ICCP COMMISSION III

Report on Self – heating of coal and coal wastes working group

2013 Round Robin Exercise

65th ICCP Meeting, Sosnowiec, August 25-31, 2013

Convenors:
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The aim of the Self-heating Working Group:

- to gather examples of various forms of transformation of organic matter in coal and coal wastes of various rank
- to establish a classification of transformed organic particles (weathered and thermally altered) in coal wastes that will reflect the complex conditions in the waste dumps.

Past activity:

- The SH WG was established during the 62nd ICCP Meeting in Oviedo (2008) and information about it was published in the ICCP News Letter No. 45, 2008.
- Four Round Robin Exercises were carried out in 2009, 2010, 2012 and 2013.
- Discussion on the established terminology took place during the 63rd ICCP Meeting in Porto in 2011.
- Discussion on HOW to present the form that has to recognized took place during the 64th ICCP Meeting in Beijing in 2012 and by e-mails after the meeting.

Factors influencing the morphology of organic particles in coal wastes:

- Internal factors: maceral composition, rank of organic matter
- External factors: heating rate, end heating temperature and time, access of air and moisture, shape of the dump

Difficulties with therminology in previous Round Robin Exercises:

- coke or char
- unaltered particle and paler in colour particle
- cutinite and bitumens

Current problems:

- how to present the form that has to be recognized (using a square marking a field within particle or cross hair or arrow or another way?),
- should we still give reflectance of the particles?
- should we modify the present classification?

How to present the forms???

1. An arrow for specific forms to be classified (e.g. devolatilization vacuoles, microfractures, cracks,...)
2. A square to the forms that need to be classified considering the whole particle (e.g. paler and darker in colour particle).

How to present the forms???

In my view the impact of the Self Heating is on "particle" level hence I describe the particles. I think that a cross hair should point the observation point, but as I describe the "particle", it doesn't really matter if it is a cross or arrow etc…

If it is a square then we are introducing a similar to "microlithotypes" concept, which might be also useful. **But then what will be the dimensions of the square?**

Classification of forms in self-heated coal wastes

The problem with the current classification particularly in the categories “Appearance” and “Structure” is that they are a bit descriptive and not prescriptive,(prescriptive as quantified, e.g. the char classification (e.g. Bailey et al 1990, in Fuel vol. 69).

Therefore, this descriptive mode is making the point under observation (cross hair or arrow) to be of importance.

If we have some categorization based on vol - % of the “Appearance” or “Structure” categories then we could be able to apply these % on the “particle” level.

e.g. a particle that has a 5% of an oxidation rim, but the cross hair is on the unaltered part, still will be classified as “altered particle with an oxidation rim”.

Classification of forms in self-heated coal wastes

For cracks and microfractures a “frequency criteria” could be established, e.g. number of cracks-fractures per dimension (and perhaps for this the use of a “square” would be more appropriate).

And definitely will be good to define “quantitatively” what “massive” and “devolatilization pores” denotes. (Perhaps introducing a similar categorization as per Bailey et al., 1990??).

Finally, I think that the classification should be open to the “right” to the “Maceral terminology” as well as to the “Char Terminology”.

Participants of 2013 Round Robin Exercise:

- Kimon Christanis
- Deolinda Flores
- James Hower
- Johan Joubert
- Stavros Kalaitzidis
- Manuela Marques
- Georgeta Predeanu
- Sławomira Pusz
- Dragana Životić
- Nikki Wagner
- Ivana Sýkorová
- Isabel Suárez-Ruiz
- Joana Ribeiro
- Sandra Rodrigues

2013 Round Robin Exercise:

- 32 photos were selected representing transformed organic matter in coal wastes undergone self-heating processes.
- The rank of unaltered organic matter was 0.6-0.7% Rr.
- Reflectance values of transformed organic matter were given in the photos as Rr or Rmax.
- Participants were asked to distinguish the forms of transformed organic matter positioned under cross hairs.

Coal waste dumps in Lower Silesian Coal Basin

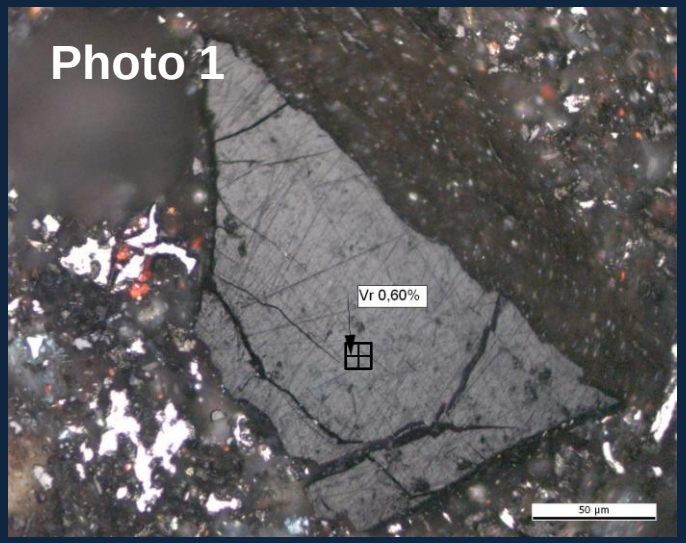
The 2011 classification of tranformed organic matter in coal wastes:

