ICCP COMMISSION III

Self – heating of coal and coal wastes working group

2011 Report

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63rd ICCP Meeting, 10-16.09.2011 Porto

UNIWERSYTET ŚLĄSKI W KATOWICACH

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The aim of the Self-heating Working Group:

- to establish an internationally accepted classification of various morphological forms of transformed organic matter

Burning dumps

Conditions for self-ignition in coal wastes:

- The presence of organic matter
- The access of air into the dump
- Accumulation of heat within dump

Conditions influencing self-heating processes within dump:

- Internal : maceral composition of organic matter, its rank, moisture content
- External: shape and size of the dump, particle size and distribution, their fractionation

Cathegories of transformed organic matter in coal wastes 2010 Classification

1. **Altered particles :**
    a. Cracks and microfractures
    b. Oxidation rims (paler and darker in colour)
    c. Plasticised particles:
        i. particles with porosity connected with devolatilisation and particles with porosity connected with the original maceral structure
        ii. particles with plasticised edges
    d. Bands
    e. Particles paler in colour

f. Coke (massive: isotropic, anisotropic; porous isotropic and anisotropic coke, and detritic coke)
g. Inertinite

2. **Newly formed particles**
   a. Pyrolytic carbon
   b. Natural chars
   c. Bitumens
3. **Unaltered particles**

Main problems with classification:

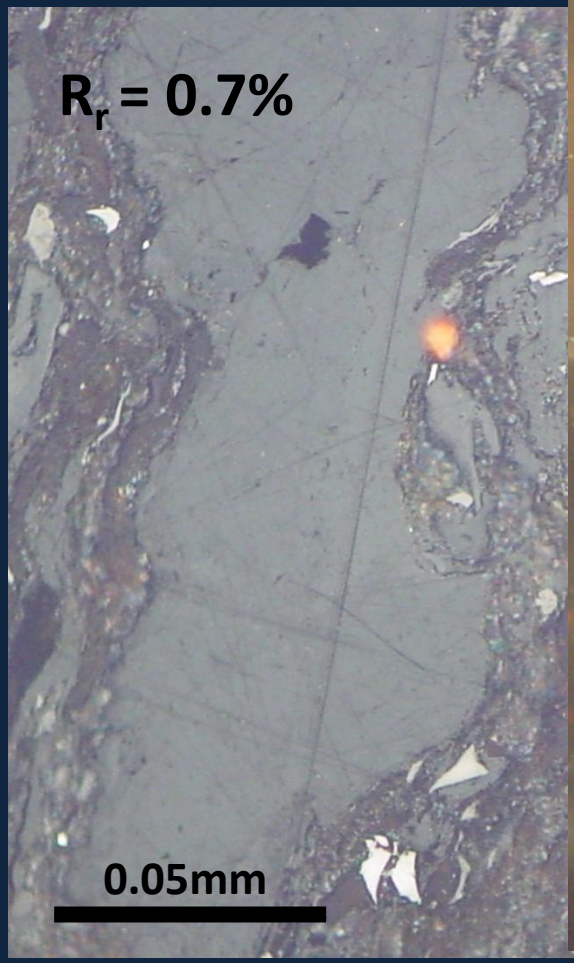
- Unaltered particles v paler in colour particles
- Unaltered liptinite v bitumens
- Coke (?)

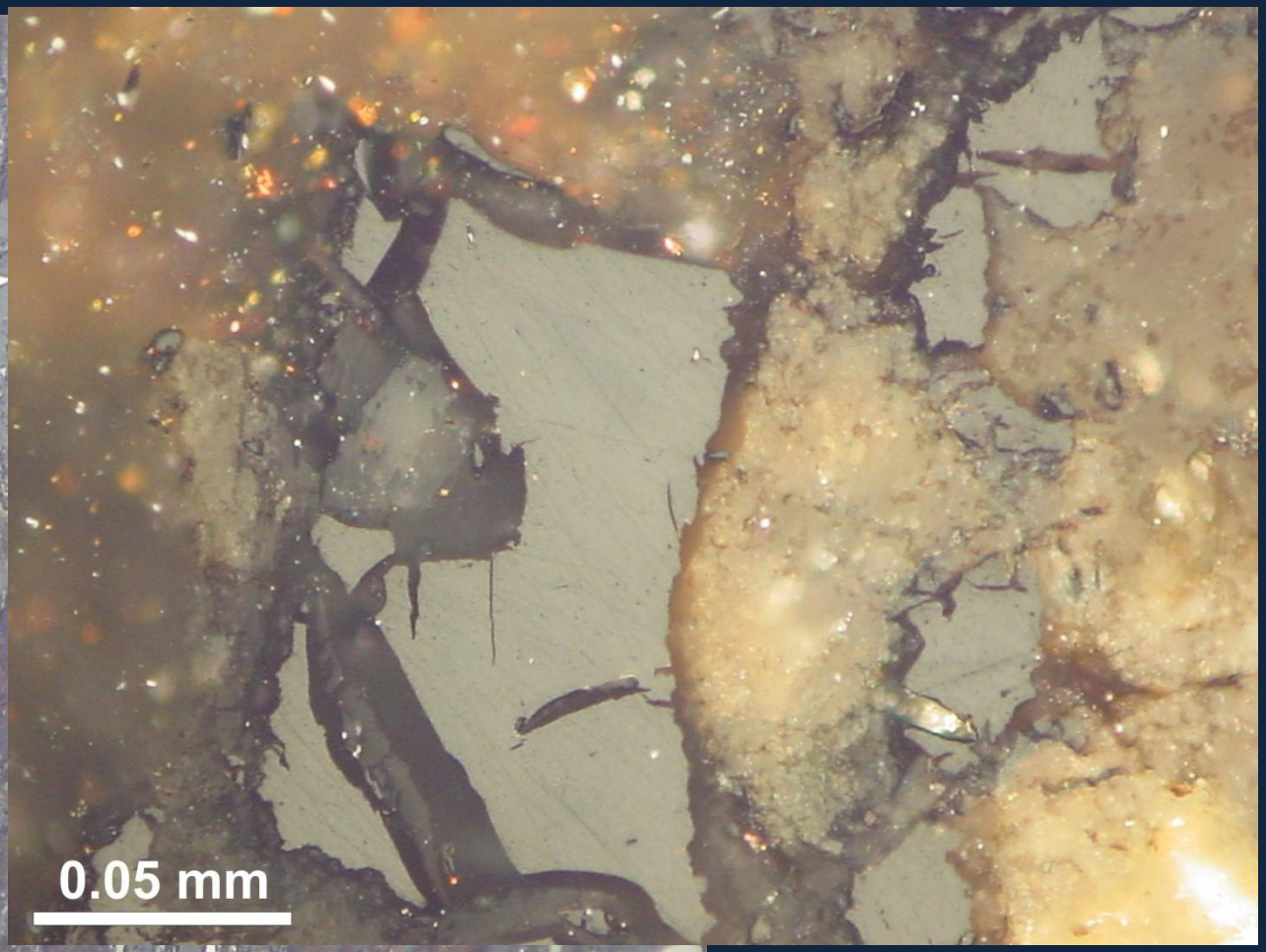
Unaltered particles v paler in colour particles

