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NEWS OF THE INTERNATIONAL COMMITTEE FOR COAL AND ORGANIC PETROLOGY

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Minutes of the 48th Meeting of the ICCP held in Heerlen, The Netherlands September, 8-14, 1996

by
Zuleika Carreta CORREA DA SILVA,
General Secretary

1. General Course of the Meeting

The 48th meeting of the ICCP took place in Heerlen, The Netherlands, from September 8 to 14, 1996. It was attended by the President, Prof. Dr. Manuel J. Lemos de Sousa, 54 ICCP members (2 Honorary, 29 Full and 23 Associate Members) and 15 guests from 23 countries. The meeting was organized by the Heerlen Office of the Geological Survey of the Netherlands and the technical sessions were held at the Central Bureau of Statistics (CBS). The meeting was officially opened by the Chairman of the Organizing Committee, Dr. W. Fermont, who welcomed the President and the attending ICCP members followed by the Mayor of the City of Heerlen, Dr. J.B.V.N. Pleumeekers and by Mr. A.L.E.W. Bovée, Director of the Geological Survey of The Netherlands. Thanks were given to the members of the organizing committee by Prof. Lemos de Sousa who closed the opening ceremony.

Shortly after the opening ceremony the General Assembly was held under the direction of Prof. Lemos de Sousa who invited Prof. Dr. D.W. van Krevelen to present his "Old Memories - Personal recollections of the beginning of the ICCP".

The President asked the meeting to stand in honour of Dr. Lazlo Soós who had passed away. Following the Statutes § 6, the General Secretary read the minutes of the 47th meeting held in Krakow, Poland from August 20 to 26, 1995 which were confirmed by the plenary without modifications.

Apologies

Apologies for absence had been received both by the General Secretary and by the Organizing Committee from the following members:

Prof. Boris Alpern, France; Dr. John Castano, USA; Dr. Kimon Christanis, Greece; Dr. H.H. Damberger, USA; Dr. Aivars Depers, Australia; Dr. Calin Dumitrescu, Romania; Prof. Marco Ercegovac, Yugoslavia; Dr. Joan Sharon Esterle, Australia; Dr. R.M.S. Falcon, South Africa; Dr. Peter Hacquebard, Canada; Dr. R.D. Harvey, USA; Dr. H. Jacob, Germany; Prof. Wang Jie, China; Prof. Jin Kuili, China; Dr. L.J. Martinez, France; Dr. B.N. Nandi, Canada; Dr. H.S. Pareek, India; Dr. Henrik I. Petersen, Denmark; Dr. Henrique Pinheiro, South Africa; Ms. Georgeta Predeanu, Romania; Mr. Hendrik Jacobus Roux, South Africa; Dr. Wilfrid Schneider, Germany; Dr. Harry Veld, The Netherlands; Dr. Rolf Wartmann, Germany.

Elections

Elections for General Secretary and Chairman of Commission 1 were called during the year. For **General Secretary** of ICCP 59 votes were cast

Z. C. Corréa da Silva	40 votes (68 %)
M. Wolf	18 votes (30 %)
Null	1 vote (2 %)

Prof. Dr. Corréa da Silva was therefore elected for a new term as General Secretary of ICCP.

In the election for **Chairman of Commission 1** 86 valid votes were cast

Alan Cook	54 votes (62 %)
Krystyna Kruszewska	32 votes (37 %)

Dr. Cook was elected as Chairman of Commission 1.

The names of Prof. Dr. Zuleika C. Corréa da Silva and Dr. Alan Cook were offered for confirmation to the plenary.

Forthcoming Elections

Elections for the following Council positions will be held before the next ICCP meeting:

Treasurer
Secretary of Commission 3

In accordance with the statutes 1.1.c.ii the Council nominated two candidates for the position of Treasurer and one was nominated from the floor of the General

Assembly. Therefore, the candidates for the position of **Treasurer of ICCP** are the following:

Dr. Reinhold Kutzner
Prof. Dr. D. Murchison
Dr. Rudi Schwab

For **Secretary of Commission 3** the Council nominated two candidates:

Dr. Deolinda Flores
Dr. Rosa Menendez

The names of candidates for Treasurer and Secretary of Commission 3 were aproved by the plenary session and the General Secretary will run the elections according to the Statutes 1.1.c.

Membership Directory and Statutes

The brochure printed during the year with the ICCP membership directory and statutes was presented by the General Secretary and distributed to the attending members. To the non-attending members the brochure will be mailed in December with the ICCP News. Members were called to contact the General Secretary for any correction or inclusion to be made in the list.

Membership

The Associate Member Dr. Cassiani Papanicolaou (Greece) was elected to FULL Member of the ICCP. The following colleagues were elected to ASSOCIATE Membership:

Dr. Komang Anggayana (Indonesia)
M.Sc. Michael Clay Frank (Canada)
Geol. Leonardus F. Jegers (The Netherlands)
M.Sc. Simon Graham Ryder (United Kingdom)
Ing. Ivana Sykorová (Czech Republic)
Dr. Manfred Vliex (Germany)
Dr. Marian Wagner (Poland)

Treasurer's Report

The report produced by the ICCP Treasurer, Prof. Dr. Duncan Murchison, and sent to the President was considered incomplete by the Council. The General Assembly agreed to give an opportunity to the Treasurer to complete the annual report by December, 31 and send to the President who will distribute copies of it to the Council.

ICCP Archives

The ICCP archives stored in the Technical University of Aachen received new documents from Dr. Alan Davis. Dr. Harold Smith will also contribute to the archives with valuable and rare documents from his own files.

Handbook of Coal Petrography

Prof. Murchison reported by letter of September 2, 1996 to the President that: "It is absolutely essential that I have a decision about what to do with the remaining Supplements by the end of this September at the very latest. Otherwise, the whole consignment (less perhaps a few examples) will have to be either stored in Newcastle at ICCP cost or pulped."

Dr. W. Fermont offered to store the Handbook supplements in Heerlen and the Council agreed to move all the materials from Newcastle to Heerlen at ICCP costs.

ICCP Statutes

Changes to the 1994 statutes of the ICCP were proposed by Mr. Aivars Depers (Full Member, Australia) concerning the Institutional Membership, the creation of the position of Honorary or Past President, the auditing of ICCP finances and changes in the voting procedures. The Council decided that the President and the General Secretary should propose the necessary modifications for next year's meeting and, after approval of the items to be revised or created, the General Secretary should run a ballot on Revision of the Statutes.

Future Meetings

The next meeting of the ICCP will take place in Wellington, New Zealand, on October 19-27, 1997. Enquiries should be addressed to:

Dr. Tim Moore
Coal Research Limited
P.O. Box 31-244
Lower Hut
New Zealand
Tel.: +64-4-566-2289
Fax: +64-4-566-7737
e-mail: T.MOORE@COALRES.CO.NZ

The 1998 meeting will be organized by the President, Prof. Manuel Lemos de Sousa, at the University of Porto, Portugal. An invitation to host the 1999 meeting in Bucaresti, Romania was approved by the plenary.

Thiessen Medal

The Thiessen Medal was awarded this year to Dr. Alan Cook for his outstanding work in coal geology and coal and organic petrology. Dr. Cook was always engaged on the work of macerals nomenclature, particularly the liptinites, was elected Secretary of Commission 1 and currently is the Chairman of Commission 1. The Laudatio was read by Dr. Alan Davis on behalf of the Thiessen Award Committee and the Medal was presented by Prof. Dr. Manuel J. Lemos de Sousa.

Meetings of the Commissions

Meetings of the three commissions were held during the week, from September 9 to September 13, at the CBS building. The short minutes of each commission are given below.

Social Programme and Excursion

The social programme was very well planned by the Organizing Committee and included an ice-breaker party, held at the Geological Museum of Heerlen on Sunday, September 8; the Conference Dinner at Hoensbroek Castle, September 11; the Happy Hour at Willem Fermont's farm, September 12 and a sightseeing tour to Maastricht, September 13. The technical programme included a visit to the Demkolec B.V. Coal Gasification Plant at Buggenum, municipality Haelen, September 12 and a field trip "Geology of South Limburg" on Saturday, 14.09.1996.

Poster Session

The poster presentation was held in the Conference building, from September 9 to September 13. Twenty nine posters were presented by different authors. The abstracts were compiled by Hans van de Laar and Petra David and printed in this number of the ICCP News.

2. Reports of the Commissions

2.1 Commission 1: General Coal and Organic Petrology

Chairman: Alan Cook
Secretary: W. Pickel

Monday, 9th of September

52 Participants (25 FM, 15 AM, 13 Guests)

Accreditation: A. Cook

A. Cook on behalf of A. Depers reported on the "Accreditation in petrographic analysis -1996 Accreditation exercise". After some introductory remarks on the method, he reported on the state of the 1996 exercises:
28 laboratories with a total of 61 analysts had applied for accreditation, of which 29 initially had entered the program, 3 were looking after provisional accreditation and 29 wanted to be re-accredited.
The accreditation and re-accreditation process was described in detail. It was proposed to install a group of three senior petrologists as a panel in cases of serious complaints, by people who looked after accreditation. It was suggested, that in general complaints should be treated, prior to the involvement of the panel, benevolently.

As a result of the following discussion on the statistical methods, there was agreement, that the method could be changed when a better one should come up, but should not be changed frequently. At this very moment, the method in use was accepted as the best available.
The work and proposals by the group were approved by the commission with no vote against.
As noted in the minutes from the last meeting, the complete report on the accreditation statistcs is available on request from A. Depers or the secretary of commission 1.

Fluorescence: A. Davis

A. Davis on behalf of J. Quick presented a revised version of the sheet "Fluorescence microscope photometry part II. Measurement of fluorescence spectra". The sheet had been circulated by commission 1 in the course of the year for approval. Of 15 replies, 7 had agreed with the sheet in the given form and content, 8 had agreed, proposing minor changes, which were incorporated inbetween by Jeff Quick. The main changes are:

- revision of the section "Summary of the Measurement Process";
- an alternative equation for the correction of the measured data distribution was added to the present one;
- $lambda_{max}$ was replaced by $lambda_{Imax}$ to define more clearly the wavelength of maximum intensity;
- the reference list was divided into two parts, the first listing papers that are primarily concerned with the method whereas the second part lists papers, that discuss applications of the method.

With no vote against, the sheet was accepted in the current form for publication in the 3rd edition of the handbook.

Internet-Demonstration: A. Davis, J. Prado

A. Davis and J. Prado presented a report on "Electronic transmission of microscope images" (Prado, J., Davis, A. & Glick, D.C.) between INCAR and Pennstate University. 5 images are installed at J. Prados homepage and accessible to everone through the world wide web (http://www.incar.csic.es/~prado/). The report also includes suggestions for the best formats and software to be used to transmit and view images. In order to view the images, a viewer program must be used, that should have zoom capability and display the x-y-coordinates of the cursor.
A series of maceral identifications was conducted successfully with the two laboratories on the images. At a final test, comparing grey levels at various given points, the two labs obtained exactly the same grey levels at all given points.

Internet: W. Kalkreuth, W. Pickel

In the absence of M. Reinhardt, the convener of the group, the necessity was expressed, to supply him with a list of desirable contents of an possible future ICCP homepage, to be edited and presented by him at the next meeting. The following possible contents were discussed briefly:

- statutes of the ICCP
- membershiplist
- "maceral of the week"
- forthcomming meetings

Possibilities of installing an ICCP website are at the moment checked by Aivars Depers, who volunteered to become a new member of the working group.

Microlithotypes: M. Wolf

M. Wolf presented a first set of drafts of microlithotypes she had prepared for the meeting. The working group that was found at the meeting is going to finish a first complete version of all microlithotypes, including carbominerite, until the end of March, 1997 and present them to commission 1 at the following meeting. The members of the working group are:

M. Wolf (editor)
Z.C. Corréa da Silva
K. Kruczewska
B. Kwiecinska
M. Lemos de Sousa + Lab.
C. Panaitescu
J. Sykorová

Microscopy Session on Vitrinite: M. Wolf

Various vitrinite macerals were displayed on a screen from microscope images and discussed according to the vitrinite classification system.

Tuesday, 10th of September

46 participants (25 FM, 12 AM, 9 Guests)

Inertinite: M. Wolf

M. Wolf reported on the progress of the inertinite working group. A complete set of sheets was presented and discussed in detail. As a result of a proposal by P. Lyons and the following discussion, it was decided to change the sheet "sclerotinite" and limit this maceral to components of fungal origin. This new maceral will be called "funginite"(14 pro, 13 against). In consequence a new maceral has to be found, to include the former resinous sclerotinites, for which the name "secretinite" was proposed but up to now not accepted. No majority was found for a proposal to group this components into "macrinite".
P. Lyons is going to send draft sheets of the new macerals to the inertinite group until the end of the year.

The other sheets, after incorporating the changes discussed at the meeting will be circulated with a ballot sheet prior to the next meeting and thus be open to further suggestions for changes to all members of commission 1. The major points of discussion at the session were:

- the term colour should be avoided, to describe grey levels,
- the term "oxidation", in general frequently used in relation to fusinite/semifusinite should be carefully used to avoid confusion with the "reduction" actually undergone by the maceral,
- the term "degree of oxidation" should be replaced by the more general "chemical constitution".

Furthermore, several editorial changes were proposed and discussed.

Standardization: D. Pearson, W. Pickel

Instead of the former convener of the working group (W. Pickel) from now on a group, consisting of D. Pearson, R. Javier and W. Pickel is in charge of the working group. A first round robin is going to be started immediatly after the Heerlen meeting, to check on reflectance measurement variations on a set of reflectance standards. Except from the use of this round robin due to the aims of the working group it is further on expected to gather useful data for the accreditation program, in order to demonstrate possible variations. Participants will be asked to calibrate their microscope as usual and measure the reflectance of the circulated standards afterwards. The reflectance of these standards will not be known to the analysts. At the meeting 20 participants signed up for the excercise. Everyone further interested should contact one of the conveners as soon as possible.
A round robin on vitrinite is still on the schedule, but will not be started earlier than the vitrinite sheets are published with attached microphotographs.

Liptinite: W. Pickel

A discussion on liptinite was adjourned in favour of the inertinite group. Everyone able to supply microphotographs is asked to send them to the convener.

Prado Proposal

At the closing plenary session a further discussion of a proposal by J. Prado, as presented at the Krakow Meeting and circulated with the minutes of commission 1 afterwards, was proposed by the president of the ICCP. The idea is, in short, to install a sample bank and supply interested analysts with samples and analysis results for training purposes. The proposal was put in the responsibility of commission 1. Members are asked to review their last years full minutes and comment on the suggestion either to J. Prado or the chairman/secretary of commission 1.

Draft agenda for the 1997 meeting

Even though it is obviously clear, that the Wellington Meeting program will be subject to several changes, we thought it to be quite reasonable to supply members as soon as possible with a first version of main topics to be discussed during the next meeting. These are:

- final discussion on the inertinite sheets, including the changes, proposed at this meeting,
- presentation and discussion of all liptinite sheets, to get them ready for circulation during the following year,
- presentation and discussion of the microlithotype sheets,
- presentation of the results from the standardization group round robin,
- a report on the accreditation program
- a discussion in detail on the possibilities of the internet,
- a discussion on possible training programs.