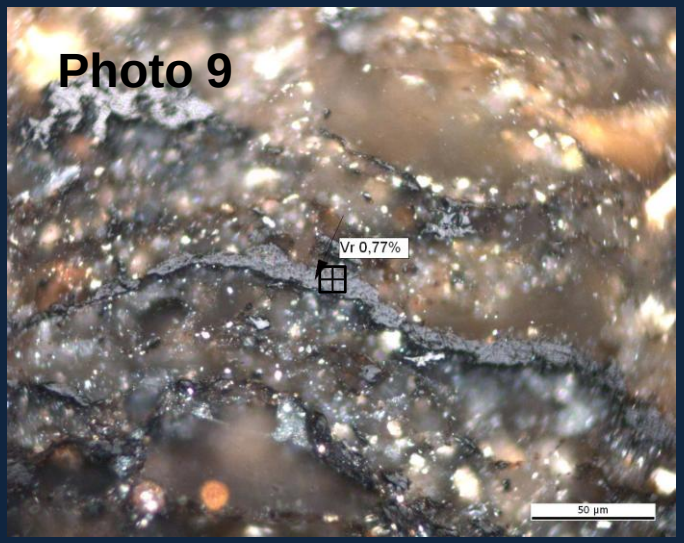
1. Unaltered particles
2. Altered particles
    1. Appearance: cracked and microfractured, oxidation rims (paler and darker in colour), plasticized edges, bands, paler in colour particle
    2. Structure: massive, devolatilization pores
    3. Texture: isotropic, anisotropic
3. Newly formed particles
    1. Pyrolytic carbon
    2. Bitumens

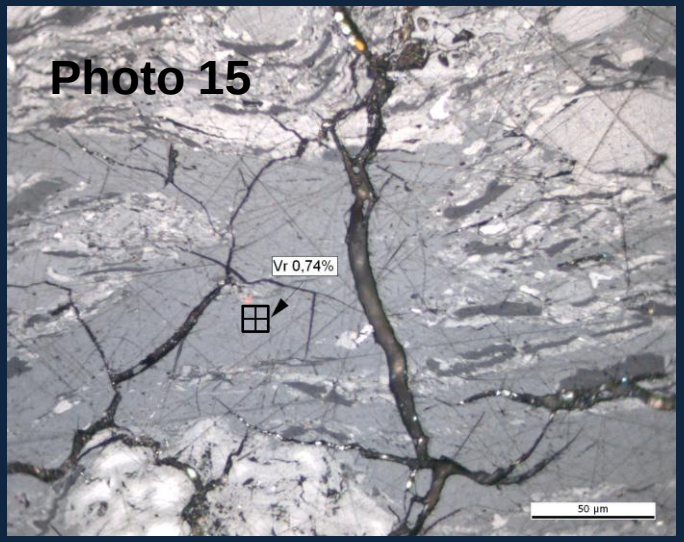
Comments from participants:

- to identify the whole particles or/and the form under cross hairs?

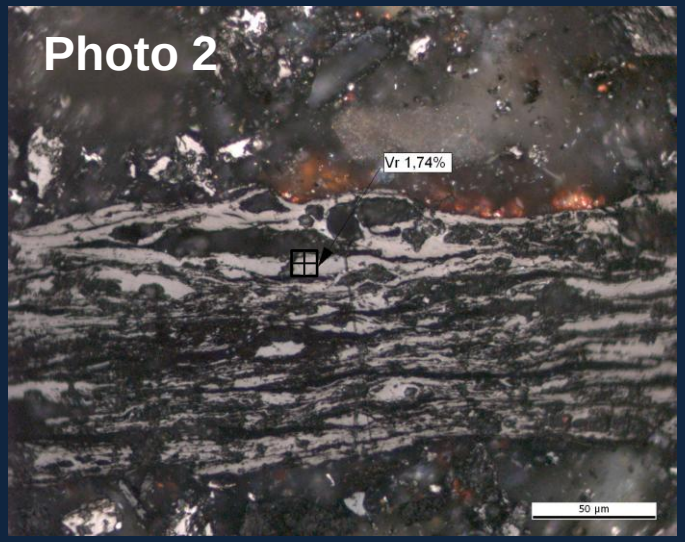
Examples of particles that were properly recognized - unaltered particles