Unaltered particles - macerals of vitrinite, liptinite and inertinite group that were not altered by self-heating processes

Paler in colour particles - particles, commonly vitrinite, sometimes liptinite, that colour is paler and reflectance higher comparing to the parent coal

Unaltered particles v paler in colour particles - examples





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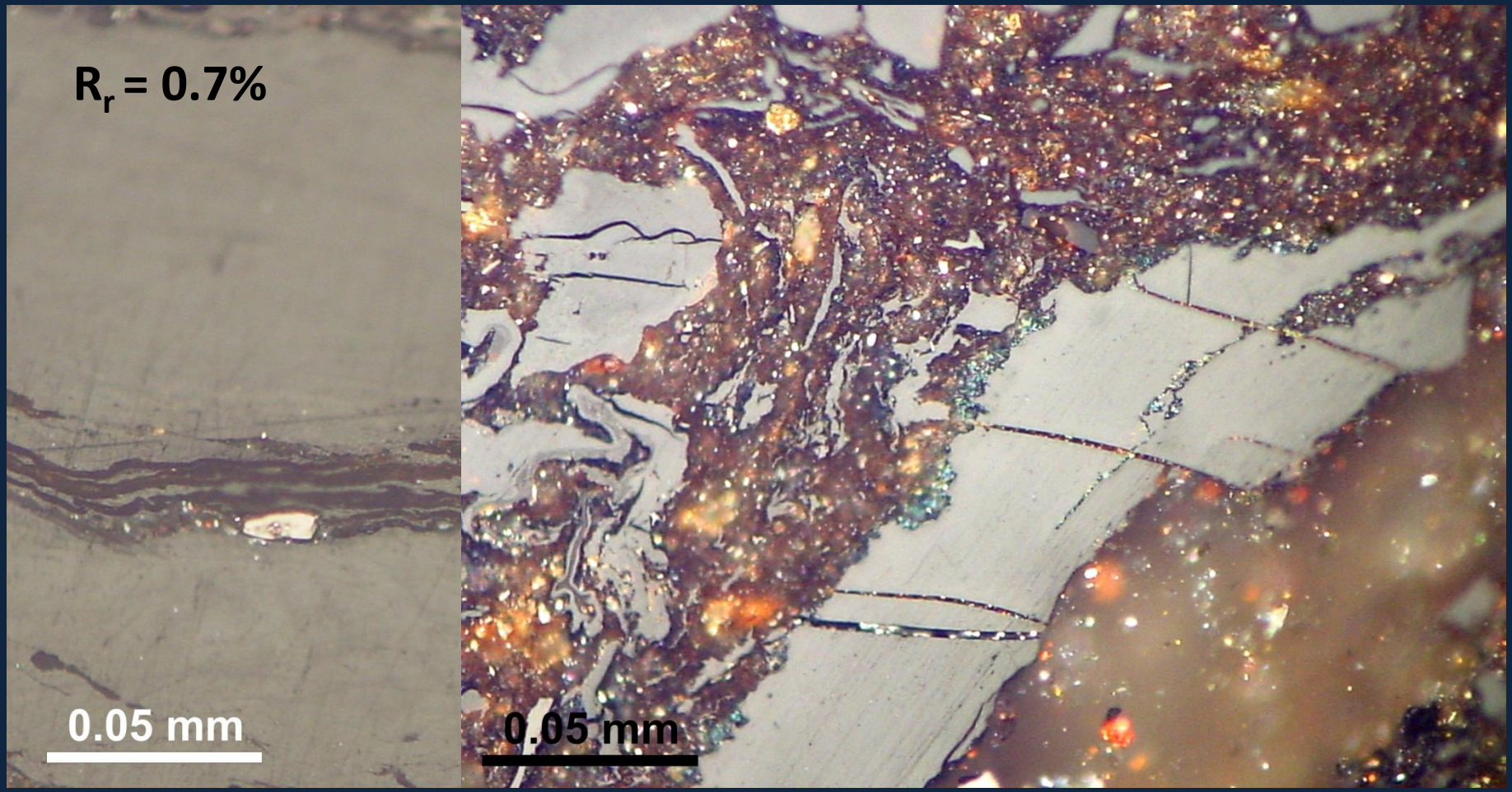