For proposals of further topics, please contact the chairman/secretary of commission 1. More detailed programs will be circulated during the year.

2.2 Commission 2: Application of Coal and Organic Petrology at Geology

Chairman: W. Kalkreuth
Secretary: W. Fermont

61 Participants (FM and AM and 17 guests)

Thermal Indices (Convener: R. Baranger/B. Pradier)

Results from last years exercise were presented by B. Pradier. The exercise was comprised of spectral fluorescence measurements on Tasmanites algae using calibrated light sources for the calculation of correction factors. The sample material distributed came from the Toarcian of the Paris Basin and contained relatively homogeneous algal bodies which were measured perpendicular to bedding. The spectral curves presented showed for all but one laboratory excellent agreement in intensities and slopes and derived fluorescence parameters such as lambda Imax, red-green quotients and colourimetric values.

New activities will consist of measuring a series of 4-5 samples with varying maturation levels. The 1996/97 exercise will be organized by the new convener A. Vieth-Redemann, Geologisches Landesamt Krefeld, Germany.
Two calibrated lamp sources will be available for those members of the ICCP, who wish to calibrate their spectral fluorescence systems against these lamps. For further information contact A. Vieth-Redemann.
In view of the excellent results of this interlaboratory exercise a proposal was made to publish a short paper on this topic in an appropriate journal.

Alginite Sheets (Convener: A. Cook)

The text part of the alginite sheets had been approved at the Krakow meeting in 1995 with minor additions to be made based on submissions made by L. Stasiuk/W. Kalkreuth (compilation of published data on spectral fluorescence measurements and an updated reference list) and A. Gomez (chemical data on Spanish oil shales). The revised text is to be circulated to a small editorial group (Gomez, Kalkreuth, Stasiuk) by March 1997 for final editing.

A series of excellent slides showing various types of alginite were presented by A. Cook and the following discussion focussed then on the format of plates which are to accompany the text. Criteria mentioned include type of alginite (structured vs unstructured), rank, geological age, facies, orientation. From the discussion it appears that 3-4 plates will be needed. Members of Commission 2 are urged to send suitable micrographs to A. Cook for consideration. Preliminary plates will be distributed to a small editorial group (Gomez, Kalkreuth, Stasiuk) in March 1997 and will be presented at the 1997 meeting for final approval.

Coal Facies (Convener: G. Nowak/M. Hámor-Vidó)

The objectives of this working group are concerned with the re-evaluation of concepts used in coal petrography for facies analysis and interpretation of paleo-depositional environments including new approaches. The concepts considered at the meeting range from lithotype and microlithotype analysis, maceral analysis and derived Tissue Preservation and Gelification Indices to etching procedures including paleobotanical studies, sequence stratigraphy and palynology. A letter with detailed instructions and time frame will be send out in the near future by the new co-convener M. Hámor-Vidó to the members of the working group asking for a compilation of relevant publications and data (most likely according to geographical areas). These submissions will form the basis for a report at the next years meeting.

Isolation of Organic Matter (Convener: J. Castaño)

In the absence of the convener a report was presented by W. Kalkreuth. The discussion focused on the final report of the 1994/95 exercise which once again showed a large scatter in the reported vitrinite reflectances and compositional data. In an attempt to improve the analytical data it was decided to produce a series of micrographs for each of the last three round robins including images from whole rock, concentrate and strewn slides. On these micrographs components will be identified and will serve as a guideline in the re-examination of the samples. The following members of the working group volunteered to produce micrographs (whole rock, concentrate) by the end of 1996:

1992/93: Round Robin; A. Penu, Romania
1993/94: Round Robin; W. Kalkreuth, Brazil
1994/95: Round Robin; A. Gomez, Spain

J. Burgess kindly agreed to make representative photographs of the corresponding strewn slides.

The micrographs will be compiled by the convener (including those which have been received from H. Pinheiro and F. Laggoun-Défarge), reproduced and distributed to the members of the working group in order to re-evaluate their previous analyses.

Basin Modelling (Convener: H. Veld)

In the absence of the convener a brief report was given by W. Fermont and W. Kalkreuth. The discussion dealt with a series of questions raised by the convener (letter of May 1996 sent to the chairman of Commission 2):

- What are the ultimate goals of the working group ?
- Should the working group aim at a standardization of basin modelling programs ?
- What can be the ICCP input in basin modelling?

Should the ICCP set up procedures, guidelines and recommendations on how to apply (optical) organic matter data in basin modelling (for maturity data and type of organic matter) ?

It was decided that at present time one of the major concerns is how to produce qualified (annotated) vitrinite reflectance data used in the interpretion of basin analysis, which would take into account parameter such as polish quality, type of OM, facies, secondary effects. In the discussion it became apparent that some members have used such annotated data for many years (N. Bostick, W. Fermont, J. Koch) and a joint proposal will be put forward by these three members in time for next years meeting.

Further activities will include a new exercise using rank data (approx. 0.6-2.6 Rmax) from the Western Canada Sedimentary Basin. The stratigraphic interval comprises about 4000 m of Upper Jurassic/Tertiary strata, in which coal-bearing successions alternate with marine strata including potential source rock intervals. A letter with details on the round robin procedure including relevant information on the geology will be distributed in early 1997.

A final report on the previous exercise (Kemperkoul well) is to be produced in time for the next meeting in New Zealand.

Environmental Applications (Conveners: J. Bailey, A. Depers)

An overwiew on the present status of the working group was given by J. Bailey. Although the membership of this working group has increased to more than 30 active members little progress was made over the last year due to other work commitments.

The atlas, discussed in detail at the Krakow meeting, has only received a minor addition (landfill site soil). The atlas as it stands now is a A. Depers atlas and more input is required by other members of the working group.

The white book has had no more additions, working group members are urged to submit additional extended abstracts (4-6 pages) before the anticipated publication date at the next meeting in New Zealand. A supplement to the bibliography has been produced and will be circulated to members, at the same time, as with the white book, more input by working group members is required.

An important aspect related to further activities of this working group is the question if funding can be raised through industrial or governmental agencies and a number of potential candidates were put forward (EC, Australian and New Zealand Governments).

Samples are being prepared for a 1996/97 round robin exercise, and may come from a polluted harbour sediment, roof dust samples or from a contaminated landfill site soil. To receive a round robin, most likely a fee will be announced, to cover sample preparation and postage.

Pseudovitrinite (Convener: L. Gurba)

A report on pseudovitrinite was presented by L. Gurba and C. Ward including a review on previous literature, slides and a microscope session on examples from a number of Australian basins.

The following discussion focussed on the very nature of pseudovitrinite, with some opinions that this material as a matter of fact might be of secondary nature (generated in the course of sample preparation), while others maintained that the occurrence of pseudovitrinite is related to botanical affinities and/or early alterations.
The increased reflectance in samples rich in pseudovitrinite may have significant implications in maturation studies, where coalification gradients might be skewed and the depth rang for hydrocarbon zones will be estimated incorrectly.

For the next year it is planned to compile an extended bibliography on pseudovitrinite by those members who signed up to participate in the activities of this working group. Members will also be asked to submit samples from various geological ages and settings containing pseudovitrinite. A round robin analysis is planned for 1997/98.

Atlas on dispersed OM (Convener: W. Kalkreuth)

A report as to the status of the atlas was presented by the convener. At present time only two submissions were received (the part on vitrinite reflectance by W. Kalkreuth and the part on huminite/vitrinite and inertinite macerals by A. Gomez including a slide presentation on potential micrographs). A new deadline of December 31, 1996 was put forward to those members of the editorial board, who for various reasons did not submit their contribution in time for the Heerlen meeting. These contributions include a section on sample preparation (M. Reinhardt), fluorescence microscopy in dispersed OM (R. Baranger), petrographic analysis (I. Suarez-Ruiz), nomenclature and classification (M. Lemos de Sousa) and liptinite macerals (W. Pickel). The atlas will also have an extended bibliography on published plates on dispersed OM, where in table format information is given as to the type of OM, geological age, mode of observation, quality etc).

It is hoped that a first draft of the atlas can be circulated to the members of the editorial board by March 1997 and a revised first draft be presented at the next year's meeting in New Zealand.

Dead line for the next issue of the ICCP NEWS is March 31, 1997!

2.3 Commission 3: Application of Coal Petrology to Utilization

Chairman: Judith Bailey
Secretary: Rosa Menéndez

Attendance: 19 members and 10 guests

Coke petrography - Convener: Raphael Javier

The convener presented the results of the 1996 Round Robin exercise. A set pictures was prepared and sent to the members of the WG. For all the selected fields, three pictures were taken using crossed polars and two different positions with a lambda plate. Participants were asked to identify the texture within a 20 μm field surrounding the indicated points. The different structures to be identified were reviewed in detail (classification and descriptions given in Krakow). In this exercise, participants were asked to identify the origin of the points, i.e. vitrinite or inertinite. The problems experienced with the exercise included the similar appearances of crumpled layers and inertinites, while the two have a very different reactivity and thus should be clearly distinguished.
The deadline for receiving the results was March 1996, but at that time only 4 results had been received from the 17 questionnaires sent. Consequently, due to the low participation, no statistics were given. The same exercise will be performed in 1997.

Two possible approaches for the identification of the different coke structures have been proposed by the convener: one genetic, and the other looking at the properties of the coke (reactivity). The former considers the origin and the latter just the size of the different structures which affect coke surface area and reactivity in the blast furnace.

The convener encouraged participation in the next Round Robin. It was proposed that participants were asked for fees in order to be able to send the set of pictures to all the individuals and to avoid the problems derived from circulation of samples.

Combustion - Convener: Judith Bailey

The convener summarized the progress of char Round Robin analyses between 1990 and 1996, period of her convenership. The amount of char categories to be identified decreased from 12 types to 4 char types, on the basis that differences in burning rate between such diverse particle types are difficult to quantify, also, the char material counted in the exercise has been changed from pyrolysis char, which is relatively intact, to more fragmented combustion char.

Several suggestions were formulated as new ways to unify criteria and get better agreement in the future. These included: the use of imaging to identify chars on the basis of porosity and/or wall thickness; the conversion of char counts from percentage volume to percentage mass; the inclusion of a measured average diameter for each type of char; the convenience of persisting with round robin analyses of combustion or gasification char rather than pyrolysis char and the consideration of the significance of anisotropic texture in combustion/gasification.

After some discussions on the type of samples to be circulated and the criteria to be followed in future studies, Diego Alvarez and Edward Lester were proposed and accepted as new conveners of this WG.

Coal blends - Convener: Alan Davis

Following a presentation made by J. Vleeskens about the trip to Buggenum Gasification Plant, the convenor reviewed the results of the 1996 Round Robin exercise. Nine individuals had conducted the analysis manually and 3 automatically. Participants in the exercise were asked to estimate the proportions and the random reflectances of the two components of the blend. The convener gave a full description of the methods used for the preparation of the blend and the polished particulate blocks, and the instructions given for both the conventional reflectance and the point-counting analysis. From the results obtained it was concluded that, even though the components of the blend were so easy to differenciate, the degree of agreement was excellent. In general, the composition of the blend was better determined by point-counting than by manual reflectance measurements, probably due to the lower statistical errors derived from the higher number of readings performed in the former case. The determination of reflectances of both coals, done both manually and automatically, was also judged to be very good. Automated microscopy provided blend compositions very similar to those achieved manually.

Three possibilities for future work were presented by the convener: i) similar exercise to that of 1996 on a blend of two coals of closer rank; ii) a blend of coals of similar rank to those used in 1995 exercise, but containing much higher inertinite contents; and iii) a 3-coal blend. The second option was selected by a voting procedure.

As an extra activity of the WG, Dr Prado will put images from the first blend on the Internet. Any one interested should contact Dr Prado or Dr Davis.

Automation - Convener: Petra David

After a revision of ICCP activities since 1985, the convener described the main aims of the WG and pointed out that the same needs still remain. A questionnaire was sent to 16, but only 7 replied. It seems that the evaluation of data will be difficult because of the differences in the automated systems. According to the questionnaire, most people would prefer to perform the analysis on single coals or accreditation samples. Bituminous coals, cokes and coal blends were reported to be the most commonly studied samples in the past.

For the future, it is proposed to start with an evaluation of automated methods and to use simple samples. The questionnaire will be recirculated and it should be answered before the end of the year. Information concerning with Round Robin will be given in the near future.

Inertinite in Combustion - Convener: Angeles Gómez

Angeles Gómez, as convener of this WG, reviewed the existing background on inertinite in combustion, and presented a proposal for a round robin exercise for the WG. This proposal included:

a. To study pyrolysis rather than combustion chars, obtained from coals ground and sieved to a narrow size fraction.
b. The proposed scheme was based on estimations of optical texture and porosity development, following a classification scheme based on point-counting rather than particle counting.
d. To defer the analysis of combustion chars to a later stage, after evaluation of the initial data.

It was suggested that the pyrolysis chars could be generated from the same coal samples selected for the Combustion WG Round Robin, so that their combustion equivalents could be studied later; and that a detailed classification scheme be circulated, in order to clarify terms such as vitrinite-derived (if it is to be used with confidence), and dense/porous (in terms of % porosity). A set of char pictures will be circulated along with the char blocks, as an aid in the identification of the different occurrences considered in the classification scheme.
The char samples for the Round Robin exercise will be kindly produced (1300 °C) by Edward Lester at the University of Nottingham.

Abstracts

The dependence between granulometric characteristics of iron sulphides and genetic practical properties of coals from Donets basin.

Eugeny Besedin[1] and Lidia Bogoliubova[2]

[1] All Russian Institute of Mineral Resources, 31 Staromonetni per., 109017 Moscow, Russia
Tel: 007-095-233-0023 ext. 3-71 / Fax: 007-095-231-4832
[2] Geological Institute of Russian Academy of Sciences, Pyshevski per. 7, 109017 Moscow, Russia. Fax: 007-095-231-4832

The tendency between granulometric characteristics of iron sulphides and technological properties, metamorphism degree and petrography of coals from Donets basin was studied.

To determine technological proporties of coals from Donets basin, we have investigated samples from more than 8 deposits on base of using the Image Analysis System, a special constructed methodically oriented instrument.

It is revealed the dependence between mass granulometric characteristics of pyrite such as the mean "mass" size and especially the "mass" quantity of particles less than 10 micron and optical properties of coals such as, firstly, the vitrinite reflectance. Along the increasing metamorphism degree the quantity of fine pyrite graines becomes more.

Having such pattern we can determine the beneficiation degree of coals upon known and measured before vitrinite reflectances. Because, as shown in the presentation at the last ICCP meeting at Krakow in Poland, the mean mass size of pyrite graines and the amount of fine pyrite graines is indicator of technological properties of a coal to ability for sulphur concentration.

Outlined tendencies is allowing to develop the forecasting model of technological and ecological properties of coals with petrography data.