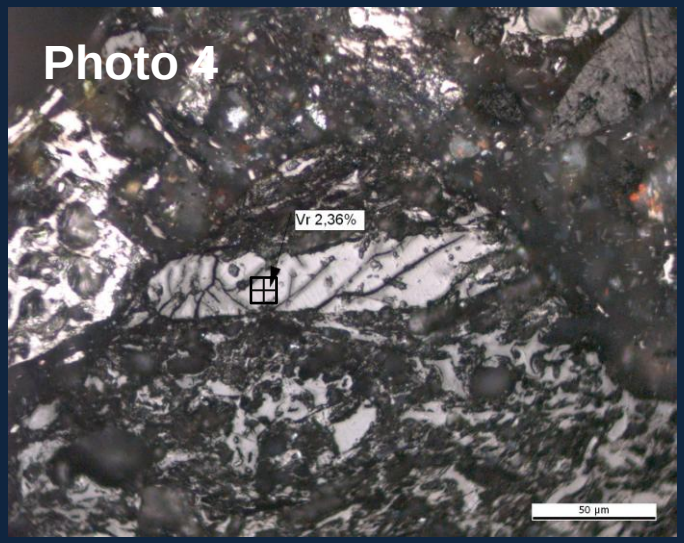


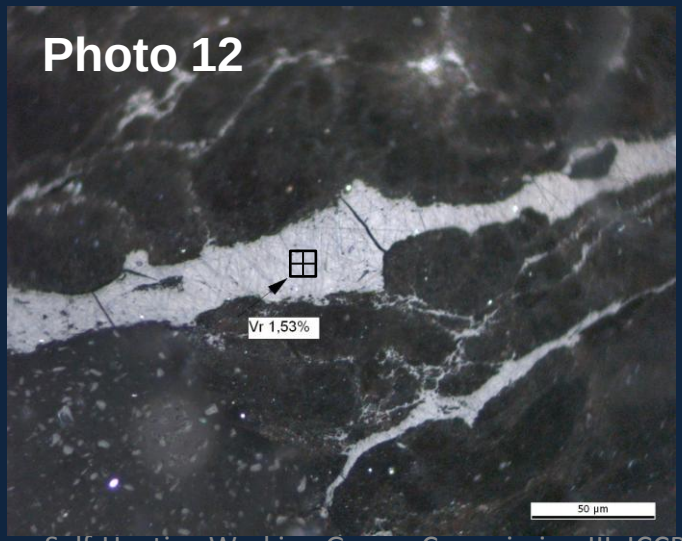




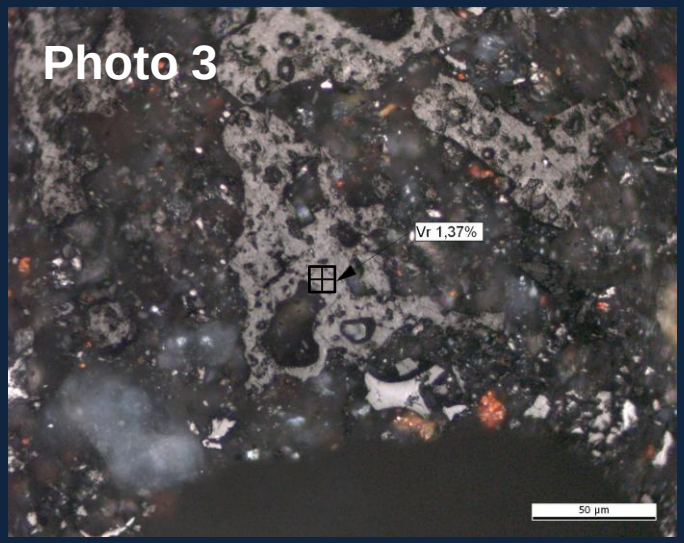
Examples of particles that were properly recognized – isotropic paler in colour particles

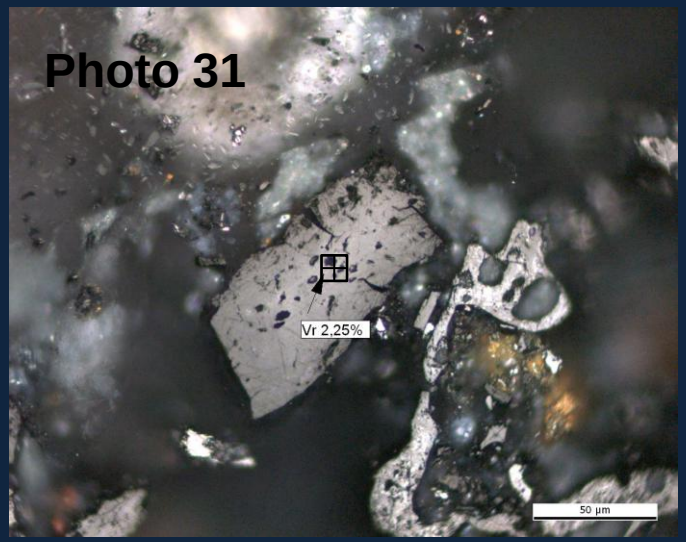




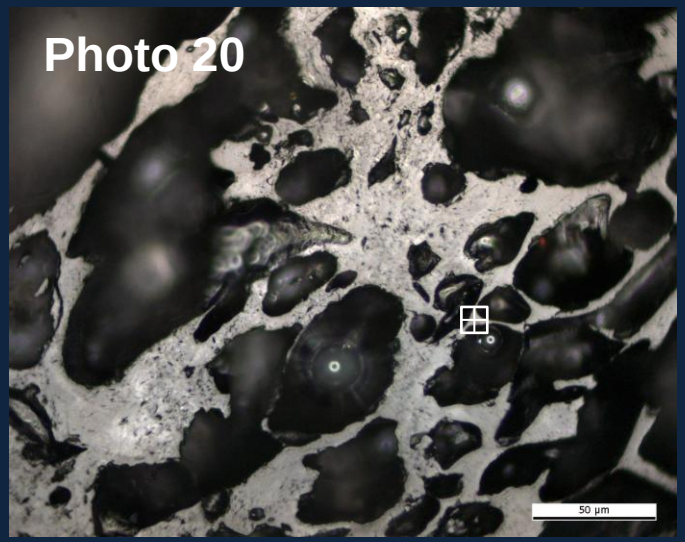


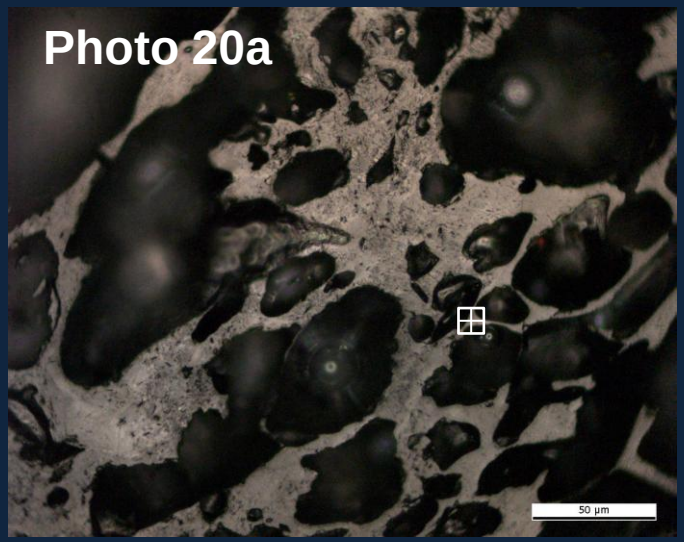
Examples of particles that were properly recognized – isotropic porous paler in colour particles