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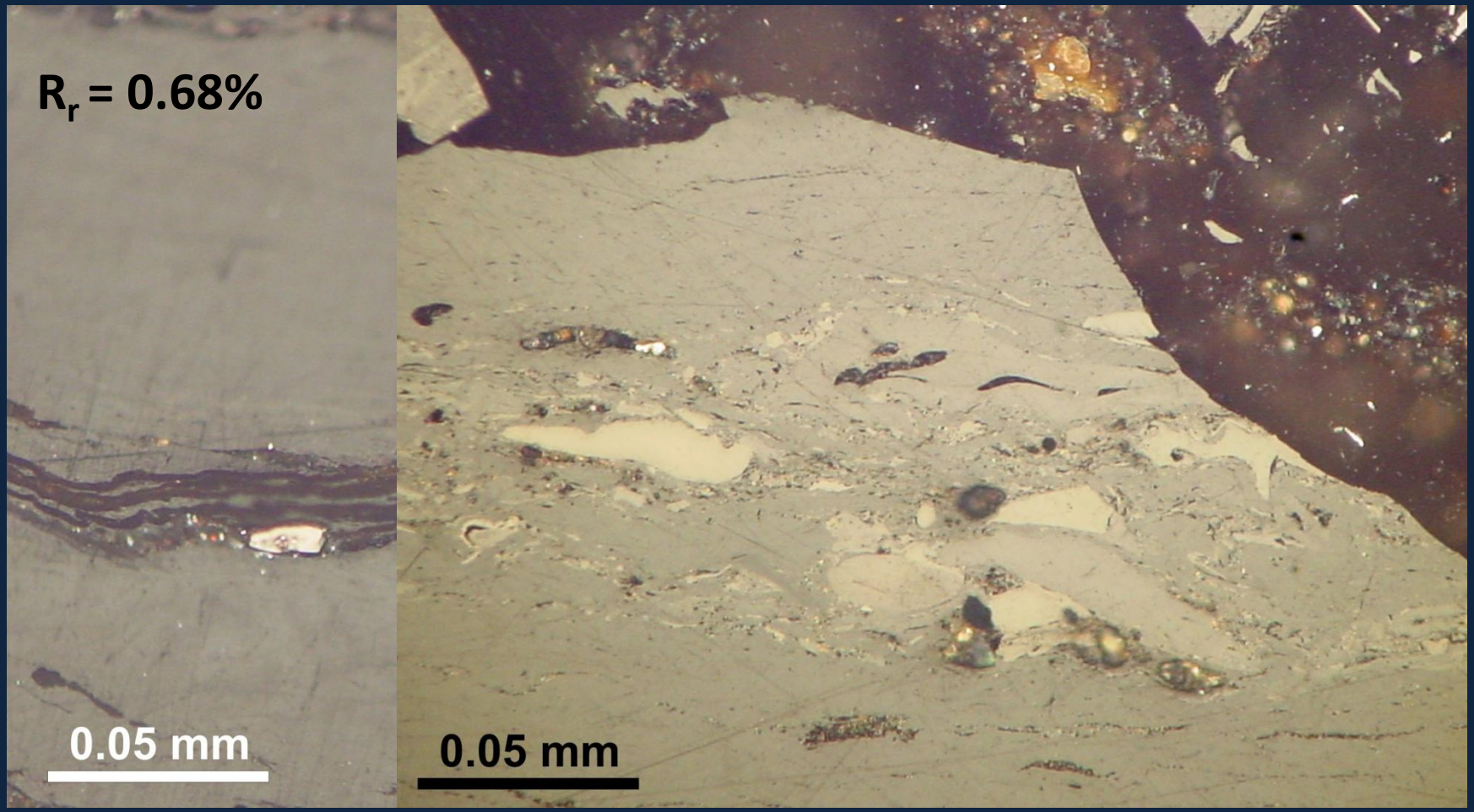
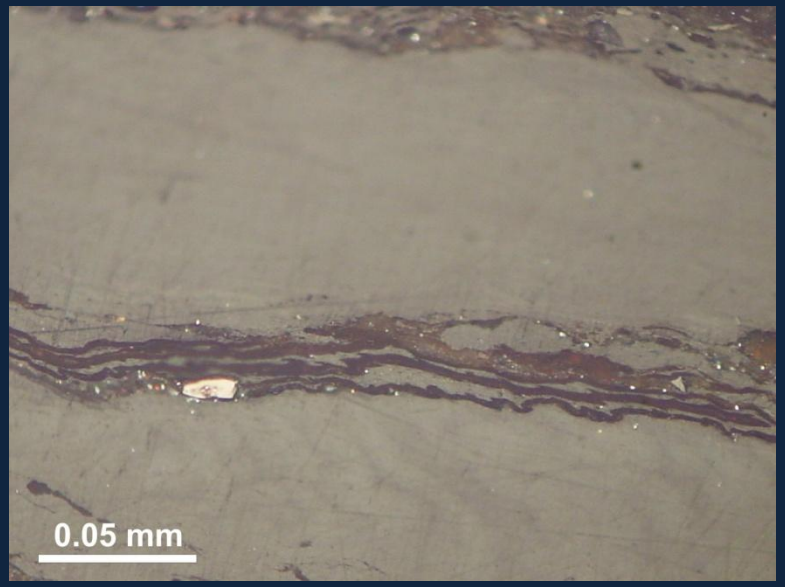


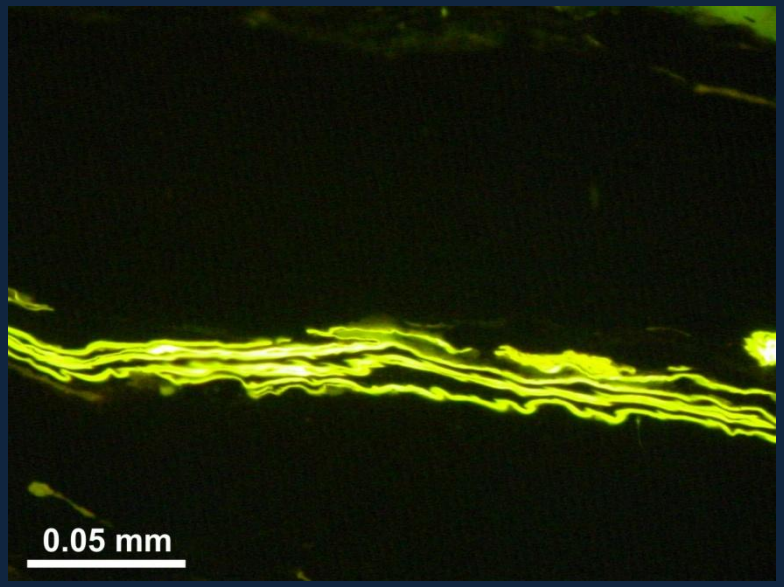
Unaltered liptinite v bitumens

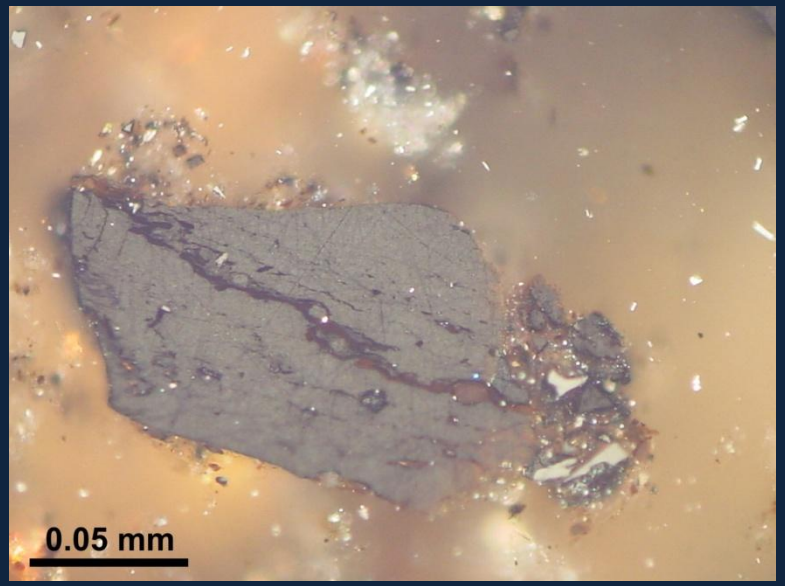
Unaltered liptinite - macerals of liptinite group that were not altered by self-heating processes