Predicting Hydrocarbon Migration Pathways and Reservoirs in Carbonates

A. Ewan Campbell

TNO - Institute of Applied Geoscience, P.O. Box 6012, 2600 JA Delft, The Netherlands

Carbonate reservoirs, while comprising over 60% of the world's estimated recoverable reserves, are notoriously difficult to appraise and develop. Porosity and permeability can be highly variable and, unlike siliciclastics, the distribution of good poro-perm is controlled, not only by depositional energy, but also by diagenesis and tectonics. Any hydrocarbon prediction scheme is, thus, of necessity multidisciplinary and needs to integrate sedimentology and petrography with diagenesis and stratigraphy.
This approach links prediction with a dynamic stratigraphic modeller. 90% of all carbonate production on a shelf or platform takes place in the top 10m of the water column. As such, carbonate depositional systems are very responsive even to low amplitude sea-level fluctuations. These early events still exert a strong influence on poro-perm architecture, especially for the world's Mesozoic and Tertiary fields.

By using relative sea-level histories to model platform geometry and the position of mean sea-level at any time prior to the cessation of platform development and deep burial, it is possible to predict where favourable conditions may be set up for in situ source rock deposition, basin-to-margin migration pathway geometry and the distribution and internal architecture. Because events are modelled in time as well as space, it is possible to predict whether flow units and migration pathways were open during generation of the hydrocarbons.

Work is currently being undertaken to develop a more advanced dynamic stratigraphic modeller that will allow hydrodynamic, as well as kinetic, modelling in a framework of time and space.

Signs of intrusion's thermal influence in coal seams in the Sosnica Coal Mine (The upper Silesian Coal Basin, Poland)

Lidia Chodyniecka and Bronislawa Hanak

Katedra Geologii Stosowanej, Politechnika Slaska, ul. Akademicka 2, 44-100 GLIWICE, Poland

Two intrusive veins were ascertained in Sosnica coal mine. Deeply altered rocks forming the veins are of porphyritic and hypidiomorphic texture and consist of dolomite, biotite, calcite, quartz, hematite, apatite, kaolinite and dickite. Pyroxene and olivine-shaped pseudomorphs were formed from primary minerals.

Significant alteration of coal (depending on thickness and distance from the veins) under influence of the intrusion was also ascertained. Natural coke is the main component of altered coal. The content of natural coke is inversely proportional to the distance from the intrusion, on the contrary to semicoke, anthracite and inertinite contents. Values of R_{max} and AR of the coke decrease in the same way. It was observed, that the last mentioned values are dependent of the intrusion thickness.

Liptinite in South Brazilian coals and shales

Z.C. Corrêa da Silva and M.B. Silva

Federal University of Rio Grande do Sul (UFRGS), Geosciences Institute, Porto Alegre, RS, Brazil

Liptinite recognition and characterization in petrographical studies of coals or any other organic rock is very important taking into account the role of liptinite macerals during technological processes, eg. coke-making, as well as for depositional environment assessment either for coals or shales. Coal petrographic observations support the view that bituminous, petroleum-like substances form mainly from liptinites during the sub-bituminous up to the medium-volatile bituminous coal stages. In this range bituminization is a typical part of the coalification process (Stach et al., 1975).

Macerals of the liptinite group are sporinite, cutinite, alginite, resinite, liptodetrinite, bituminite, fluorinite and exsudatinite.

Sporinite is the most important maceral of the liptinite group in coals of different ages and is also very common in oil-shales. It consists of skins of spores and pollen grains.

In South Brazilian Gondwana coals sporinite occurs as *Macrosporinite*, Microsporinite, *Tenuisporinite* as well as *Crassisporinite*. Rare *Sporangium* also occurs. Specific types of spores, characteristics of a seam or a group of seams, have been described and used for both seam and facies identification (Marques-Toigo & Corrêa da Silva, 1984). Sporinite also occurs in the Upper Permian Irati oil shale, Paraná Basin (Corrêa da Silva & Cornford, 1985), and consists mainly of skins of saccate pollen grains.

The colour of sporinite under reflected white light depends on the rank and varies from dark to light gray and dark brown with inner reflections. Under UV irradiation sporinite fluoresces from pale yellow up to dark orange colours according to the coalification.

Cutinite is less frequent than sporinite in coals and its origin is referred to the "cutine" which forms the outer layer of leaves, needles, shoots, stalks and stems. According to their thickness the cuticles are named *Tenuicutinite* (thin bands), and *Crassicutinite* (thick bands) respectively.

Under the microscope the cuticles are characterized by their shape and colour which varies from dark to medium gray. Cutinite can be well studied by using incident fluorescent light, and under UV irradiation their colour varies from pale to bright yellow to orange in the range of sub-bituminous up to high-volatile bituminous A coal.

In samples from the upper Paleozoic Brazilian coals cutine occurs mainly as *Tenuicutinite* with very bright yellowish colour. Microscopic examination of macerated cuticles from those coals (Corrêa da Silva et al., 1984 and Guerra-Sommer, Marques-Toigo & Corrêa da Silva, 1990) showed the peat-forming plant community to be rich in Gymnospermic leaves.

There is no reference of cutines in Brazilian organic rocks other than coals.

Alginite is not found in normal humic coals but seems to be common in sapropelitic coals and shales. In microscopic examination it is very dark in normal white light and very bright under UV irradiation.

Alginite in coals orginates mainly from algae colonies of the *Botryococcus* type and is an important maceral of "bogheads".

Both *Telalginite* and *Lamalginite* have been recognized in South Brazilian coals (Marques-Toigo & Corrêa da Silva, 1984) as well as in the oil-shales of the Irati Formation (Corrêa da Silva & Cornford, 1985). Telalginite in coals occurs mainly as algae remains of *Portalites* and *Botryococcus* type in the oil shales as Botryococcacae colonies. Lamalginite, from unidentified algae types, is an abundant maceral in oil-shales and in some sapropelitic type coal seams.

Resinite comprises not only resins but also other plant secretions such as essential oils occurring in the leaves and converted into resin with the form of small rounded bodies; in coals it appears as cell fillings, layers or finely dispersed (Stach, 1975).

In reflected white light resinite shows dark grey to grey colours and sometimes internal reflections. Under UV irradiation the low rank resinites fluoresce strongly, from blue green to pale orange, and with increasing rank the colour changes to yellow and orange.

Resinite occurs in South Brazilian Gondwana coals mainly as oval and rounded bodies, very dark grey in low rank coals to pale grey. The fluorescence colour is always darker than the associated sporinite.

Liptodetrinite is a collective term for liptinite constituents of different form, reflectance and fluorescence which cannot be assigned to any of the other macerals of the exinite group and appears to be characteristic of coals which have been deposited under water (Stach, 1975).

Most of the gondwanic coals in South Brazil are supposed to have been formed under aquatic conditions (hypautochthonous) (Marques-Toigo & Corrêa da Silva, 1984; Corrêa da Silva, 1989) and, in the low rank coals liptodetrinite is a common maceral (from 0.50 to 35 % in the group). Nevertheless, the recognition of liptodetrinite is very difficult in ash-rich coals under white normal light but the figures change when the observation is made under UV irradiation (Corrêa da Silva & Marques-Toigo, 1985).

Bituminite, fluorinite and exsudatinite have not yet been counted in Brazilian coals although they have been rarely recognized.

Table 1 Composition of the main seams in South Brazil (Corrêa da Silva, 1989)

Coalfield	Coal Seam	Vitrinite	Liptinite	Inertinite	Minerals
Candiota	Upper	40	8	16	36
	Lower	39	4	16	40
Capané	Capanezinho	22	15	25	38
Iruí	Upper	36	14	22	28
	Lower	16	12	33	39
Leao	Lower	39	14	21	26
	Upper	41	15	28	16
Charueadas	I2B	40	7	29	24
	IIF	31	13	26	30
	MB	42	7	20	31
Faxinal	Upper	57	3	12	29
	Middle	68	1	10	21
	Lower	63	2	12	23
Morungava	M.1	34	12	22	32
	M.2	42	13	23	22
	M.6	33	3	43	21
Chico Loma	CL.2	43	12	20	25
	Cl-.4	27	10	26	37
	CL.6	36	3	18	43
S. Terezinha	ST.4	19	3	9	69
S. Catarina	Barro Branco	32	22	25	21
	Irapuá	35	10	29	26
	Pré-Bonito	24	11	16	49
Paraná	Ribeirao Novo	13	41	21	25
	Marins	33	30	14	23

Table 2 Liptinite macerals of the Candiota Upper and Lower Seam under reflected normal white light (a) and under UV irradiation (b), (Corrêa da Silva & Marques-Toigo, 1985)

Coal Seam	Macrosp.		Microsp.		Resinite A		Resinite B		Cutinite		Alginite		Liptodetr.		Total	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Lower Candiota	0.2	1.0	1.4	4.5	0.0	2.3	0.0	1.5	0.0	0.2	0.3	1.1	2.1	3.7	4.0	15.3
Lower Candiota	0.4	0.4	1.2	4.0	0.3	1.0	0.0	1.9	0.0	0.1	0.4	1.7	2.2	3.7	4.5	12.8
Lower Candiota	1.5	0.8	2.8	3.3	0.2	1.4	0.0	2.3	0.0	0.0	0.1	0.8	2.8	4.5	7.4	13.1
Upper Candiota	2.6	1.3	2.0	7.3	0.2	0.6	0.0	2.5	0.0	0.0	0.0	0.7	3.3	4.3	8.1	16.0
Upper Candiota	1.5	1.2	3.6	4.4	0.2	0.5	0.0	3.1	0.3	0.2	0.4	0.7	2.0	4.2	7.7	14.3
Mean	1.2	0.9	2.2	4.7	0.2	1.2	0.0	2.5	0.06	0.1	0.2	1.0	2.5	4.1	6.3	14.3

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Effects of air oxidation on petrographic and coking properties of coals and coke quality

R. Damiani[1], A. Barsotti[1], M. Ferraro[3], G. Iurilli[2], and L. Ottobrini[2]

[1] Technical Consultant
[2] Acciaierie di Cornigliano - RIVA Group, Via Muratori 15, 16152 Genova, ITALY
[3] Centro Sviloppo Materiali, Via Appia, Km. 648 - Dis 2, 74100 Taranto, ITALY

Coals for cokemaking are required to have plastic properties and coking power in order to assure coke quality for good blast furnace performance.

Before being utilized, they are stored in piles for a period, depending on various factors such as quantity, percentage of use and number of components in the blend, productivity, during which a phenomenon of deterioration of the above mentioned properties can occur. In fact coal, due to its organic nature, tends to oxidize and to modify its structure.

Coal weathering was studied by a lot of researchers[1-15], in particular the kinetic aspects of this process were deeply reviewed by Van Krevelen[1].

The researchers[2-14] agreed in concluding that coal oxidation causes a degree of plastic properties (dilatation and fluidity), coking power and consequently coke quality (mainly in terms of hot and cold mechanical strength[2-6, 8, 11, 14, 17-21]) and a variation of optical characteristics[2-4] of the coke. Some authors focused their attention on the effect of oxidation on wall and gas pressures, mean section of coke and coking time[3,4,22], other ones on storage conditions[23-24].

This study aimed at defining the aptitude of different coals to change (in terms of plastic and petrographic properties) during storage and at assessing the maximum limit (in terms of days) after which the deterioration causes a decrease of coking power and subsequently effects coke quality.

Hence some coals of different rank and origin were considered; the study was divided in two parts:
- air oxidation in order to evaluate the aptitude to the phenomenon of each coal
- artificial oxidation in a muffle furnace in which the temperature increased from 20°C up to 60°C with a gradient of 5°C per week, in order to feign better the conditions of piles.

During both phases, Ruhr dilatometer and Gieseler fluidity tests and petrographic analyses were carried out on samples belonging to each coal. Besides, in order to evaluate operative parameters and coke quality changes, coking tests at pilot oven were carried out at the beginning and at the end of the study.

Conclusions about the aptitude of the coals to be affected by weathering and about the trends of coal properties and coking power during the time of storage were drawn. The alarm limit of storage time was determinated, too.

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Density estimation of *in situ* coal constituents by a combined study of 3D-Computer Tomography and 2D-Colour Image Analysis

Petra David[1], Willem Fermont[1] and Frédéric Verhelst[2],

[1] Geological Survey of The Netherlands, Dept. of Organic Geochemistry, P.O. box 126, 6400 AC Heerlen The Netherlands

[2] Delft University of Technology, Centre for Technical Geoscience, Faculty of Applied Physics, Laboratory of Seismics and Acoustics, P.O. Box 5046, 2600 GA Delft, The Netherlands

Summary

Computer Tomography (CT) provides information on the 3D density distribution of solid matter. With Colour Image Analysis (CIA) the surface percentages of coal components based on their colour characteristics are determined. Data obtained from both techniques can be linked using multivariate statistics. This allows for *in situ* density estimation of coal components.

Introduction

CT is a nondestructive, medical, visualisation technique which provides information on the density distribution in three dimensions. This method can be applied to rocks as well. CIA analysis is an automatic technique which allows the determination of surface percentages of rock components based on their colour characteristics. The density information which has been obtained by multiple regression techniques can be used to distinguish between macerals on the basis of bulk density.

Sample Preparation

A coal sample (0,97%Rr) from a cored section of well Peer (Campine Basin, Belgium) was cut perpendicular to the bedding plane. Two measurement traces were selected normal to it. The core was cut into four blocks, imbedded in binder, polished and analysed by CIA along the traces. Prior to CT analysis, the blocks were glued together on a glass plate.

Techniques

Colour Image Analysis. CIA is a two-dimensional technique for identification and classification of coal maceral groups that differ in optical properties. The instrument used was an Olympus CUE-3 Colour Image Analysis System (David and Fermont, 1993a,b). For the determination of the amount of each maceral group inside an image a surface fraction analysis was carried out. Five components, vitrinite, liptinite, inertinite, pyrite and binder have been analysed. One CIA-image corresponds to an area of 175 x 300 mm^2 of the polished block. The total area analysed on each block was approximately 25 x 0.3 mm^2 for each trace.

Computer tomography. Objects to be investigated by CT (Hounsfield, 1972) are positioned in a rotating X-ray tube. X-rays cross the object at various angles. The attenuations of the rays are recorded at the opposite side. By using reconstruction algorithms (Wellington and Vinegar 1987) the attenuation coefficients in all volume elements are calculated. The CT scanner used is a Siemens Somaton plus S. Measurements were conducted during three revolutions of the X-ray source. The highest resolution for each voxel is 60 mm x 60 mm x 1 mm. The CT measuring units, the Hounsfield Units (HU), are converted to quantitative bulk densities or tomo-densities using different correction factors (Herman, 1980, Natterer, 1986).

Resampling and cross-correlation. The CT and the CIA sampling intervals are 60 and 175 mm, respectively. For a comparison of both CT and CIA signals a simple resampling procedure was used to convert the CT-signal with a small sampling interval into a signal with a larger sampling interval (Telford et al., 1990).

Fourier analysis. A non-periodic discrete signal can be decomposed into its frequency spectrum by using the Fast Fourier Transform (FFT) algorithm (Brigham, 1988). The discrete signal is appended by at least an equal quantity of zero's. The total number of samples has to be of the form 2^n, were n is a natural number.