Examples of particles that were properly recognized – anisotropic paler in colour particles with devolatilisation pores





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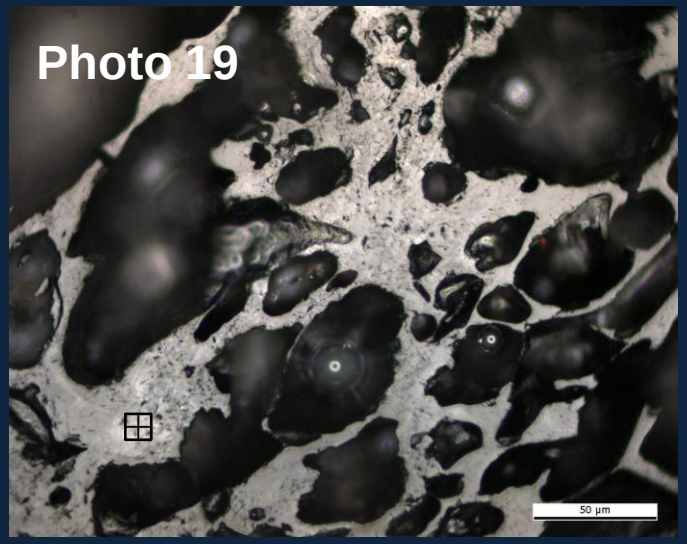
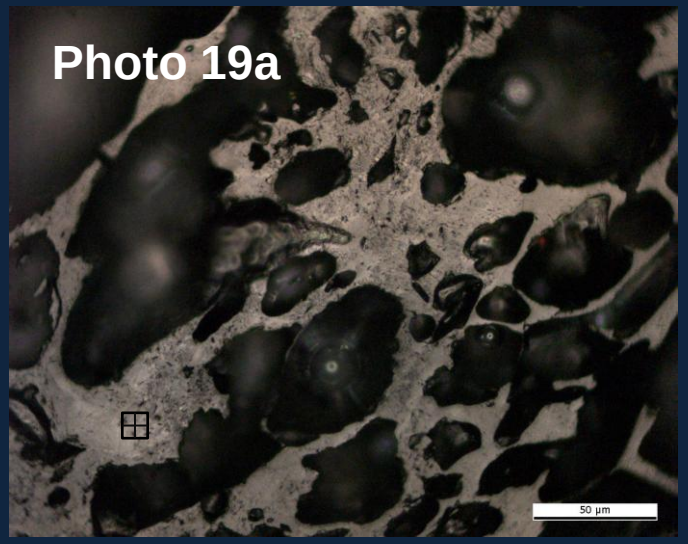
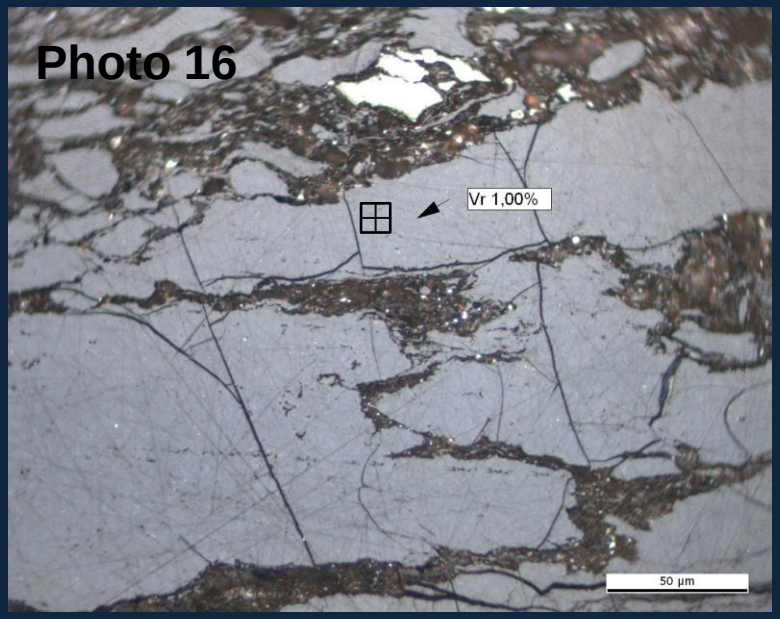
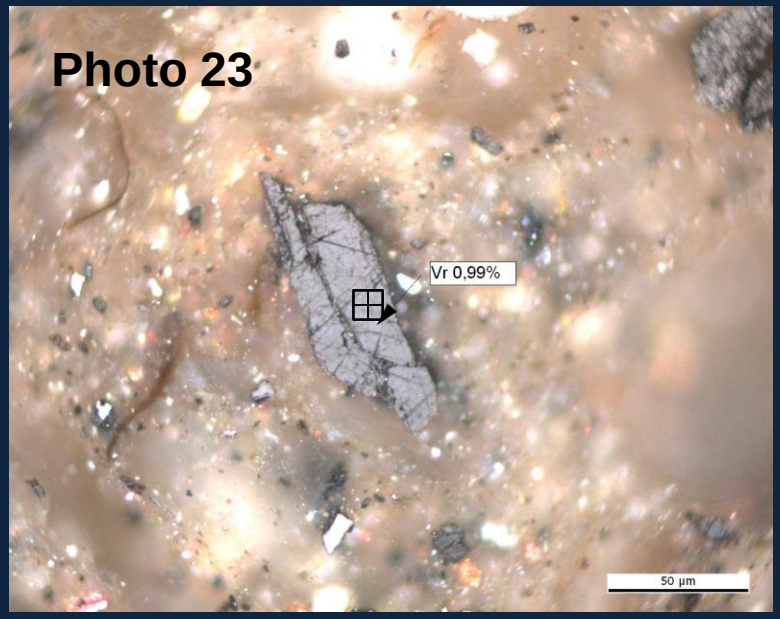