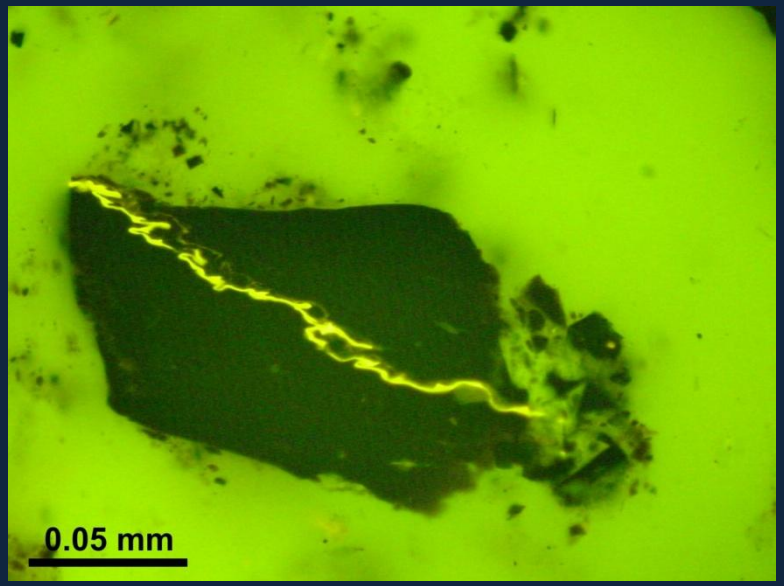
Bitumens - expulsions of hydrocarbons generated during self-heating processes from liptinite macerals; they have various shape: droplets, thread-like structures or they are irregular; commonly they co-occur with minerals and have strong yellow fluorescence

Unaltered liptinite v bitumens - examples









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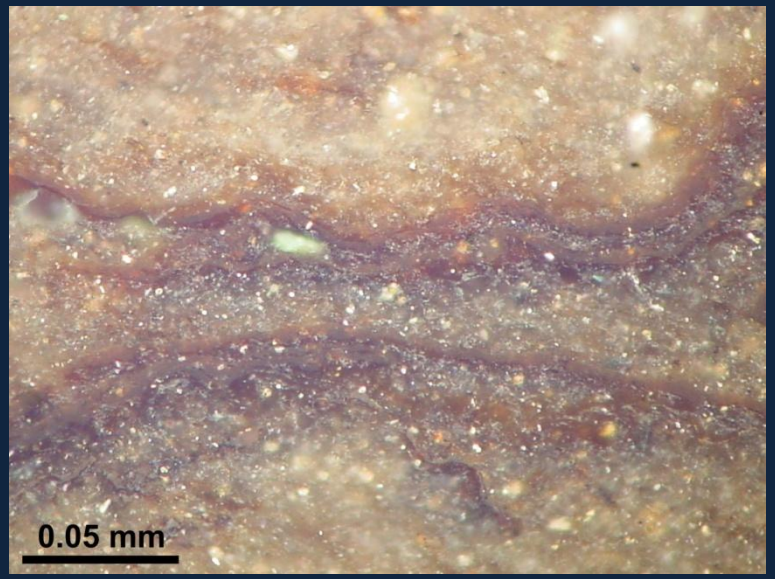
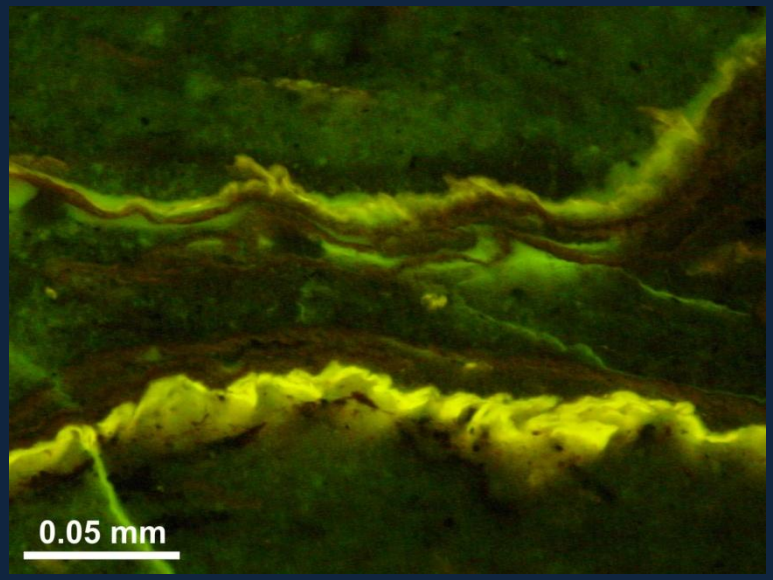
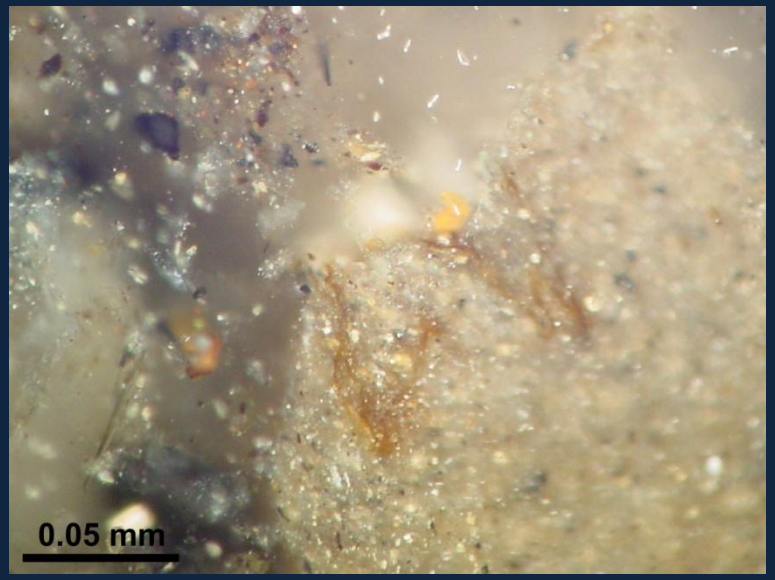
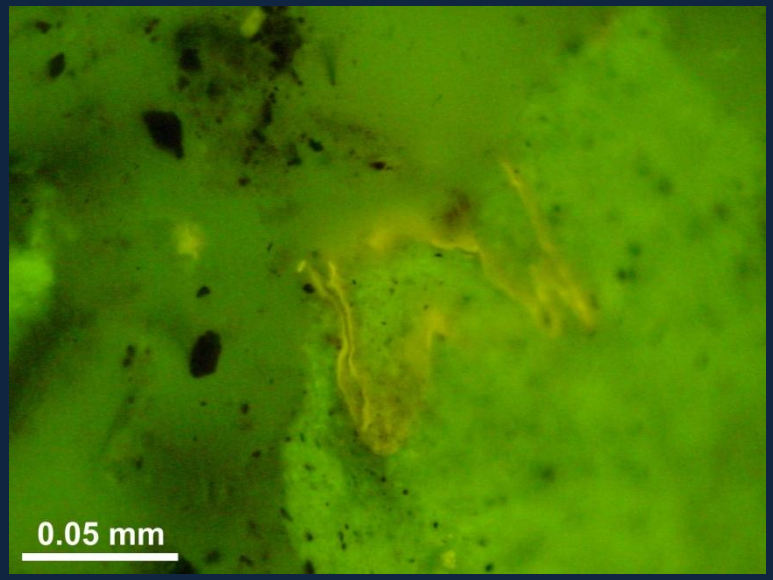
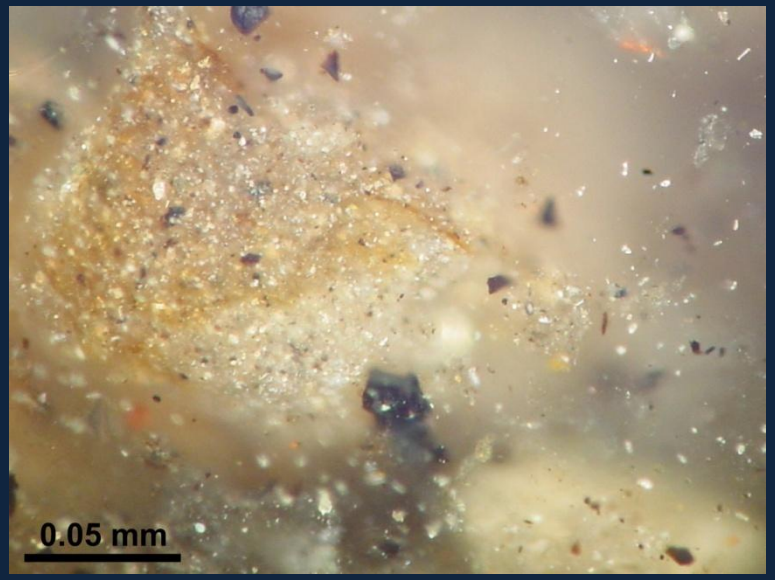