Multiple regression. The tomo-densities were correlated with the surface fractions of the groups considered. The data were compared by means of multiple regression.

Results

CIA. The maceral group composition of all four blocks was analysed along two traces. A broad scatter of the relative abundances of all five components can be observed. Subsequent samples frequently show similar compositions which reflects the banded character of coal. The data of trace 1 were used for the comparison with tomo-density data.

CT. Hounsfield units (HU) were recalculated to tomo-densities, which were resampled at a rate of 175 mm, which is almost three times the original sampling rate of 60mm. For each block three resampled data sets were made, each shifted 60 mm with respect to the other. The final data set was chosen on the basis of the results of the cross-correlation with the CIA surface fractions. For this cross-correlation with the HU the most abundant fraction, vitrinite, was selected. As a control a cross-correlation between inertinite (the second most abundant maceral) and HU was conducted.

Fourier analysis. The tomo-density signal is smoother than the CIA signals. From the amplitude spectra of the original tomo-density signals it has been concluded that the higher frequency components of the tomo-density signals are much smaller than those of the CIA signals at wavelengths of approximately 1400 to 1600 mm. To compare signals with the same frequency content, the higher frequency components of all signals are removed. After filtering, small negative compositional fractions may occur and the compositional fractions do not sum up perfectly to 100 %. Both features are artefacts due to the FFT-filtering.

Multiple Regression. Multiple regression analysis produced partial regression coefficients B_{Yi} and their significances. These were used to predict tomo-densities. Correspondence between measured and predicted tomo-densities is extremely good. The curve of the predicted tomo-densities is relatively smooth because the derived B_{Yi}-factors are used on the FFT-filtered compositional signals. If partial regression coefficients are used on the original compositional signals, a more variable reconstructed tomo-density is found. The correspondence of this tomo-density with the original compositional signal is plotted. Using the partial regression coefficients (B_{Yi}), density estimates for the CIA-components are calculated. Average densities of the CIA-groups are calculated using a weighted averaging method (Hodges & Lehmann, 1970).

Discussion

The comparison between 3D-CT volumetric scans and 2D-CIA analyses, by means of multiple regression, allows for density estimates of *in situ* coal constituents. The density estimates of vitrinite, inertinite and pyrite are in accordance with existing literature data. Estimated liptinite and binder densities deviate from literature data. The following sources of error are considered as important:

The heterogeneity of coal is extreme. This unavoidably induces discrepancies between surface scans (CIA) and volume scans (CT). Optical methods recognize particle properties down to approximately 1 mm. CT-scanning weights also the density of components smaller than 1 mm, but considers voxels of 60 mm x 60 mm x 1 mm. Colour Image Analysis is based on threshold setting of colour characteristics of each coal constituent. There is some overlap between the threshold settings of the components that constitute coal.The CT-equipment was not calibrated for coal material. This may cause a systematic error in the density estimates.

Conclusions

The application of CT in cored material provides valuable information concerning the relative density distribution of *in situ* coal constituents. CIA on the surface of polished blocks is a rapid method to quantify maceral groups (vitrinite, inertinite, and liptinite), pyrite and binder. The advantage of the combined methods employed here is that not only *in situ* maceral densities may be estimated, but also the spatial density distribution of coal.

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Hydrocarbon generation from Carboniferous coals in The Netherlands

W.J.J. Fermont[1], P. David[1], P. Jongerius[2], and H. Veld[1]

[1] Geological Survey of The Netherlands, Postbus 126, 6400 AC Heerlen, The Netherlands
[2] Geological Survey of The Netherlands, Postbus 157, 2000 AD Haarlem, The Netherlands

The Netherlands on- and off-shore area covers approximately 100.000 km^2. Notwith standing its small dimensions relative to neighbouring countries it is a major gas-producing country. Hundreds of gasfields are discovered, many of which are in production. Since the discovery of the Groningen Gasfield in the early sixties the cumulative gas production has increased to approximately 4 billion m^3 in 1993. The remaining gas reserves amount to approximately 2000 billion m^3.

Prominent potential source rocks are present in the Dinantian limestones, the Westphalian coal measures, the Jurassic Posidonia Shales and the Lower Cretaceous Delfland Group. The major part of the hydrocarbon occurrences is sourced from the Westphalian Coal Measures. Gas reservers are most frequent in the Upper Rotliegend sandstones, but hydrocarbon plays are also discovered in older and younger strata like the Upper Permian Dolomites, several Cretaceous productive rock units and the Lower North Sea Group.

The Westphalian Coal Measures have been deposited in the Variscan foredeep. Rapid Late Carboniferous subsidence and high sedimentation rates kept balance for approximately 25 Ma. The Upper Carboniferous (Namurian to Westphalian) strata of the Limburg Group are characterized by paralic sediments. The marine influence gradually diminishes towards the end of the Westphalian. Stephanian deposits are commonly eroded, and if present they do not contain significant amounts of coal. Preserved Upper Carboniferous sediments of the Limburg group may amount up to 3000 m and more. At average they contain 3-4 percents of coal. In addition the shales contain significant amounts of dispersed organic matter. The Carboniferous sub-crop has been modified during the Variscan orogeny, as well as during younger tectonic events.

The present maturity of the Carboniferous may be the result of one coalification phase or more. In some areas only one coalification phase took place during Late Carboniferous-Early Permian times. In other basins rocks have undergone two or even more phases of coalification. The result is a complex coalification pattern at the top of the Carboniferous sub-crop.

Hydrocarbon generation is directly related to coalification. The transformation of Organic Matter into hydrocarbons may take place in successive phases. Multiphase coalification is frequently observed in The Netherlands. The prospectivity for hydrocarbons depends largely upon the relative increase of maturity, especially during the last phase of coalification.

Sophisticated software allows the reconstruction of hydrocarbon generation as a function of time. The input variables comprise geological, geochemical and geophysical data. Areas where no Tertiary hydrocarbon generation took place and areas with high Tertiary hydrocarbon generation can be distinguished.

The hydrocarbon generation map can be compared to actual gas occurrences. There is only partial agreement between the distribution of gas occurrences and the Tertiary gas generation map. However, in areas where the modeling proved that gas generation did not take place during the Tertiary, plays are virtually absent.

Multivariate analysis on the basis of gas composition results in a subdivision of eight clusters of gases. 95 % of the gases (not corrected for volume) are collected in the clusters 6, 7 and 8. These three clusters show subtle differences in the amount of N_2, C2+ and C1. The three main clusters are separated geographically. In conjunction with the spatial distribution of the different gas clusters it is evident that the history of these gases is complex. Mixed source rocks, different migration routes, different timing of coalification, and lateral facies differences of source rocks contribute in various quantities to the complexity of the observered patterns.

Reflectance anomalies in Permian coals of the Gunnedah Basin, New South Wales, Australia

Lila W. Gurba[1], Julie Moloney[2] and Colin R. Ward[1]

[1] Department of Applied Geology, University of New South Wales, Sydney, Australia
[2] New South Wales Department of Mineral Resources, Singleton, Australia

Several different types of anomalies have been identified that affect the three-dimensional distribution of vitrinite reflectance values in the high-volatile bituminous coals of the Gunnedah Basin, New South Wales, Australia. Apart from the effects of igneous intrusions, a number of seams in the sequence have vitrinite reflectance values (Rv_{max}) that deviate significantly from the general vertical coalification trend. The distribution of these anomalies in both a lateral and vertical sense reflects the depositional environment of the coal seams. Correlation of optical and chemical rank indices with detailed information on sedimentary environments is therefore needed to identify these anomalies, and hence to assess the effect of environment of deposition on the regional reflectance pattern. The anomalies themselves can also be used as stratigraphic markers in the sequence.

The Gunnedah Basin is a part of the Permo-Triassic Sydney-Bowen foreland basin system of eastern Australia. It contains up to 1200 m of marine and non-marine Permian and Triassic sediments, resting unconformably upon Early Permian (and possibly Late Carboniferous) silicic and mafic volcanics which form the effective basement for the basin. The Permian sedimentary sequence was formed by three major terrestrial depositional episodes separated by two marine transgressive/ regressive events. Coals occur in two separate stratigraphic intervals, the Early Permian Leard and Maules Creek Formations and the Late Permian Black Jack Group, with a thick marine succession, the Porcupine and Watermark Formations, in between. The coal-bearing sequence is unconformably overlain by an upward fining fluvial Triassic sequence up to 200 m thick. The western and northern parts of the basin are also overlain by the Jurassic to Cretaceous Surat Basin succession.

The rank of the Permian coals in the Gunnedah Basin has been analysed using both petrographic and chemical methods. The coals have vitrinite reflectance values (Rv_{max}) ranging from 0.6 to around 1.0% (Gurba and Ward, 1995). Three types of reflectance anomalies have been identified (Gurba and Ward, 1996) that produce departures from the expected linear trend of increasing vitrinite reflectance with depth. These are:

a) Higher vitrinite reflectance arising from proximity to igneous intrusions, which are relatively common in the coal-bearing succession of the Gunnedah Basin;

b) Lower vitrinite reflectance due to marine influence on the coal seam or to an abundance of liptinite in the coal itself. Such suppression of vitrinite reflectance is well-known from a number of studies in other sequences, including those of Diessel (1992), Price and Barker (1985), Kalkreuth (1982), Newman and Newman (1982) and Hutton and Cook (1980);

c) The occurrence of higher than normal reflectance, noted by the present study in vitrinite that has a characteristic pattern of slits in one or two directions. This material resembles a component first described in American coals by Benedict et al. (1968) as "pseudovitrinite". Similar high reflectance is also noted in some vitrinites that have an abundance of mineral (typically quartz) inclusions.

Anomalies of type (a) are easily recognised because of the sharp sudden increase and decrease in reflectance on each side of the intrusive body. The reflectance associated with such bodies is typically very high, above 1 or 2%. Such anomalies, however, although in themselves significant, are not considered further in the present discussion.

Abnormally low vitrinite reflectance values occur in seams overlain by or intimately associated with marine strata. As a result of low reflectance gradients generally, reflectance data from many boreholes in the Gunnedah Basin may even appear to show negative rank gradients with depth. The lack of increase in reflectance in such cases is due mainly to marine influence on the coal seams in key parts of the section, which has also produced a sulphur rich perhydrous vitrinite.

Evidence for the suppression of vitrinite reflectance due to marine influence on the coal seam can be identified in two major intervals of the Gunnedah Basin sequence: the Maules Creek Formation in the lower part of the section and the lower part of the Black Jack Group in the upper part of coal-bearing succession. Sediments of the lower Black Jack Group were deposited in an environment which was broadly deltaic, with occasional brief marine incursions. The majority of coals studied from this interval, as well as at least the upper part of the Maules Creek section, have a perhydrous character, suppressed reflectance, observably more intense fluorescence and higher sulphur and hydrogen contents.

The coals with anomalously high vitrinite reflectance values appear to contain pseudovitrinite, a material not previously reported in Australian bituminous coals. They are most commonly found in the Maules Creek Formation and in the upper part of the Black Jack Group.

Both low-reflectance anomalies due to marine influence and high-reflectance anomalies due to pseudovitrinite need to be taken into account when interpreting maturation patterns from vitrinite reflectance data. Abnormally low vitrinite reflectance values may also be useful in marking sequence boundaries in stratigraphic and sedimentological studies.

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The effects of early diagenesis on organic stable carbon isotope ratio changes and maceral composition of Miocene lignites in N-Hungary

Mária Hámor-Vidó[1] and Ede Hertelendi[2]

[1] Geological Institute of Hungary, P.O. Box 106, H-1442, Budapest
[2] Institute of Nuclear Research, Debrecen

The term coal facies is mainly determinated by the peat-forming vegetation, water and nutrient supply, marine influence and fire. The preservance of organic matter depends on early diagenesis, where chemical changes like transformation from cellulose and lignin to fulvo and humic acids are the main processes.

Former studies on recent and ancient wood samples (Hatcher and Breger, 1981) showed that there is a linear correlation between chemical composition and $\delta^{13}C$ ratio changes during early diagenesis (Spiker and Hatcher, 1987). Degradation and loss of cellulose in buried wood may result $^{13}C/^{12}C$ ratio changes (Spiker and Hatcher, 1984).

Coal petrological studies were carried out in the frame of paleo-environmental reconstruction of early Miocene lignite seams (Hámor-Vidó, 1992, 1993). In those works we tried to show an evaluation of the mire belt system using maceral analysis. Coal petrological studies helped us to determine the state of the organic matter (preservance, grade of degradation, transportation). The type of coal facies was interpreted by the help of maceral analysis. Four facies were distinguished in double triangle diagram. The three peaks of the upper triangle represent swamp, marsh, aquatic facies respectively. The swamp facies dominantly consists of woody origin macerals and sclerotinite. In the marsh facies gelinite, detrited woody materials, cutinite and levigelinite are the major constituents. In the aquatic facies carbominerite, minerals, alginite and sporinite and amorphous organic material are the most dominant macerals. In the lower triangle inertinite and humodetrinite are the dominant macerals and the fourth peak represents terrestrial, or allochtonous peat forming environments.

Comparing results of different methods we chose 53 samples from two coal seams in the East Borsod region. The studied samples were mainly coals, but in some cases we made measurements on coaly shales and shaly coals as well. In each of our samples we determined the coal facies and organic stable carbon isotope ratio. Beside coal facies analysis gelification index was given to show the preservance of organic matter. Gelification Index determines the ratio of well preserved and degraded humic macerals similarly as used by Von der Brelie and Wolf (1981).

First a comparison was made with relative ash content (Vol % of maceral analysis) and with $\delta^{13}C$. Evaluating the diagram it was established that at more than 30 % of ash content the $\delta^{13}C$ values varied in a relatively narrow range compared to low ash content samples. For these reasons in the next step we left the high ash content samples out of consideration. There were only three exceptions among high ash content samples. These samples showed similar $\delta^{13}C$ values like the next upper samples. They showed a transition to their neighbour coal facies.

Finaly we represented the correlation between GI, $\delta^{13}C$ and coal facies. By the help of using Gelification Index GI and organic stable carbon isotope ratio more detailed conditions (pH, Eh) of different peat forming environments could be described. Swamp facies was below 1.0 GI and marsh facies varied between 1.0-100.0 GI. In a given coal facies exponencial connection was between GI and $\delta^{13}C$. As a result it was established that the higher is the Gelification Index and the lower the value of $\delta^{13}C$ the degree of decomposition is the larger. So at high GI and low $\delta^{13}C$ the pH was just below neutral and the peatification conditions were more or less aerobic and dry.

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Incorporation of color images (reflectance and fluorescence) to maceral analysis by Image Analysis

A. Jimenez[1], J.G. Prado[2], I.Suarez-Ruiz[2], B. Pradier[3] and L. Martinez[1]

[1] Centre de Geochimie de la Surface, 1, rue Blessig, Strasbourg F-67084, France
[2] Instituto Nacional del Carbon, Ap Co. 73, Oviedo E-33080, España
[3] Elf Aquitaine Production, CSTJF, Pau Cedex F-67018, France

The aim of this work has been to develop an automatic maceral analysis using both reflected and fluorescence light images. In recent years, the usefulness of image analysis applications in coal petrology has been proven. The development of image analysis systems has made it possible to define complex units such as coal macerals, by analyzing the colour of different objects (David & Fermont, 1993).