The most troublesome forms





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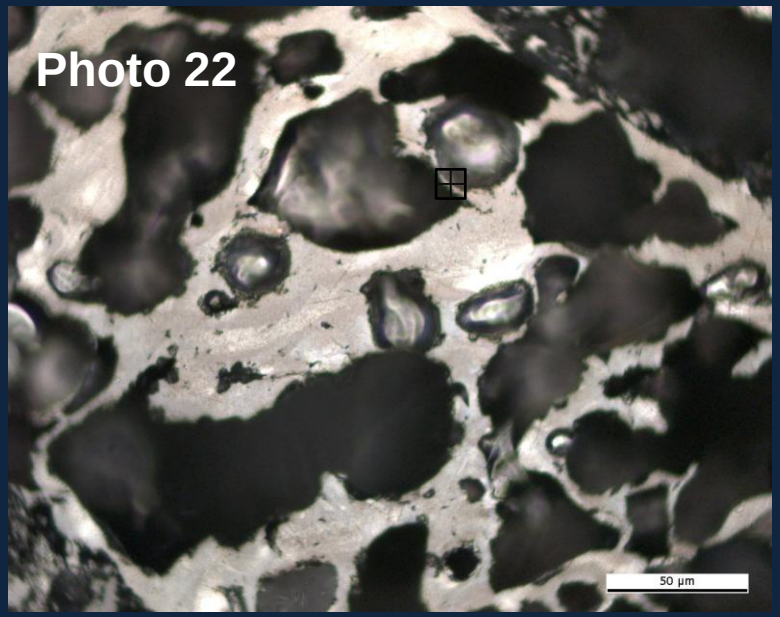

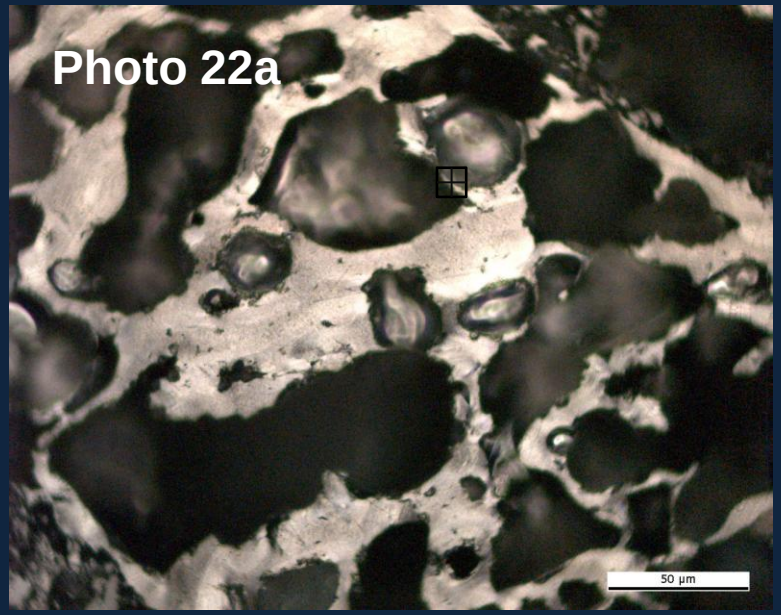

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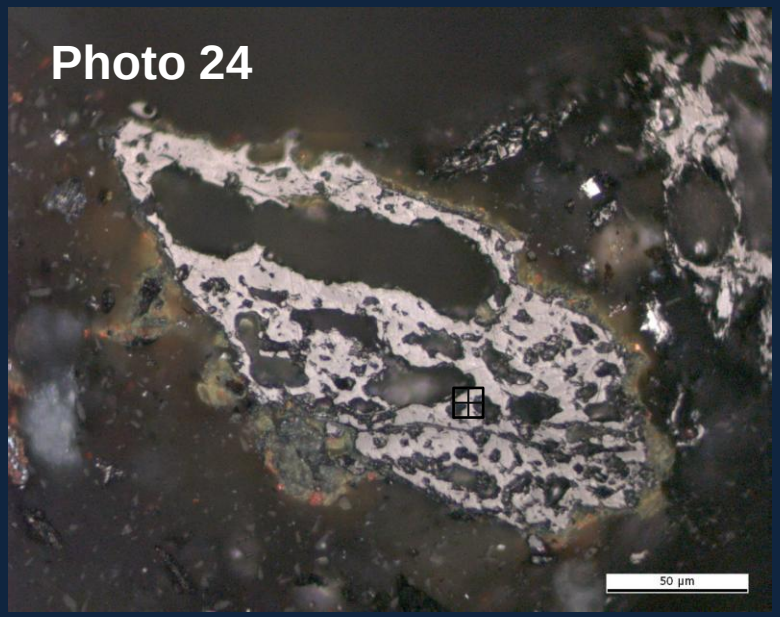