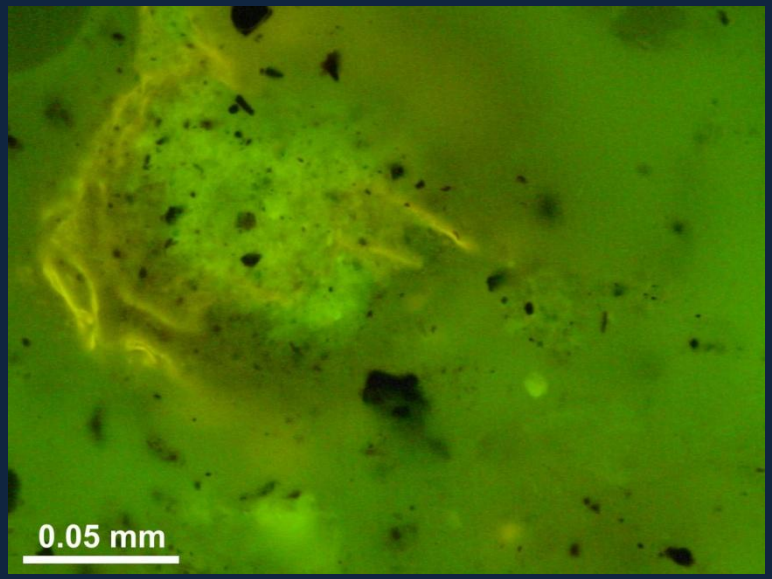


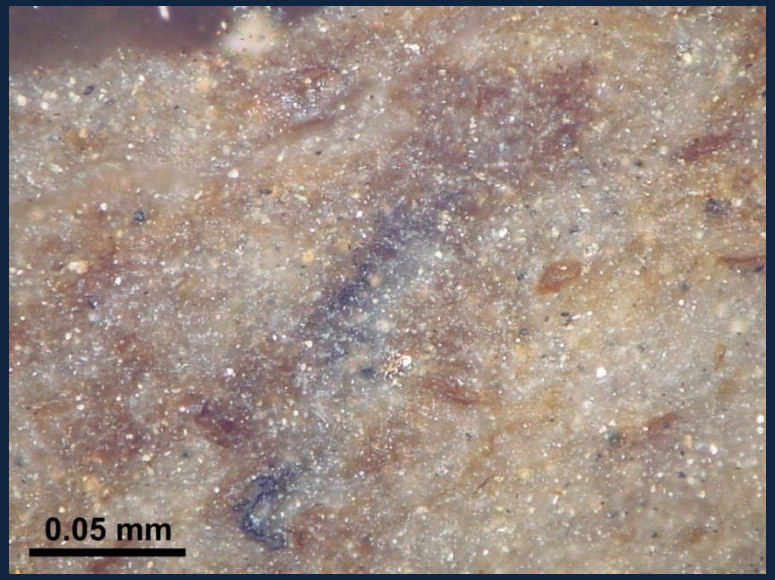


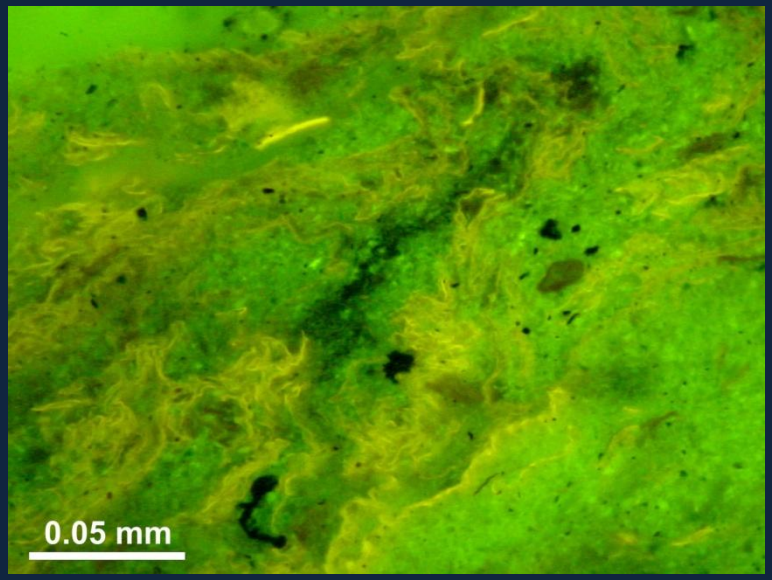


Unaltered liptinite v bitumens - examples









