ICCP COMMISSION III

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

2012 Round Robin Exercise

ICCP Meeting, Beijing 14-19.09.2012

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

- 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.
- to establish a classification of transformed organic particles (weathered and thermally altered) in coal heaps and coal seams undergone self-heating processes.

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.
- Two Round Robin Exercises were carried out in 2009 and 2010.
- Discussion on the established terminology took place during the 63rd ICCP Meeting in Porto in 2011.

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

Participants of 2012 Round Robin Exercise:

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

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

2012 Round Robin Exercise:

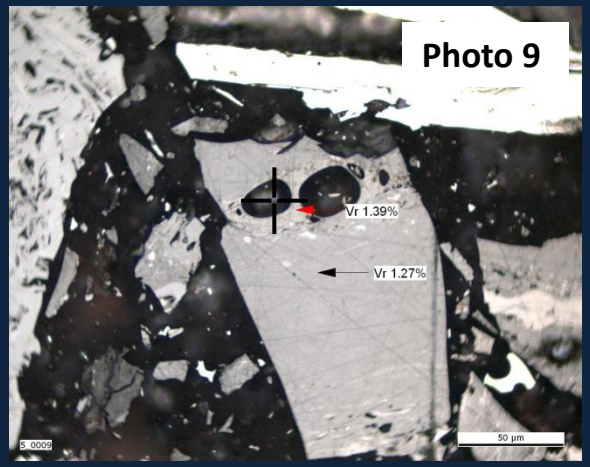
- 30 photos were selected representing transformed organic matter in coal wastes undergone self-heating processes.
- The rank of unaltered organic matter was 0.6-0.7% Rr.
- Reflectance values of transformed organic matter were given in the photos as Rr or Rmax.
- Participants were asked to distinguish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

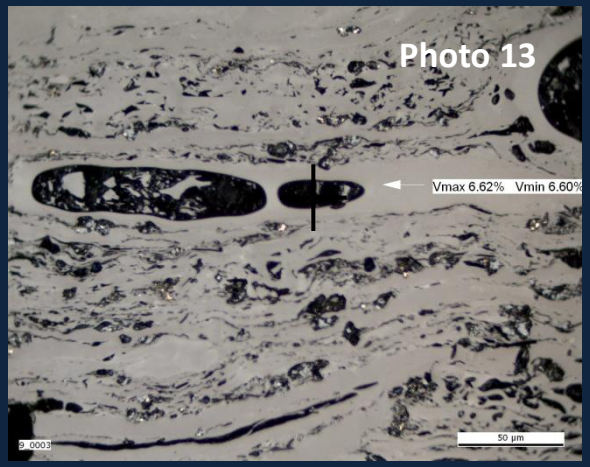
Comments from participants:

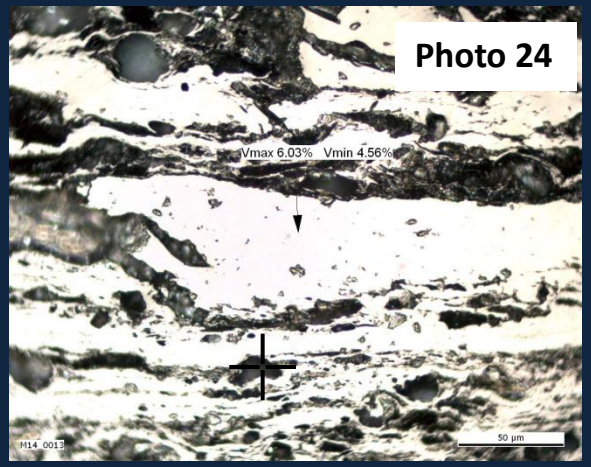
- to identify the whole particles or/and the form under cross hairs?
- when we distinguish unaltered particle should we also describe the other categories for altered particles?
- to use one category or more than one?

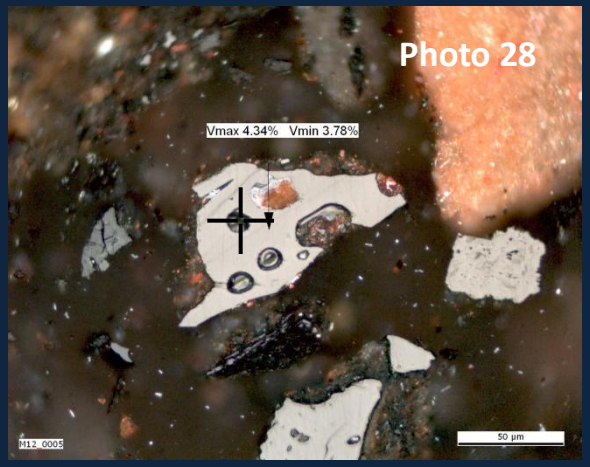
Unaltered particle	Altered particles										Newly formed particles	
	Appearance						Structure		Texture			
	Cracked and microfractu-red	Paler in colour oxidation rim	Darker in colour oxidation rim	Plasticised edge	Band	Paler colour particle	Massive	Devolatili-sation pores	Isotropic	Anisotropic	Pyrolytic carbon	Bitumens

The highest agreement (100 %) was obtained for devolatilisation pores

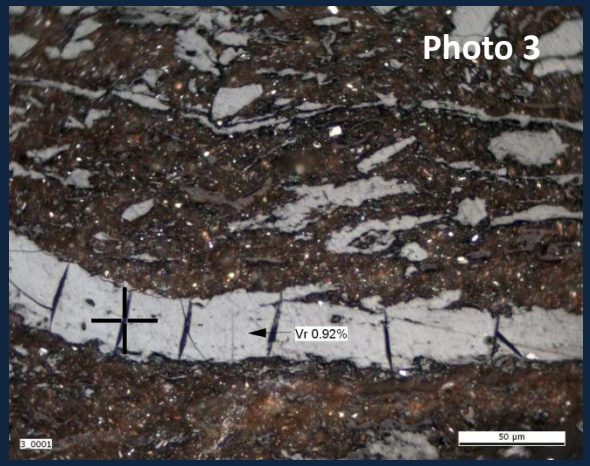


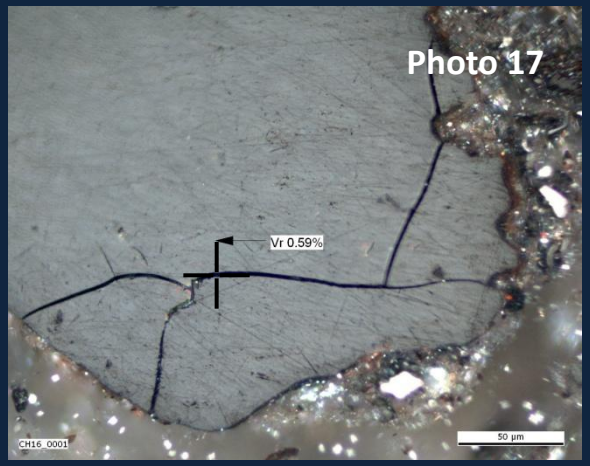


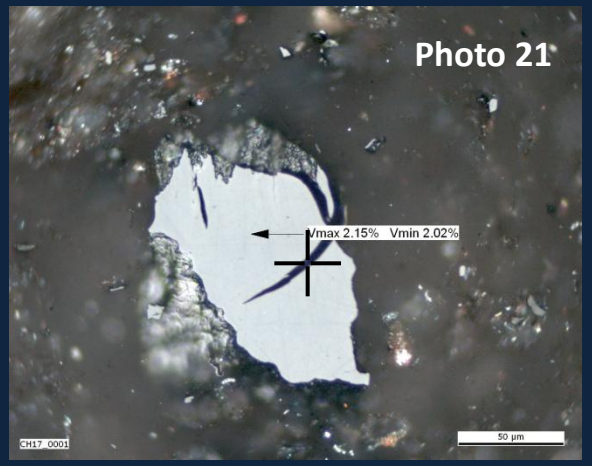


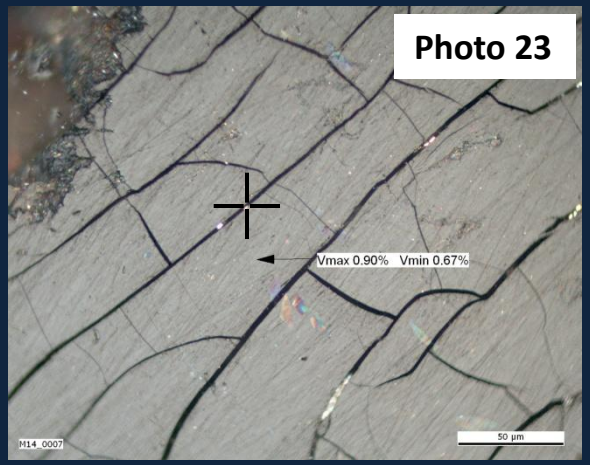


The highest agreement (100 %) was obtained for cracks and microfractures



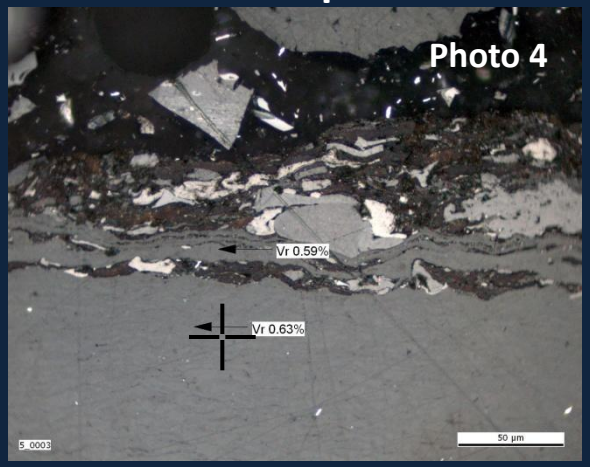




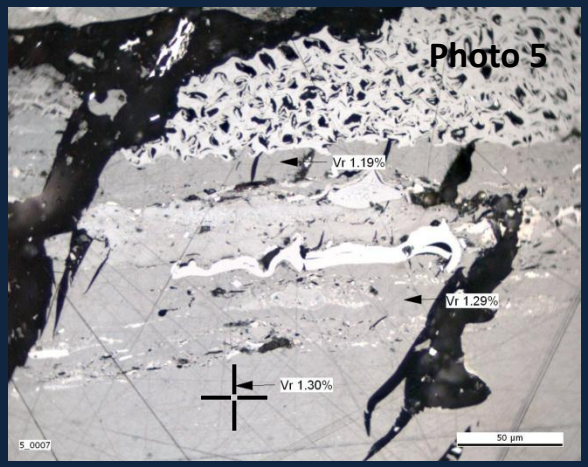


High agrement (93.3 %) was obtained for forms presneted in Photo 4 , 5, 22, 19 and 25

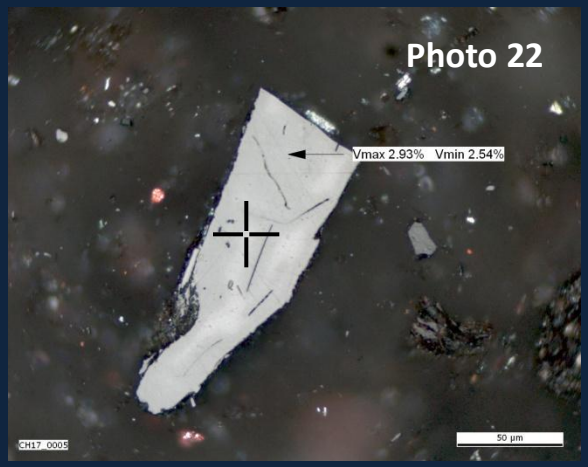
unaltered particle



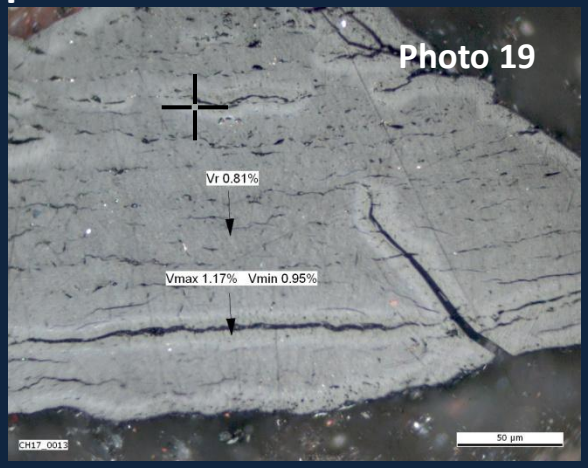
cracks and microfractures



cracks and microfractures



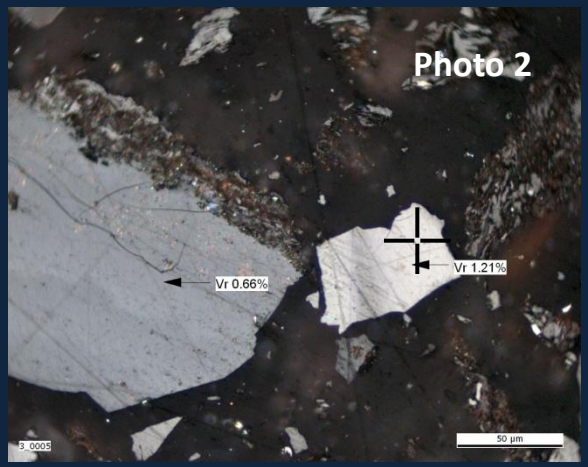
paler in colour oxidation rim



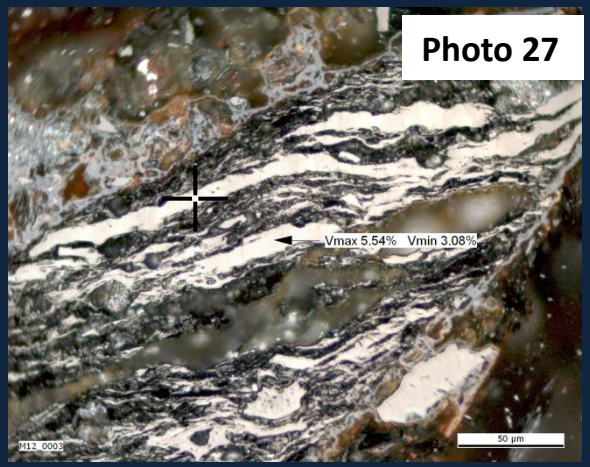
pyrolytic carbon

High level of agreement (86.7 %) was obtained for forms in Photos 2, 27 and 29

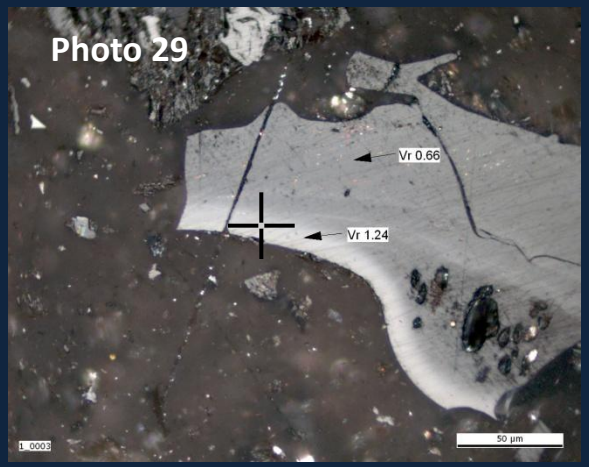
paler in colour particle



paler in colour particle

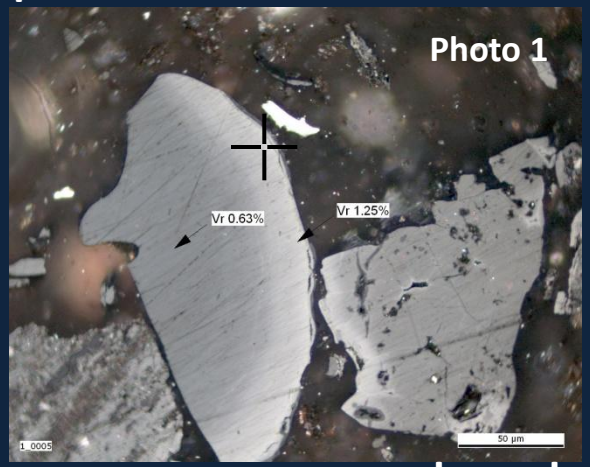


paler in colour oxidation rim

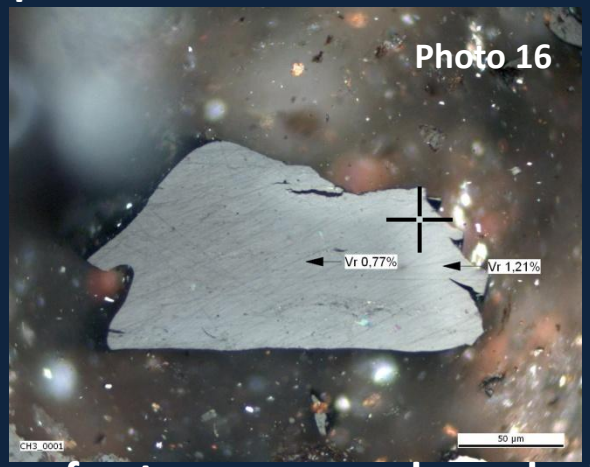


High agreement (80 %) was obtained for forms in Photos 1, 2, 11, 20 and 22

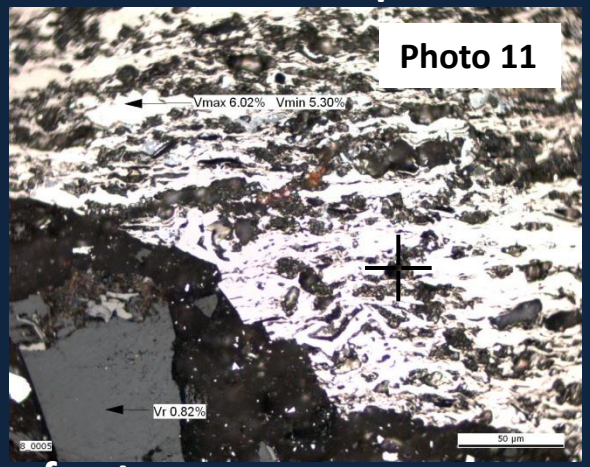
paler in colour oxidation rim



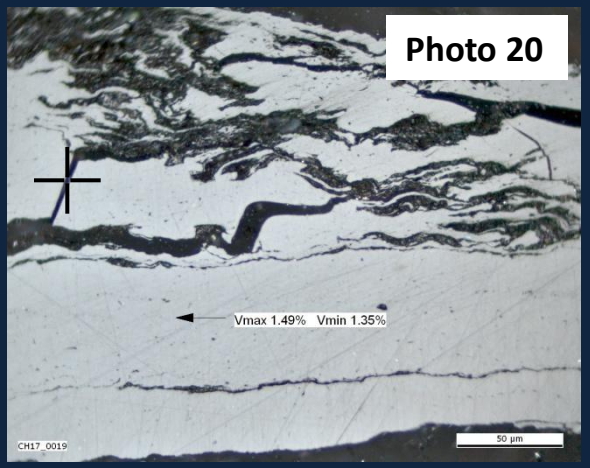
paler in colour oxidation rim



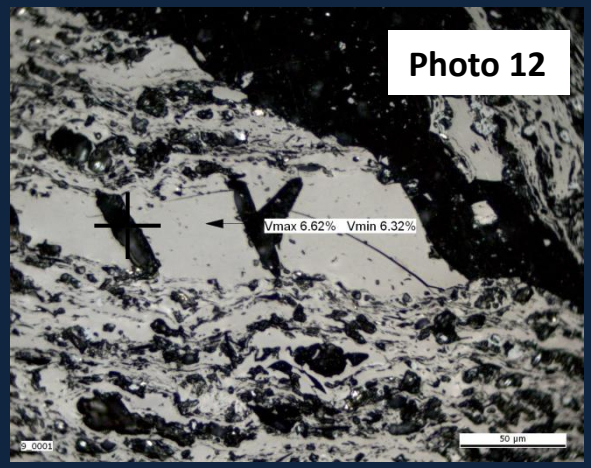
devolatilisation pores



cracks and microfractures

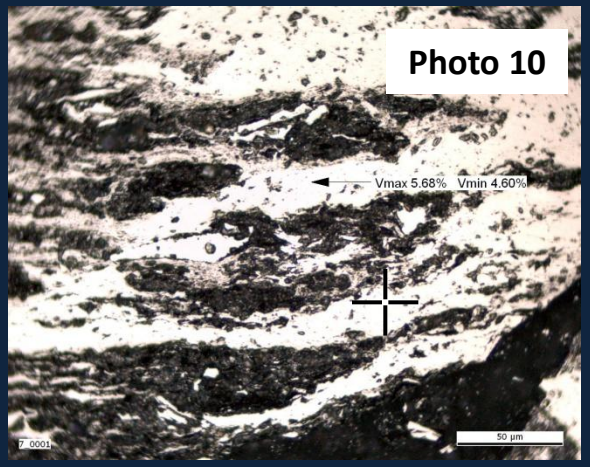


cracks and microfractures

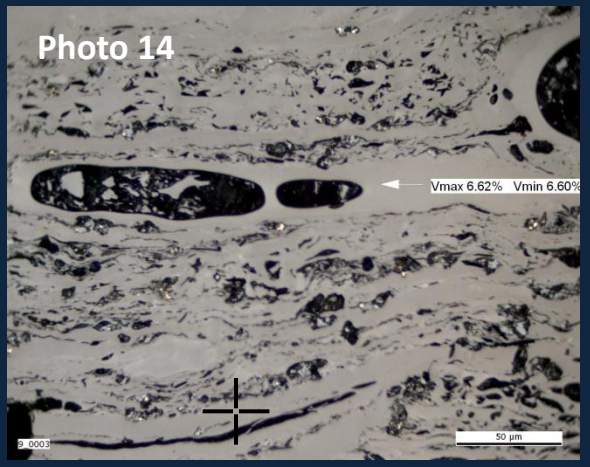


High agreement (73.3 %) was obtained for forms in Photos 10 and 14

paler in colour particle

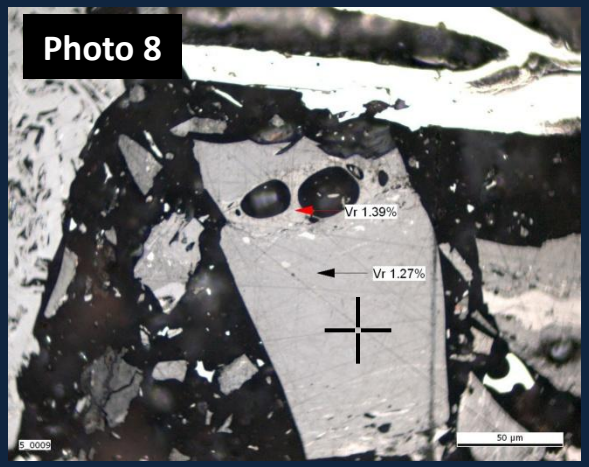


paler in colour particle

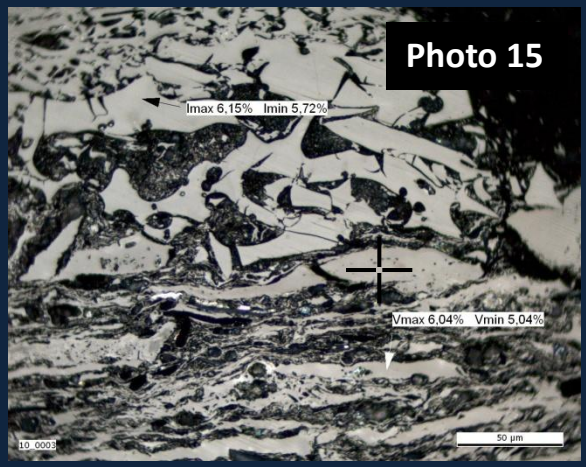


High agreement (66.7 %) was obtained for forms in Photos 8 and 15

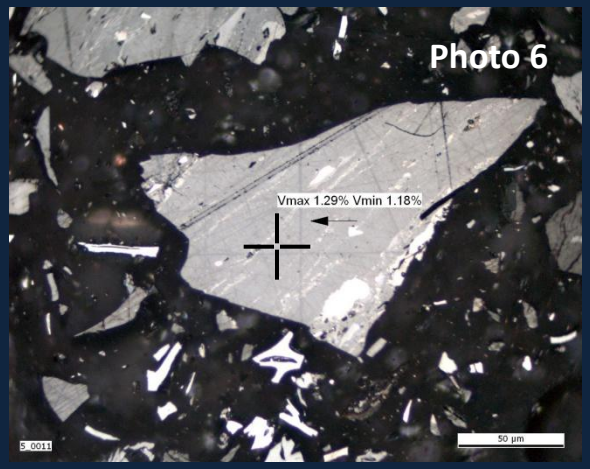
paler in colour particle

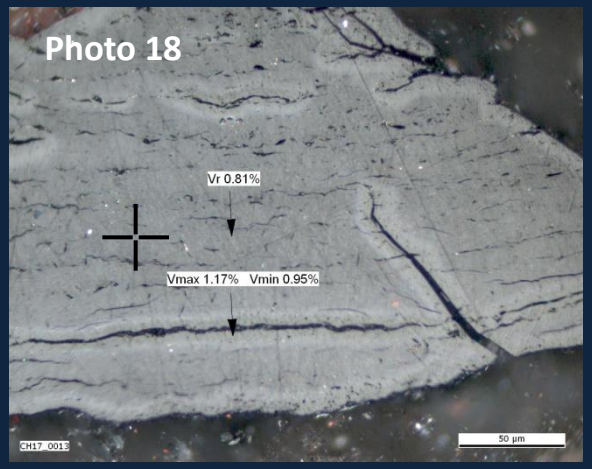


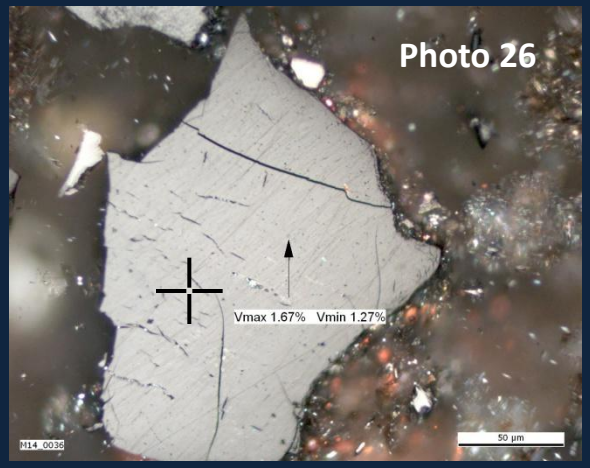
paler in colour particle

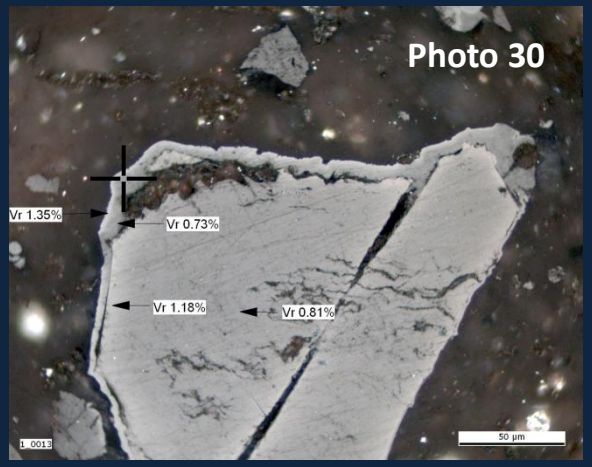


The most troublesome forms





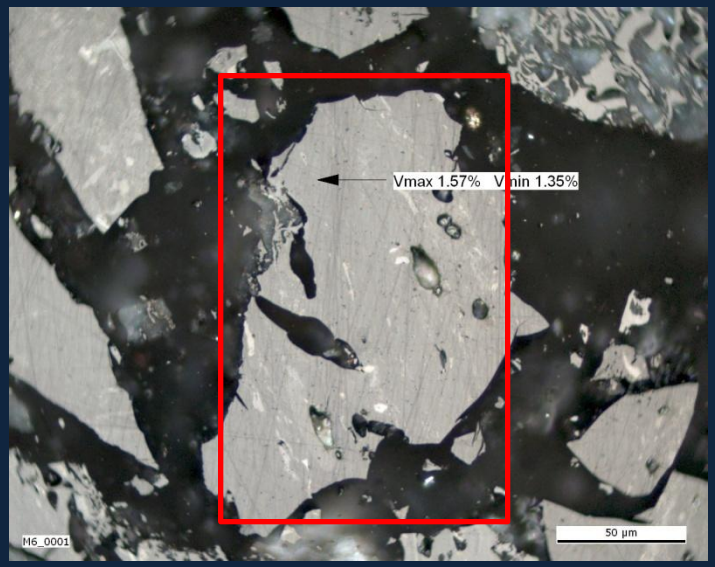




How to present the forms?

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

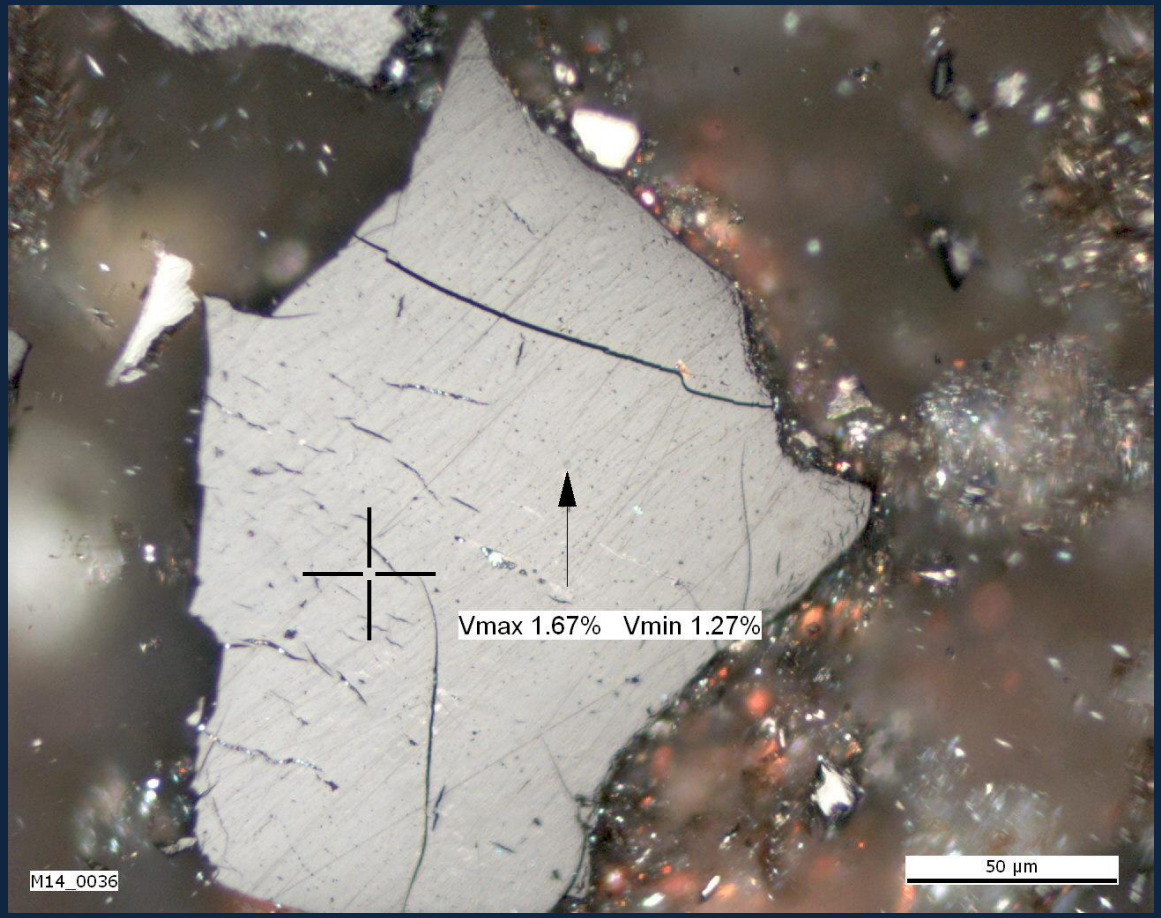
- **structure**
- **texture**



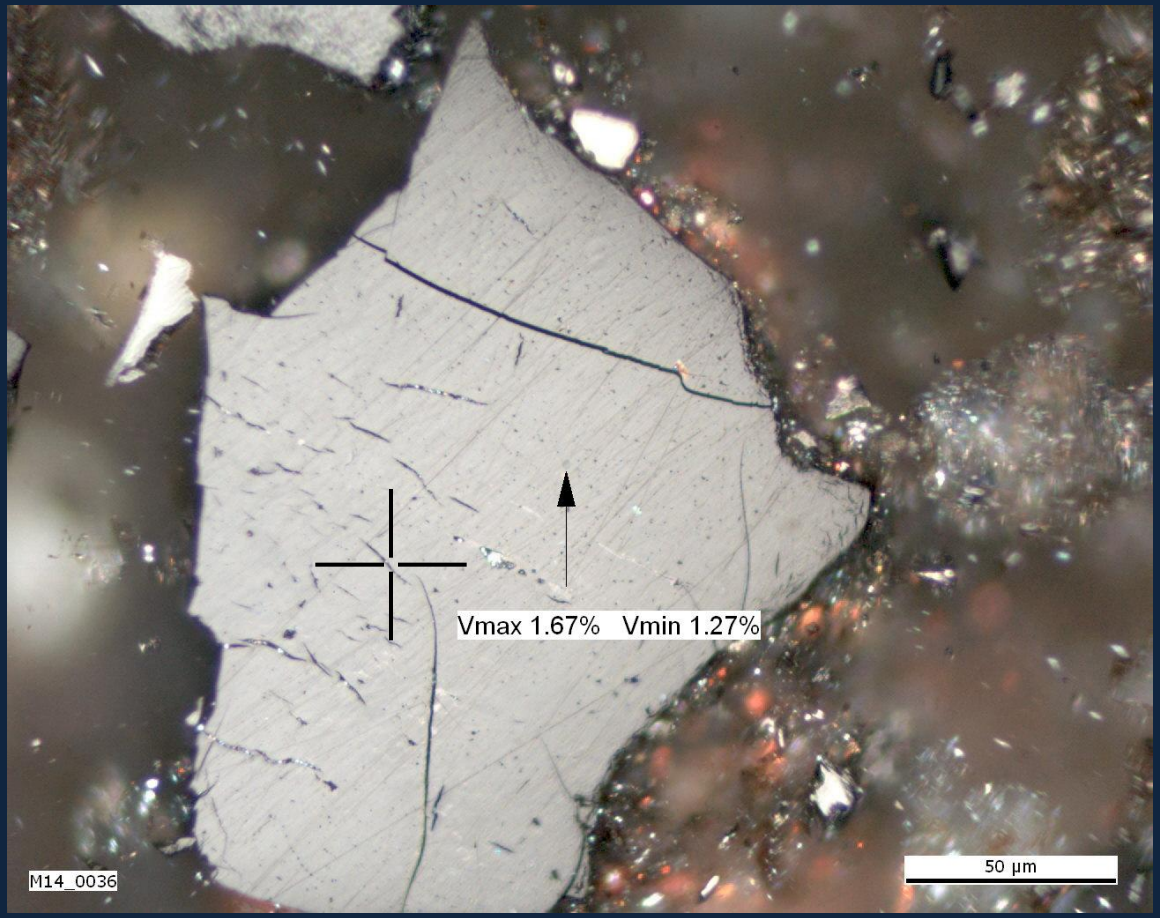
Cross-hair for <u>point specific</u> forms such as:

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

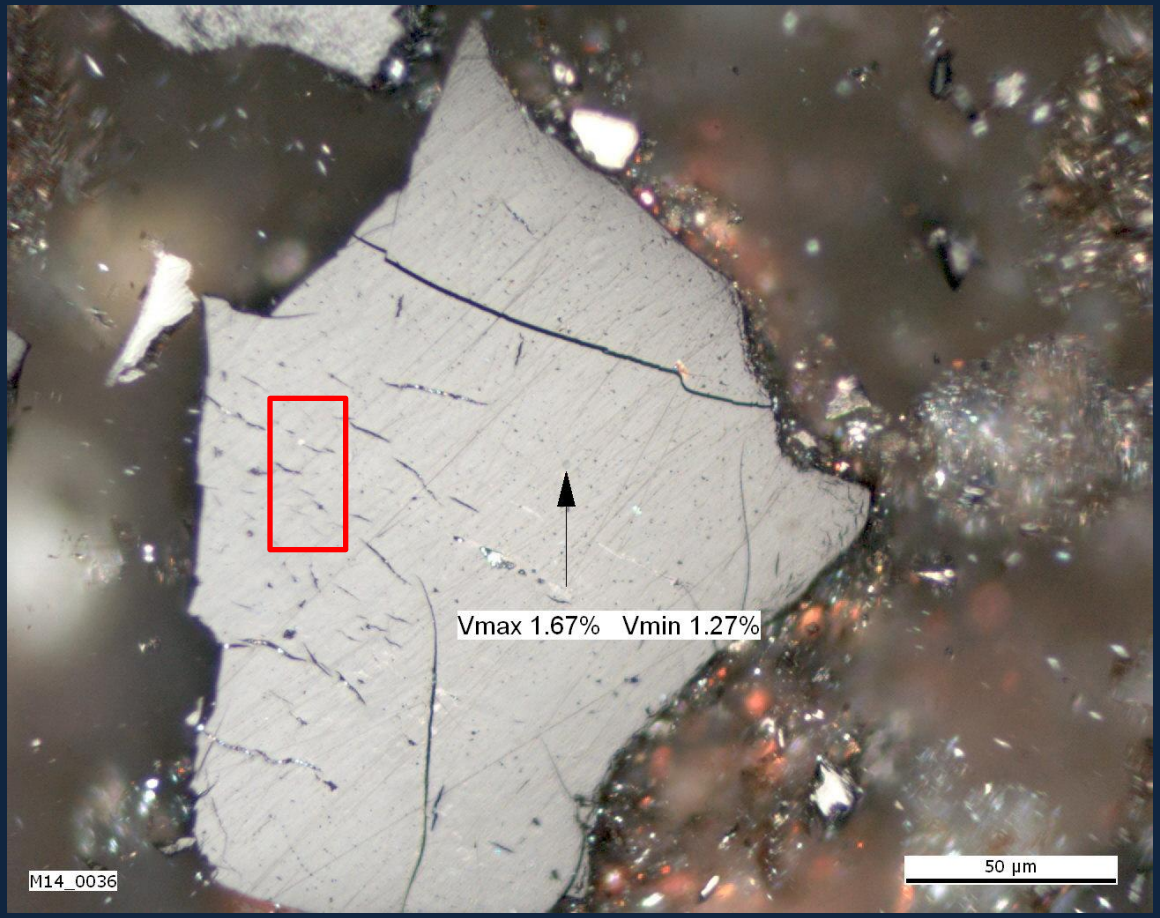
How to present the forms?



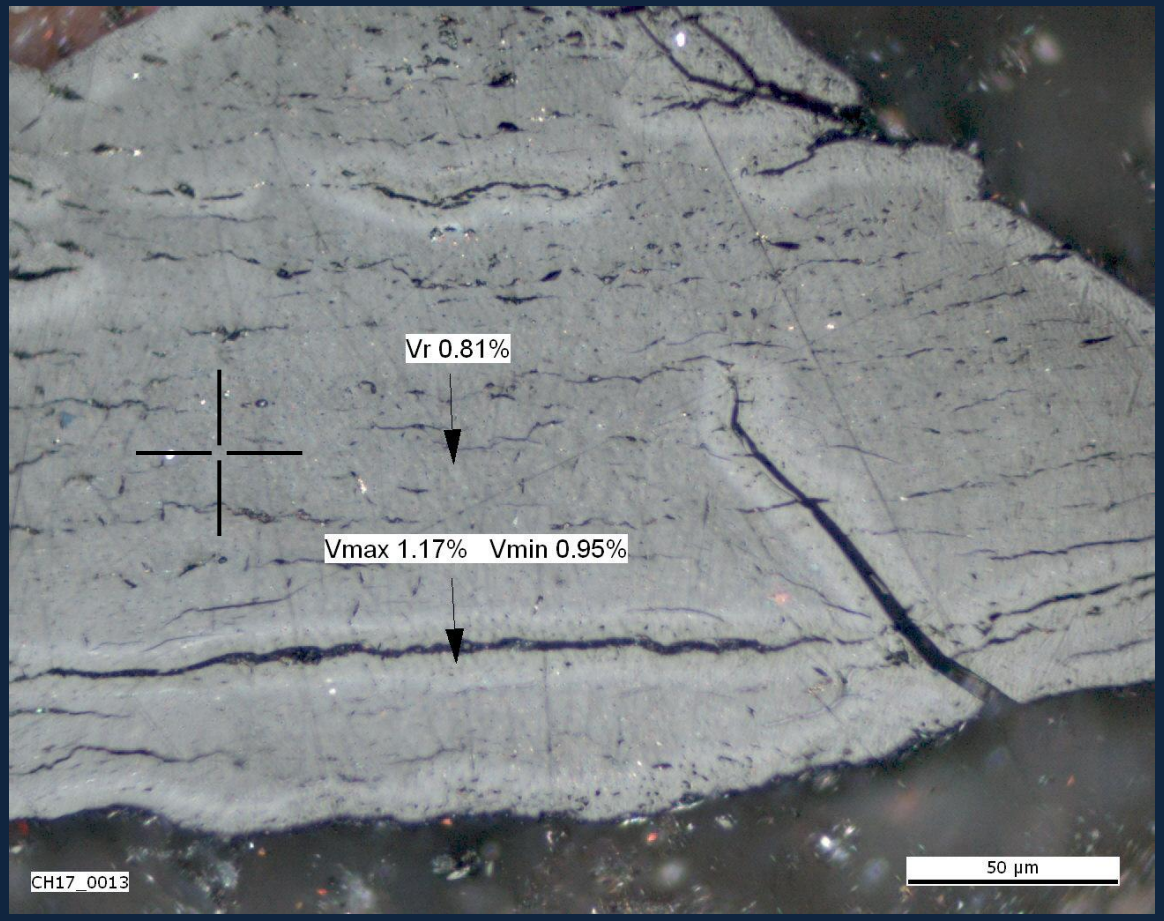
How to present the forms?



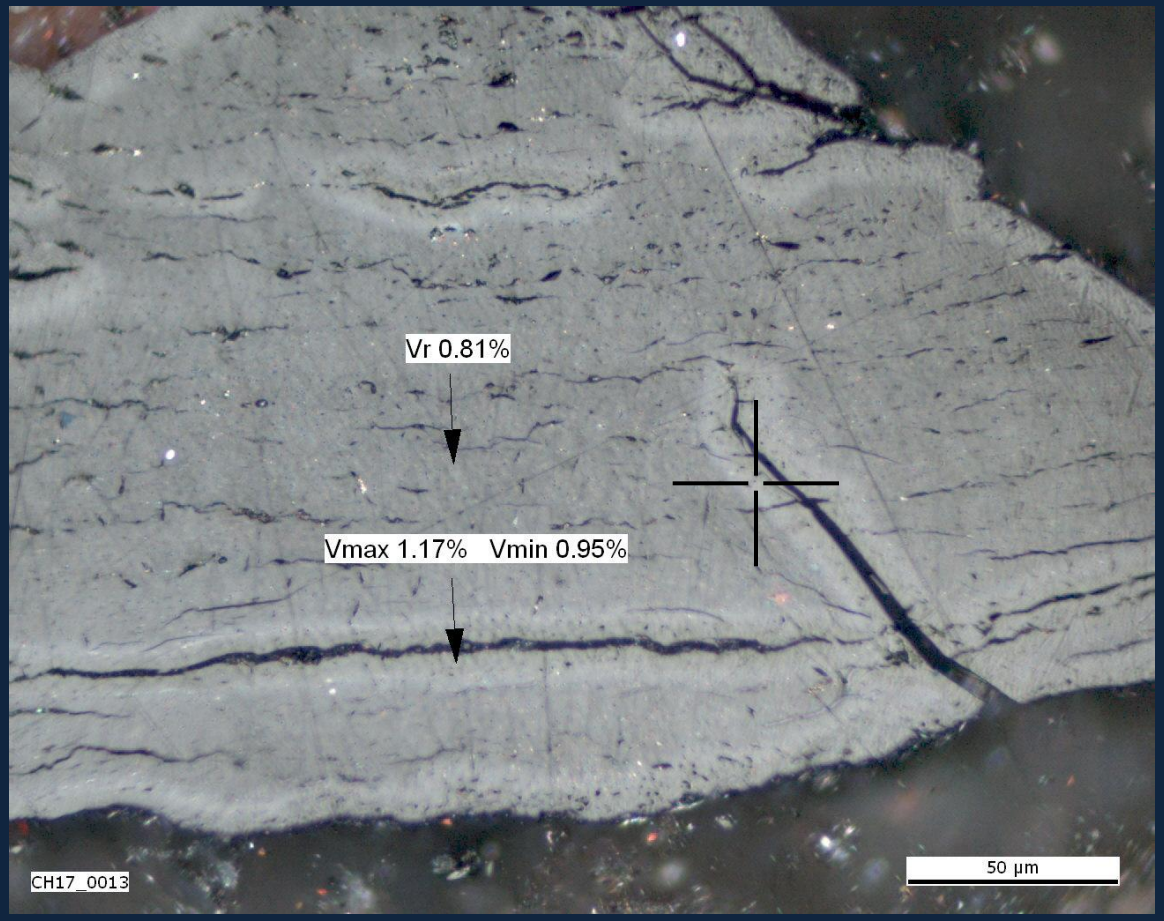
How to present the forms?



How to present the forms?



How to present the forms?



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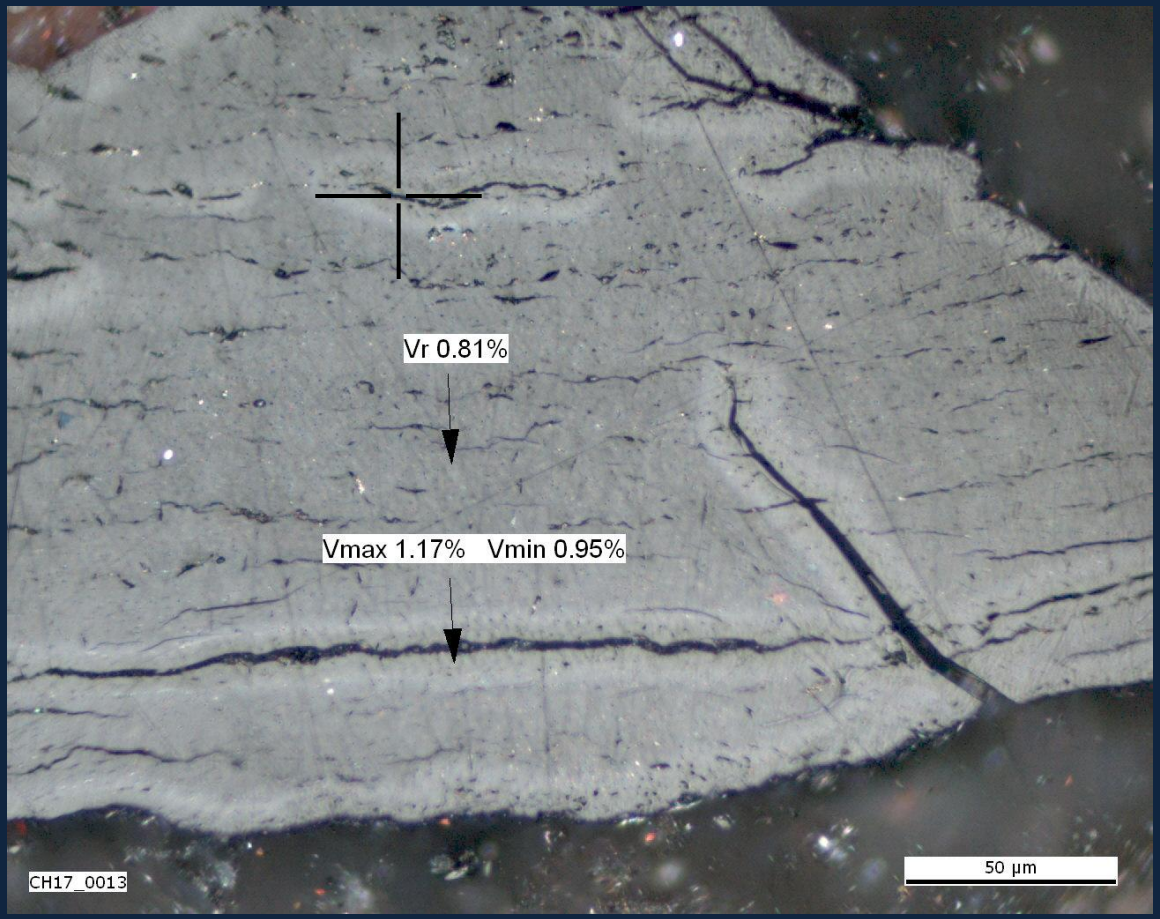
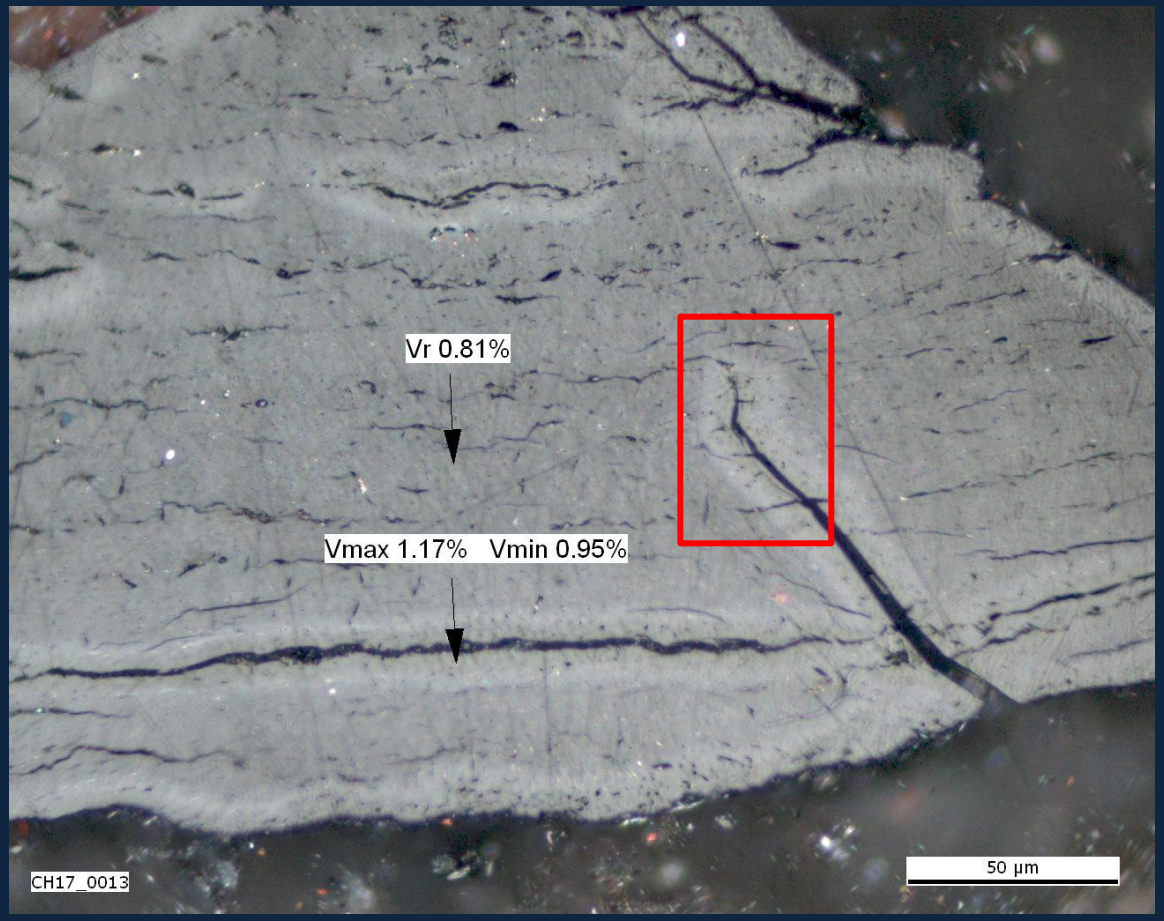
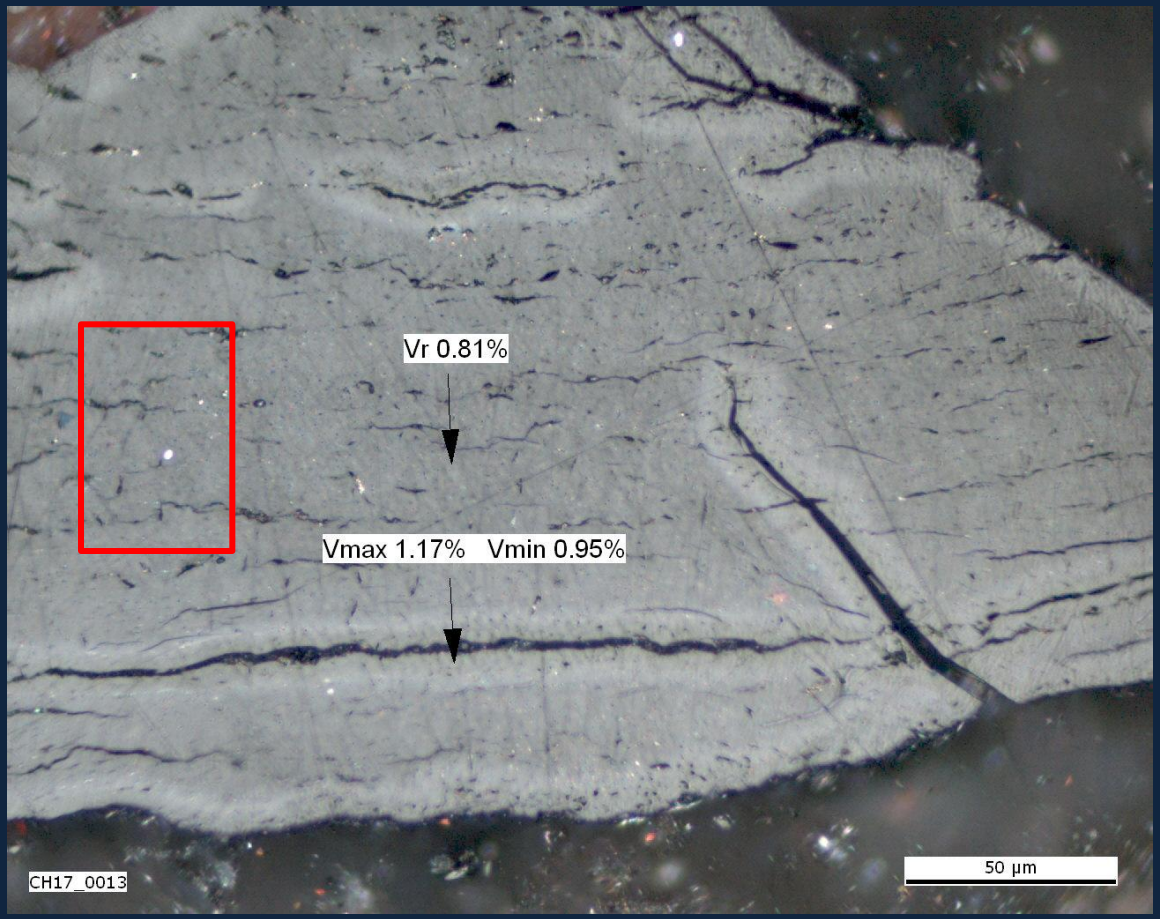


How to present the forms?



How to present the forms?



Proposal of a modified classification for the 2013 Round Robin Exercise

Unaltered particle	Altered particle										Newly formed particle	
	Cracked and mircofra-ctured	Paler in colour oxidation rim	Darker in colour oxidation rim	Plasticised edge	Band	Devolatili-sation pore	Paler colour particle				Pyrolytic carbon	Bitumens
							Structure		Texture			
							Massive	Porous	Isotropic	Anisotropic		

Unaltered particle	Altered particle (VR transformed ≥ VR unaltered)										Newly formed particle	
Without forms, structure, texture	Forms occurring within the particle						Particles identified as whole grain				Pyrolytic carbon	Bitumens
	Cracked and mircofra-ctured	Paler in colour oxidation rim	Darker in colour oxidation rim	Plasticised edge	Band	Devolatili-sation pore	Paler colour particle					
							Structure		Texture			
							Massive	Porous	Isotropic	Anisotropic		

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 unambiguously the form, structure and texture to be identified.

Future activity:

- To carry out one more Round Robin exercise on alteration of organic matter in coal wastes undergoing self-heating. The exercise will be based on 30-40 pictures applying all the suggestions discussed during our meeting in Beijing.
- The report will be presented during our next meeting in Poland and by the middle of 2014 a draft paper will be prepared and send to all participants for their comments. The paper will be sent for publication in e.g. International Journal of Coal Geology. That will end the activity of Self-Heating Working Group on coal wastes.
- In 2014 we start working on self-heating of coal heaps and seams or identification of mineral phases in self-heating coal wastes.