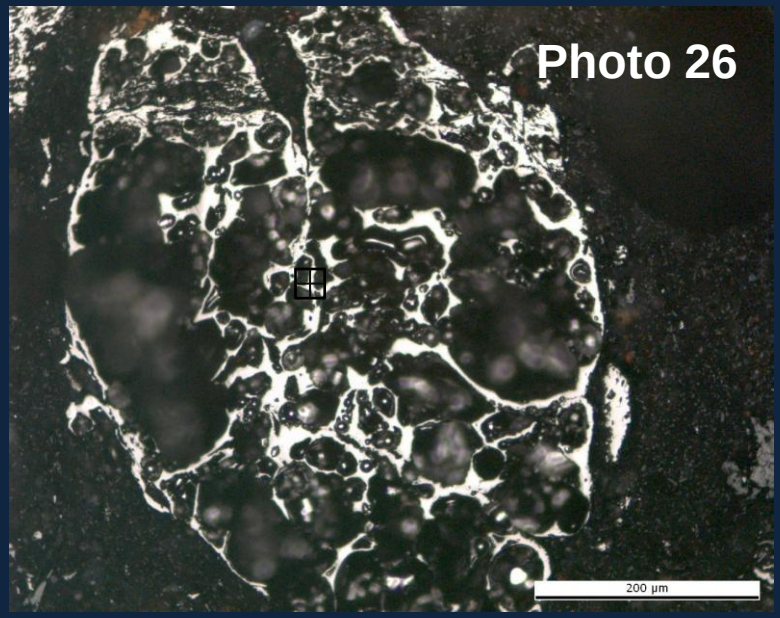

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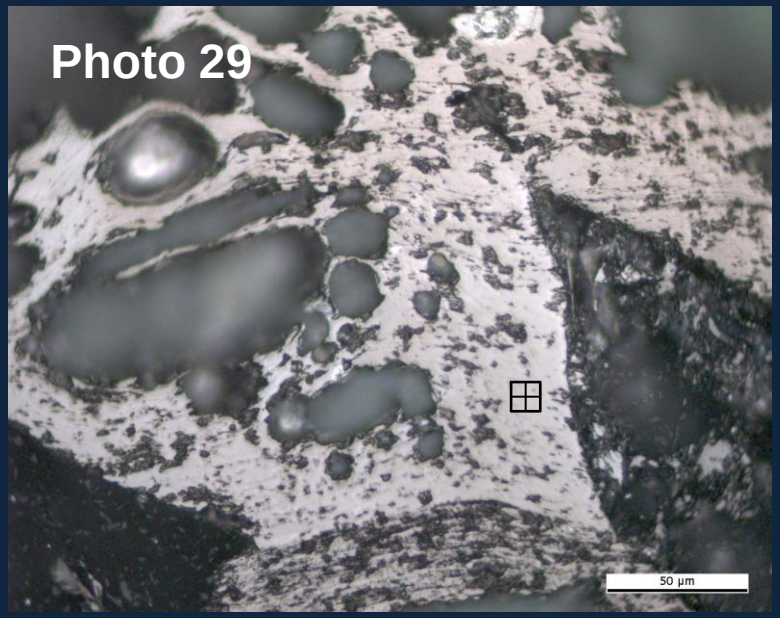
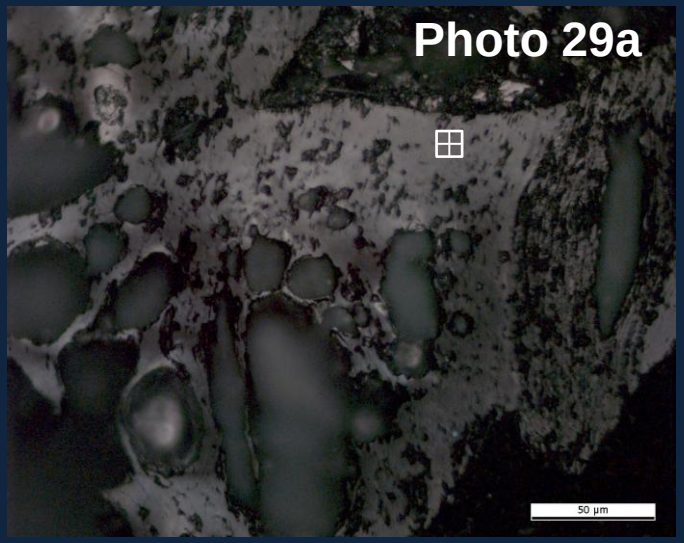




Problems that arose:

in case of altered particles, not all participants marked all the three categories, i.e. appearance, structure and texture

the most troublesome were taken in polarized light with analyzer

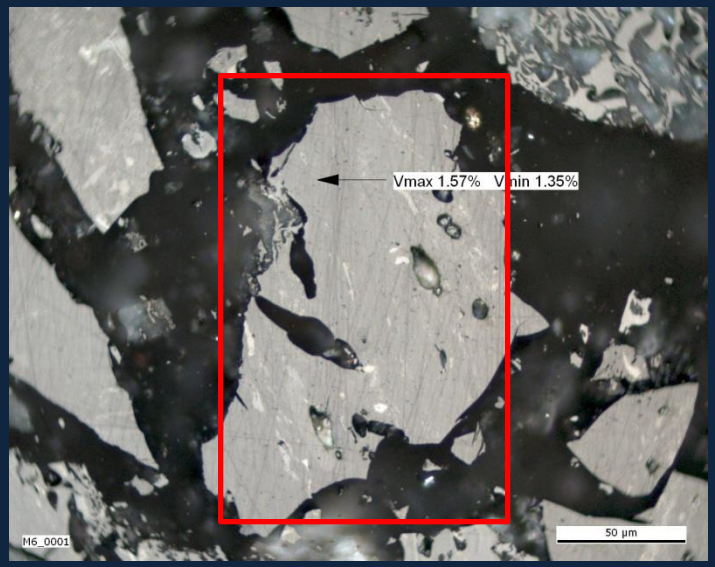
Discussion

- how to present the forms?
- what about our classification?
- can we now publish results? or we better modify classification, have one more Round Robin Exercise and.... publish?