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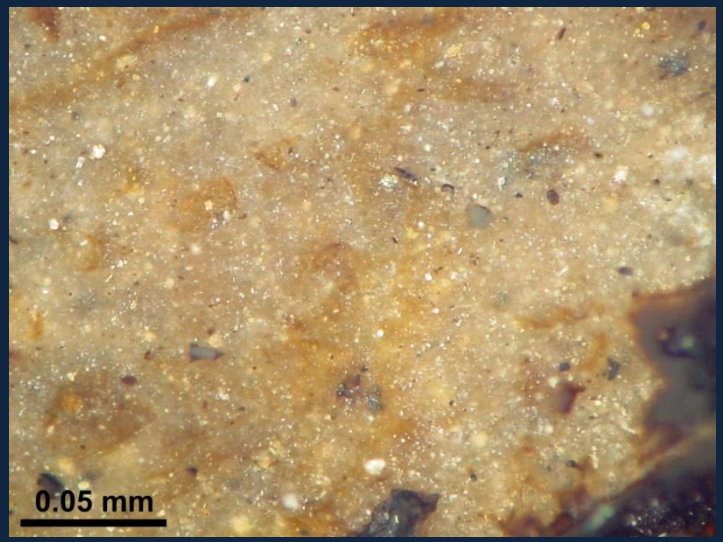
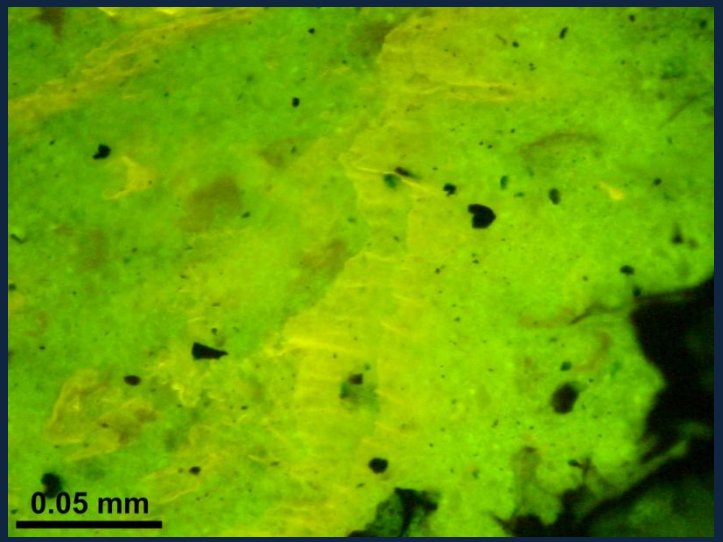
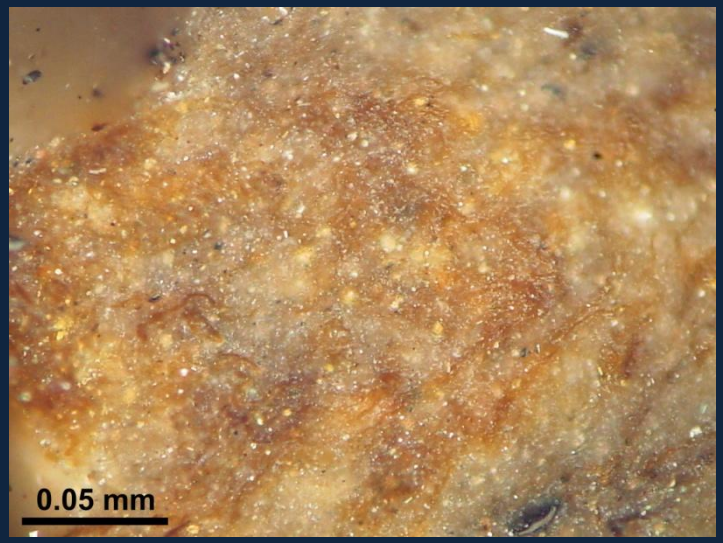
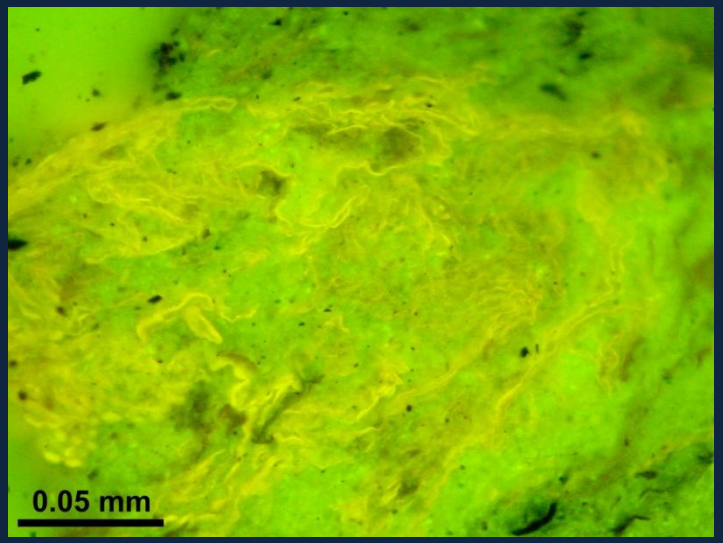








Coke (?)