Up to now, several automated systems have been adapted for maceral and reflectance analysis based on the reflectance intensity of coal macerals. One of the limitations of these methods is that of differentiating liptinite macerals from the other dark points due to clay accumulations or imperfect polishing (Catalina et al., 1995). In order to avoid this problem, the fluorescence characteristics of liptinite have been incorporated into the present work.

The separation of each maceral group was obtained from the average of the threshold measured for each of the three RGB channels.

The conclusions obtained are:

1) Incorporation of fluorescence images into maceral analysis using image analysis allows a better definition of liptinite macerals and therefore a more accurate maceral analysis (% volume).

2) Colour Images (24 bits) give more useful information than gray-level images (8 bits) for establishing an adequate threshold that will permit the optimization of the separation between coal macerals.

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Behavior of pseudovitrinite under heating conditions

Krystyna Kruscewska

Department of Earth Science, University of Silesia, 41-200 ul Bedzinska 60, Poland

The aim of the presented poster is an evaluation of pseudovitrinite reactivity on laboratory scale. For this purpose two different South African coals were chosen. Their chemical and petrografic characteristics are as follows:

sample	Chemical analysis				
	CV%	H2O%	Ash%	VM%	FixC%
1	29.2	2.8	9.1	37.2	50.9
2	30.4	0.5	15.0	24.2	60.3

sample	Petrographic analysis				
	V%	PV%	L%	I%	Rr%
1	70	21	5	4	0.63
2	74	8	0	12	1.07

Note: PV - pseudovitrinite

Coals were heated in argon atmosphere using Roga apparatus. The following temperatures were applied: 350°C, 450°C, and 900°C. Heated coals were subsequently analyzed under the microscope and their petrographic composition and reflectivity were evaluated with special emphasis on the appearance and distribution of pseudovitrinite.

The results and conclusions:
In both cases the amount of pseudovitrinite has raised in samples which were heated to 350 °C and maintained at the same level at the temperature of 450°C. This suggests that some part of this component does not display its characteristic features in untreated coals.

At the temperature of 450°C the characteristic cracks in pseudovitrinite occur in primarily carbonized forms. In samples heated to the temperature of 900°C, with few exceptions they are not visible any more. The inert material in both isotropic and anisotropic cokes consist exclusively of inertinite components and inert pseudovitrinite forms were not observed. This leads to the conclusion that pseudovitrinite reactivity is similar to that of vitrinite in the same coal.

Determination of spore colour alteration by means of colour image analysis

Hans van de Laar and Petra David

Geological Survey of the Netherlands, P.O. Box 126, 6400 AC Heerlen, the Netherlands

This investigation presents the first results in our laboratory of the application of Colour Image Analysis to palynology. Eleven selected palynological slides from one core interval from the Carboniferous Coal Measures in the southern part of the Netherlands were examined. The vitrinite reflectance values of this Carboniferous section range from 0.70 to 0.95 % Rr, whereas the TAI values according to the scheme of Batten, Aberdeen, range from 4.5 to 5.

From each of the 11 studied slides 8 specimens of the sporomorph *Crassispora kosankei* were selected. The colour composition of each spore specimen was determined by measuring the intensities of the red, green and blue colour components on two selected areas. The data were evaluated using nested analysis of variance.

Our study shows that the colour alteration of spores due to thermal stress is most sensitive in the red part of the visible light spectrum. Three different sources of error can be distinguished. Within the studied sporomorph population, the variance which can be attributed to rank amounts to 65 %. The variance due to variation within the sporomorphs of one sample and the variance due to the variation within one sporomorph amount to 22 % and 13 %, respectively.

The results of this investigation indicate that the application of Colour Image Analysis is an useful tool and reduces the subjectivity in spore colour alteration studies. This method allows for a more subtle subdivision of rank on the basis of spore colour alteration, as compared to TAI.

Coal resources of Kyrgyzstan -- Geology, character, distribution and importance to the nation

E. R. Landis, N. H. Bostick*, H. J. Gluskoter, C. D. Harrison, D. W. Huber, and E. A. Johnson

*U.S. Geological Survey, ms-939, Denver Federal Center, Denver CO 80225-0046 USA

The mountainous country of Kyrgyzstan, newly independent of the USSR, contains about one-half of the coal reserves of central Asia. (Other countries included in the region are Uzbekistan, Tadjikistan and Turkmenistan).The Jurassic coals are in at least 64 localities in eight regions of Kyrgyzstan. Seperation of the deposits resulted more from earth movements in this complex terrain than from deposition in separate basins.

Mining has been concentrated around the Fergana Valley in the southwest part of the country. In the nearby Uzgen basin high-quailty coals ranging in rank from subbituminous A through anthracite have been discovered, but little mined. The Kavak basin in north central Kyrgyzstan has large reserves of subbituminous coal in positions that allow surface mining, but transportation is difficult. In the northeast, near lake Issyk Kul bituminous coal is mined for local use. More outlying coals in other regions are produced recently because of government support for the new Small Private Enterprise Mining Program.

Our standard coal analyses, petrographic study and major-, minor- and trace element determinations indicate the following. The coal is largely of subbituminous and high-volatile C bituminous rank, most has low and medium ash and sulfur content, and coals of higher rank (some with coking character) are present in one region. The coals have little liptinite, and the vitrinite / inertinite ratio is highly variable. Hazardous elements would not be a problem for most uses, though some coals yield more sulfur dioxide relative to heat value than desirable.

Many mines produce more fine coal than can be used presently so introduction of briquetting has potential economic sense despite the weak present economy of the country. The large potential users of fine coal near the capital in the north can no longer receive coal from the main producers because the rail lines cross three new national borders since the breakup of the USSR, and currencies are not generally convertable. Production has fallen from the four million tons over many years until 1990 to a half-million in 1995. This resulted from many factors, including worn-out equipment, shortage of diesel fuel, loss of markets, non-payment of workers and loss of experienced people. To provide for the heating needs of the population the coal industry must be restructured. Mines with smaller production, not dependent on complex equipment, that can supply relatively local needs, must be supported to provide the infrastructure for future expansion when transportation is improved and movement across national borders becomes possible.

The role of char structure on the combustion behaviour of inertinite-rich coals

Rosa Menendez, Diego Alvarez and Angeles G. Borrego

Instituto Nacional del Carbon (INCAR-CSIC), Ap. 73. 33080 Oviedo (Spain)

The pyrolysis behaviour of coal particles during p.f. combustion strongly depends on the characteristics of the coal, namely rank and petrographic (maceral) composition. The variations with coal rank in plasticity and porosity development achieved by char particles can be understood on the basis of the variations in the molecular structure of the vitrinites. Liptinites have little importance as far as the characteristics of chars are concerned, since most of them are evolved as volatile species. However, the characteristics of chars from inertinite macerals show a wide variety of occurrences, due to the different degrees of alteration undergone by the parent plant materials prior to coalification.

It was the objective of this study to gain an insight into the pyrolysis behaviour of inertinites. To achieve this, seven coals with increasing inertinite contents and similar rank were fully characterised using petrographic techniques. The degree of alteration of the inertinites was estimated from reflectance measurements. Pyrolysis chars from these coals were also characterised by optical microscopy and image analysis techniques. Finally, combustion experiments at 1100 °C were carried out on these coals in order to evaluate their combustion performance.

Results from the char characterisation showed that low reflecting inertinites behaved much the same as vitrinites for the rank used in this work. However, high reflecting inertinites tended to form massive structures with low porosities. On the other hand, the combustion efficiency of the coals did not depend on the porosity of their chars. In fact, high inertinite coals burnt to a higher extent than low inertinite coals.

Thus, it was concluded that the inertinite content of coals could be responsible for the unburnt carbon in fly ash, due to the low accessibility to oxygen of their chars. However, at the low combustion temperatures used in this work, the diffusion of oxygen to the surface of the carbonaceous matter was not the rate-limiting step, and the high combustion efficiency of the highest inertinite coals could be due to the disordered molecular structure of the chars, with a higher active site concentration and thus better properties for burning under conditions in which there is a chemical control of the combustion process.

An unbiased, semi-automatic method for char classification

Rosa Menendez, Diego Alvarez and Angeles G. Borrego

Instituto Nacional del Carbon (INCAR-CSIC), Ap. 73. 33080 Oviedo (Spain)

The gasification of the chars generated in the pyrolysis of coal particles in a p.f. boiler has a foremost importance in the overall combustion process, as the characteristics of these chars will be responsible of the amount of unburnt carbon in the ashes leaving the boiler. However, the extensive studies carried out on the morphology of coal char did not so far yield conclusive results about the relationships between char structure and reactivity. The subjectivity implicit to the descriptions of char types and the difficulty in accurately estimating parameters such as porosity or wall thickness can be responsible for the lack of useful data for modelling combustion processes. In this study, the most relevant structural parameters of chars have been accurately measured by means of standard image analysis techniques, the obtained data giving precise descriptions of the individual char particles which, in turn, allow for the establishment of an unbiased semi-automatic char classification system.

Specifically, the work was aimed at the onset of precise and objective definition of the main structural types commonly found in chars. Emphasis has been put on the discrimination between cenosphere and network chars, and also between thin and thick-walled structures. Massive, non porous chars are also identified by this method.

Data obtained from the application of the proposed techniques to chars samples from three coals with different ranks and maceral compositions clearly reflected the differences between these samples which could be expected from the plastic properties of the parent coals. The accuracy and objectivity of the measurements carried out by these techniques make them a useful tool to provide data for the modelling of char oxidation in full-scale plants.

The relationships among photo-oxidation, luminescence and hydrophobicity of bituminous vitrains

G.D. Mitchell, A. Davis, and S. Chander*

The Pennsylvania State University , Coal & Organic Petrology Laboratories and *Mineral Processing Section, 105 Academic Projects, University Park, PA 16802, U.S.A.

Light-induced photo-oxidation of bituminous rank vitrain shares some similarities with the natural weathering of coal. In both cases there are distinct changes in the luminescence properties and the affinity of these surfaces to the cationic dye safranin 0, suggesting that the degree of surface oxidation may be monitored with photometric measurements [1,2,]. Surface oxidation is known to have a profound influence on hydrophobicity and floatability of coals [3].

The objective of this research, therefore, has been to use photo-oxidation to induce changes in the surface chemistry of vitrains and investigate the relationships among the resulting surface oxygen functionality, luminescence intensity, hydrophobicity, and flotation yield.

Blocks and powdered concentrates of vitrain were prepared from three coals of hvC, hvA and mv bituminous ranks. Vitrain bands in the polished blocks were photo-oxidized using blue-light irradiation (390-490 nm) under the microscope for various time intervals and examined for specific changes in luminescence intensity, surface chemistry and wettability. Powdered vitrains were irradiated under ultraviolet light ($\approx$366 nm) and then tested for changes in flotation.

Analytical results from reflectance-mode FTIR show that the irradiation of the vitrain surfaces induces photo-oxidation, resulting in increased aromatic carbonyl and hydroxyl groups and decreased methyl group concentration with irradiation time. Contact angle measurements on fresh and photo-oxidized vitrains show that surface wettability increases with irradiation time, the magnitude of this change decreases with increasing coal rank. Film flotation results show that increasing levels of surface oxidation diminishes flotation yields.

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Comparison of modern and fossil plant cuticles by selective chemical extraction monitored by Curie-Point-Pyrolysis, Gas Chromatography/Mass Spectrometry and Electron Microscopy

Barbara Mösle[1,2], Paul Finch[1], Margaret E. Collinson[2] and Andrew C. Scott[2]

[1] Chemistry Unit and [2] Department of Geology, Royal Holloway and Bedford New College, University of London, Egham Hill, Egham Surrey, TW20 OEX, United Kingdom.

In order to investigate the roles of diagenetic and selective preservation processes in the occurrence of plant materials in the fossil record [1] we have undertaken a comparative study of modern and fossil conifer cuticles by chemical and microscopical methods. Cuticles are released from modern leaf tissue with hydrogen peroxide in aqueous acetic acid, but some chemical changes occur as revealed by Curie-Point Py-GC/MS. The cutin (polyester) components of cuticles can be selectively removed by saponification, and the polysaccharide and lignin by acetyl bromide in acetic acid [2]. These treatments reveal the presence of a resistent cuticle biomacromolecule with the characteristic cutan pyrolysis pattern in all cuticles analyzed.

The pyrolysis patterns can be clearly correlated with electron microscopy of the cuticles at different stages of chemical treatment; in particular the presence and removal of extracuticular cellular material can be visualized and accounted for.

Fossil cuticles were removed from the rock using 40 % w/v hydrofluoric acid and examined by Py-GC/MS and electron microscopy. The characteristic "cutan" pattern of alkene/alkane doublets has been identified in all of the samples. Additionally phenolic, other benzenoid, and triterpenoid compounds have been found. The contribution of PY-GC/MS studies to the investigation of the processes involved in plant preservation will be discussed.

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Controls on coal character in a small pull-apart basin, New Zealand

T.A. Moore[1] and J.S. Esterle[2]

[1] Coal Reserch Ltd., P.O. Box 31-244, Lower Hutt, New Zealand
[2] CSIRO, P.O. Box 883, Kenmore, Qld., Australia

Coal seam character in the Waikato Coalfield (Eocene) of New Zealand is controlled by differential basin subsidence as well as macroscopic coal types.

Two coal seams (the stratigraphically lower Taupiri and the overlying Kupakupa) in a small pull-apart basin are both thickest (5-12 m) in similar geographic locations. Sediments separating the thickest coal areas of both seams correspond to basement lows indicating a structural control on seam geometry.

Macroscopic coal types are very different between the Taupiri and Kupakupa seams; the former is predominantly bright but nonbanded whilst the Kupakupa is both bright and banded. In either bed, however, the highest concentration of vitrain bands occurs at the top and bottom of the seams.

Chemical analyses show that the nonbanded coal type has the highest volatile matter whilst the banded coal has the highest moisture, ash and fixed carbon values. Other coal quality values are also correlated quite closely to coal type.

These associations allow predictive modelling of both coal distribution and properties. Application of these models by the coal industry, therefore, permits a higher efficiency in mining methods.

The coals in thermic contact with sulphides and gold mineralization from Baia Sprie - Maramures (N W Romania)

Costel Nedelcu

S.C. "Prospectiuni", 1 Caransebes st S.A., Bucharest 78344, Romania

The Baia Sprie area is a very known place of various mineralogy from Europe. The first written informations of the mining from Baia Sprie are in 1141 years, but simple exploitation was begun many thousands years ago, by geto-dacic people. Baia Sprie is a famous area because its polymetalic mineralization is a natural collection which has 80 metalic minerals. Recently, I discovered the natural coke and pyrocarbone in the coals which are in thermic contact with polymetalic mineralization from Baia Sprie.

Baia Sprie area is formed by neozoic geological formations (magmatites and hydrothermal altered products and polymetalic mineralizations postpannonian, Pannonian sedimentary deposits and other younger rocks). The Pannonian sedimentary deposits were formed by marls, sandstones, volcanogen-sedimentary rocks and bituminous coals to anthracites. The Pannonian geological formations are crossed by the veins of chalcopyrite + pyrite + galena + sphalerite + bornite + tetrahedrite + haematite + chlorite + albite + adulare + baritina + other interesting minerals and quartz + gold + calcite. Two aspects are very important at the contact of the mineralizations with Pannonian sedimentary deposits:

1. In "Herneanu Valley", at the zone of number 5 shaft, the polymetalic and gold mineralization crossed the Pannonian sedimentary rocks. Often, the quartz + gold and calcite has replaced the vitrinite. In the same time the vitrinite was replaced by pyrocarbone and natural coke. But, the pyrocarbone hasn't a good cone in cone structure. It is as inflated round zone (10-20 μm) in the middle of vitrinite. The natural coke hasn't the mosaic anisotropic structures in meta-anthracites from anchimetamorphic geological formations of Romania, for example. The reflectance of vitrinite of coals from "Herneanu Valley" zone is 1 - 3 %, bituminous coal to anthracite.
2. In quarry "Hill Mine" zone the Pannonian sedimentary deposits with coal are crossed by quartz + gold veins and calcite; rarely it was observed polymetalic mineralization. In this place (quarry "Hill Mine"), the reflectance of vitrinite is 0.60-0.70 % only. The pyrocarbone and natural coke was not formed. In this bituminous coals with 0.60-0.70 % RmVi, the vitrinite has been substituted by hydrothermal quartz and gold (1-5 μm and 1.34 g/t, in chemical analyses) and calcite, often.

Conclusions
In "Herneanu Valley" zone the temperature of hydrothermal sulphides polymetalic mineralization has transformed the organic matter in pyrocarbone and natural isotropic coke. The temperature was by 250 - 300°C (determinated in geothermometrically method, Nedelcu and Pintea 1993).
In quarry "Hill Mine" zone the coals are in bituminous coal stage only and in there it was not formed the natural carbonic products of temperature. The temperature of hydrothermal solutions of quartz + gold + calcite was by 100 - 150°C only.

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A new method to characterize the textural components of metallurgical coke and its changes in the blast furnace

Ollig, A.[1)], Hagemann, H.W.[2)], and Janhsen, U.[1)]

1) Thyssen Stahl AG, Kaiser Wilhelm-Str. 100, D-47166 Duisburg, Germany
2) Lehrstuhl für Geologie, Geochemie und Lagerstätten des Erdöls und der Kohle, RWTH Aachen, Lochnerstr. 4-20, D-52056 Aachen, Germany

Method: One of the main tasks of coke in the blast furnace is to ensure a good gas flow through the self-supporting column. This is why particular importance is placed upon strength. Until now technological and chemical values of the coke before charging into the blast furnace have been used to determine the quality. The conditions in the blast furnace have only been simulated in few testing methods. One such method is perhaps the most common and determines the strength of the coke after a 2-hour reaction with CO_2-gas at a temperature of 1100°C. This value is called CSR and stands for coke strength after reaction. In general the value increases with decreasing reactivity. The question as to whether the load on the coke in the blast furnace can be so determined remains open.

However: What are the decisive influences on the coke in the blast furnace and in what ways do they change the coke. Where do these changes take place? These were the questions which were pursued in this project with emphasis on the microtexture of the coke.

In order to be able to characterize the microtexture under an optical microscope an image analysis measuring method was developed. It distinguishes between the optical isotropic and anisotropic areas in the coke due to their differing reflective behaviour in polarized light. The intensity of the reflected light of the polished coke is transformed into digital grey values by the image analysis system. With the help of an automatic polarizer in the beam of the incoming light, the image analysis system determines two grey values images of the visible section in the microscope whose pixels portray either the maximum or minimum reflection values in grey values.

From these images the image analysis system provides a picture which represents the "normalized bireflection" of each pixel. This means, that for each pixel a grey value/anisotrope index is established to show the difference between maximum and minimum grey value related to the maximum grey value and multiplied by 255 for each pixel. This facilitates the possibility of quantitively comparing the amount of optical anisotropy of coke areas with different maximum reflection strength, meaning a major difference to the usual method of coke petrography. By linking the grey value/anisotrope index and the minimum grey value five coke phases were defined.

The measuring process here developed measures the distribution of the phase composition of some 200 visible sections in the microscope of finely ground polished coke in percentage terms. It is not then the amount of coke phases but the distribution of the phase composition which characterizes the coke. In this investigation therefore, changes in the coke can occur in the increase or decrease in tenor of only one or two of the five coke phases. Nevertheless it still makes sense to retain the five phases to characterize the coke, as the three other phases may possibly be the key to other relationships not here investigated.

Laboratory tests: - The solid charging materials of the blast furnace begin to smelt in the cohesive zone. The conditions were simulated in a laboratory for coke of very high and very low CSRvalue by rolling them in a drum after the reaction with CO_2 at a temperature of 1100°C during a two or four hour reaction period with and without pre-alkaliinfiltration. The thus treated coke did not differ greatly in distribution of the phase composition.

- After the cohesive zone the coke near the shell sinks to hotter zones or into the dead man. The influence of the temperature of 1600°C in inert atmospheres in laboratory furnaces also had no effect on the distribution of the phase composition, so that untreated and treated coke appear not to differ greatly from each other.
- When the conditions were simulated in which coke of varying value of CSR were heated by CO_2/N_2-gas up to 1600°C during a period of 2 hours, two of the four cokes tested showed clear changes in their distribution of the phase composition.

Tuyere-tests: The changes in the coke phases in the blast furnace were carried out on tuyere-coke-samples from blast furnace campaigns with charged coke of a very low and very high postreactive strength. A sampling tube was inserted through a tuyere into the blast furnace Schwelgern 1 to the dead-man, and material extracted. The distribution of phase composition of the tuyere coke from the shell, in the dead man and from the transition zone as well as the charging coke in question were measured.

Neither of the charge cokes differed in their distribution of phase composition. In the blast furnace however they showed clear differences in their behaviour patterns. Whereas there was no significant change in the phase composition of the more reactive coke neither from the top to tuyere level nor from the core to the shell at tuyere level, the phase composition of the less reactive coke showed obvious changes.

From these results we can conclude that charging coke with a high CSR-value shows a good gas flow zone, rich in CO_2 at some 1600°C in the area around the tuyeres. In the dead man either the temperature or the CO_2-concentration or even both are significantly lower.

Summary: To sum up it is possible to say that relative to its reactivity the changes in the distribution of the phase composition of the coke in the blast furnace are influenced by the temperature of 1600°C coupled with a high CO_2-concentration. In no existing coke test process is the fact taken into account. Therefore with this newly developed method to distinguish between the textural components in metallurgical coke, it has for the first time been made possible to see such relationships.

Sedimentology, well log characteristics and source rock appraisal of the Upper Carboniferous (Westphalian) in well Kemperkoul -1, South Limburg, The Netherlands.

B. Pradier[1], F. Lafont[1], C. Boutet[1], G. Nicolas[1], W. Fermont[2], H. Veld[2] and J. M. Champanhet[3]

[1] Elf Aquitaine Production, CSTJF, Pau Cedex F-67018, France
[2] Geological Survey of The Netherlands, P.O. Box 126, 6400 AC Heerlen, The Netherlands
[3] Elf Petroland Exploration, P.O. Box 93280, 2509 AG The Hague., The Netherlands

Introduction

The sedimentological and geochemical study of the Kemperkoul-1 well (RGD), cored and logged continuously over a length of about 1200 m in the Westphalian B and C series, made it possible to define the depositional model of the Westphalian and locate the various types of source rock in the sequential evolution within the Carboniferous series of South Limburg. Moreover, the maturity interval of this section covering the range 0.7 to 1.5% Vro, allowed the detailed study of the catagenetic behaviour of the different source rocks facies.

Geological Model - Sequential Evolution - Source rock facies

The depositional model consists of a delta plain dominated by a fluvial influence (channels, lacustrine deposits and marshes) in which occurred some obvious marine incursions (marine bands) characterised by storm deposits (Hummocky Cross Stratifications).
The basic depositional sequence consists in a progressive transgression of subaerial deposits by lacustrine or marine facies. A surface, characterised by the development of frankly subaquatic deposits, then marks the maximum of the flooding event. A regressive sequence, limited at the top by an emersion surface (pedogenesis - siderite - root traces) finally develops. The source rock facies are systematically found in the transgressive part of the sequence, between the emersive and flooding surfaces. Two major types of source rock have been identified:
Coal, with a high source rock potential. Their depositional environments (essentially swamp to wet forest conditions) have been characterised by maceral and microlithotype analysis.
Organic clays, with a good source rock potential, very often associated with coal, deposited in an inundated swamp environment.
The thickness of the source rock facies varies considerably and depends on the persistence of the depositional environment (slow flooding, absence of fluvial incursions, etc.). The geochemical characteristics of the coals and the organic clays differ. The various parameters issued from kerogen analysis (petrography and Rock-Eval pyrolysis) and extract analysis (LC-GC) lead to some very contrasting results when plotted against maturity, taking into account the lithological type of the sample

Conclusions

The detailed study of the Kemperkoul-1 well, cored continuously in the Westphalian B and C sediments, made it possible to characterise the environments favourable to the deposition of the different source rock types, to understand their position in a typical sequential evolution and to precisely monitor their catagenetic behaviour in a 0.7 - 1.5% Vro range.

Coke reactivity as a result of its petrographic structure and composition

Georgeta Predeanu[1], Cornelia Panaitescu[2], Dumitrescu Câlin[3] and Gabriela Plesa[4]

[1] Metallurgical Research Institute ICEM S.A., Str. Mehadia nr. 39, cod 77769, sector 6, Bucharest, Romania
[2] Polytechnical University, Bucharest
[3] Consultcarbo S.R.L.
[4] SIDEX - Galati

In the blast furnace, the most critical function of coke is that of mechanical support, in order to form a permeable burden for gas and liquid, in the lower part of the furnace. The optimum coke properties required are different from plant to plant but generally, coke must exhibit a high resistance to size degradation when exposed to the combined influences of partial gasification with CO_2 and alkali attack, at high temperatures.
As powder coal injection becomes common practice in most of the countries - in Romania has already started the first PCI installation at SIDEX- Galali steel plant - the amount of coke needed will be significantly reduced. However, it must be pointed out that this reduction in coke rate will require less reactive and stronger coke, to sustain the blast furnace burden.
In order to have a complete view of coke's strength in the blast furnace many studies were done and some reactivity tests were developed in the last decades.
In the most common test used all over the world - Nippon Steel's - coke reacts with CO_2 at 1100°C, for 2 hours. In this way coke quality is determined by means of two indices:

- CRI (coke reactivity index) which represents the percent of the coke samples gasified weight loss;
- CSR (coke strength after reaction) which represents the percent of + 10 mm coke after reaction and mechanical treatment in a typical laboratory drum.

The works carried out on coke's physical and technological properties - mechanical resistance at room and high temperature - demonstrated the strong relationship existing between coke behaviour and its petrographic structure and composition.
The aim of this paper is to present the results of Romanian researches, following two important petrographic aspects which can explain the coke reactivity mechanism:

- the different structural textures (the composition of coke matrix: isotropic and anisotropic textures, inclusions) which determine the chemical reactivity;
- the porous structure (quantity, size and distribution of macropores, micropores and also the interporous system) which determine the diffusion reactivity.

We pointed out that indifferent of the reactivity test used, the behaviour of coke produced and utilized in our experiments, depends (according to literature) on coal rank and maceral composition. The two petrographic parameters determine the ratio between different optical textures on the coke matrix. We considered also the influence of charge preparation and coke making technology on the plastic phase.
These relationships are sustained by the fact that the weight loss after thermochemical reactions causes:

- the reducing of pore wall thickness;
- the changing of the ratio between different optical textures and inertinitic inclusions of the coke structure.

The paper presents the petrographic experimental results - qualitative and quantitative - of the above considerations, before and after the different reactivity tests.
Some of the most interesting structural aspects are presented as coke micrographs.

Geological basis for coal quality in the SW part of the Upper Silesian Coal Basin, Poland.

Krystian Probierz and Andrzej Kubik

Katedra Geologii Stosowanej, Politechnika Slaska, ul. Akademicka 2, 44-100 GLIWICE, Poland

The poster shows the results of investigations on coking coal deposits in the south-western part of the U.S.C.B. The study area comprises the Poruba coal bearing beds of Upper Namurian age, situated on boths sides of the significant Orlova - Boguszowice overthrust zone.

The studies exhibited, on the distance of 7 km, vast reduction in coal capacity and thickness of the beds towards the east, due to varying pace of sedimentary basin subsidence as well as an effect of zonal structure of deep basement.

In addition, considerable changes in rank of coals have been ascertained (R_O = 0.99-1.52 %), which resulted in strong variations in petrographic composition of coals and their utility properties. Additional, thermal metamorphism of coals in the eastern part of the area has been assumed.

Coal petrography of activated carbon from Northern Thailand coals

Benjavun Ratanasthien[1], Mongkon Rayanakorn[2], Lek Srikong[3], Pisan Kijsawadpiboon[2], Mayuree Phromputha[1], Pipop Roppiree[1] and Premvadee Avithanananth[4]

[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2] Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[3] Department of Mining Engineering and Metallurgy, University of Prince Songkhlanakarine, Haad Yai, Song Khla
[4] Department of Public Service, Chiang Mai University, Chiang Mai 50200, Thailand

Lignite to subbituminous coals in northern Thailand were subjected to charbonization at 600, 700, 800°C respectively, prior to be activated with steam and carbondioxide at 800 °C .

High liptinite coal from Mae Chaem provide the best reaction after charbonization at 700°C, but did not show different between activated by steam, carbondioxide or both steam and carbondioxide.

Coal petrographic evidences show higher porosity of high liptinite coal of Mae Chaem than the coal from Mae Tan and Mae Teep which made up entirely of tree trunks.

Dead line for the next issue of the ICCP NEWS is March 31, 1997!

Alginite association in Northern Thailand fossil fuel deposits

Benjavun Ratanasthien

Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

Alginites associated with northern Thailand fossil fuel vary accordingly to their environment of deposition. They are generally composed of more than one algae type in the deposits and some vary in their lithologic column. *Pila* algae is the most common but scattered through out layers whereas the others form thick accumulation. They are found associated with thick wall alginite in oil shale of Mae Teep and Mae Chaem coalfields. They are found associated with *Botryococcus braunii* in Li oil shale along with temperate pollens such as *Pinus* sp., *Alnus* sp.

In lacustrine environment of Mae Moh and Wiang Haeng, *Pila* algae is found associated with lamalginite and *Reinschia* with spores of water-dwelling fern.

At Mae Sod, *Pila* algae is associated with *Reinschia* in the Mae Pa deposit, northern part of Mae Sod whereas lamalginite is dominated in Mae Ku, southern part of Mae Sod basin.

The limitations of the optical morphotype and porosity classification of combustion chars in the middle burnout interval

Henning Sund Sφrensen, Per Rosenberg, Henrik Ingermann Petersen, Erik Thomsen and Carsten Guvad

Geological Survey of Denmark and Greenland, Thoravej 8, DK-2400 Copenhagen NV
Tel.: +31 10 66 00, Fax +31 19 68 68, e-mail hss@geus.dk

Combustion chars from various laboratory reactors as well as full scale chars have previously been studied with respect to morphotype and porosity. The results show that only chars produced at temperatures and heating rates close to those present in full scale combustion (higher than around 1300°C) should be used to make conclusions on full scale char burnout (Rosenberg et al., 1996a; Rosenberg et al., 1996b). Special attention was therefore given to chars produced in the SANDIA laminar flow reactor at temperatures between 1250 and 1400°C.

As also demonstrated by Vleeskens et al. (1993), no evolution in the morphotypes compositions was observed in the middle burnout interval ranging from 40% to above 70% (d.a.f.). Surprisingly the optically measured porosity, also did not comprise any development in the same interval, and only at burnout levels at 79% (d.a.f.) and higher an increase in overall porosity was observed. It was thus evident that the mass flow in this interval could not be explained using these techniques. An extensive scanning electron microscopy (SEM) study of particulate char particles (Sφrensen and Rosenberg, 1996) yielded important information on both structural and porosity evolution during burnout. In SEM it is evident that the mass loss in the middle burnout interval is associated with development of secondary "semi-micropores" below 5 mm in diameter. This porosity development occurs to a lesser extent in unfused particles than in fused particles, showing that burnout depends upon char morphotype in the middle burnout interval.

The results demonstrate a limitation of the optical methods since they cannot detect or quantify the textural development that has been observed by SEM in the middle burnout interval. At present the SEM method is purely qualitative and additional work needs to be done to further elucidate the development of "semi-microporosity", and to make the method quantitative as an important supplement to existing optical methods.

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Petrography of North Bohemian brown coals and their solid residues from carbonization, coprocessing and fluidized bed combustion

I. Sykorová

Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic V Holesovickách 41, 182 09 Prague 8, Czech Republic

This work is aimed at microscopic analysis of brown coal and solid residues - char from coal/oil coprocessing, carbonization and fluidized bed combustion. Coals used for experiments originated from all North Bohemian open pit mines are now exploited (Libous, Nástup, Vrsany, Sverma, Lezáky, Bílina, Chabarovice). Two of the coals, Centrum and Kohinoor, come from deep mining. The examined coals represent the group of brown coal orthotype. They are characterized by huminite reflectance R_0=0.33 - 0.40%, ash content A^d=3.4 - 32.9%, carbon content C^{daf}=68.0 - 72.5% and sulphur content S_t^d =0.3 - 2.5%. Huminite content varies from 64% to 90%. The most abundant macerals of huminite are ulminite (38 - 52%) and densinite (11 - 36%). The concentration of attrinite and gelinite is substancially lower 3 - 19% and 1 - 8%, respectively. Textinite and corpohuminite content does not exceed 4%. The maceral composition of liptinite is determined by fluorescence analysis (content 4 - 13%). Sporinite and liptodetrinite predominate particularly in the CSA and Centrum samples. The remaining liptinite macerals, i.e. cutinite, resinite, exsudatinite, bituminite, suberinite, and fluorinite are accesory. Inertinite is more abundant in only Sverma and Lezáky coals (3 - 5%), where inertodetrinite and macrinite addition to sclerotinite and fusinite.

The major part of the mineral matter of samples is represented by clay minerals, iron sulphides, quartz, carbonates and accessoric sulphates. Clay minerals and FeS_2 are finely dispersed through the detrite, filled in the cellular tissues components and occasionally occur in form of separate layers. Despite the differences in the petrographic composition, the coals give similar reactivity during conversion, pyrolysis, and combustion. Random reflectance, morphology and optical texture of coprocessing residues and chars from pyrolysis and combustion are determined.

Random reflectance of solid residues from coal/oil coprocessing between 410°C and 455°C increases from 1.2% to 3.5%. The solid residues are built by fragments of coal matter (27 - 2%), isotropic (97 - 11 %) and anisotropic (3 - 88%) material. The isotropic material contains fragments of granular residue, humoplast, fragments of fusinite, sclerotinite, mineral matter and low portion of humoplast with mesophase-spheres. The anisotropic material exhibits mainly mosaic texture (3 - 75%). The solid residues produced under more severe conditions (at temperatures ≤ 440°C) containes anisotropic material with a larger portion of domains (14%).

The chars produced by carbonization of coal samples at 650°C in nitrogen atmosphere are isotropic porous material. The difference in random reflectance of chars with walls prevail over pores is significant R_r=2.3 - 4.8%. Chars with larger pores are probably formed from ulminite (texto-ulminite) and densinite. The massive grains of gelinite remain nearly unchanged. Their smooth, higly reflecting planes are partly disturbed by fissures and pores.

Densinite and especially attrinite represent sources of finely porous chars with numerous pores and fissures around the almost unchanged fragments of resinite and inertinite. Finely porous chars are formed by the decomposition of liptodetrinite and mineralized detritic matter.

The organic residues of particulate emissions (bottom ash from the combustor, fly ash captured in a cyclone) produced during fluidized bed combustion (bed temperature 1100°C, concentration of oxygen in flue gas 1 - 12%) are isotropic chars, with variable reflectance (R_r=1,1 - 4.9%), morphology, shape and porosity.

The mineroid type of chars is dominated in all size fractions of fly ash and mainly in bottom ash from the combustor. The fractions of the fine particles (0 - 40μ and 40 - 63μ) consist of this type of chars: solid, network and low amount of cenospheres. The fraction of coarse particles (63 - 90 μ) contains networks and cenospheres. The concentration of thick- and thin-walled cenospheres, network and solid residues originated mainly from ulminite, densinite, attrinite, liptodetrinite, fusinite and sclerotinite, increase in fractions 90 - 200 μ and >200 μ.

The studies show effects of the maceral composition and mineral matter on formation of solid residues - chars produced by carbonization, combustion and coprocessing of North Bohemian brown coals.

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Rank of Polish brown coals according to the international classification of coals

Marian Wagner and Barbara Kwiecinska

University of Mining and Metallurgy, Al. Mickiewicka 30, Krakow, Poland

The results of studies on the brown coals occurring in the Mesozoic and Tertiary deposits of Poland are presented. The Mesozoic brown coals occur only as the intercalations among the sandstones, mudstones and siltstones. These coals are hard, black, bright, strongly gelificated and highly coalificated (Tab. 1; No. 19-26). Polish Tertiary deposits belong to two huge paleogeographic-structural units: geosynclinal including the Carpathians and the Carpathian Foredeep; and epicontinental being a part of the North-West European basin comprising the Polish Lowlands. Both units display a complicated geological structure.

The geosynclinal unit has highly diversified stratigraphy and various degree of coalification in particular stratigraphic horizons. The brown coals of both units are soft and they are occurring in form of traces, thin intercalations and interlayers, small lenticular deposits as well as the huge deposits with the resources running into a milliard and more tons.

On the Polish Lowlands, the Neogene deposits, developed in swamp and limnic facies, lying within the Miocene sediments, are of the main econonic importance. Others, found in the older Tertiary (Paleogene), have no economic value due to the considerable depth of their occurrence. The Neogene brown coals are of limnic origin while the Paleogene are paralic.

Among the Tertiary brown coals the following deposits are distinguished: seam-lenticular deposits (Tab. 1; No: 1,2,3,7,8,9), deposits of tectonic troughs (Tab.1; No.: 4,5,6,10), glacitectonic deposits, (Tab. 1; -No. 11), carst deposits as well as relict deposits and the 'patch' coals.

In order to evaluate a degree of coalification of the Polish brown coals the samples from all the working mines (Tab. 1 ; No. 1 - 11), from some of the perspective deposits and from the other places, where brown coals show low (Tab. 1; No. 12-18) and high coalification (Tab. 1; No. 19-26), have been studied.

At present, in Poland, the German (DIN) classification of brown coals is applied, in which several lithotypes are distiniguished within the soft and hard brown coals. Criteria for the evaluation of degree of coalification are two parameters - carbon content and calorific value in dry ash free stage (daf). International classification (ECE 1993) as well as more important classifications of the particular countries do not take these parameters into account. They base mainly on the measurements of calorific value in moisture and ash free stage (maf).

In coals studied Qs maf parameter (Tab. 1) has been indicated however, it shows small precision with reference to the coals of varied petrographic composition.

Because in tbc ECE system, mean vitrinite reflectance is the classification parameter for the high rank coals, an attempt has been made to correlate this parameter with both calorific (maf) and bed moisture of coal, calculated also in ash free stage.

Correlation of Ro ulminite and vitrinite of brown coal with its calorific value is high ($r=0.97$, $n=80$) for the coals of the wide variety of petrographic composition. It has been found that the projection points of coal lie within the confidence limits for regression line and predicted values when the content of macerals of huminite/vitrinite group is higher than 65% and the minerals of the inertinite group do not exceed 20%.

According to these results, Ro index seems to be a good rank indicator of degree of coalification also for brown coals. The range of its application can comprise the whole coal series. Random investigations of Ro of the Holocene peats from the area of Poland show that their Ro of ulminite does not exceed 0.15 % and therefore, we propose to use this value (0.15 %) as the lower limit of lignite of the 'ortho' phase. It is equal to 5 MJ/kg of gross calorific value in moisture and free stage. Between 'ortho' and meta phases there is a limit value of Ro that equals 0.35%, whereas 0.4-0.5% value is proposed to be put between meta lignite and sub-bituminous. Limit value at the transition into bituminous coal stage needs further studies. The indicated Ro values correlate well with the calorific value from the ECE classification.

Basing on the studies of Alpern et al. (1989) and Peschel et al. (1989), inter-correlations between total moisture (af), calorific value (maf) and reflectance index have been pointed out. The correlation between Ro and Qs is strong ($r=0,95$), and the indicated limit values with reference to the ECE classification correspond with those accepted in the coal series (Stach et.al.,1982). Bed moisture of brown coals can be an additional parameter in classification but it should be kept in mind that its value strongly depends on the hydrogeological conditions and degree of dewatering of deposit at the specific petrographic composition of coal.

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Table 1: Variability of the rank and quality of brown coals

A. Soft brown coals

Number %	**Coal Deposit** %wt	**Ro** %	**Wt(maf)** MJ/kg	**A(d)**	**Qs (maf)**	**Age**
1JOZWIN	0.287	53.2	15.2	11.810	Miocene	
2	PATNOW	0.286	57.3	23.2	10.995	Miocene
3	KAZIMIERZ	0.286	53.3	15.5	12.190	Miocene
4	LUBSTOW	0.261	59.7	12.2	10.300	Oligocene
5	TUROW Ip	0.303	53.8	14.1	12.640	Miocene
6	TUROW IIp	0.281	53.5	6.7	11.555	Miocene
7	ADAMOW	0.285	58.3	22.9	10.210	Miocene
8	WLADYSLAWOW	0.234	58.9	34.6	9.642	Miocene
9	KOZMIN	0.270	57.8	10.4	10.635	Miocene
10	BELCHATOW	0.287	57.8	14.0	10.390	Miocene
11	SIENIAWA VII	0.252	58.7	9.8	10.340	Miocene
12	TRZYDNIK	0.205	58.9	32.7	9.747	Miocene
13	JAROSZOW	0.207	55.6	12.7	10.048	Miocene
14	ZEBRZYDOWA	0.243	54.2	28.4	11.518	Miocene
15	LUTYNKA	0,252	52.6	4.9	11.371	Miocene
16	LEKNICA	0.255	56.7	7.1	10.651	Miocene
17	PRZEWOZ	0.261	56.9	3.1	11.024	Miocene
18	NISKOWA	0.270	57.8	7.5	11.110	Miocene

B. Hard brown coals.

19	OPOCZNO	0.35	45.0	2.7	14.853	Jurassic
20	GRUDNA DLN	0.37	40.0	15.5	16.286	Miocene
21	LIPNICA M.	0.39	37.2	17.0	16.120	Miocene
22	BOLESLAWIEC,	0.35	36.0	2.8	15.200	Cretaceous
23	ZAWIERCIE	0.46	18.1	20.0	22.692	Jurassic
24	KAMIEN POM.	0.45	25.0	19.0	20.185	Cretaceous
25	OPATOW	0.44	25.0	15.4	20.935	Cretaceous
26	CARPATHIANS	0.38-0.51	23.0-38.5	3.9-34.3	15.91-21.77	Jurassic+Eocene

Explanations of symbols:

Ro random reflectance in oil, **Wt (maf)** - total moisture (ash free), **A (d)** - ash yield (dry),
Qs (maf) gross calorific value (moisture, ash free)

Artificial evolution by open system pyrolysis of a vitrinite presenting its reflectance suppressed

R. Zorroza[1], M.J. Iglesias[1], A Jiménez[2] and I. Suárez-Ruiz[1]

[1] Instituto Nacional del Carbón (CSIC), Ap. Co. 73, 33080 - Oviedo. Spain
[2] Université Louis Pasteur, CGS., 1 Rue Blessig, 67084 Strasbourg. France

The impregnation by oils taken place in a Kimmeridgian vitrinite (Asturian Jet composed of ulminite and phlobaphinite with reflectance of 0.39 and 0.72 % respectively) during the initial diagenetic stages of evolution modify its structure. It confers to this coal a special perhydrous composition, strong discrepancies between its rank parameters and it suppresses the reflectance of the ulminite. In order to investigate the influence of the mentioned impregnation during a further evolution, this coal was artificially evolved by means of an open pyrolysis system at temperatures ranging from 250 to 450°C. The artificial diagenetic series of vitrinite thus obtained was studied through petrographic and geochemical techniques.

Below 325°C, the most important process is the elimination of hydrocarbons. Some of these hydrocarbons derive from the incipient cracking of the vitrinite and other correspond to those introduced and retained inside ulminite porosity. This elimination produces a significant decrease in S_2 and a slight increase in ulminite reflectance. However, Tmax parameter and H/C, O/C atomic ratios undergo very little variations in the initial temperatures. The ulminite is only the component affected by the thermal increase at these stages.

Between 325 and 375°C the thermal degradation of the macromolecular structure affects the whole vitrinite. It is shown by the strong variation of all the physico-chemical parameters. In particular, the rank parameters increase significantly. At 375°C stage, optical differences between, ulminite and phlobaphinite disappear. Both vitrinite components show the same reflectance value. Furthermore, a development of significant porosity of variable size was observed. The results obtained suggest that the evolution of this vitrinite takes place inside the oil window up to the 350-375°C range of temperatures. This interval corresponds to the transition between oil window and wet gas zone. Therefore, the values of vitrinite reflectance and Tmax (1.35% and >465°C, respectively) for this transition are close to those described for natural series. On the other hand, the expulsion of hydrocarbons as well as the formation and expulsion of water explain a faster decrease in H/C than O/C atomic ratios.

In conclusion, the studied vitrinite presenting its reflectance suppressed, follows a specific evolution path inside the catagenesis which is different to that found in other artificial and natural series as a result of the presence of hydrocarbons inside its structure. Thus, coals which have been naturally impregnated by highly hydrogenated compounds (hydrocarbons) during the early diagenetic stages should retain these components during a further evolution. These materials are good fuels in the whole catagenetic process with a high calorific value and an important hydrocarbon potential.

Call for Nominations for the Rheinhardt Thiessen Award

Nominations are sought for candidates for the 1997 Reinhardt Thiessen medal award. The award is made for individuals who have made outstanding contributions in the field of coal or organic petrology. Any person of high standing in the field is eligible for the award; ICCP membership is not a prerequisite. Only Full Members of the ICCP may submit a nomination.

The award is made by the ICCP Council acting on the recommendation of the five members of the Thiessen Award Committee and will be presented at the 1997 ICCP meeting to be held in Wellington (New Zealand) in October. The Committee invites you to send your nominations to:

Dr. Alan Davis, Chairman of the Reinhardt Thiessen Award Committee,
Coal and Organic Petrology Laboratories,
105 Academic Projects Building,
University Park, PA 16802, USA
Fax: 1-814-865-3573.

Letters of nomination should provide the reasons for and justification of the proposal and must be received by **March 1, 1997** at the latest.

Alan Davis

Book Review

On the occasion of the 30th International Congress in Beijing (China) several books were printed dealing with different aspects of the geology of China. Two of them, connected with coal petrography and coal metamorphism shall be reviewed here.

JANG Jongkuan (Ed. in chief): Atlas for Coal Petrography of China. 321 pp, 111 plates (colour and black-and white photographs). China University of Mining and Technology Press, 1996.

The atlas is dedicated to the 30th International Congress held in August, 1996 in Beijing. As is known, it is the second case of publishing a regional atlas for coal petrography for an international geological congress. The first atlas was published in 1937 for the 17th IGC held in Moscow ("Atlas of Microstructures of USSR coals").

China is very rich in coal resources. Brown coal shares about 5 %, bituminous coal about 85 % (coking coal approximately 25 %) and anthracite about 10 %. At present the coal production in China is the largest of the world. The distinctive character of the coals is their occurrence in deposits of a wide age range - from the Lower Paleozoic to the Tertiary.

The "Atlas for Coal Petrography of China" consists of two parts: Fundamentals of coal petrography and petrography of coals formed during major coal-forming periods. A group of Chinese specialists managed to show in their fundamental work a remarkable diversity of coals in their country: Primary plant material, petrograpic composition, quality and conditions of deposition. The work is done on a modern level with the consideration of new methods for coal investigation. The high quality photos of coal microstructures show transmitted light pictures and fluorescence pictures in colour and reflected light pictures in black and white. The whole book is of a very high standard.

The Chinese text is accompagnied by a large introduction in English. The text to all plates is given in Chinese and English. The atlas is a considerable achievement in modern coal petrology and of great interest for petrographers and coal geologists in various countries.

I. B. Volkova

YANG Qi, (Ed. in chief) WU Chonglong, TANG Dazhen, KANG Xidong, LIU Dameng, PAN Zhigui, CHEN Jiniang, SU Yuchun, ZHUO Chunguang, LIU Gang and LUO Yingjuan: The Coal Metamorphism in China. 212 pp. 12 plates (colour and black-and-white photographs). China Coal Industry Publishing House, 1996.

The book is written in Chinese but contains additional the title-page, the table of contents (without page-numbers) and an abstract of five pages in English. Also the captions of the figures within the text and of the plates are translated in English. The review given here is basing only on these English informations.

Besides the introduction dealing with fundamentals of the tectonic setting of coal metamorphism in China, the types of coal metamorphism in China and the methods to study them, the book is subdivided in seven chapters. The first to fourth chapter describe the different sources of coal metamorphism (geothermal energy, telemagmatic heating, contact metamorphism, hydrothermal metamorphism). In chapter 5 the "thermal dynamics analysis of coal metamorphism in China" is given. Chapter 6 contains the description of the structural evolution of coal and the mechanism of coal metamorphism. Finaly in chapter 7 are summarized the different processes of "multistages metamorphic evolution and multiheat sources superimposed metamorphism of Chinese Coals."

The different types of coal metamorphism are seen as the result of the very complicated geotectonic history of China which is situated at the southeastern corner of the Eurasian plate. The main times of coal formation and tectonic activity are different in the different parts of this large country and recure from time to time. This makes the explanation of the recently occuring coal metamorphism so difficult.

The thermal dynamics of coal metamorphism are explained by numerous mathematical derivations, e.g. T/t diagrams, the influence of different heat conductivity of the sediments and other geological facts. These investigations allowed the modelling of the geological history of many coal basins whereby some anomalies as the "super-coalification of the Fushun basin" were discovered.

The structural evolution of coal was studied using different chemical and physical methods. The results are shown in a big number of chromatograms, histograms and other diagrams.

In general, the book seems to be a very good compilation of the modern knowledge about coal metamorphism in China. For foreigners the use of the book is very difficult because the English translations are too few. The comparison between the chapters within the book and the English list of contents is difficult because the page numbers in the list are missing. The translation of the captions of figures is too restricted. When the explanation of signs and signatures is not translated and the names of cities in the maps are not transcribed non Chinese speaking scientists are not able to understand the pictures. The same is true in view of the tables where in most cases the head lines are not translated.

The book was dedicated to the 30th International Geological Congress but the international spreading of it will be restricted by the reasons mentioned above, which is a great pity.

M. Wolf

ICCP-Handbook

The ICCP-Handbooks have been transferred to The Netherlands. They are available at the Geological Survey of The Netherlands. Please contact:

Dr. Willem Fermont
P.O.Box 126
NL-6400 AC Heerlen
The Netherlands
Tel.: ++31-45 561-6464
Fax: ++31-45 561-6461
e-mail: w.j.j.fermont@rgd.nl

Miscellaneous

A NOVEL STRATEGY FOR COLLECTING FOSSIL METEORITES FROM COAL

Andrew A. Sicree and David P. Gold

Pennsylvania State University, Department of Geosciences, University Park, PA 16802, (814) 865-6427
Internet: sicree@geosc.psu.edu

The recovery of ancient or "fossil" iron meteorites from coal is the focus of a research project recently begun by geologists at the Pennsylvania State University in State College, Pennsylvania, U.S.A. Electromagnets used at coal mines to pull "tramp" iron from the raw coal stream may also be collecting fossil meteorites. By examining the output of these magnets and by encouraging coal miners and coal geologists to do likewise, Penn State geologists Andrew Sicree and David Gold hope to find what may prove to be the world's oldest falls of iron meteorites.

Upon impact with the Earth's surface most iron meteorites begin to rust away rapidly, typically surviving only a few dozen years. In desert environments they may persist for several thousand years or so. Those which have been recovered from Antarctic ice may represent falls which may have occurred as early as 300,000 to one million years ago but their terrestrial ages cannot be greater than the age of the ice sheets themselves.

Meteorites have fallen on the Earth throughout geological time, but fossil meteorites (*i.e.*, those which have been preserved in sedimentary rocks and have geologically-old terrestrial ages) are quite rare. Only a few fossil meteorites are known and their discoveries have largely been matters of chance.

Henderson and Cooke (1942) report an extremely weathered octahedrite (*Sardis*) from Miocene sediments in Georgia although whether or not the meteorite fell during the Miocene is uncertain; the terrestrial age this meteorite was determined by C-14 methods to be in excess of 10,000 years (Buchwald, 1975). An iron meteorite reportedly was found during the drilling of an oil well in Eocene rocks in Texas but subsequently lost (Lovering, 1959). The terrestrial age of the *Ider* iron meteorite from Alabama has been estimated at 3.1 million years, and that of the *Tamarugal* iron meteorite from Chile at 2.7 million years (Buchwald, 1975). Yudin (1971) described relict chondrules of stony meteorites found in Mesozoic bauxites from the Ural Mountains. Thorslund and Wickman (1981) described a chondrite found in Middle Ordovician limestone from Brunflo, central Sweden, and Nyström, *et al.* (1988) reported a second chondrite from Ordovician limestones in the Österplana quarry at Kinnekulle, southern Sweden. These chondrites were heavily altered and were identified by means of relict chromite grains (Thorslund, *et al.*, 1984). An iron meteorite reportedly from Carboniferous rocks in Ukraine has been determined to be a fragment of the *Sikhote-Alin* meteorite by virtue of its chemical composition and by use of the cosmogenic radioisotope Mn-53 which gives a terrestrial age of less than 10 million years (Petaev, 1992). Most recently, a small, nickel-bearing meteoritic fragment thought to have fallen 65 million years ago has been recovered from a sediment core from the floor of the northwest North Pacific Ocean (Kerr, 1996).

The reduced state of coal leads us to suspect that iron meteorites may be preserved in coal seams in a relatively unaltered state. Examination of the Fe-S-H_2O phase diagram indicates that in the presence of sulfide an iron meteorite might become coated with a rind of pyrite which would inhibit alteration of the interior of the meteorite. Additional evidence that iron can survive in its native state exists. Although terrestrial native iron is rare in nature it has been found in large masses in basalts on Disko Island, Greenland (Palache, *et al.*, 1944), and it has been noted in coal at Cameron, Clinton County, Missouri (Allen, 1897). More recently, native iron has been reported in a Cretaceous coal from the Dutch Creek Mine in Pitkin County, Colorado, where it occurs within the coal seam at the coke-coal interface near a felsic porphyry dike intruding through the coal seam (Thorpe, *et al.*, in press).

By examining materials captured by large electro-magnets placed over conveyor belts at coal mines, one can search for fossil iron meteorites preserved in coal. Such equipment is quite expensive but, fortunately, many coal mines already have such magnets installed in order to remove "tramp iron" from the coal stream before it reaches their primary crushers. These electromagnets are highly efficient: some are capable of recovering a peanut-sized fragment of iron from beneath two feet of coal on a rapidly moving conveyor belt. In effect, coal mines already have the equipment in place to recover iron meteorites and have been doing so for years, but the output of these magnets has not yet been examined.

Estimates of the present-day flux of meteorites vary over four orders of magnitude, but most range from 100 to 1000 metric tons of meteorites per day for the whole of the Earth's surface, about 1% of which is recoverable "macro"-meteorites (Parkin and Tiles, 1968; Ceplecha, 1992). Using the lower figure, one can calculate an average macro-meteorite flux of 7.2×10^{-7} grams per square meter per year.

Estimates of the rate of coal accumulation indicate that a meter-thick seam of coal represents 1000 to 10,000 years of history. If a coal accumulated at the rate of 0.1 mm/year, the above macro-meteorite flux can be used to calculate amounts of meteorites in a typical coal seam, assuming that present-day fluxes applied to the past. Thus, one would expect to find about 100 grams of macro-meteorites in every 16,000 short tons of coal. If only 5% of these meteorites were strongly magnetic (*i.e.*, iron, or stony-iron meteorites rather than much less magnetic stony meteorites), then every million short tons of coal should yield about 300 grams of recoverable magnetic macro-meteorites, assuming a 99% efficiency in recovery by the tramp iron magnets.

For example, in a large Pennsylvania, U.S.A., coal processing plant such as the Keystone Coal Processing Facility in Armstrong County which moves about 3.4 million tons of coal annually, recovery of about 1000 grams of magnetic macro-meteorites per year is possible. A large Western U.S.A. coal operation such as the Black Thunder Mine in Wyoming which moves about 36 million tons of coal each year could be expected to yield more than 10,000 grams of magnetic macro-meteorites per year. These calculations only give a rough estimate of the amounts present. Actual amounts of meteorites recoverable from coal seams could vary by as much as a factor of one hundred in either direction depending on factors such as the geochemical reactivity of iron-nickel and variations in meteorite flux throughout geologic time.

The Meteorite Recovery Project (MRP) aims to find fossil meteorites in coal and involves the cooperation of scientists from a variety of disciplines. The MRP team is headed up by Mr. Andrew Sicree, a Ph.D. candidate in geochemistry and curator of the Penn State Earth & Mineral Sciences Museum, and Dr. David P. Gold, professor of geology and an expert on meteorite impacts. Other project personnel include Dr. Alan Davis, director of the Coal and Organic Petrology Lab in Penn State's Fuel Sciences program, Dr. Paul Howell, a metallurgist and expert on iron meteorites, Dr. Mark Klima, professor of mineral processing, and several undergraduate students in geology and mineral engineering at Penn State University. Project funding has been provided by the U. S. Government's National Aeronautical and Space Administration (NASA) and by the Earth & Mineral Sciences Museum at Penn State University.

HOW COAL MINING PROFESSIONALS AND COAL GEOLOGISTS CAN HELP FIND FOSSIL METEORITES

Recovery of fossil meteorites promises to expand our knowledge of the history of the solar system by allowing scientists to study meteorites which fell to Earth hundreds of millions of years ago. Assistance in the search for fossil meteorites is sought from coal miners, mine managers, coal geologists, and all other coal mining professionals.

If you work at a coal operation which has tramp metal magnets on-line, set up a bin to save all materials caught on the magnets. Discard any obviously man-made objects and save any unknown metallic or rock-like particles. Send these objects to the Meteorite Recovery Project for analysis. A fossil meteorite may not look very much like a meteorite - it may be heavily corroded. Coal mining professionals are encouraged to send any and all unknown materials to:

The Meteorite Recovery Project

c/o Penn State University Earth & Mineral Sciences Museum, 122 Steidle Building, University Park, PA 16802 USA

For additional information about this project or to receive posters describing the search for fossil meteorites which can be posted on company bulletin boards, please contact Andrew Sicree at the above address or call (814) 865-6427. Your assistance with this effort is greatly appreciated.

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Andrew A. Sicree, July 7, 1996

Imprint

Editorial management:
Dr. Monika Wolf
Mergelskull 29
47802 Krefeld
Germany
Fax: +49-2151-561169

Layout:
T. Gleu, Aachen
R. Wuropulos, Aachen

Regional coordinators:

Australia/New Zealand:
Dr. R. Sykes
Institute of Geological & Nuclear Sciences
PO Box 30368
Lower Hutt
New Zealand
Fax: +64-4-5695016
email: SRLNOS@LHN.GNS.CRI.NZ

Southeast-Asia, Japan:
Dr. A. Cook
Keiraville Consultants Pty. Ltd.
7 Dallas Street
Keiraville, N.S.W. 2500
Australia
Fax: +61-42-299624

China:
Dr. Wang Jie
China University of Mining & Technology
Xuzhou, Jiangsu 221008
People's Republic of China
Fax: +86-516-888682

North America:
Dr. St. Bend
Department of Geology/E.R.U.
University of Regina
Regina, Saskatchewan O82 S4S
Canada
Fax: +1-306-5855205

South America:
Dr. C.V. Araujo
Petrobras - Cenpes Divex/Segeq
Cidade Universitaria
Ilha do Fundao, Quadra 7
21910 Rio de Janeiro, RJ
Brazil
Fax: +55-21-5986799

South Africa:
Dr. R. Falcon
Falcon Research Laboratory
P.O. Box 41086
Craighall 2024
Johannesburg
Republik of South Africa
Fax: +27-11-8839611 or 4843193

Europe:
Dr. Monika Wolf
Mergelskull 29
47802 Krefeld
Germany
Fax: +49-2151-561169

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