How to present the forms?

Square for particle surface <u>area</u> such as:

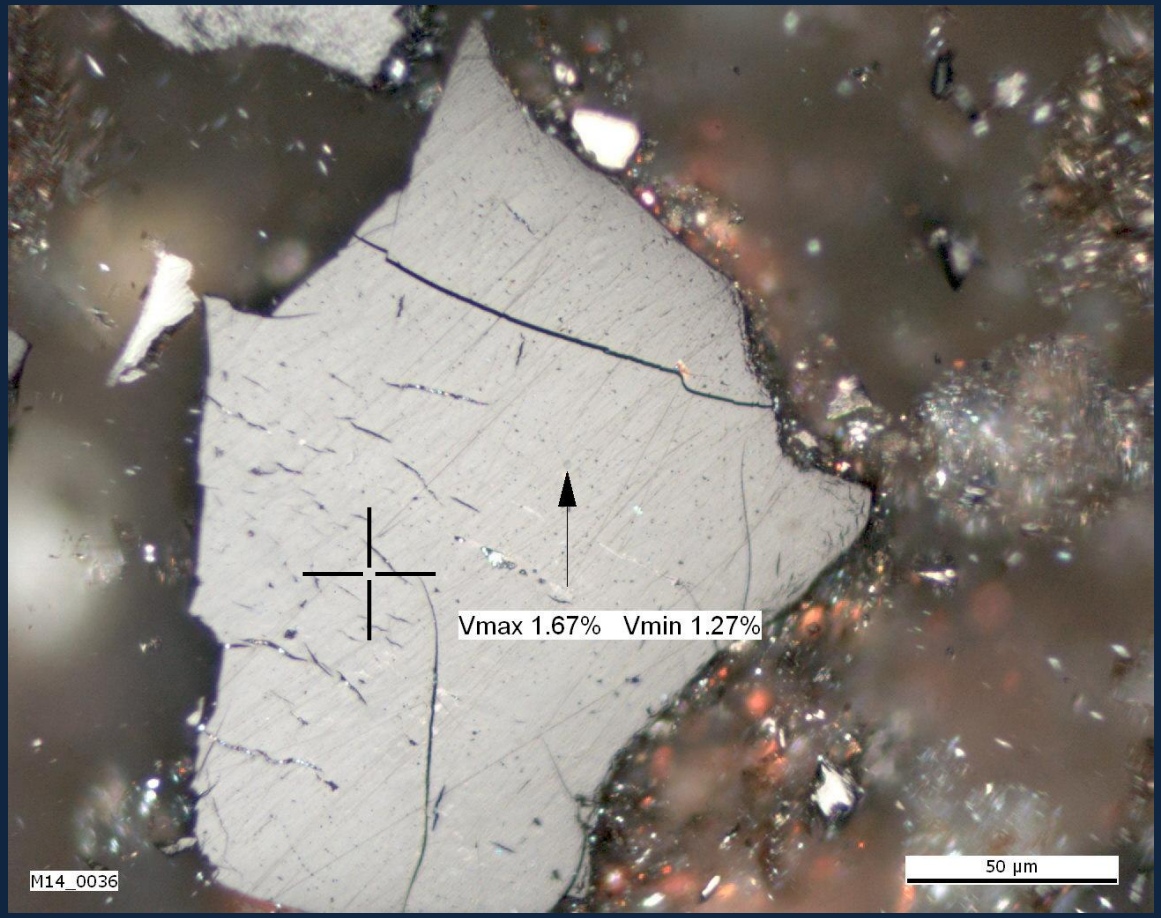
- **structure**
- **texture**



Cross-hair for <u>point specific</u> forms such as:

- **devolatilisation pores**
- **cracks and microfractures**
- **oxidation rims**

How to present the forms?