Coke - organic particles paler in colour comparing to the parent organic matter; they colour is white or yellowish and they might show isotropy/anisotropy and porosity

- massive: isotropic, anisotropic
- porous: isotropic, anisotropic

Coke (?)

- **Char -** porous particles of cenosphere or network type; they were formed during sudden influence of high temperature on organic particle that lead to devolatilisation

Coke

Kwiecińska and Petersen (2004) described natural coke as "coal thermally affected by an igneous intrusive body".

Groups of microconstituents present in natural coke:

1. matrix (groundmass) formed by total alteration of vitrinite and liptinite
2. macerals of the inertinite group with preserved structures and textures visible in the unaltered coal
3. new components, which are partly high-carbon material and partly mineral matter

Coke

Commercially, the term “coke” is used to describe a product of carbonization of bituminous coals that have been heated in a closed chamber to a bright red heat. The temperatures exceed 1000°C (Taylor et al., 1998).

Coke

Commercially, according to International Committee for Characterization and Terminology of Carbon coke is described as “highly carbonaceous product of pyrolysis of organic material at least parts of which has passes through a liquid or liquid-crystalline state during a carbonization process and which consists of non-graphitic state

Natural char

organic particles with pyrolysis char morphology in coal seams and carbonaceous mudstones; they higher reflectance than the associated huminite/vitrinite, and commonly the reflectance is also higher than the associated inertinite. Natural char is characterised by a random distribution of pores and a varying porosity (Petersen and Kwiecińska, 2004).

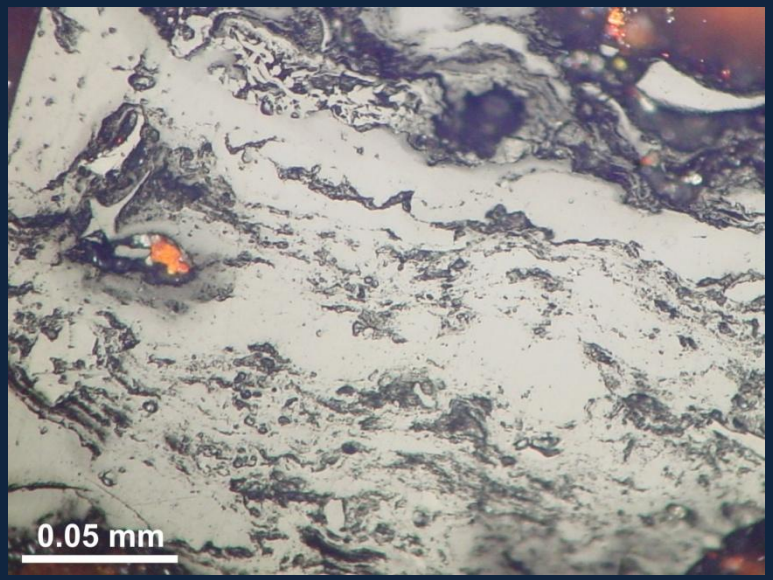
Thermally altered particles

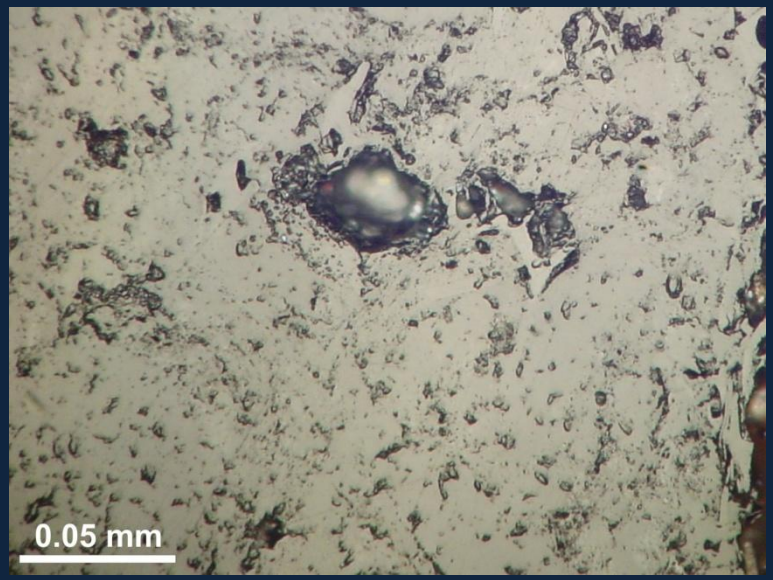
Appearance: cracked and microfractured, oxidation rims, plasticized edges, bands, relatively paler colour

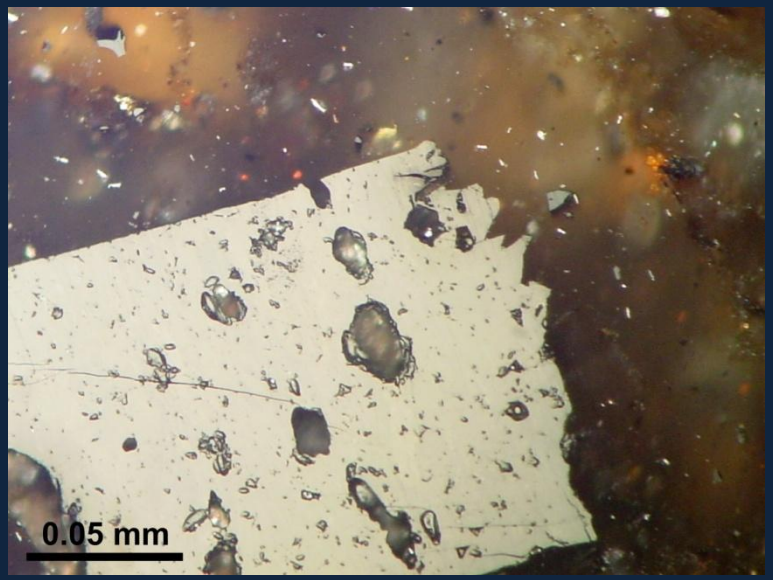
Structure: massive, devolatilization pores

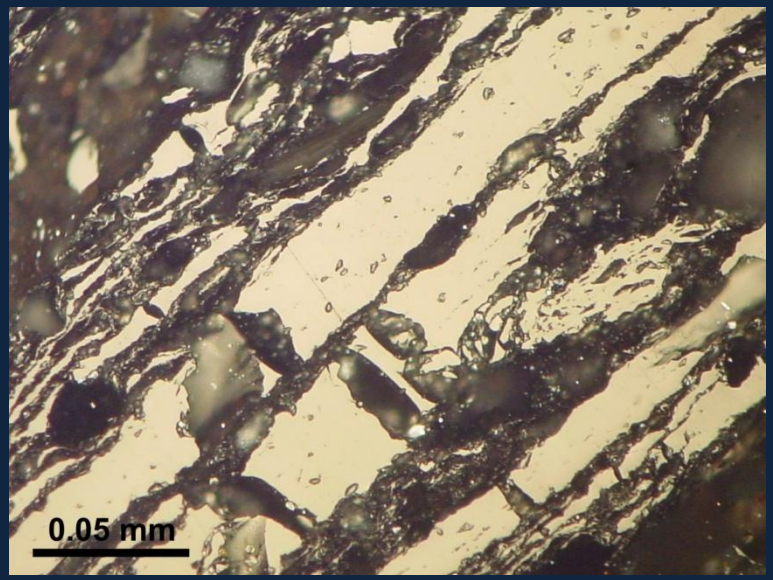
Texture: isotropic, anisotropic

Thermally altered particles - examples









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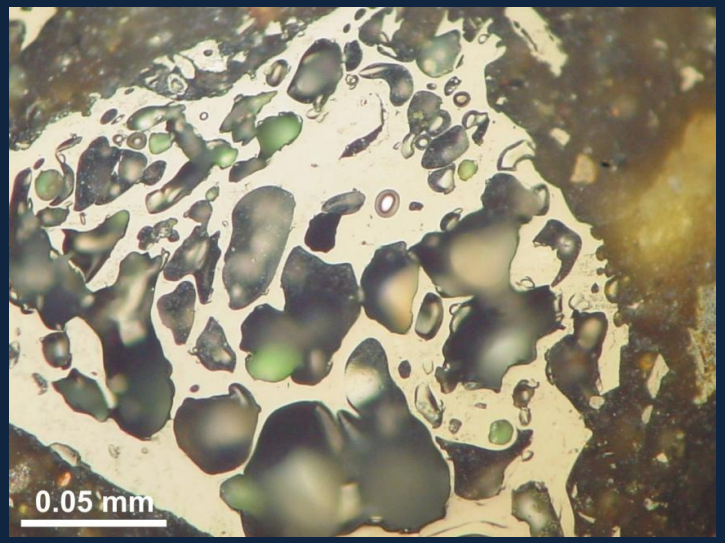

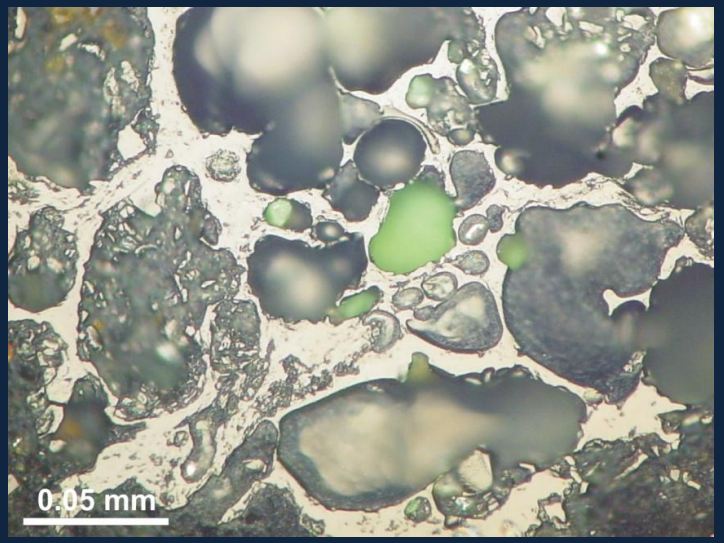

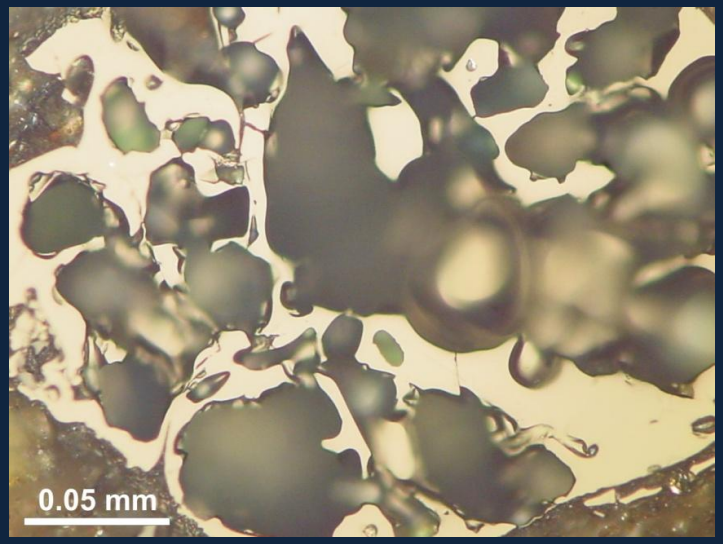

The 2011 classification of tranformed organic matter in coal wastes

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

Suggestions for future activity:

- A short presentation with several forms discussed now will be sent to participants. The evaluation will be done within a few weeks and results sent to all participants. Depending on the level of agreement, the classification might be further optimized.
- A new exercise on self-heated organic particles will be prepared by the end of April 2012 and report will be presented during our next meeting.
- If the results be satisfactory, a report from that activity including classification of organic forms in coal wastes will be prepared for publication in International Journal of Coal Geology.
- That would close the activity of this Working Group on coal wastes and we start working on self-heated organic forms in coal (coal seams and coal heaps).