*Illawarra Coke Company*

Coals from the Southern Coalfield in NSW lie within or close to the optimum range of rank ($\bar{R}_v$ max 1.0 to 1.42 %) for the production of good quality metallurgical cokes. The majority of reserves of coal are within the Bulli Coal and this has a mineral free vitrinite content that ranges from about 35% to 55% on a full seam washed product basis. The Wongawilli Coal has a vitrinite content (mf) of about 75 to 80 %. The feed to the slot ovens at the steelworks normally consists of a blend of these two coals. The non-recovery coke ovens have mainly used blends from the Bulli Coal but some Wongawilli coals have been used for some blends. The mean maximum vitrinite reflectance for the blends for the non-recovery ovens has typically been in the range 1.20 to 1.3 % $\bar{R}_v$ max and the vitrinite content is typically in the range 39 % to 48 %.

Illawarra Coke Company (ICC) runs two plants at Coalcliff and Corrimal, both near Wollongong and produces approximately 250,000 tonnes a year of high quality metallurgical coke. The product from the non-recovery ovens is suitable for use in the foundry industry, blast furnaces and in a variety of smelting processes such as the Imperial process. This has required a large coke with good strength and reactivity characteristics. The cokes produced are large in size and generally blocky. Typical size yields are >31.5 mm greater than 90 %, >50 mm greater than 50 % and >100 mm greater than 5 %. In terms of cold strength, the averages to the end of June 2003 for the 2003 production is set out in the following table.

CSR values for Corrimal coke for 2003 average 70.4 (range 67.3 to 72.7) and CRI averages 22.7 (range 20.8 to 24.6).

In hand specimen, the cokes show a structure that is for the most part massive, but some discrete grains derived from inertinite-rich coal can be seen.

| | Coalcliff Plant | | Corrimal Plant | | | |
|---|---|---|---|---|---|---|
| | M40 | M10 | M40 | M10 | ASTM 1" Stab | ASTM ¼" Hard |
| Mean | 89.5 | 6.4 | 90.2 | 5.5 | 69.0 | 71.2 |
| Max | 86.4 | 5.6 | 88.4 | 5.1 | 66.1 | 68.4 |
| Min | 91.5 | 7.4 | 91.1 | 6.0 | 70.6 | 73.2 |

Microscopically, the cokes are seen to be well fused. The percentage of mosaic coke ranges from average values close to 50 % to 60 %, so that it is clear that a proportion of the material reporting as mosaic has been derived from inertinite. However, discrete inertinite-derived domains are prominent. These are well bonded into the main mass of the coke. The large inertinite-derived grains generally do not have surrounding zones of highly porous coke. This is because the inertinite in the blends is not associated with liptinite as is commonly the case for coke prepared from N. Hemisphere coals of Carboniferous age.

Mosaic size is mainly within the coarse category although small amounts report to the medium category and some flow structures are also seen. Fine inertinite is completely enveloped within mosaic coke. The larger grains derived from inertinite-rich coals are generally well bonded.

The coal blends differ markedly from those that are commonly supposed to be required for the production of high quality cokes. The coals produce good quality cokes that are much better than most coke strength prediction systems allow, for a number of reasons. Firstly, most of the coke strength prediction methods are much more provincial than is commonly admitted. Additionally, these methods usually oversimplify the behaviour of coals with a moderate or high liptinite content. A third factor is that inertinite from higher rank coals (vitrinite reflectance greater than about 0.9%) plays a role within coke structures that is qualitatively different from that played by inertinite from lower rank coals. For the ICC coals, the high coke strengths can be related to a combination of the blend coals all being near the optimal rank for high coke strengths and liptinite being either absent or present only in trace amounts. Some of the inertinite does produce a mosaic, but it is an absence of liptinite combined with the absence of inertinite from lower rank coals that are critical to the good coke structures that are produced.

In summary, the feed to the ovens has a vitrinite content between about 35 % and 48 % and a mean maximum vitrinite reflectance of between 1.20 % and 1.30 % and produces coke with high coke strength indices and excellent coke reactivity characteristics.

## International Accreditation in Organic Petrography: Past Efforts, Present Status and Future Developments

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The ICCP has established a scheme that accredits coal petrographers in two methods vitrinite random reflectance and maceral content. Vitrinite content, on a minerals-free basis (mfb), is the sole maceral group assessed for the maceral content technique. Exercises were conducted in 1993, 1994, 1996, 1999, 2000 and 2002. In each exercise either mounted coal blocks or a sub-samples of crushed coal are analysed by participants. Crushed coals are supplied with a top size of 1 mm, with the fine-grained fraction (<45 µm) removed during preparation. Numbers of participants vary from exercise to exercise. In the 2002 Exercise, 57 participants from 31 laboratories in 13 countries registered and were evaluated. Failure rates for exercises are low.

All data are placed into a database. Data from each analysed coal are statistically evaluated against the Group Mean and Group Standard Deviation values calculated from the total data for that coal in the database. The Group Mean and Standard Deviation data have stabilised over the six exercises. For the vitrinite random reflectance method, changes in the Group Mean occur in the second or third decimal place and for the maceral content (mfb) method, in the first or second decimal place. Similarly, for the Standard Deviation data, changes occur in the third or fourth decimal place for the vitrinite reflectance method and in the first or second decimal place for vitrinite content (mfb). Accurate statistical data are now possible when evaluating analysts.

A coal bank has been established at the University of Wollongong and comprises in excess of 40 coals from major Permian and Carboniferous coal basins. Coals include whole seam, selected plies, run of mine (ROM) product and washed product. The reflectance range of the 15 coals used in the six exercises is 0.50 - 1.80 % mean vitrinite random reflectance, based on Telovitrinite macerals, and the vitrinite content (mfb) range is 40 - 85 %. There is a fairly uniform spread of data in the 15 coals for both variables being tested. Coals are to be added that will extend the range of parameters being evaluated and also comprise values close to data for coals already in the coal bank.

Future plans include obtaining ISO 9000 accreditation status for the scheme and the evaluation and accreditation of automated coal petrographic measurement systems. The ICCP started a coal blend accreditation scheme in 2003 and a scheme for evaluating dispersed organic material (d.o.m.) in sedimentary rocks is planned.

Mackowsky at Pau, 1981, with Murchison (far left), Hevia, Spackman, Hacquebard and Noel (with camera). *Photo Alan Cook*

## On the petrography of an unusual coal seam in the Sydney basin, Australia

Claus F. K. Diessel
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Drilling done in the Sydney Basin, New South Wales, in a hitherto unexplored region south of Newcastle, has revealed a 6.1 m thick section of the Great Northern Seam in the upper portion of the Newcastle Coal Measures. One of the fully recovered coal cores was subjected to detailed microscopic analysis for the purpose of palaeo-environmental studies. To this effect, the fresh coal core was sliced longitudinally with the aid of a diamond saw. One half of the core was stored as reference while the other half was set in epoxy resin and cut into (whenever possible) slightly overlapping, not more than 40 mm long specimens for microscopic analysis. After grinding and polishing, each block was divided visually into coal lithotypes whose widths (5 mm minimum) were marked on the polished surface. Each lithotype was then subjected to conventional maceral and vitrinite reflectance analysis. In addition, telovitrinite fluorescence was measured in parts of the coal core that were deemed to be of special interest.

The gradational upper and lower contacts of the seam, as well as the almost total absence of iron sulphide indicate that coal formation began with the terrestrialisation of a body of fresh water and was terminated by non-marine flooding. The intervening coal shows the frequently observed vertical gradation from predominantly vitrinite-rich bright coal in the lower portion to inertinite-rich dull coal in the upper part of the seam. At the drilling site, the coal is relatively clean and contains few stone bands, mainly in the form of pelletoidal claystones. Some of these thicken laterally and grade into fluvial sandstones and conglomerates. Other inorganic inclusions consist of widely scattered, small siderite concretions that in two cases concentrate to form layers underneath tonstein bands.

The primary, upward trend from vitrinite-rich bright coal to inertinite-rich dull coal is not uniform but the product of the superposition of smaller-scale secondary and tertiary trends, in which the dominance of vitrinite over inertinite in the lower part of the seam is reversed in its upper portion. The secondary trends may comprise several decimetres. With few exceptions, they begin with a flooding horizon that is indicated by a high detrital mineral content and elevated proportions of sporinite and inertodetrinite. Some of these minerals and macerals are likely to be the recycled products of the peat exposure that preceded the flooding event.

The distribution of vitrinite displays a cyclical arrangement at the secondary trend level. Its proportion is commonly low within and immediately above the flooding horizon, but it waxes and wanes as the depositional conditions pass from limnotelmatic to telmatic and then deteriorate due to peat exposure and oxidation. Naturally, an opposing development is displayed by inertinite.

As shown in similar studies elsewhere, the distribution of telovitrinite reflectance lends weight to the palaeo-environmental interpretation. While mean random telovitrinite reflectance for the whole seam is 0.81 %, individual sample means vary from a maximum of 0.93 % underneath a pelletoidal claystone (Graupentonstein) marking an intra-seam unconformity, to little more than 0.7 % in some of the flooding horizons. These variations are mirrored by the trends in telovitrinite fluorescence, but the spread of the optical data about their respective mean values offers further insight into the depositional environment. For example, the upward deterioration of the peat-depositional conditions shown by the changing lithotype and maceral composition is also mirrored by a parallel change in the coefficient of variation of random telovitrinite reflectance from 0.043 in the lower half to 0.055 in the upper half of the seam. Although in some cases a large dispersion of telovitrinite reflectance may be due to the autochthonous/allochthonous mixing of the vitrinite precursors, the inertinite-rich lithotypes in the upper portion of the seam tend to contain several generations of root-derived telovitrinite that show distinct differences in reflectance.

The secondary cyclic trends can be further divided into lower-level, tertiary trends. Depending on their position within the secondary cycles, these small-scale events are dominated by either vitrinite or inertinite. In either case, the basal vitrinite content is relatively high but it declines upward over a vertical distance of a few centimetres in favour of inertinite. Occasionally, this ABCABC-pattern is replaced by a truly cyclic ABCBA-trend that may also affect the secondary cycles.

In the terms of sequence stratigraphy, the three above-mentioned scales of depositional trends found in the Great Northern Seam represent three inter-related magnitudes of variations in accommodation/peat-accumulation ratios at the sub-parasequence level.

## Petrographic response to oil agglomeration of coal

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Several eastern Kentucky coals were investigated for their behavior in oil agglomeration beneficiation. The study samples are all Pennsylvanian-age, high volatile A bituminous, single coals or coal blends representing a clean product from a preparation plant. In this respect, the samples differ from a typical feedstock for oil agglomeration, which would normally be a fine fraction of the whole coal. Coal samples were selected to represent a range of vitrinite reflectances within the hvAb rank range and, to a lesser extent, to represent relatively high- and low-vitrinite coals. Experimental conditions varied the oil concentration and the pH of the slurry. The resulting concentrate and reject coal samples were analyzed for moisture, ash, and sulfur, and for their combined maceral and microlithotype composition. Response to agglomeration is dependent on the rank of the coal, the oil concentration, and the pH; with sharper maceral separations noted at higher ranks, lower pH, and lower oil concentration.

Mackowsky and Prado in Dubrovnik, 1985. *Photo: Alan Cook*

## A simple and effective evaluation of reactive inertinite- a new approach

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*mailto:kjk@wnoz.us.edu.pl*

Identification of the inertinite which is reactive in carbonization is recently resolved by using modern image analyzers. However the problem still exists in a large number of laboratories which are not equipped in these systems. Also when an analyst is dealing only with a three maceral analysis, and the need of quick evaluation of reactive inertinite arises. In case there is a single petrologist in the laboratory he needs a proof that the results are accurate. The aim of this paper is to provide a quick and reliable method of reactive inertinite evaluation on the base of the routine coal maceral analysis.

**Methodical approach**

The work was carried out on the base of some 36 results of maceral and scan (K. Kruszewska 1989) analyses. All of them were completed by Vivien du Cann who has the ICCP accreditation, which has assured their accuracy.

The results of maceral analyses both routine (manual) and by scan were compared, and their correlation turned to be very high, at the correlation coefficient level 0.99 (Fig. 1) for total inertinite value. However the scan method has some weak points namely, the necessity for corrections in case the vitrinite content exceeds 88 % or is lower than 20 %. In present evaluation, the focus was exclusively on inertinite. The next step was to elaborate a formula for the evaluation of the reactive inertinite content on the base of the total inertinite content. The details will be presented at the Mackowsky Symposium in Utrecht.

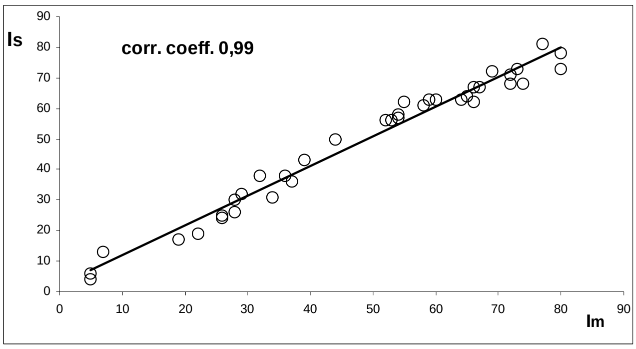


*Fig. 1 Total inertinite (manual) versus total inertinite (scan) Note: Is = total inertinite (%) by scan; Im = total inertinite (%) by manual analysis*

**Discussion of results**

In effect of detailed calculations the reactive inertinite values were calculated for each sample basing on the total inertinite content. Further on, they were correlated with the reactive inertinite contents being obtained by the routine maceral analyses of the same set of samples (Fig. 2). The correlation coefficient was in this case as high as 0.98.

Finally the formula for the RI calculation was verified on some 90 results of manual analyses of South African coals (Pinheiro *et al.* 1999). Most of differences between reactive inertinite content obtained by microscopic observations and RI calculated from the total inertinite values did not exceed 3 % which is in accordance with the ISO Standard. Only in 5 cases the difference were slightly higher: 4 % in two and 5 % in three instances.

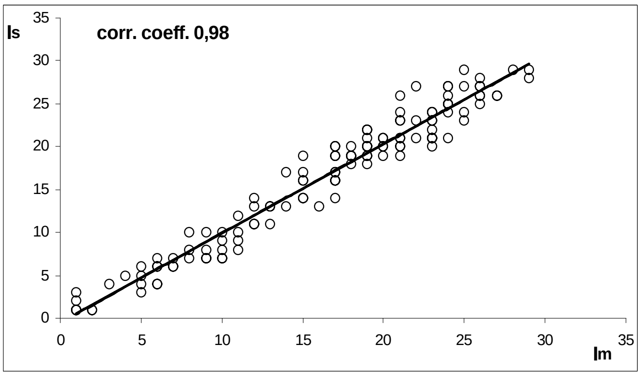


*Fig. 2 Reactive inertinite (manual) versus reactive inertinite (scan). Note: in Fig.2 Is = reactive inertinite content (%) by scan; Im= reactive inertinite content (%) by manual analysis*

This allows the conclusion that the method could be useful tool in the reactive inertinite evaluation straight from the routine three maceral group analysis.

It could be also a good instrument for the verification of RI values evaluated microscopically. The only condition is accuracy in microscopic identification of maceral groups in the sample.

**References**

Kruszewska ,K.J.,1989. The use of reflectance to determine maceral composition and the reactive-inert ratio of coal components, Fuel 68,pp753 - 758

Pinheiro H.J.,et al., 1999. A techno-economic and historical review of the South African coal industry in the 19th and 29th centuries and Analyses of coal product samples of South African Collieries 1988-1999 .Ed H.J. Pinheiro ,CSIR; SABS, Pretoria

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## The influence of heating rate in laboratory and natural environments

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The influence and importance of heating rate on the alteration of organic matter are widely accepted.

Effects of heating rate are perhaps best appreciated in coke technology where even relatively small changes in heating rate can produce quite pronounced changes in the resulting coke product. Within the geological environment there is widespread acknowledgement that heating rate is now as important a factor in causing alteration to coals and dispersed sedimentary organic matter as is level of temperature, time of exposure to raised temperature, thermal conductivity of associated sediments and various other factors. Where appreciation is perhaps not so sensitive is the way in which heating rate impacts on the properties of organic matter, sometimes producing surprising if not dramatic contrasts. Some examples will be given.

Originally a mineralogist, Marie-Theresa Mackowsky had a formidable and eminent background. With her wide understanding of the coking field, she surely appreciated the importance of heating rate in all aspects of her work. She, herself, if provoked, occasionally displayed dramatically the effects of 'rapid heating rate', sometimes to the consternation of others. Some examples will be given!

## Development of the applied coal petrology at the Bergbau-Forschung /DMT during the last 50 years

Monika Steller, Paul Arendt and Helmut Kühl
*Deutsche Montan Technologie GmbH - Coke Marking Division-Essen, Germany*

Developments in coal petrology at the Bergbau-Forschung/DMT GmbH during the last 50 years are reviewed.

Marie-Therese Mackowsky started her professional life on 1st January 1940 at the Verein für die bergbaulichen Interessen (Syndicate for Mining Interests - Research Department for Raw Materials) located in Essen, from which was the world renowned Coal Petrographic Laboratory of the Bergbau-Forschung GmbH developed under her influence. Officially, her work found recognition in 1965, when she was promoted to the Direktor of the Section for Mineralogy and Petrology in the Bergbau-Forschung GmbH till she retired from this position in 1978.

In this time particularly in Germany - Mackowsky and her staff developed methods to analyze and describe coals. They elaborated and standardized the quantitative analyses of coals and introduced their application into the mining industry. Coal petrography, thus, has become an indispensable tool for characterizing coals and decide about their utilization.

Her activities were the basis of applied coal petrology.

Coal petrology/petrography, and particularly coal microscopy could not only help to solve the problems but also exhibit whether such a contribution was economically reasonable und justified for coal preparation, carbonization, briquetting, combustion, hydrogenation etc. The formerly independent Section for Mineralogy and Petrology was joined **1979** with the Chemical Section. Through these organizing steps the efficiency of the both sections was evidently increased by synergetic effects. In addition, analytical methods could be offered to solve petrological questions. Development modification and automation of reflectance and fluorescence measuring equipments is typical for this period.

To answer the question of coal reactivity in technological processes-coals, coal macerals and coal products were characterized by petrographical methods, fluorescence, by mass-spectrometry, gas chromatography and NMR.

**From 1990**, after the foundation of DMT GmbH, worldwide competition in the market for hardcoals and hardcoal-based coke as well as the change to alternative energies have caused a permament loss of market shares from domestic hardcoal deposits. Based on political reasons a strong decrease of financial supports of the German government and the EU limited the scientific programs.

In that period, scientific studies were concentrated on ashes from fluidized-bed.

In spite of changes in the course and interests of applied coal petrology during the last 50 years, the method of predicting coke strength from data of analyses by maceral groups and coal types suggested by Mackowsky & Simonis (1969) has not decreased in value until today. We don't want to enumerate all her scientific activities and to describe their development in detail. Some examples of the application of coal petrographics should be given in the end to explain the importance of this methods up to now.

It was found out based on the finding of Mackowsky that pyrolytic deposits influenced the coke homogeneity in coke ovens as well as the coke quality parameters like CRI and CSR. These highly graphitic layers of carbon protect the inner of coke pieces against gasification- thus a less reactive coke results for the use in blast furnaces.

Moreover it seems to be possible to predict wall load response to maximum internal gas pressure to prevent coke ovens from damage. These mathematical equations for the selection of coking coals and coal blends are also based on petrographic data but other influences as bulk density or chamber width of the coke oven are also involved.

Mackowsky (right) holds her audience at Pau, 1981. *Photo: Alan Cook*

## Geochemistry and Mineralogy of Coals from Rio Maior (Portugal) and Peñarroya-Belmez-Espiel (Spain): Technological Implications

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This study focuses on the geochemistry and mineralogy of lignites from Rio Maior Basin (Portugal), and bituminous coals and anthracites from Peñarroya-Belmez-Espiel Basin (Spain). The coal ashes were analysed for major and trace elements contents. The identification of mineral species in LTA was carried out on selected coal samples from both basins. Furthermore, the main affinities of the determined elements were also studied on the basis of Pearson's correlation coefficients. The variations identified were primarily related to the physico-chemical conditions during incarbonization in Peñarroya-Belmez-Espiel Basin, whilst palaeoenvironmental depositional conditions were the more important factor in the Rio Maior Basin.

The relationship between ash behaviour and inorganic composition of these coals, as well as the fouling and slagging propensity by using appropriate indices were also investigated.

## Coal and char petrography, NO and $N_2O$ emissions from fluidised bed combustion: case study

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Key-words: Coal; Char; NO; $N_2O$; Fluidised Bed combustion (FBC)

The work tentatively aimed at developing a correlation between coal and char petrography and the emissions of NO and $N_2O$ during fluidised bed coal combustion. Seven commercial coals, from different origins, were well-characterised both chemically and petrographically prior to their devolatilisation and combustion in a laboratory scale fluidised bed (FBC) at 700º C, 800º C, 900º C and 1000º C to simultaneous determine their NO and $N_2O$ emissions.

Vitrinite rich coals produced higher masses of high porous chars (cenospheres and tenuinetworks) than inertinite rich coals. The former coals also emitted less concentrations of NO.

As expected, $N_2O$ emissions strongly decreased with temperature but, in general, the emissions of $N_2O$ from vitrinite rich high volatile coals were less than the emissions from inertinite rich coals. Additionally, high porous chars were observed to be associated with lower emissions of NO and $N_2O$ than low porous chars.

# 55th ICCP Meeting Poster Papers

The following poster papers were presented at the 55th ICCP Meeting.

## Presentation of the petrographical composition of the Southfield Lignite deposit of Ptolemaida (GR)

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The objective of the poster, after a short geological briefing, is to reconstruct the paleoenvironment during formation of the lignite deposit of Southfield. The deposit is part of Ptolemaida basin, which is the more important central part of elongated basin of Monastery (Bitola) - Elassona. The Southfield lignite deposit consists of alternations of relatively thin lignite layers with sediments (approximate total thickness of lignite layers up to 68 m, while intermediate sediment bands are in total up to 5 m thick). The sediments of the lignite horizons are mainly clay and sands with rare psephit concentrations. Apart from the lignite layers, layers of humic clay often occur with fragments of xylite and flora residues.

In this poster we selected 14 samples of lignite from a representative drillhole, namely KNP12-00 in order to discern its petrography. Optical microscopy under both incident white and blue light excitation using 500 point counts showed that the huminite group macerals are dominant, raging from 69.0 to 91.9%. Humotelinite is higher for only the upper part of the seam (40.1 to 48.6%) while for the rest samples rages from 6.4 to 34.6%. Humodetrinite rages from 20.3 to 66% and is particularly high at the lower part of the seam; humocollinite is present in very small amounts. Macerals of the liptinite and inertinite groups are found in small concentrations, with liptinite macerals being more dominant.

In order to reconstruct the conditions prevailing during peat formation we used indices such as: a) Ground Water Index (GWI), b) Vegetation Index (VI), c) Gelification Index (GI) and d) Tissue Preservation Index (TPI). The above indices were modified to reflect low-rank Tertiary Greek lignites [re-modified by Kalaitzidis et al., 2000 to fit Greek lignites, based on modifications done by Kalkreuth et al. (1991)].

Based on the correlation of this indices, and the their ratios (e.g. VI/GWI, TPI/GI) conclusions on the paleoenvironment and the shaping conditions were exported. The results indicate a hydroseral succession of mire types from limnic to swamp in strongly rheotrophic conditions and the paleoenvironmental ecosystem is predominantly aquatic/herbaceous.

*Keywords: Greece, Southfield-Ptolemaida, lignite, petrography*

## The Application of Coal Petrography and Vitrinite Reflectance To High Resolution Sequence Stratigraphy - An Example from the Book Cliffs, Eastern Utah, USA

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The fine balance between the rates of accommodation creation and peat accumulation required for coals to form makes them highly sensitive recorders of changes in these variables. However, detailed studies of changes in coal composition are rarely undertaken in sequence stratigraphic studies. This project aims to integrate detailed coal petrographic and vitrinite reflectance analysis with a high-resolution sequence stratigraphic study of a coal bearing succession from the Book Cliffs of Eastern Utah, USA.

The Sunnyside coal seam of the Cretaceous Blackhawk Formation is a 5 m thick, bituminous coal formed in a large ombrotrophic mire along the shoreline of the Western Interior Seaway. The seam caps two 15 m thick shallow-marine parasequences, the upper of which pinches out in a split in the seam. Changes in the composition of the unsplit part of the coal enable the flooding surface which formed this split to be traced at least 15 km back up depositional dip beyond the landward extent of the split, this provides the basis for integrating sequence stratigraphic models based on the study of the coal and shallow-marine facies.

Further analysis of vertical and lateral changes in coal composition and vitrinite reflectance enables a detailed model for accommodation change to be developed for the duration of coal formation. This can be now integrated with and used to refine the existing models based on the study of the shallow-marine portion of the Sunnyside Member.

This poster is available online at: http://www.liv.ac.uk/~rdavies/iccp
For further details please mailto:rdavies@liv.ac.uk

## Optical properties of the anthracites: a parameter to evaluate their ability to graphitize

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Graphite materials were prepared from two Spanish anthracites of different characteristics (Table 1) by heating at temperatures within the range 2000-2800 ºC. The microtexture of the anthracites was related to its ability to graphitize [1, 2], specifically when there is a preferential planar orientation of the polyaromatic basic structural units (BSU's). Apart from other methods such as TEM [1-3], the microtexture of the anthracites can be studied based on their optical properties which are defined by the reflectance indicating surface (RIS). Principal axes ($R_{MAX}$, $R_{MIN}$ and $R_{INT}$) and RIS parameters ($R_{ev}$, $R_{st}$, $R_{am}$) characterize the textural anisotropy and the structure of the BSUs (microtexture) of the anthracites as well as their changes during heat treatment [4-6]. Assuming that the anisotropy of the texture (spatial arrangements of the BSUs), as calculated from the optical microscopy measurements (Bw), increases with the degree of planar orientation, anthracites with larger bireflectance values ($B_W$) should be expected to show a better degree of graphitizability. However, according to the bireflectance ($B_W$) values in Table 2, the most graphitizable AF anthracite exhibits lower degree of textural anisotropy than ATO anthracite. On the other hand, due to the transformations cause by thermal treatment which include devolatilization, aromatization and rearrangement of the BSU's [7], values of $R_{MAX}$, $R_{MIN}$ and $R_{INT}$ of the AF and ATO anthracites increase during carbonization at 1000 ºC. The magnitude of this increase is higher for AF anthracite, leading in turn to a carbonized sample AFC with a larger anisotropy of the texture, as shown by the value of the $B_W$ parameter in Table 2.

*Table 1 Proximate and elemental analyses and sulfur forms of AF and ATO anthracites*

| | ATO | AF |
|---|---|---|
| *Proximate analyses (wt.% db)* | | |
| Ash | 10.12 | 19.74 |
| Volatile matter | 4.12 | 8.72 |
| *Elemental analyses (wt.% daf)* | | |
| Carbon | 93.13 | 91.00 |
| Hydrogen | 2.03 | 3.01 |
| Nitrogen | 0.87 | 1.40 |
| Organic sulfur | 1.01 | 0.92 |
| Oxygen (diff.) | 2.96 | 3.67 |
| *Sulfur forms (wt.% db)* | | |
| Total | 1.07 | 1.08 |
| Pyrite | 0.15 | 0.33 |
| Sulfate | 0.01 | 0.02 |
| Organic (diff.) | 0.91 | 0.74 |

The RIS parameter, Rev, has been suggested to characterize the structure of the BSU's [7], its improvement during heating being a consequence of their chemical structural ordering. As shown in Table 2, a higher value of this parameter is obtained for ATO, suggesting a more ordered structure of the BSU's in this anthracite which also shows a larger anisotropy of the texture when compared to that of AF, as measured by the $B_W$ parameter. At temperatures up to 1000 ºC, changes in the structure of the BSU's are mainly of chemical nature as a consequence of the removal of heteroatoms and other light compounds. The significance of these changes depends on the amount of hydrogen available and the microtexture of the initial anthracite. Therefore, AF anthracite shows a greater growth of $R_{ev}$ during carbonization (Table 2). However, based on the values of $R_{ev}$, the structure of the BSU's is still more ordered in the carbonized sample of ATO anthracite (ATOC) than in AFC sample. Nevertheless it should keep on mind that, although higher values of RIS parameter $R_{ev}$ were calculated for anthracites with a more anisotropic texture of the BSU's as determined by the bireflectance $B_W$, no direct relation was found between these two optical parameters [7]. In conclusion, the analysis of the optical properties of the samples in Table 2 suggests that the ability of the anthracites to graphitize depends, among other factors, on the anisotropy of the texture of the their carbonized, the presence of a higher amount of hydrogen in the raw anthracite facilitating both the structural ordering and the rearrangements of the BSU's in the carbonization process.

*Table 2: Optical parameters, measured (%) and calculated, of AF and ATO anthracites and their carbonized (1000ºC) samples AFC and ATOC*

| Sample | Measured values | | | RIS Axes | | |
|---|---|---|---|---|---|---|
| | Ro | R'max | R'min | $R_{MAX}$ | $R_{INT}$ | $R_{MIN}$ |
| AF | 2.37 | 2.65 | 2.10 | 2.82 | 2.55 | 1.62 |
| AFC | 7.17 | 7.31 | 5.47 | 7.67 | 7.05 | 3.70 |
| ATO | 3.63 | 4.22 | 3.19 | 4.70 | 3.93 | 2.40 |
| ATOC | 7.01 | 7.65 | 6.10 | 7.90 | 7.43 | 4.94 |

| Sample | $B_w$* | RIS Parameters | | |
|---|---|---|---|---|
| | | $R_{ev}$ | $R_{st}$ | $R_{am}$ |
| AF | 1.21 | 2.26 | -17.59 | 0.900 |
| AFC | 3.97 | 5.84 | -22.19 | 0.115 |
| ATO | 2.30 | 3.53 | -11.96 | 0.105 |
| ATOC | 2.97 | 6.61 | -21.40 | 0.078 |

*$B_w = R_{MAX} - R_{MIN}$


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# The Role of Coal in a Sustainable Future


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**Development in Context (Coal is Black but Sustainable)**

Sustainable Development presents a considerable challenge to the coal industry. In addressing the challenges of Sustainable Development, three basic and inter-related objectives must be met: economic security and prosperity, social development and advancement, and, environmental sustainability. Sustainable development provides a framework under which communities can use resources efficiently, create efficient infrastructure, protect and enhance quality of life, and create new businesses to strengthen their economies.

Coal plays an important role in Sustainable Future as the most widely used energy source in electricity generation and steel production. Australia is the world's largest coal exporter, making coal vital to the national economy.

**The Past: Coal's Bad Reputation**

The coal industry is still viewed with the 19th century image; dirty to dig, dirty to transport and dirty to utilise. Much of this image was attributed to coal and other fossil fuel-burning power stations that emit particulates, sulphur oxides ($SO_x$), nitrogen oxides ($NO_x$) and carbon dioxide ($CO_2$) during combustion. To optimise the contribution of coal in a sustainable future, this old paradigm must be changed.

**The Present: The Greenhouse Threat**

Recently, the greenhouse effect has become the focus of environmental attention. Greenhouse gas emissions, especially from the coal-fired energy sector, are seen as a major threat to environmental sustainability. The Cooperative Research Centre for Coal in Sustainable Development (CCSD) has initiated new research to articulate the key role that coal will play in a transition to a sustainable future.

CCSD is part of a national program sponsored by the Australian Government and supported by universities, CSIRO and industry. The Centre incorporates a wide range of researchers and organisations and is the largest concentration of researchers in Australia focussing on sustainable development of coal. In addition to developing research in Australia, the Centre established a number of international links (Japan, Europe, and USA) in order to promote a wider debate on the emerging opportunities for coal.

The research program is concerned with sustainability issues along the whole coal chain, from Sustainable Coal Resource Management through Clean Coal and new utilisation technologies to utilisation of coal combustion by-products. Environmental regulations and international agreements such as the 'Kyoto Protocol' are driving research to identify ways to reduce emissions, limit and utilise waste, and extract more energy from each kilogram of coal.

**The Future: Zero Emissions**

Technology is providing pathways by which coal will continue to remain the primary fuel in the foreseeable future. The challenge is not to reduce global dependence on coal, but to accelerate the development and deployment of innovative, advanced, efficient, cleaner coal technologies that enhance sustainable development. A sustainable Australia will use the 'best mix' of all available energy supply options. Australia is well placed to make a significant contribution to the world's greenhouse gas reduction targets and the transition to 'zero-emission' coal technologies, by providing high quality black coals together with information and guidelines on the performance of Australian coals in new technologies.

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## Comparative assessment of peat-forming environments on Late Miocene-Pliocene lignites in Hungary and Ukraine

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*Keywords: Late Miocene - Pliocene, coal petrology, sulphur, environment*

Lignite formations were studied in two locations at the central and distal part of the delta environment from the Late Miocene (Pannonian s.l.) Bükkalja Lignite Formation (BL) at Visonta open-pit mine, Hungary and the Trans-Carpathian, Ilnice (IN) open-pit mine, Ukraine. The aim of the study was to compare peat formation in the central and distal part of the delta system of the Pannonian Basin. For the reconstruction of peat formation coal petrology, and proximate analysis extended by detailed sulphur content analysis were used. Maceral analysis was done by transmitted and reflected light microscopy. Sulphur content was measured as total $S_t^d$, organic $S_{org}^d$ and pyrite $S_{py}^d$.

Lignite formation took place during the Late Miocene 8.07-7.43 Ma (Lantos, 2000) in the central part of the Pannonian Basin delta system, in Hungary, while in remote parts of the basin e.g. in the Trans-Carpathian region lignite formation prolonged until the Pliocene. Productive area of BL is situated on the southern foreland of the North Hungarian Uplands in a range of 120-140 km E-W with width of 10-30 km. The extension of IN is smaller than 50 km$^2$. The thicknesses of both sequences are about 300-400 m and seam number varies from 15 to 30. Average thickness of lignites is 1.5 m, coaly shale and clay intercalations are frequent. The vegetation and climate of the regions are similar, characterized by humid forest swamp conditions in warm and moderate climate with restricted tropical flora (László, 1989; Syabryaj, 2001 personal communication).

The thicknesses of the studied sections are 10 m in BL and 1.0-1.5 m in IN, respectively. Characteristic lithotypes of BL are light, earthy and banded dull, while of IN are medium light, dull and banded lignites. Vitrinite reflectance of BL is lower (0.27-0.29 %) than IN (0.3-0.34 %) representing more intensive orogenesis at the Carpathians.

Maceral compositions of the two studied sections are similar. Lignites are huminite types in which texto-ulminite, eu-ulminite and attrinite are the dominant macerals. Gelinite occurs very seldom as like as densinite. Texto-ulminite still contains cellulose frequently and in some samples the gymnosperm woody tissue is strongly degraded. It has bright yellowish fluorescence and shows gelified, often structureless form. Liptinites are represented mostly by resinite, cutinite and sporinite, but in the coaly shale samples liptodetrinite, Botryococcus type alginite and laminated alginite also occur in higher density. Inertinite is characteristic in the upper third part of the two sections with semi-fusinite, fusinite.

Seam formation shows development from the wet forest swamp facies up to dry forest conditions in both sites. Development of seams is not continuous. Low-energy aquatic sedimentation interrupted the peat formation in BL five times with 0.3-0.5 m thick coaly shale beds, coarse quartz grains occur only in the lower part of the profile.

The total sulphur content shows significant difference between the two sites. In the central part of the Pannonian Basin BL, the average $S_t^d$ is 3.4 % while in IN this is about 2 %. $C_{org}$ and $S_t^d$, $/S_{py}^d$, $/S_{org}^d$ show linear correlation with each other. This correlation is the strongest between $S_{org}^d$ and $C_{org}$. Although $S_t^d$ values at BL and IN indicate different peat-forming environments, - higher values in the central delta system due to higher salinity and lower values at the distal freshwater part of the delta system-, composition and preservation of organic matter is similar.

## Calibration of the MACE300™ System

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First demonstrated at the 50th ICCP meeting in Porto, the automated coal petrography system now known as MACE300™ has gone through several stages of development. A number of calibration issues have been faced. With the assistance of the ICCP accreditation program for vitrinite reflectance and maceral content analysis, a rigorous calibration method has been developed.

The system generates reflectance-calibrated images by using a knowledge-based image processing method to correct for all known image distortions and artefacts. The calibration routines involved system parameters, instrument setup, specimen preparation, reference standards and image analysis operations. However, the system bias needed to be determined. The initial determination was by reference to a single laboratory [1]. To test the system against a wider representation of the coal petrographer community, it was used by one of the authors in the Petrographer Accreditation Programme of the ICCP (TABLE 1) [2]. In these exercises the 'right' answer is given as the group mean values. The group results were used in the final calibration of the system, which improved the system's performance markedly. It has now been demonstrated that the system can meet existing manual standards and can provide a foundation for a range of new and unique analyses

*TABLE 1. Assessment of (A) Vitrinite Random Reflectance Analysis and (B) Maceral Content Analysis [6]. In 2000 the system was calibrated against a single laboratory. In 2002 the system was calibrated against the group mean results of the 2000 exercise. Ranking is by UMSD (Unsigned Multiple of the Standard Deviation) and SMSD (Signed Multiple of the Standard Deviation).*

| Analysis Type | UMSD - dispersion around round-robin group mean values, a measure of accuracy | | |
|---|---|---|---|
| | **<1.5** | | **≥1.5** |
| | PASS - Your analytical technique is acceptable | | FAIL - You have serious problems with your analytical technique |
| | Year 2000 | Year 2002 | |
| (A) | **0.67** | **0.34** | |
| | Year 2000 | Year 2002 | |
| (B) | **1.34** | **0.52** | |

| Analysis Type | SMSD - bias of reported results(±) indicating consistency of analyst | | | |
|---|---|---|---|---|
| | **< ± 0.5**<br>Minor bias | **± 0.5 -< ± 1.0**<br>Medium bias | **± 1.0 -< ± 1.5**<br>Significant bias | **≥± 1.5**<br>Extreme bias |
| | Your results are always consistent | Some improvement is required | Examine the method being used | You have serious problems with your analytical technique |
| (A) | Year 2000 Year 2002<br>+0.44 0.26 | | | |
| (B) | Year 2002<br>+0.14 | Year 2000<br>-0.69 | | |

[1] The collaboration of Mr Graham O'Brien and CSIRO is gratefully acknowledged.
[2] The cooperation of Mr Aivars Depers and the ICCP is gratefully acknowledged

## New Developments in Automated Coal Petrography

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The future of automated coal petrography systems looks promising but many challenges remain. The MACE300™ system under development in Australia is a knowledge-based image processing system which produces full phase reflectograms and reflectance-calibrated images of individual coal grains. For single seam coals the identification of the main maceral groups is performed by statistical analysis of the bulk data. However, the analysis of bulk data from blended coals is far more difficult and requires prior knowledge of the blend components. In this work a new method for blend analysis has been tested which is based on the analysis of identified images of individual grains, produced by the MACE300™. Pattern recognition techniques were employed to differentiate the blend components without prior knowledge of their reflectance distributions. Visual cues familiar to petrographers, such as maceral reflectance, texture and topography, were embodied in the grain-by-grain image analysis routines. Once the grains were sorted into separate component classes, a reflectogram was generated for each component which could be analysed using normal single-seam analysis methods (Figure 1).

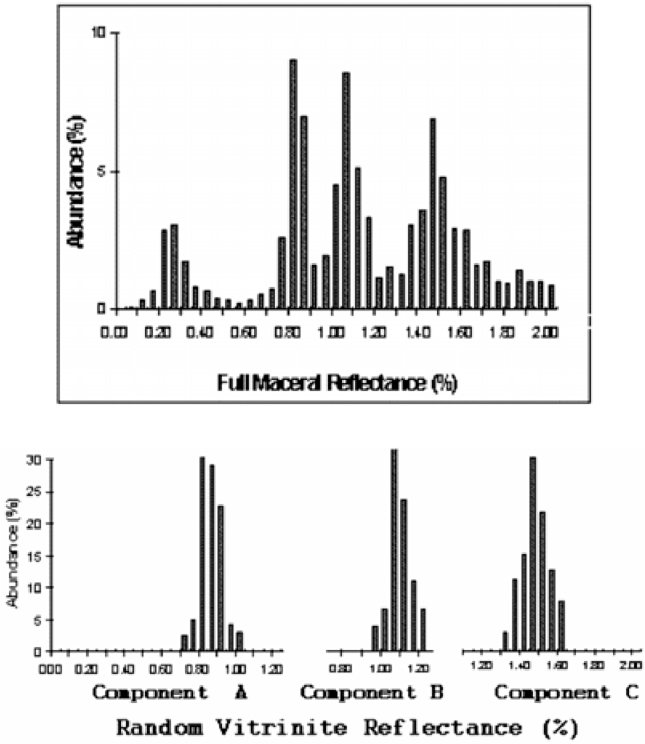


*Figure 1. Blend analysis results for sample '4b-2003' (distributed by ICCP blend analysis working group) obtained using the new grain-by-grain sorting method.*

Another area of interest is the use of high resolution digital cameras (12-bit and 14-bit) to allow a wider range of macerals and minerals to be characterised under a single exposure condition. A program has been written to convert reflectance calibrated high resolution images to 8-bit format using a selective compression technique that retains the contrast of low-reflecting macerals and minerals, and high reflecting minerals and other phases, while compressing the intervening ranges. This technique made it possible to identify several types of bright mineral and bright phases such as natural coke, while retaining the sensitivity to discriminate dark minerals, liptinite, and vitrinite.

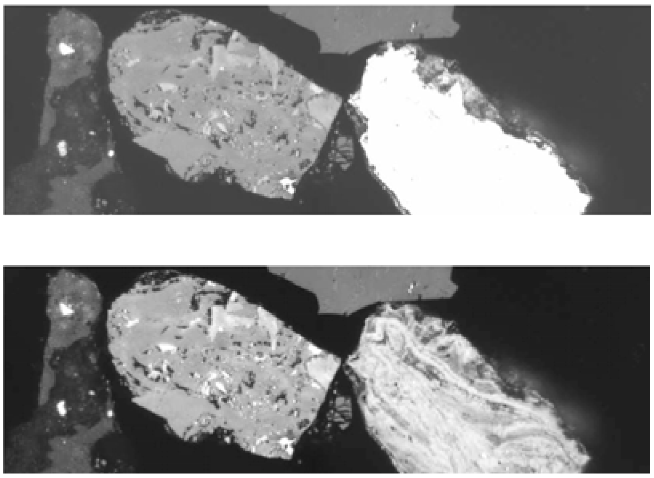

*Figure2. Above: 8-bit image (256 grey levels) exposed to give optimum contrast for coal macerals. Below: 12-bit image (4096 grey levels) converted to a 8-bit image retaining contrast of bright phases.*

## Key Problems of Interpretation of Thermal Maturity Data in the Upper Silesian Coal Basin (Poland)

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The main purposes of the presentation are to describe the experience in methodics and the concluding results of research in the field of coalification of organic matter (OM) of coal seams in the Upper Silesian Coal Basin (USCB).

The first stage of thermal maturity studies of coal seams in the USCB resulted in setting up of a general model of coal maturity changes with increasing depth expressed by $V^{daf}$, $M^a$, RI, SI, $Q_s^{daf}$, dilatation, $C^{daf}$ and $H^{daf}$ within the $R_r$ range 0,5 - 2,5, as well as in differentiation of a zonal coal maturity pattern defined by $V^{daf}$, $M^a$, RI and "coal type" isomaturity surfaces over the basin area. The non-linear vertical changes of coal maturity indices are forming a unique spatial system superimposed discordantly on most structures of the Carboniferous strata. In general, the results of study were leading to the assumption of a multiphase genesis of the thermal maturity field recorded in the coal-bearing formations of the USCB.

The next step of study was based on an extensive sample set of $R_r$ examinations in samples from coal seams from 151 coal exploration wells. In most wells the vertical $R_r$ changes show clearly linear trends, in other wells the linear trends reveal sharp deflections, but the resulting trend sections don't loose their linear character. The study led to the identification of three principal types of linear vitrinite profiles:1 - single linear, 2 - double-segmented (composed of two linear parts linked at one deflection point), and 3 - triple-segmented (composed of three linear parts - the "dog leg type" profiles), related to different thermal regimes responsible for the formation of three thermal maturity fields (A, B, C) recorded in well profiles. Field A was formed during subsidence and burial of the basin, field B is related to basin inversion and temperature compensation between the hinterland of the variscan orogen and the folded foreland sedimentary wedge; field C represents thermal events related to rifting processes in the time span Triassic - Tertiary.

The post or syn-inversional age of the maturity field has been confirmed in the western parts of the basin by studies of optical anisotropy of vitrinite in oriented coal samples, but there is still no firm direct dating of thermal events by use of fission-track thermochronology (AFTA) methods or K-Ar methods applied on clay minerals. Only one account on dating of temperature-controlled crystallization of diagenetic illite from the basin has been published. The presented results fit well to our concept of multiphase thermal evolution of the USCB. Analyses of samples from the very western parts of the basin show that they have reached temperatures of about 80-100˚C within the time span 290-250 Ma, and, from the central and eastern part of the basin, within 220-140 Ma respectively. The data point to Lower Permian (Saalian orogenic phase) and Upper Triassic and Jurassic ages of the related thermal events.

The comparison of paleotemperature gradients, resulting from conversion of the $R_r$ data to maximum temperature (Tpeak) recorded in the strata by vitrinite reflectance (according to the formula proposed by Barker and Pawlewicz 1986), with present temperature profiles of the same wells clearly demonstrates that the composite thermal maturity profiles constitute the record of separate thermal events of different intensity. The problem of paleotemperatures and corresponding paleoheatflows, calculated from vitrinite reflectance profiles, is much more complex, depending heavily on temperature conversion equations proposed by different researchers.

The studies of thermal maturity of organic matter of the coal-bearing formations of the USCB provide valuable conclusions and input for regional basin evolution hypotheses. Crucial to the study is the concept of the "coalification (thermal maturity) field" as a preserved record of maximum poleotemperatures reached by the coal-bearing formations. Hence, the shape of the maturity field represents paleotemperature fields subject to geometric presentation. The present thermal maturity field of the USCB is the result of a complex thermal history not only of the Moravo-Silesian orogenic belt and its foreland but also of the Carpathian foreland. It is a specific record of a continuous thermal evolution from early Carboniferous time to present, consisting most probably of several causally related thermal and tectonic events of different nature, intensity, location and extent. During particular thermal events different organic maturation factors may have played a leading role, contributing to the complexity of the problem.

# Physical Properties of Polish Coals of Wide Rank Studied with EPR, Optical Microscopy and Ultrasounds

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*Keywords: coal physics; elasticity; reflectance; EPR*

**Introduction**

Coal is an almost non-volatile, insoluble, non-crystalline, extremely complex mixture of organic molecules varying considerably in size and structure [1]. Detailed structural characterization has been found to be extremely difficult, so that coal structure research is still a challenging task. Details of coal network architecture are still lacking.

The aim of our study was to get the more complete information about coal structure within the wide rank using for the same samples the following physical methods: EPR spectroscopy, molecular acoustics and optical microscopy. Various physical parameters: true density, porosity, ultrasonic velocity, dynamic elastic modulus, reflectance and EPR parameters calculated from EPR spectra (linewidth $\Delta B_{pp}$, g-factor, etc.) were determined for coals of wide rank. The results were related to Hirsch's model of coal structure.

**Experimental**

Several various Polish coals collected from mines situated in the Upper Silesian Coal Basin and anthracites from Donbass (Ukraine), with carbon content between 83.1 and 98.3 wt%, were selected to study. The parameters of technical and elementary analysis of these samples were determined. The measurements of true density were made using a helium pycnometer Micromeritics® (USA). It allowed to determine the porosity of coals.

The EPR spectra of coal samples were measured using an X-band (9.3 GHz) electron paramagnetic resonance spectrometer with magnetic modulation frequency of 100 kHz. The EPR spectra were obtained at low microwave power (~0.7 mW) to avoid signal saturation. The experimental EPR spectra were fitted by different superpositions of Gauss and Lorentz lines. The parameters of the best fitted lines, namely linewidth $\Delta B_{pp}$, g-factor and integral intensity were calculated. Total concentration of paramagnetic centers and concentrations of the individual groups of paramagnetic centers in the studied coals were determined.

Elastic properties of coals were studied by means of ultrasounds, because the determination of dynamic elastic moduli requires the measurements of the velocity of ultrasonic wave propagating in the studied material. Ultrasonic velocities measurements were performed using an ultrasonic tester CT1 (UNIPAN-ULTRASONIC) based on the transmission method. The heads of 100 kHz were used. For anisotropy investigations, velocities of ultrasonic waves were measured along three directions of the sample's cubicoid.

The microscopic studies were made using reflected light microscope Axioskop (Zeiss, Germany) with polarized light $\lambda$ =546 nm, in immersion oil. Petrographic analysis was performed according to the procedure recommended by ICCP carrying out 500 points per sample. Reflectance values $R_m$, $R_{max}$ and $R_{min}$ were measured and some optical parameters were calculated for all samples studied.

**Results and Discussion**

EPR spectra of the studied coals were superposition of broad and narrow lines. Fig. 1 shows the plot of EPR lines for three coals with different carbon content. The strong dependence of multi-component structure of EPR spectra as carbon content in coal was observed. Broad EPR lines are dominant in the spectra of samples with a low carbon content. Broad and narrow lines exist in EPR spectrum of medium-rank coals. For coals with a carbon content above 90 wt% only the EPR narrow lines were measured.

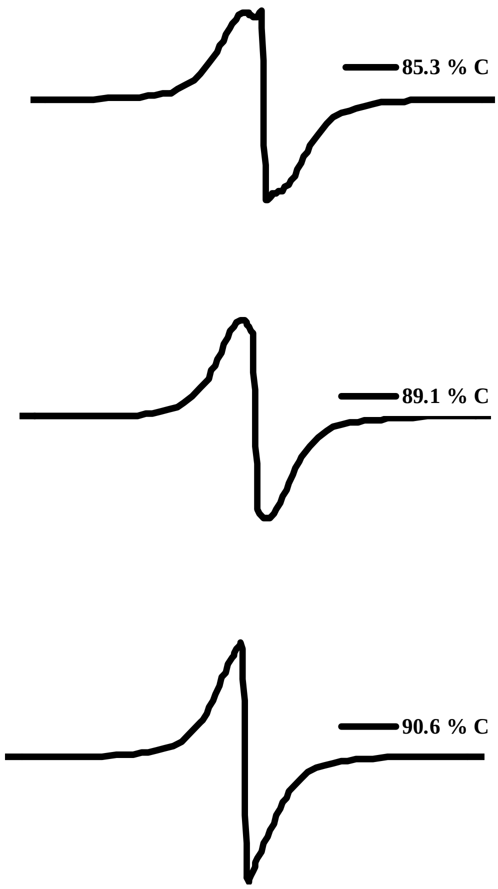


*Fig.1. The plot of EPR lines for three coals with different carbon content.*

Fig.2 shows the correlation between line-widths of broad and narrow EPR lines and carbon content. It was found that linewidths $\Delta B_{pp}$ of broad EPR lines decreases with carbon content. The lower content of heteroatoms N, O and S in the highly metamorphosed coals indicates these correlations.

Dipolar interactions in simple coal aromatic units are strongest in the coals with the low carbon content.

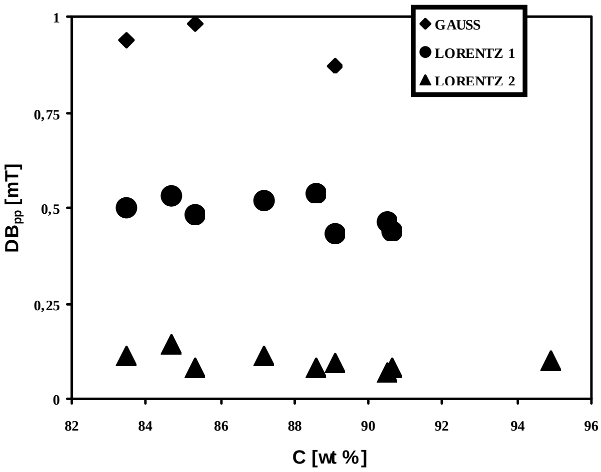


*Fig.2. The correlations between line-widths of broad and narrow EPR lines and carbon content*

Fig.3 shows the dependence of true density ( true) measured using helium pycnometer. It can be seen that true exhibits a flat minimum for carbon content equal to about 86-87 wt% and strongly increases with increasing coal rank for coals with carbon content over 91 wt%.

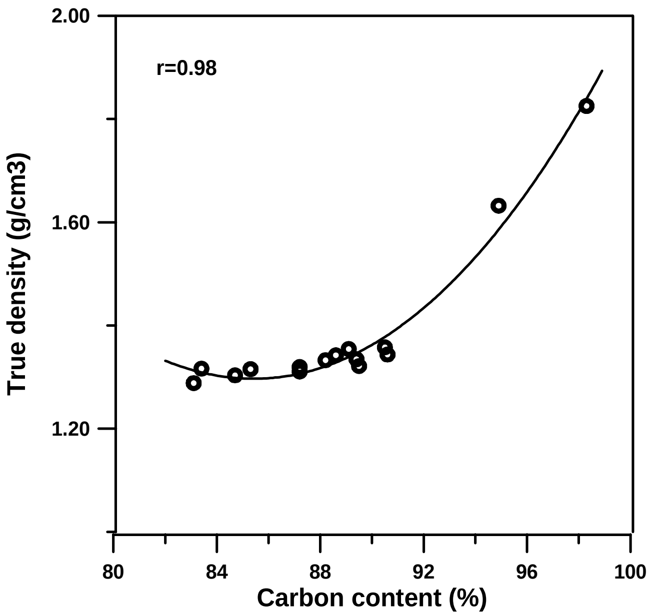


*Fig.3. The plot of true density versus carbon content*

Fig.4 shows the plot of the velocity of longitudinal ultrasonic waves of frequency of 100 kHz, dependent on coal rank. The velocities were measured along three mutually orthogonal directions. Similarly as true density, also velocity - a parameter showing elastic properties of coal, exhibits a flat minimum at carbon content of about 86-87 wt%. For coals with carbon content higher than 91 wt% a clear anisotropy of elastic properties is seen.

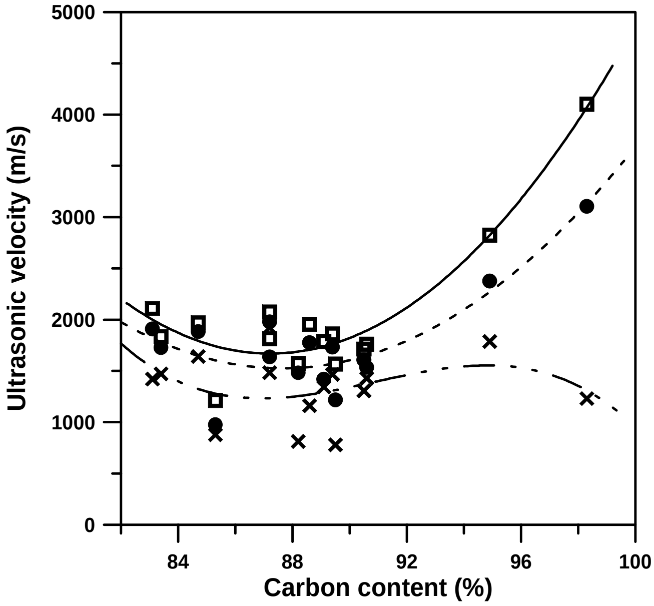


*Fig.4. The plot of the ultrasonic velocity measured along three directions versus carbon content*

Fig.5 shows the plot of bireflectance ($R_{max}$ - $R_{min}$) in dependent on coal rank. To the carbon content about 90% coals are almost isotropic, while for higher rank coals optical anisotropy strongly increases.

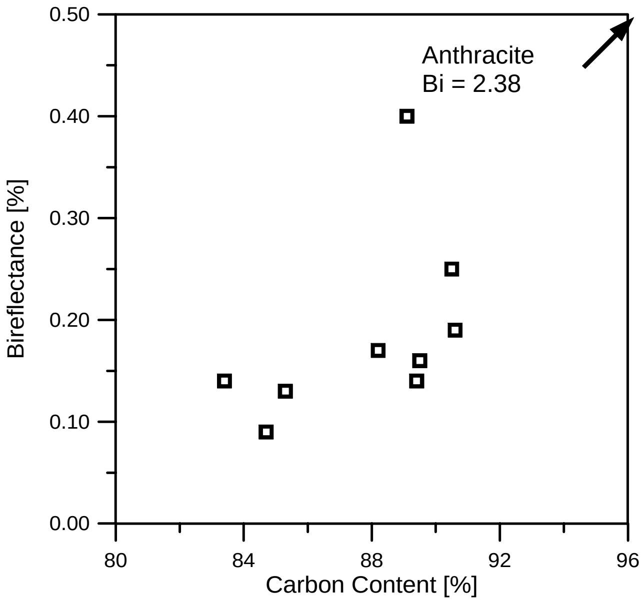


*Fig.5. The plot of bireflectance ($B_i$) versus carbon content*

Our results are consistent with the Hirsch's model of coals [1]. Hirsch distinguished between three types of structures, i.e., the "open structure" - characteristic of the low-rank coals in the range up to about 85% carbon, the "liquid structure" - the typical structure of the bituminous coals in the range from about 85 to 91 % carbon, and the "anthracite structure" - seen especially in high-rank coals with a carbon content of over 91 %. Studied coals covered all range of carbon content characteristic for these three structures.

The studied properties decrease inconsiderably with increasing coal rank to a flat minimum for C = 85-91 wt%, and then increase rapidly over carbon content of 91 wt%. Coals with C=83-85 wt% can be described by "open structure", coals with minimum values of physical parameters, almost constant within a flat minimum, exhibit "liquid structure", while high rank coals have strongly anisotropic "anthracite structure".

**Conclusions**

Various physical methods: EPR spectroscopy, molecular acoustics and optical microscopy were used to get the more complete information about coal structure within the wide rank using for the same samples. Physical parameters were found to exhibit a flat minimum for carbon content of about 85-91wt%, decreasing inconsiderably for C<85 wt% and rapidly increasing for C>91 wt%. Results were consistent with the Hirsch's model of coal.

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## The distribution of selected trace elements in coal, slag and fly ash from Bełchatów Power Station (Poland)

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*Key words: coal, slag, fly ash, trace elements, combustion*

**Introduction**

Coal, in addition to the obvious C, O, H, and N, contains a host of trace elements that behave in a variety of ways during combustion. Some of these tend to concentrate in gases, some in fly ash, some in slag and some to be equally distributed between fly ash and slag (Smith, 1987). As, B, Bi, Cd, Ge, Hg, Mo, Pb, S, Se, Sn, Sb, Tl, Hg concentrate in fly ash whereas Cu, Fe, Mn concentrate in slag. Elements that show no segregation between slag and fly ash include Li, Be, V, Cr, Co, Ni, Zn, Ga, Rb, Sr, Zr, Y, Cs, Ba, Ta, W, Th, U, Al, Ca, K, Mg, N, Na, P, Ti and REEs (Querol et al, 1995). The concentration of these elements is enhanced through the loss of carbon, hydrogen, nitrogen and oxygen during combustion (Muckhopadhyay et al, 1996).

Bełchatów Power Station (Poland), the largest brown coal fired power station in Poland was selected for the present study. It is sited in the vicinity of large Tertiary brown coal deposits. Coal from these deposits is combusted in pulverized boilers of BB - 1150 type producing 1150 tonnes of steam per hour.

This contribution is part of a comprehensive study of (a) coal macerals and slag and fly ash chars, and (b) trace-element contents and distributions in the feed coal, slag and fly ash, from Bełchatów. Here, the distribution of selected trace elements is outlined and initial comparisons are drawn between element occurrences in the slag and ash from four operating boilers.

**Sample collection**

Samples of coal, slag and fly ash were collected once a week during the period June 12 - July 3, 2002. In total, 4 coal samples and 12 slag and fly ash samples were collected from 4 boilers. The pattern of collection depended on which boilers were actually operating on the day of collection. Thus one sample of slag and one of fly ash was collected from Boiler 1, four samples of each from Boilers 2 and 3 and three samples of each from Boiler 4. Coal samples were collected from the conveyer belt prior to crushing. After an interval deemed appropriate by the staff of the power station, fly ash samples were collected at the entrance to the electrofilter and slag samples were collected from the slag collector. Proximate and ultimate analyses were carried out on the coal samples. *Inter alia*, Ba, Sr, Zr, V, Cr, Cu, Ni, Pb, and Zn contents were determined for all samples (see Table 1).

**Results**

The moisture contents ($W^a$) of the coal samples investigated range from 5.69 - 11.26 %, ash contents ($A^a$) from 14.62 - 21.36 %, volatile matter ($V^{daf}$) from 52.78 - 54.35 % and the heating value (daf) from 23.26 - 25.16 MJ/kg. The results of the ultimate analyses show that $C^{daf}$ ranges from 56.54 - 64.02 %, $H_2^{daf}$ from 4.70 - 5.24 %, $(O+N)^{daf}$ from 29.21 - 37.26 % and $S^{daf}$ from 0.67 - 2.26 %.

The concentration of the analysed trace elements is lower in the slag than in the fly ash. The elements showing the highest enrichment (2 - 7 times) in the fly ash as compared to the slag are Ba and Sr. Zn occurs in similar quantities in both the slag and the fly ash. In some of the samples examined, however, this is not so - the Zn content is greater in the slag than in the fly ash. Zr, V, Ni, and Cr tend to concentrate in the fly ash - the fly ash/slag concentration ratio is always greater than 1.5. Other elements (Cu and Pb) show a comparable distribution between the slag and the fly ash - the lowest fly ash/slag concentration ratio was below 1.5. Some samples of the fly ash show enrichment in these elements. One slag sample is characterized by a higher Pb content than that of the fly ash sample collected from the same boiler and collected so as likely to involve the same coal. The highest Pb content of all was recorded from that particular slag.

Elements that show the greatest enrichment (from 6 - 13 times) in the fly ash comparing to the coal are V and Zr. Other elements (Ni, Cr, Sr, Ba, Pb) exhibit smaller enrichments (from 1.5 to 12 times). Among these elements, Ni shows the greatest dispersion of results. In some cases, some elements, e.g., Cu and Zn, show lower concentrations in the fly ash than in the coal. The copper content is unusually high in one coal sample (131 ppm) - exceeding the upper value for most world coals (Taylor et al, 1998) by a factor of about three. In addition, the Zn content in one sample of the coals investigated was much greater (74 ppm) than in the others (16 - 35 ppm).

As in the fly ash, the elements exhibiting the highest enrichment (2 -7 times) in the slag when compared with the coal are Zr and V. Ba, Ni, and Cr are the elements that occur in the coal and the slag in similar quantity - the lowest slag/coal concentration ratio is lower than 1.5. These elements show some tendency to concentrate in the slag. The remaining elements show no clear segregation between coal and slag. The degree of enrichment of individual elements, when compared to their content in the coal, is less in the slag than in the fly ash.

An attempt was made to determine the relationship between individual element concentrations in the slag and the ash from the individual boilers. Despite their similar sizes and specifications, it is to be expected that there would be differences in their operation/efficiency and, thus, it would be reasonable to expect differences in the slag and ash distribution of individual trace elements from each. The results (Table 1) show that the highest concentrations of Ba, Sr, Zr, V and Ni characterize the fly ash from Boiler 2. The highest contents of all the other elements (Cr, Cu, Pb, Zn) characterize the fly ash from Boiler 4. The highest slag concentrations of all elements except Cu and Pb occur in slag from Boiler 4. In sharp contrast, the lowest slag contents of these two elements occur in the slag from Boiler 1. Cu occurs in similar if differing quantities in both slag and ash from Boilers 2-4. The Pb content is highest in slag from Boiler 2.

*Table 1. Average trace element contents (ppm) in slag and fly ash from individual boilers from Bełchatów Power Station*

| | **Fly ash** | | | |
|---|---|---|---|---|
| | Boiler 1 | Boiler 2 | Boiler 3 | Boiler 4 |
| Ba | 350 | 403 | 338 | 382 |
| Sr | 566 | 726 | 602 | 688 |
| Zr | 229 | 247 | 229 | 239 |
| V | 109 | 149 | 136 | 145 |
| Cr | 113 | 125 | 122 | 130 |
| Cu | 39 | 45 | 43 | 48 |
| Ni | 35 | 39 | 37 | 36 |
| Pb | 20 | 31 | 28 | 32 |
| Zn | 59 | 55 | 60 | 61 |
| | **Slag** | | | |
| | Boiler 1 | Boiler 2 | Boiler 3 | Boiler 4 |
| Ba | 121 | 126 | 136 | 161 |
| Sr | 159 | 123 | 158 | 214 |
| Zr | 136 | 117 | 124 | 142 |
| V | 51 | 57 | 56 | 65 |
| Cr | 51 | 53 | 51 | 62 |
| Cu | 16 | 23 | 23 | 23 |
| Ni | 16 | 16 | 16 | 19 |
| Pb | 9 | 15 | 12 | 12 |
| Zn | 40 | 49 | 46 | 87 |

No relationship between the concentration of individual elements in the coal and in the slag and the fly ash derived from the coal was determined. High concentrations of an element in the coal feeding a particular boiler does not necessarily result in a high concentration of that element in the resulting slag or fly ash. Conversely, low concentrations of an element in the coal may be linked to high slag and ash concentrations.

**Conclusions**

The lack of any consistent relationship between the concentrations of individual elements in coal and slag and fly ash is likely to reflect their varying behaviour during combustion and/or the form in which they occur in the feed coal. The combustion conditions (temperature, time, amount of oxygen, boiler characteristics) probably also influence the distribution of the elements.

The elements enriched in the fly ash compared to the slag are Ba, Sr, Cu, Cr, V and Ni. Zn and Pb show similar concentrations in both slag and fly ash. The elements showing the greatest enrichments in slag and fly ash derived from the same coal are V and Zr. Ni, Cr, Sr, Ba, Pb are also enriched in fly ash. Ba, Ni and Sr show a tendency to be enriched in slag compared to coal. The remaining elements show no clear segregation between coal and slag.

Based on this preliminary study from Bełchatów Power Station, the relative concentrations of elements in coal, slag and fly ash appears to depend more on combustion conditions than on their contents in the feed coals. Combustion conditions are the most plausible explanation for the greater concentration of trace elements in slag from Boiler 4 and for the greater concentration of some of the elements in fly ash from that same boiler.

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## Characteristion of coal - biomass blends


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Blending biomass and coal for co-firing presents an economic and environmental opportunity for power stations. The Australian Renewable Energy (Electricity) Act, 2000 created a target of 9,500 gigawatt hours (GWh) of renewable energy generation per year by 2010. A cost efficient method for large-scale biomass use is co-firing with a bulk fossil fuel as coal.

Potential biomasses in Australia consist of a variety of material such as bagasse (sugar cane waste), sawdust and woodchip. The variety of materials can present different problems in the utilization process, for example different moisture contents can influence the combustion efficiency, biomass may cause problems in the size reduction process and varying ash contents and compositions may contribute to problems of slagging and fouling. Within the fuel transfer systems feed segregation can occur and affect the combustion efficiency and the propensity for slagging and fouling to occur within individual boilers.

To monitor and consequently optimise the co-firing processes requires a simple analysis of the blends to ensure that blend integrity is maintained for all steps in the utilization chain. Hence it is necessary to determine the abundance and identity of the coal and biomass constituents anywhere in the process.

Point counting was applied to determine the abundance of constituent coals and biomasses in blends of power station feed. Known proportions of sawdust and bagasse were mixed with milled coal to produce blends of pulverised fuels.

Tests were conducted to determine the optimum conditions for microscopically identifying the biomass and coal components. Point counting was used to determine the volume percentage of biomass in these blends, hence of the mass percentages. The different fluorescence characteristics of plant/wood based biomass and fossil fuels allow an easy and accurate identification. Point count analysis in white reflected light proved to be similarly accurate. The technique was validated with a limited round robin exercise.

This method was tested to enable the proportions of the coal and the biomass constituents at different sampling points within power plants to be qualified and quantified. It can be applied to determine the biomass distribution to the individual boilers in the plant or for forensic studies that require the biomass residence time through the plant, relative to the coal, to be determined.

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## Timing of coalification of organic matter

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Opinions on the rate of coalification of organic matter and development of a coal seam from peat differ considerably. For instance, Karweil (1956), M. and R.Teichmüller (1968), a.o. thought that coalification of organic matter is a prolonged process, which lasted tens of millions years at depths of a few thousands of metres. On the other hand, numerous authors are of the opinion that the transformation of peat into coal is a process of which duration does not exceed a system or it rather occurred within one stage (Cross 1952, Pietzch 1962, Pešek 1978, Reichel 1970, a.o.). The examination of clastic dikes penetrating coal seams and studies of coal clasts occurring in Late Paleozoic basins, e.g., in Germany, Great Britain, USA, former Soviet Union, Czech Republic and Poland showed that there exist some doubts about the depth and time needed for the formation of subbituminous and bituminous coal and precondition of gererally high temperatures during the Variscan orogeny.

### Clastic dikes

The origin of clastic dikes, particularly in the Bolsovian of the Plzen and Kladno-Rakovník basins (Czech Republic) and Pennsylvanian sediments in several basins in the USA appears to be an interesting issue as concerns the timing of coalification. Pešek (1978) identified clastic dikes in the Upper Radnice Seam (Bolsovian) of the Plzen Basin. This author is of the opinion that the 50 - 100 cm deep fractures filled with superposed clastics originated in already "mature" slightly coalified seam of bituminous coal, exposed during a hiatus between the Bolsovian and Westphalian D. These dikes have either irregular shape or form conic bodies with sharp boundaries. The filling of either irregular or conic clastic dikes does not show any signs of postsedimentary deformation. Consequetly, these dikes could not have originated in peat because during its coalification and solidification would have to suffer from deformation (meandering). Some conic forms with sharp boundaries were observed in mine entries a few tens of metres long. Similar phenomena were described, e.g., by Price (1933) in West Virginia and in Pennsylvanian Basin and by Damberger (1973) in the Illinois Basin.

### Coal clasts

Coal clasts occurring in closer or remote hanging wall of coal seams are a few mm up to several cm large, being subangular or angular. However, there also exist clasts of which one side is angular to subangular, whreas their opposite side is markedly sharp. Coal clasts are mostly slightly less coalified (of the order of 0.0X %) by comparison with the nearest coal seam. Palynological studies carried out by different authors enabled to obtain exact but often very suprising ages of coal clasts. With the exception of studies, which dealt with the Polish and Czech parts of the Upper Silesian Basin, the coal clasts were always found in a unit of evidently same age (cf. Pašek 1984, Gayer et al., 1996 and Daněk et al., 2002). Pašek (1984) and Daněk *et al.*(2002) identified such clasts in the Plzeň and Kladno-Rakovník basins of which sedimentary filling is of Bolsovian up to Stephanian C ages. Their sediments are in subhorizontal position being mostly disturbed by only normal faults. The rank of coal clasts corresponds to high volatile bituminous coal. In contrast, the remaining findings come from folded basins of foredeep type. If bituminous coal seams were eroded, which has been proved by many observations, then the coalification of organic matter is believed to have been very fast, i.e., within a substage, maximum during 1-2 million years or even shorter period of time. Whilst Gayer et al.(1996) assume preceding burial of coal seams to a depth of about 1 km at increased geothermal gradient (600C.km$^{-1}$) connected with the ascent of hot fluids along tectonic lines leading to fast coalification to the rank of bituminous coal, the deep burial of organic matter in continental basins in the Bohemian Massif could not have occurred. Coal clasts in the Kladno-Rakovník Basin occur in the basal unit, whereas clasts in the Plzeň Basin found by Pašek (1984) were in close hanging wall of the Nýřany Main seam (Westphalian D). Palynological studies proved these coal clasts to belong to the Westphalian D. In contrast, coal clasts in the Kladno-Rakovník Basin, consisting of banded coal are of Bolsovian age. Therefore, it is obvious that coalification of coal seams in the Plzeň as well as in the Kladno-Rakovník basins was not only very fast, almost in leaps and bonds, but it is thought to have occurred at a depth of only tens up to a few hundreds of metres. The only logical reason leading to such fast coalification of biomass could have been high value of geothermal gradient in these basins of the Bohemian Massif. A number of large or smaller plutons of which many are 307-350 million years old appear to have played important role in the increase of heat flow (thermal gradient) during the Late Paleozoic in the Bohemian Massif.

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## Microscopically evaluation of xylite activated carbon LIFE Environment Project

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**Abstract**

This paper provides some information concerning the possibility of microscopically assessment of activated carbon made from Romanian xylite. Due to their physico-chemical (low rank and ash content) and structural characteristics (similar to the strong consistence wood), that can develop on activation a highly porous system, xylites are promising materials for activated carbon production.

Romanian xylites that belong to Oltenia's Pliocene deposits, less coalificated than other European deposits, could determine comparable or even better results in the process of activated carbon preparation. Concerning the botanical origin of xylite, the high cellulose contents could be explained by the acid environment having a decreased bacterial activity in forest Glyptostrobus swamps where the most xylite accumulated. Since the beginning of the seventh decade, in Romania appeared the necessity of xylite removal to increase the coals combustion efficiency in the power plants.

A microscopical evaluation of the efficiency of

preparation and combustion processes of high xylite coal dust has been carried out as well. Microscopical characterisation was used to determine the internal composition and structure of the coal, charcoal and activated carbon grains. The xylite structural composition is very important because it influences the structure and texture of the pyrogenated coal. These two determine the process of activated carbon manufacturing and thus, the size and characteristics of the adsorption surface. The results regarding the aspects of the structural - organic and mineral - composition are presented. In the xylite activated carbon the development of porosity depends on: the original petrographical components; the raw material grain size; pyrogenation parameters. In our case, the choosing of the proper conditions for rotary kiln and fixed bed steam activation involved lots of experiments which reveals the influence of the burned gases temperature and xylite grain size on the developing of the charcoal and than, activated carbon surface area. The charcoal microstructure reveals some interesting aspects concerning the carbonization process, both as evolution and efficiency and as the structural characteristics. An activated carbon with a wide surface area and a higher adsorptive property is made only by special char gasification process. In the xylitic char, which is composed almost solely of carbonized woody-like organic material, activation causes changes that are typical for this material. The porous structure depends strongly on coal rank, grain size, carbonization and activation temperatures and reaction time, during both processes.

The mechanical preparation by crushing and sizing of the supplied xylite determined the establishing of an optimal granulometric distribution that improved the quality of the final product. The microscopical structural composition, mainly as structurated woody material - cellular and fibrous textinite - is very important because it influences the structure and texture of the pyrogenated and activated xylite. The paper reveals that microscopical evaluation could be useful even in some domains in which only the classical physical methods seems to be efficient.

**Acknowledgements**

This work has been suported by the European Commission - Directorate - General Environment by the Project LIFE 02 ENV/RO/000461.

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## Physical and Technological Parameters of Laboratory Produced Cokes in Relation to Properties of Initial Coals

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*Keywords: elastic properties; optical properties; coke reactivity; CSR*

**Introduction**

In recent years, modern blast furnaces technologies stream to minimize the cost of pig-iron production, and consequently, to limit coke consumption per unit. It results in increase of requirements for coke qualitative parameters. Coke reactivity and strength after reaction with $CO_2$ (CSR) are principal criteria by which coals are selected to make blast furnace coke. Because the determination of coke reactivity (CRI) and CSR is expensive and time-consuming procedure prediction methods using characteristics of initial coals are intensively researched. There are several prediction methods based on rank, inerts and some others parameters of parent coals (fluidity, dilation, mineral matter amount, type and distribution in the organic matrix, etc.). Up to now however, there is no universally applicable prediction formula.

The purpose of this work was to find correlation between some physical parameters of laboratory-produced cokes and properties of initial coals (RI, carbon content, etc.)

**Experimental**

Fifteen coals of different coking ability were selected to the study. The results of elemental and technical analyses and Roga Index of studied coals are presented in Table 1.

*Table 1. Elemental and technical analyses and Roga Index of studied coals. Notation: $A^d$ - ash content, dry basis; $C^{daf}$ - carbon content, dry, ash free basis; $V^{daf}$ - volatile matter, dry, ash free basis; RI - Roga Index*

| Coal | Parameter | | | |
|---|---|---|---|---|
| | $C^{daf}$ | $V^{daf}$ | $A^d$ | RI |
| 1 | 94.9 | 2.5 | 5.8 | 0 |
| 2 | 88.2 | 23.1 | 3.3 | 69 |
| 3 | 89.5 | 30.2 | 5.8 | 67 |
| 4 | 85.3 | 26.5 | 8.9 | 69 |
| 5 | 88.6 | 20.4 | 8.0 | 65 |
| 6 | 90.5 | 17.8 | 4.0 | 38 |
| 7 | 90.6 | 22.0 | 6.2 | 51 |
| 8 | 89.4 | 21.9 | 1.6 | 54 |
| 9 | 87.2 | 23.4 | 9.0 | 30 |
| 10 | 84.7 | 38.0 | 5.6 | 51 |
| 11 | 83.1 | 38.3 | 26.8 | 21 |
| 12 | 83.4 | 33.5 | 4.6 | 53 |
| 13 | 87.2 | 29.5 | 5.6 | 44 |
| 14 | 89.1 | 23.0 | 5.5 | 76 |
| 15 | 93.1 | 42.9 | 9.5 | n.d. |

Every coke was produced using only one single coal. Block samples of coals of diameter about 80/80/90 mm were coking in laboratory oven up to the temperature 1000˚C. Heating time was 3 hours. In final temperature samples were kept 1 hour and after that, they were cooled in room temperature. Gases produced during coking process were currently removed from the oven. The scheme of apparatus used for laboratory coking is shown in Fig. 1.

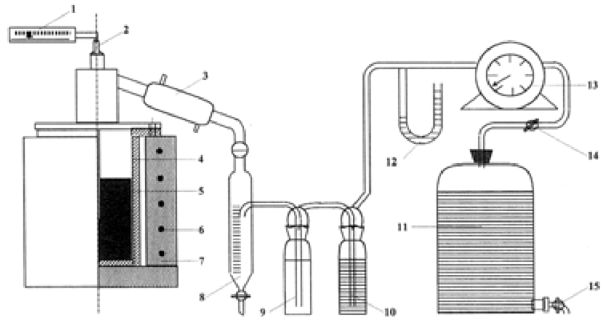


*Fig.1 Scheme of laboratory apparatus for coking of coals studied. Notation: 1. Thermometer, 2. Thermocouple Pt-RhPt, 3. Radiator 4. Retort 5. Single coal sample, 6. Electrical furnace 7. Fire-clay 8. Separator of heavy tar 9. Separator of small particles of tar 10. Washer 11. Reservoir for gas 12. Manometer 13. Gas-meter 14, 15. Valves*

Elastic and optical properties of coke samples were determined and then compared with some physical and technological factors of initial coals. Since elastic and optical properties are not normally defined for cokes, NSC coke strength after reaction (CSR) and coke reactivity index (CRI) were determined for standard characteristic of cokes studied. They are presented in the Table below.

*Table 2.*

| | Coke | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| CRI | n.d. | 21.3 | 55.5 | 46.8 | n.d. | 59.5 | 50.8 | 49.1 |
| CSR | n.d. | 69.6 | 24.1 | 52.2 | n.d. | 66.7 | 53.2 | 60.8 |
| | Coke | | | | | | | |
| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | |
| CRI | 61.2 | 60.2 | 59.4 | 58.6 | 72.2 | 26.2 | 20.1 | |
| CSR | 61.6 | 24.7 | 23.9 | 38.1 | 50.7 | 71.5 | 77.3 | |

Reflectance parameters ($R_{max}$, $R_{min}$, $R_m$ and $Bi = R_{max} - R_{min}$) were determined with optical microscope Axioskop MPM 200 (Opton-Zeiss, Germany) using monochromatic polarized light of $\lambda$ = 546 nm, with immersion oil. Bireflectance ($Bi = R_{max} - R_{min}$) were also calculated for all coke samples.

The dynamic elastic moduli were determined using an ultrasonic velocity measurements. The velocities of longitudinal ultrasonic wave of frequency of 100 kHz were measured for three mutually perpendicular directions with an ultrasonic tester (Tester CT1, UNIPAN-ULTRASONIC, Poland) based on the pulse transmission method. Cokes exhibit less complicated structures in relation to symmetry directions than those of single crystals and therefore the dynamic elastic moduli were determined from apparent density and ultrasonic velocity according to a simple equation:

$$E = \rho v^2$$

where $\rho$ is apparent density and $v$ is ultrasonic velocity.

**Results and Discussion**

Figure 2 shows the plot of the parameter of elastic anisotropy of cokes, defined as a maximum ultrasonic velocity divided to a minimum ultrasonic velocity, versus Roga Index determined for initial coals. It can be seen that the value of $v_{max}/v_{min}$ exhibits a wide minimum for RI ranging from about 40 to 55. This range of RI is characteristic for coals applied for the preparation of coking blends. Cokes produced of single coals with RI between above magnitudes are isotropic. Cokes produced of initial coals characterised by RI higher or lower than values in the range of 40 - 55 are anisotropic.

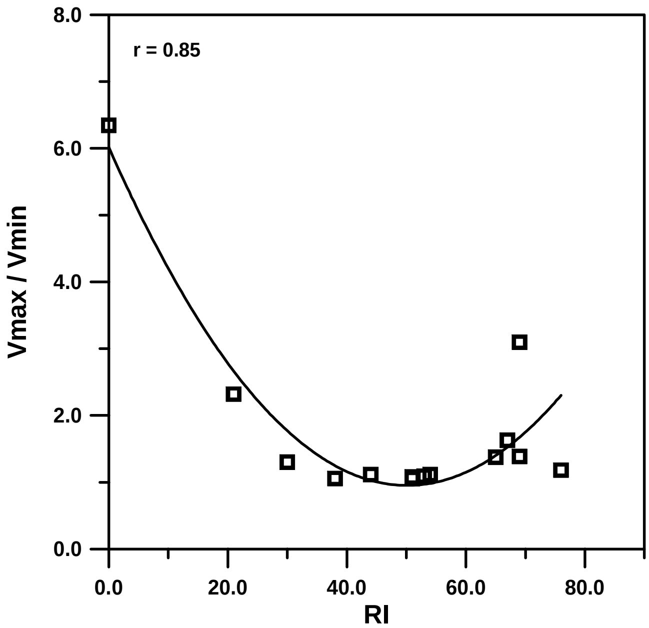


*Fig. 2 The plot of $v_{max}/v_{min}$ related to elastic anisotropy of cokes vs. the Roga's parameter determined for initial coals*

Optical parameters of cokes studied show relationship with the rank of initial coals determined by carbon content or by mean reflectance value (Fig.3). The higher rank of parent coals the greater optical anisotropy of resultant cokes.

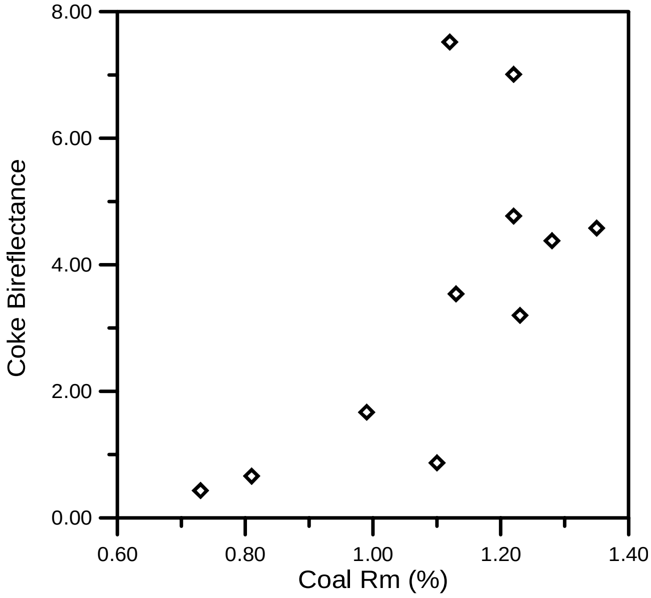


*Fig.3 The plot of mean reflectance ($R_m$) of parent coals versus maximum reflectance ($R_{max}$) of resultant cokes*

Correlation between physical properties of cokes and initial coals were found. Ultrasonic studies result in the statement that the higher elastic properties (maximum ultrasonic velocity) of coals, the higher elasticity of cokes. However, the data are scattered because of heterogeneity of samples. Cokes are isotropic or anisotropic dependently on the Roga Index. Studies are in progress.

**Acknowledgements**

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## Thermal Maturity and Source Rock Potential of Some Mesozoic Sedimentary Rocks in Sri Lanka

S.P. Ranasinghe[1], A.C. Cook[1]

**Abstract**

Sedimentary rocks of probable Jurassic ages occur in a number of narrow grabens in the northwestern

part of Sri Lanka. Examination of two suites of samples collected from bore cores taken from the Andigama and Pallama Basins shows silty lacustrine sediments with high contents of algal material of lacustrine origin. Although the sediments are lacustrine in origin, a large higher plant-derived component of organic matter (mainly vitrinite) is also present. Lamalginite is the most abundant form of alginite, but telalginite colonies are abundant in many of the samples and form prominent lenticular masses. Maturation levels appear to range from marginally mature (vitrinite reflectance of 0.55 %) in the very shallow parts of the section to mid oil-mature (vitrinite reflectance of up to 0.70 %) near the base of both of the wells studied. Small amounts of oil are occluded within mineral grains in some of the deeper samples providing direct evidence of oil generation from the organic matter within these sections.

## Adsorption - Desorption Behaviour of Coals: From Lignite to Anthracite

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**Abstract**
Both macro- and microscopically, coal is physically and chemically a non-homogeneous micro-structured material composed of organic and mineral phases. The complex process of coal formation and natural evolution corresponds to different coalification stages in which distinct organic products are formed composed mainly by molecules varying considerably in chemical composition, size and structure.

Several authors have demonstrated that a micro-structured material when submitted to a fluid injection does not adsorb the fluid unconditionally and homogeneously. This process depends not only of the volume and the weight of the atoms but also of the molecules of the micro-structured material and of the volume of the intermolecular and interparticules spaces that can be occupied by the fluid.

Our experiments demonstrate that the gas behaviour between adsorption and desorption processes varies dramatically from lignites to anthracites, as theoretically expected, according to their different structures. In fact, studies carried out so far showed that cross-links between layers of organic material turn up, progressively, more organized (coal structure is successively more aromatic) from lignite to anthracite, inducing a progressively more stable relationship between the coal organic molecules and the injected gas molecules. The coal structure, successively more organized as coalification increases, produces a higher internal surface area which consequently corresponds to more space that can be occupied by gas. This fact is also confirmed by the hysteresis between adsorption and desorption curves. In medium- and high-rank coals, yet depending on the progressive more or less level of the structure organization, no significative hysteresis is detected. However, the hysteresis in low- rank coals occurs due to their poor organized structure. During the adsorption process low- rank coals behave as a normal adsorbent, which easily store gas in the structure. In the desorption process it is only necessary to start reducing the pressure for a rapid gas release, since the structure can not create links strong enough to maintain the gas store in the coal structure.

Experimental conditions of the adsorption/desorption processes were as follows: bath temperature of 35ºC, pure methane as the fluid, sample with moisture content equal or greater than the Moisture-Holding Capacity, particle size of the samples less than 212 µm, and sample mass c.a. 100 g.

## Micro-Raman Spectroscopy of Vitrinite, Liptinite and Inertinite

B. Valentim[1], A. Guedes[1], A.C. Prieto[2] & M.J. Lemos de Sousa[1]
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**Abstract**
Several authors have already demonstrated the

usefulness of Raman spectroscopy in characterizing the state of structural order of carbonaceous materials, kerogen, coals and graphite, however the punctual characterization of specific coal macerals by this technique is unknown so far. A fast, punctual and non-destructive characterization of the local state of carbonaceous material may be achieved with a micro-Raman spectrometer, since spectra from micrometric areas can be recorded. Therefore, it is obvious the potential of this technique is in the field of coal macerals.

The aim of this investigation is to study and compare the Raman spectra obtained on vitrinite, liptinite and inertinite of the same coal.

The results show not only the presence of the usual peaks at 1580 $cm^{-1}$ (O peak) and 1350 $cm^{-1}$ (D peak) on the first-order Raman spectrum, but also the presence of two additional weaker peaks, one between 1187 $cm^{-1}$ and 1280 $cm^{-1}$ and another between 1489 $cm^{-1}$ and 1533 $cm^{-1}$. No second-order features were observed. Differences of the first-order spectrum include (i) a shift of the 1580 $cm^{-1}$ peak toward higher wavenumbers accompanied by its narrowing from vitrinite to liptinite and inertinite; and (ii) a shift of the 1350 $cm^{-1}$ peak toward lower wavenumber from vitrinite to liptinite and inertinite accompanied by its narrowing from vitrinite to inertinite and to liptinite.

**Acknowledgements**
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## Micro-Raman spectroscopy of coal chars

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[2]*Departamento de Física de la Materia Condensada, Cristalografía y Mineralogía, Universidad de Valladolid, Valladolid, Spain.*

**Abstract**
The characterization of the structure of coal and char may be achieved with reflectance and micro-Raman spectroscopy, since these techniques permit a fast, punctual and non-destructive analyses on the different components.

The aim of this study is to correlate the reflectance of vitrinite, macrinite and their char morphotypes - cenospheres and macrinoids - with the ratio of the intensities of the 1350 $cm^{-1}$ and 1580 $cm^{-1}$ Raman peaks to improve the understanding of the char structure. For that purpose a high volatile bituminous coal was devolatilised at several temperatures in a fluidised bed reactor and the reflectance and Micro-Raman spectroscopy analyses were carried out on the coal and their devolatilisation chars.

The results permit to conclude that vitrinite chars have higher mean random reflectance values than the macrinite ones. The Raman parameter I1350/I1600 increased both in cenospheres and macrinoids as the devolatilisation trials temperature increased. Finally, mean random reflectance and I1350/I1600 values correlate directly.

**Acknowledgements**
This work has been supported by two grants of FCT (SFRH/BPD/5530/200 and SFRH/BPD/5506/2001).

## Know Your Coal Petrologist #8

Dangerous mining conditions call for innovative roof support measures. Who is doing his best to ensure the roof does not cave in? Answer page 46.

## DEADLINE FOR NEXT ICCP NEWS :

## 14TH JUNE 2004

## 56TH ANNUAL MEETING OF THE INTERNATIONAL COMMITTEE FOR COAL AND ORGANIC PETROLOGY- ICCP

## 12-18TH SEPTEMBER 2004, BUDAPEST INCLUDING A ONE-DAY SYMPOSIUM ON "ENVIRONMENTAL MANAGEMENT IMPLICATIONS OF ORGANIC FACIES STUDIES"

## SECOND ANNOUNCEMENT

The President of the International Committee for Coal and Organic Petrology, ICCP, and the host organisations of the meeting, the Geological Institute of Hungary and the Hungarian Geological Society, have the honour to invite all ICCP members to the 56th Meeting of the International Committee for Coal and Organic Petrology in Budapest. During the conference, Working Groups of the three ICCP Commissions will convene and hold sessions over four days. On 15th September a one-day Symposium titled "Environmental management implications of organic facies studies" will be organised.

**Venue** Geological Institute of Hungary
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- Coal Blends Working Group
- Coke Petrography Working Group
- Improved Image Analysis Working Group
- Combustion Working Group

## Tentative programme

| | 12th September Sunday | 13th September Monday | 14th September Tuesday | 15th September Wednesday | 16th September Thursday | 17th September Friday | 18th September Saturday |
|---|---|---|---|---|---|---|---|
| **Morning** | | Registration and Opening Plenary Session | Commission I Sessions | One-day Symposium | Commission II Sessions | Commission III Sessions | Field Trip |
| **Lunch** | | | Microscope session | Poster session | Microscope session | | |
| **Afternoon** | Council Meeting | Commission I Sessions | Commission II Sessions | One-day Symposium | Commission III Sessions | Closing Plenary Session | |
| **Evening** | Registration and Ice-breaker | | | Conference Dinner | | | |

**Poster and oral presentations**
Posters will be exhibited during the meeting (poster size: 200 x 100 cm). Oral presentations will be on the one-day symposium "Environmental management implications of organic facies studies" on 15th September. For more information please see on our website.

**Proceedings**
The International Journal of Coal Geology is planning to publish the proceedings of the Symposium in a Special Issue.

More information is available on http://www.mafi.hu/ICCP/index.html
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Reservation deadlines and conditions are different for different hotels. Please contact the hotels directly above.

[1]**Danubius Hotel Gellért**: See attached **HOTEL BOOKING FORM** on http://www.mafi.hu/ICCP/index.html.

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[3]**OM Guest House**: Dormitory room. Bathroom is on the corridor. The price of the breakfast is excluded.

For other hotels: Breakfast is included.

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# From the TSOP President

## Welcome to TSOP

The Society for Organic Petrology (TSOP) is an international professional society for scientists and engineers involved with coal petrology, kerogen petrology, organic geochemistry, petroleum geochemistry, and related disciplines. TSOP members receive a quarterly newsletter, membership directory, and abstracts and program volume from the annual meeting. A peer-reviewed collection of papers from each annual meeting is published as a special issue of the *International Journal of Coal Geology*. TSOP has published the CD-ROM based **Coal Geology and Petrology Atlas** with the AAPG Energy Minerals Division. Of the 214 current members of TSOP, 45% are from countries other than the United States, including Canada, Australia, and the United Kingdom. TSOP members are primarily involved in oil, gas, coal, and environmental research: 49% said they conducted oil and gas research, 53% conducted coal research, and 16% conducted environmental research. TSOP members are affiliated with universities (35%), industry (25%), government agencies (18%), or are private consultants (13%), students (5%), or retired (4%).

Our 21st annual meeting will be held at Coogee Beach near Sydney, Australia from September 26 - October 1, 2004. For information on this meeting visit http://www.tsop.org, or contact the conference organizers: Neil Sherwood (mailto:neil.sherwood@csiro.au), Colin Ward (mailto:c.ward@unsw.edu.au) or Lila Gurba (mailto:lila.gurba@ccsd.biz. The meeting will feature Technical Sessions on **Coal in Sustainable Development** and **New Techniques and Applications**, as well as **Coal-bed Methane** and **Non-marine Source Rocks**. Field trips will be conducted to see the **geology of the Sydney Basin coal measures near Newcastle** and to see the **oil shale (torbanite) geology at the historic Joadja mine site**. There will also be a pre-meeting short course on the **Analysis and Significance of Mineral Matter in Coal**. We are planning to initiate a student activity function run by and for students interested in coal science and organic petrology. ICCP student members are welcome to participate in this event at no charge. TSOP is collaborating with ICCP in developing the technical program on New Techniques and Applications for the meeting, and the ICCP President has also been invited to address the meeting. We look forward to seeing you there.

We have a number of current TSOP **Research Committee** projects. These include a TSOP-ICCP dispersed organic matter classification committee and a committee on coal-bed gas in low-rank coals. TSOP has a **Graduate Student Research Grant Program** that offers up to $US 1000 to help foster research in organic petrology (including coal and kerogen petrology, organic geochemistry). For information and application forms contact Suzanne Russell (mailto:suzanne.j.russell@shell.com) or see our web site (http://www.tsop.org).

TSOP recently awarded the first complimentary subscription for the *International Journal of Coal Geology* to Dr. Marko Ercegovac of the University of Belgrade. ICCP members will be notified of all future opportunities for obtaining such complimentary journal subscriptions. Incidentally, TSOP members can subscribe to the *International Journal of Coal Geology and Review of Paleobotany and Paleonology* at special reduced rates.

TSOP and ICCP have many common interests and goals. It is our desire to explore with ICCP ways in which our organizations can effectively work together for the mutual benefit of our membership and for the advancement of coal science and organic petrography.

For information or comment, please contact Bob Finkelman (mailto:rbf@usgs.gov) or visit our web site (http://www.tsop.org) to learn more about our Society.

# News from TSOP

## 2003 ANNUAL MEETING

The Society for Organic Petrology (TSOP), 21st Annual Meeting, September 26-October 1, 2004, Sydney, Australia. Information:

Neil Sherwood
CSIRO Petroleum Resources
PO Box 136
North Ryde
NSW 1670 Australia
Phone: +61-2-9490-8666
Fax: +61-2-9490-8197

mailto:Neil.Sherwood@csiro.au
OR Colin Ward
mailto:C.Ward@unsw.edu.au
Further details: http://www.tsop.org/mtgsyd.htm

Abstracts due 4/30/04. Oral and poster sessions September 27-30. Topics include coal in sustainable development, methane in high and low rank coals, new techniques in organic petrology and geochemistry, and non-marine source rocks.

Short course (Sept. 27) on analysis and significance of mineral matter in coal.

Field trips to Joadja torbanite (oil shale) deposits (9/26) and Hunter Valley coals (10/1).

## 2003 STUDENT GRANT PROGRAM

The Society for Organic Petrology (TSOP) invites applications for graduate student research grants. The purpose of the grants is to foster research in organic petrology (which includes coal petrology, kerogen petrology, organic geochemistry and related disciplines) by providing support to graduate students from around the world, who demonstrate the application of organic petrology concepts to research problems.

Grant Size: Monetary awards up to a maximum of $1,000.00 US will be granted. TSOP will also provide Merit Awards, in the form of certificates redeemable for TSOP publications, to top-ranking applicants not receiving grants. The program awards a maximum of two grants each year.

Use of Grant: Grants are to be applied to expenses directly related to the student's thesis work, such as summer fieldwork, laboratory analyses, etc. A portion (not to exceed 25%) of the funds may be used to attend TSOP Annual Meetings. Funds should not be used to purchase capital equipment, to pay salaries, tuition, room, or board during the school year. Funds must be spent within 18 months of receipt of the award.

Application Deadline: TSOP graduate student research grant application deadline is May 1, 2004. Grants will be awarded in September, 2004. Detailed information and an application form on the TSOP web site http://www.tsop.org/grants.htm or applications may be obtained from

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Shell UK Exploration and Production
1 Altens Farm Rd.
Nigg, Aberdeen AB12 3FY
United Kingdom
fax: +44(0)1224 88 3689 ;
mailto:suzanne.j.russell@shell.com

# ICCP and International Journal of Coal Geology

There exist logical connections between the work of the ICCP and the scope of the *International Journal of Coal Geology*. ICCP serves as the organization developing and refining nomenclature and techniques in coal and organic petrology and the contributors to *International Journal of Coal Geology* are among the most frequent users of ICCP's developments. As such, ICCP has a standing invitation to publish the results of their nomenclature refinements (the maceral sheets), final products of working groups, and proceedings of technical sessions in the journal.

The rules for submission and review would be similar to most other papers, with the exception of the maceral sheets. We will assume that the maceral sheets have been subjected to tedious internal review prior to final submission and, except for minor grammatical changes, are ready for final approval by the editor-in-chief. All other papers would be subject to peer review. The proceedings of technical sessions would, in most cases, be handled initially by a guest editor, as in the case of the ICCP-TSOP session and Teichmüller symposium at the 2001 Copenhagen meeting and the Mackowsky Symposium at the 2003 Utrecht meeting.

Authorship can be a sticky issue. The authors should be the individuals professionally responsible for the research, interpretation, and writing. In the case of working groups, the authorship decision rests with the chair of the working group. It is assumed that the listed authors of maceral sheets would be the individuals most responsible for the coordination and editing of the final product. In all cases with working groups and maceral sheets, authorship should be by individuals, not by the organization, although the byline "on behalf of the International Committee for Coal and Organic Petrology" can be added.

*Jim Hower*
*Editor in Chief*
*International Journal of Coal Geology*

A flock of illustrious New Zealand (and NZ-associated) coal geologists taking a well earned break during examination of the Buller Coal Measures, West Coast, South Island in 1990. From left: Jon Lindqvist (rear), Peter King (front), Romeo Flores (joint field trip leader), Mike Isaac (rear), John Barry (front), Phil Kirk, Jane Newman, Jane Shearer, Peter Crosdale (rear), Malcolm Laird (middle), Steve Edbrooke (front), David Pocknall, Simon Nathan, Joan Esterle. *Photo by Richard Sykes (joint field trip leader), contributed by Tim Moore.*

# ICCP Classifieds

A free service to ICCP members. Send your 'For Sale', 'Wanted to Buy', 'To Give Away' etc. to the editor.

## WANTED TO BUY

- Objective: Leitz 50/0.85 P oil , Infinity/0
  *Dave Pearson*
  *mailto:dpearson@coalpetrography.com*

- Point counter
  *Peter Crosdale*
  *mailto:peter.crosdale@energyrc.com.au*

## DONATION NEEDED

- an old working photomultiplier microscope for vitrinite reflection measurements;
- a point counter;
- the last edition of COAL - Van Krevelen's.

for the Carbochemistry Laboratory's benefit (Industrial Chemistry Faculty -University Politehnica Bucharest) which is deeply involved in petrological activities (graduation diplomas and Ph.D. students of Prof. Cornelia Panaitescu).

*Contact: Dr. Georgeta Predeanu:*
*mailto:gpredeanu@metal.icem.ro or*
*mailto:gpredeanu@yahoo.com*

## NEW HOME NEEDED FOR BOOKS

In seeking to reduce my holdings of books and reprints I offer the following books to any member/Research Institute/Library wishing to augment their archive of historical publications in Coal Petrography:

**1.** Seyler, C.A. (1929) The Microscopical Examination of Coal. DSIR Fuel Res. No.16 HMSO London.

**2.** Stach, E. (1949) Lehrbuch der Kohlenmikroskopie. Verlag Glückauf GMBH

**3.** Stach, E., Mackowsky, M-Th., Teichmüller, M. et al. (1975) Stach's Textbook of Coal Petrology. Gebrüder Borntraeger, Berlin.

The only charge will be for postage, to be advised

mailto:a.h.smith@sheffield.ac.uk

# Answer to Know Your Coal Petrologist #8

**Rolando Carrascal** is doing his bit to provide additional leverage to the already heavily supported roof of the Pampahuay Mine, Oyon coal basin, Peru.

# ICCP Awards and Calls for Nominations

ICCP offers a number of awards to recognise outstanding achievements in coal and organic petrology at various stages of career development. Awards available and a brief summary are given below. Full details on the nature of the award, its terms and conditions and how to apply can be found on the ICCP home page at http://www.iccop.org or by contacting the chair of the award committee (see inside front cover).

## Young Scientist Award Call for Nominations

For recent higher degree graduates under 35 years of age who have potential to make outstanding contributions in the field of coal and organic petrology during their career. The award consists of:

-$500US cash
- 3 years of ICCP Membership
-a certificate

In addition, the ICCP Council may invite candidates of exceptional merit to attend the next ICCP meeting to present their results. In this case, up to an additional $1500US will be provided to cover expenses. Meeting costs will be included.

Applications close on **December 31** of each year and should be sent to:

Dr A.C. Cook
Chair ICCP Young Scientist Award Committee
Keiraville Konsultants Pty Ltd
7 Dallas Street
Keiraville, NSW 2500
Australia

## Organic Petrology Award Call for Nominations

The Organic Petrology Award recognises outstanding contributions by coal and organic petrologists at an intermediate stage of their career. It is limited to applicants under 50 years of age. The award consists of a bronze medal. Applications for the award are called for every second year. Nominations close on **APRIL 30th 2004** and should be sent to:

Dr R.M. Bustin
Chair, Organic Petrology Award Committee
Department of Geological Sciences
University of British Columbia
6339 Stores Road
Vancouver, B.C. V6T 2B4
Canada

## Thiessen Medal

This is the highest award offered by ICCP. It recognises a lifetime of achievement and outstanding contributions in the fields of coal and organic petrology. The award consists of a bronze medal. Awards are made sporadically but applications are called for every 2 years.

## WHAT'S HAPPENING

### 20 -28 August 2004

**32nd International Geological Congress,** Florence, Italy.
mailto:secretariat@32igc.org
http://www.32igc.org/home.htm

### 12 - 18 September 2004

**56th Annual Meeting of ICCP,** Budapest, Hungary
Contact : Dr Mária Hámor-Vidó
mailto:vidom@mafi.hu
http://www.iccop.org

### 13 - 17 September 2004

**21st Annual International Pittsburgh Coal Conference,** Osaka, Japan
http://www.engrng.pitt.edu/~pccwww/
For topic areas 12 (Coal Chemistry) and 13 (Coal Geosciences and Resources)
Contact : Jim Hower or Toshimasa Takanohashi
mailto:hower@caer.uky.edu
mailto:toshi-takanohashi@aist.go.jp
http://www.engrng.pitt.edu/~pccwww/

**27 September - 1 October 2004**

**21st Annual TSOP Meeting,** Sydney, Australia
Contact : Neil Sherwood or Colin Ward
mailto:Neil.Sherwood@csiro.au
mailto:C.Ward@unsw.edu.au
http://www.tsop.org/mtgsyd.htm

**11 - 15 April 2005**

**The World of Coal Ash,** Lexington, Kentucky, USA
Contact : Dr Jim Hower
mailto:hower@caer.uky.edu
http://www.worldofcoalash.org/

**11 - 14 September 2005**

**22nd Annual TSOP Meeting,** Louisville, Kentucky, USA
http://www.tsop.org

**18 - 23 September 2005**

**57th Annual Meeting of ICCP,** Patras, Greece
Contact : Assoc. Prof. Dr. Kimon Christanis
mailto:christan@upatras.gr
http://www.iccop.org

# ICCP Publications

## ICCP Handbook

*International Handbook of Coal Petrography 2nd Edition (1963)* (in English) as CD ROM
- PC and Mac Compatible
- Requires Adobe Acrobat Reader Ver. 4 or above
- ICCP / TSOP member - $25US (including postage)
- ICCP non-member - $50US (including postage)

*International Handbook of Coal Petrography, supplement to the 2nd edition*, second print (in English) 1985 US$30

*International Handbook of Coal Petrography, 2nd supplement to the 2nd edition* (in English) 1986 US$10

*International Handbook of Coal Petrography, 3rd supplement to the 2nd edition* (in English) 1993 US$20

Prices do not include shipping unless stated (approx US$15 in Europe and outside US$23 Europe per item) or cost of money transfer.

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**Payment can be accepted by credit card (Mastercard or Visa) or cheque.**

At the Mackowsky Symposium - Marco Ercegovac (left), Monika Wolf and Claus Diessel. *Photo: Peter Crosdale*

**If undeliverable return to :**
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