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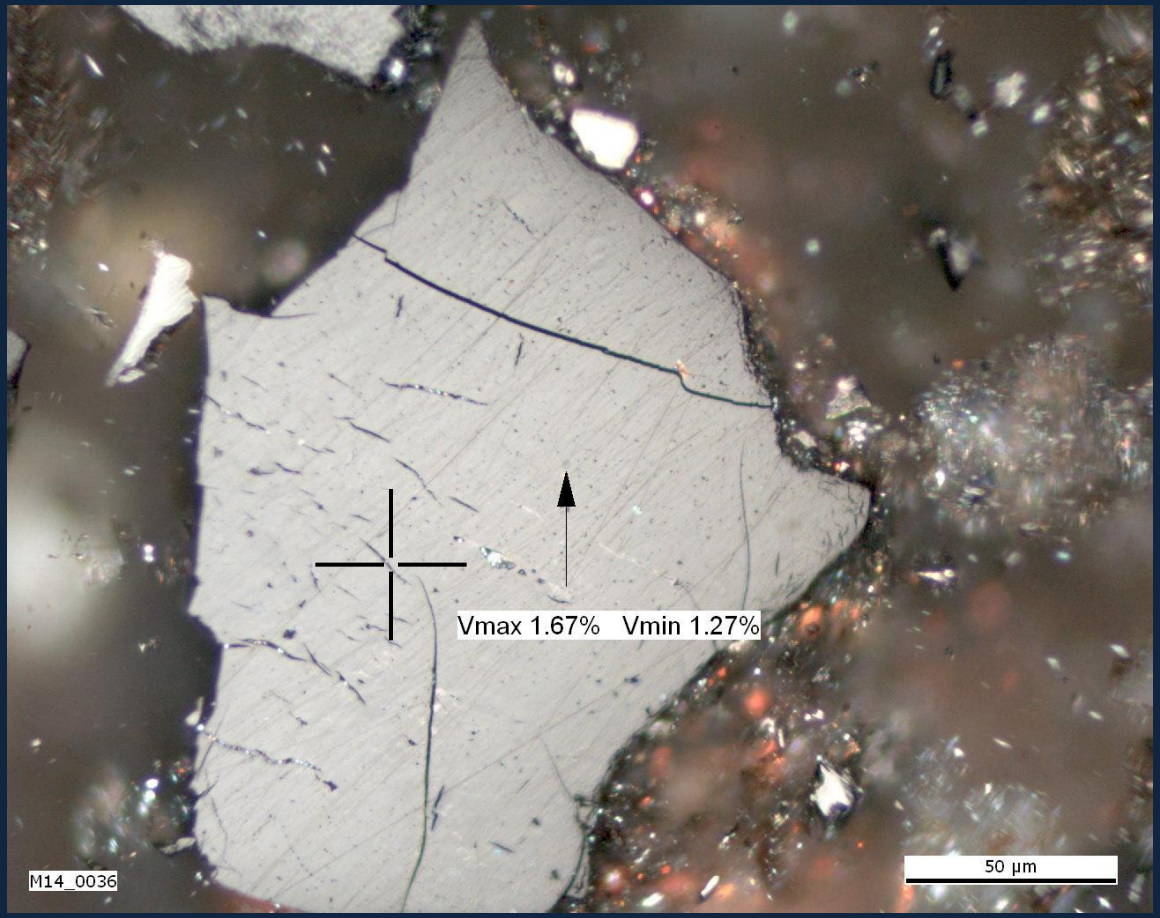

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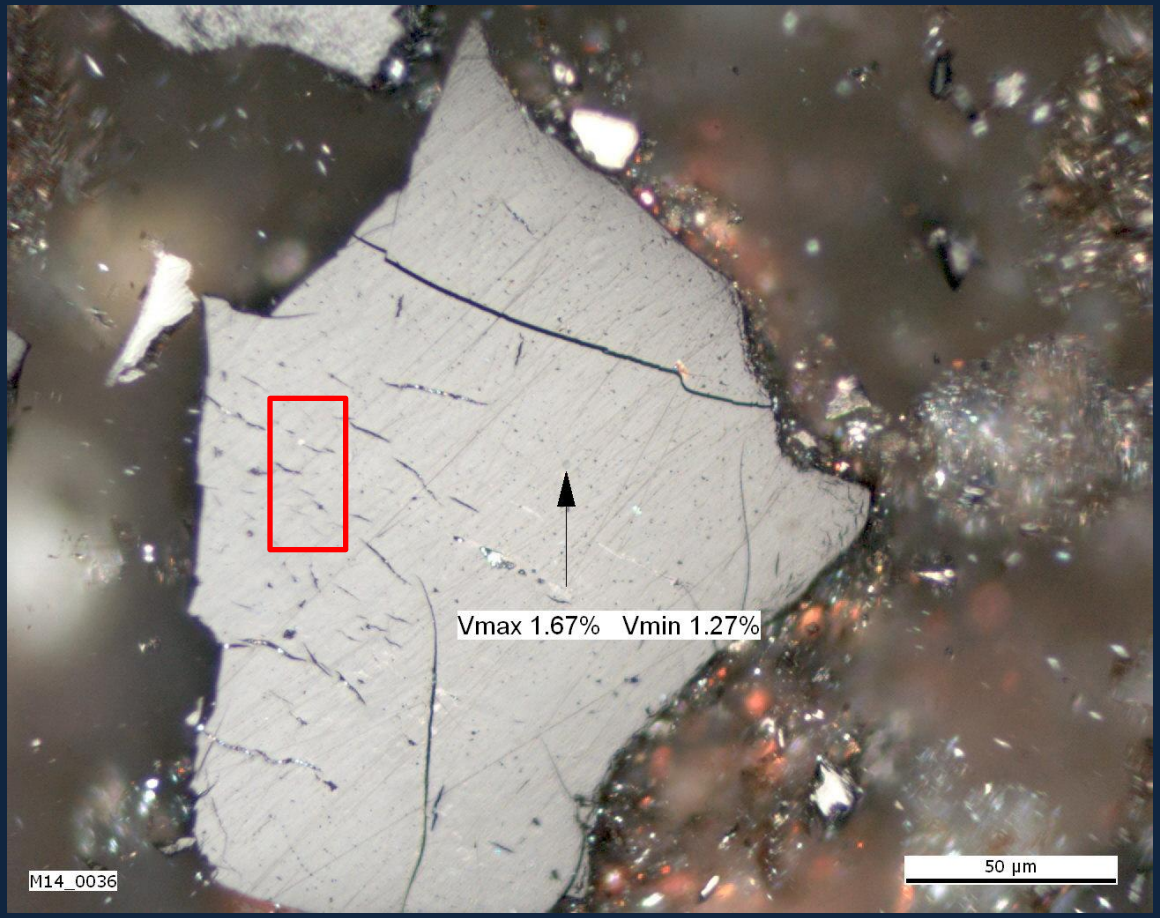

Conclusions from the exercise:

- The results obtained this year were good and proofed that giving the vitrinite reflectance is necessary to differentiate between thermally altered and unaltered organic matter.
- The difficulty was of a technical nature: how to mark the form

Future activity: