Tracing the maceral origin in combustion chars. The inertinite in Combustion WG of ICCP.

Exercise on identification of char material in medium rank coal A and medium rank coal B (ISO 11760: 2005) Vitrinite random reflectance 1.0%<Rr<2.0%

INCWG Exercise MRB-A (ICCP 2009)

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This exercise was prepared to test agreement on the identification of the optical texture of coal char material. The exercise was carried out by the participants in the Inertinite in Combustion W.G. of the ICCP in the years 1999, 2000 and 2007

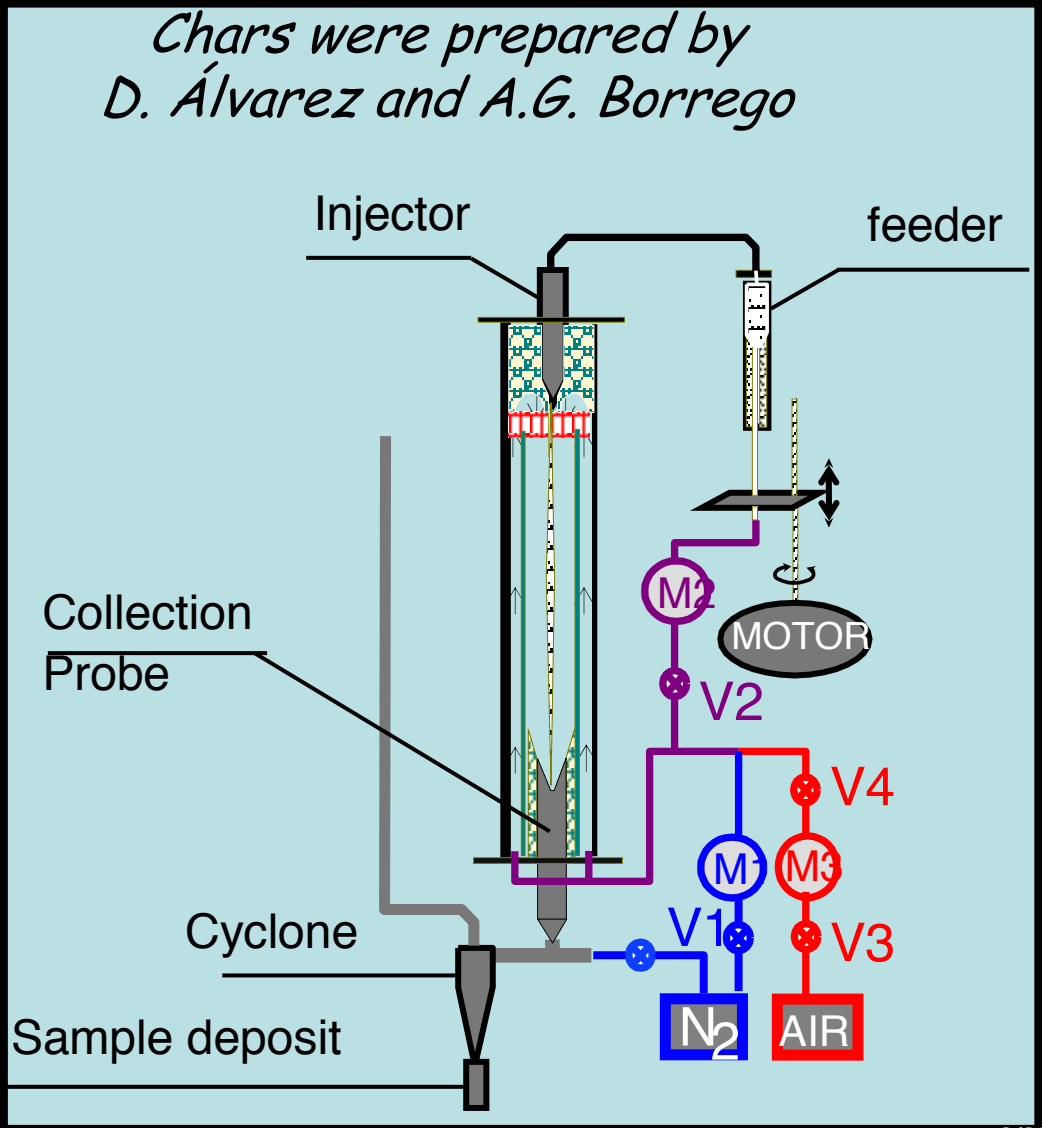
The results of the participants have been used to prepare the ICCP Atlas “Tracing the maceral origin in coal chars” (Borrego et al., 2009). The exercise consists of 4 presentations listed below and an excel sheet in which the results can be reported and evaluated against the WG results. The images have been taken with crossed nicols using 1 λ retarding plate

INCWG Exercise LRB-A
INCWG Exercise MRD-C
INCWG Exercise MRB-A
INCWG Exercise HRC-B
INCWG Results sheet

Chars were prepared in the Drop Tube Reactor existing at INCAR-CSIC under the conditions described below

Conditions

Temperature: 1300 ºC
Particle size: 36-75 μm
Feed rate: 1 g min^{-1}
Residence Time: 0.3 s
Flow Rate: 900 L h^{-1}
Atmosphere: 2.5% O_2 in N_2



Images belong to any of the following coals from which chars were prepared. Their rank and maceral analyses are given below.

Coal	Rr (%)	Vitrinite (%)	Inertinite (%)	Liptinite (%)	VM-daf (%)	ISO	ASTM	Country
M	1.05	55.0	45.0		28.9	MRB	mvb	CA
B	1.07	55.6	44.0	0.4	25.6	MRB	mvb	CA
L	1.28	54.2	45.8		22.3	MRB	mvb	AU
P	1.56	69.3	30.7		17.6	MRA	lvb	AU
T	1.77	71.6	28.4		13.6	MRA	sa	UK

The lettering in white, close to the image, refers to the image identification code: Thus, a code "*Rn"* means images from coal R, "*Ln"* images from coal L and so on.

Classification of Char Optical Texture. ICCP System 1996

A rather simple classification scheme was established in the Meeting held in Heerlen (1996), in which the criteria to distinguish between classes consider both the optical texture (isotropic/anisotropic) and the porosity development. The system has 7 different classes that cover all the possible char occurrences.

Origin	Behaviour	Optical texture	Porosity	Group
Vitrinite				G1 (VT)
Inertinite	Fused	Anisotropic	Porous	G2 (AP)
			Dense	G3 (AD)
		Isotropic	Porous	G4 (IP)
			Dense	G5 (ID)
	Unfused		Massive	G6 (UM)
			Fusinoid	G7 (UF)

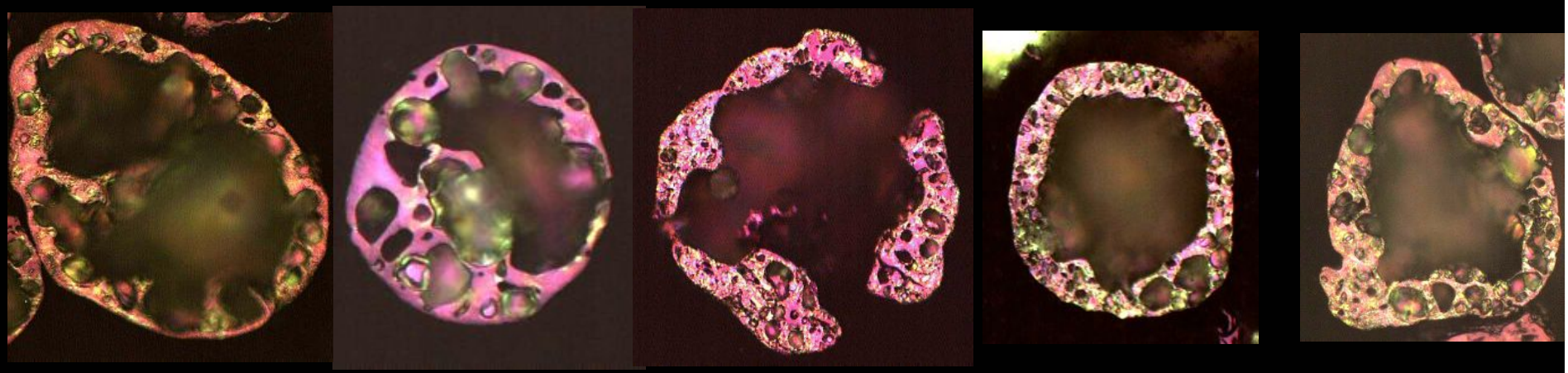
The counting procedure considers **the material under the crosswire** with a homogeneous optical appearance and **not the whole particle**.

Classification of Char Optical Texture. ICCP System 1996

- ***G1*** refers to all kind of domains which could derive from vitrinite (**VT**), and these can be isotropic or anisotropic, fused or unfused, depending on the rank of the coal.
- ***G2*** refers to anisotropic porous (**AP**) materials which have been presumably formed from inertinites, but have been highly altered during pyrolysis, showing both anisotropic texture and an important porosity development (ρ > 50%).
- ***G3*** refers to anisotropic dense (**AD**) materials formed from inertinites which have developed an appreciable anisotropy and without significant porosity development (ρ < 50%).
- ***G4*** refers to isotropic porous (**IP**) inertinite-derived material, which have devolatilized developing a porous structure (ρ > 50%).
- ***G5*** would include the isotropic dense (**ID**) domains with evidence of having fused (i.e.: small spherical degassing pores) (ρ < 50%).
- ***G6*** refers to unfused massive (**UM**) inertinites not showing cellular structure. They will be mainly massive isotropic material without any sign of transformation.
- ***G7*** would only include the unchanged fusinites (**UF**). They will be typically isotropic but might also exhibit wavy-like anisotropy.

As you cannot have a look of the sample to figure out how typical vitrinite-derived material looks like, below there are some images showing selected views of vitrinite-derived material in Bituminous B coal chars

Vitrinite-derived material in Bituminous B (Rr-1.0-1.4%) coals (samples M & B & L)

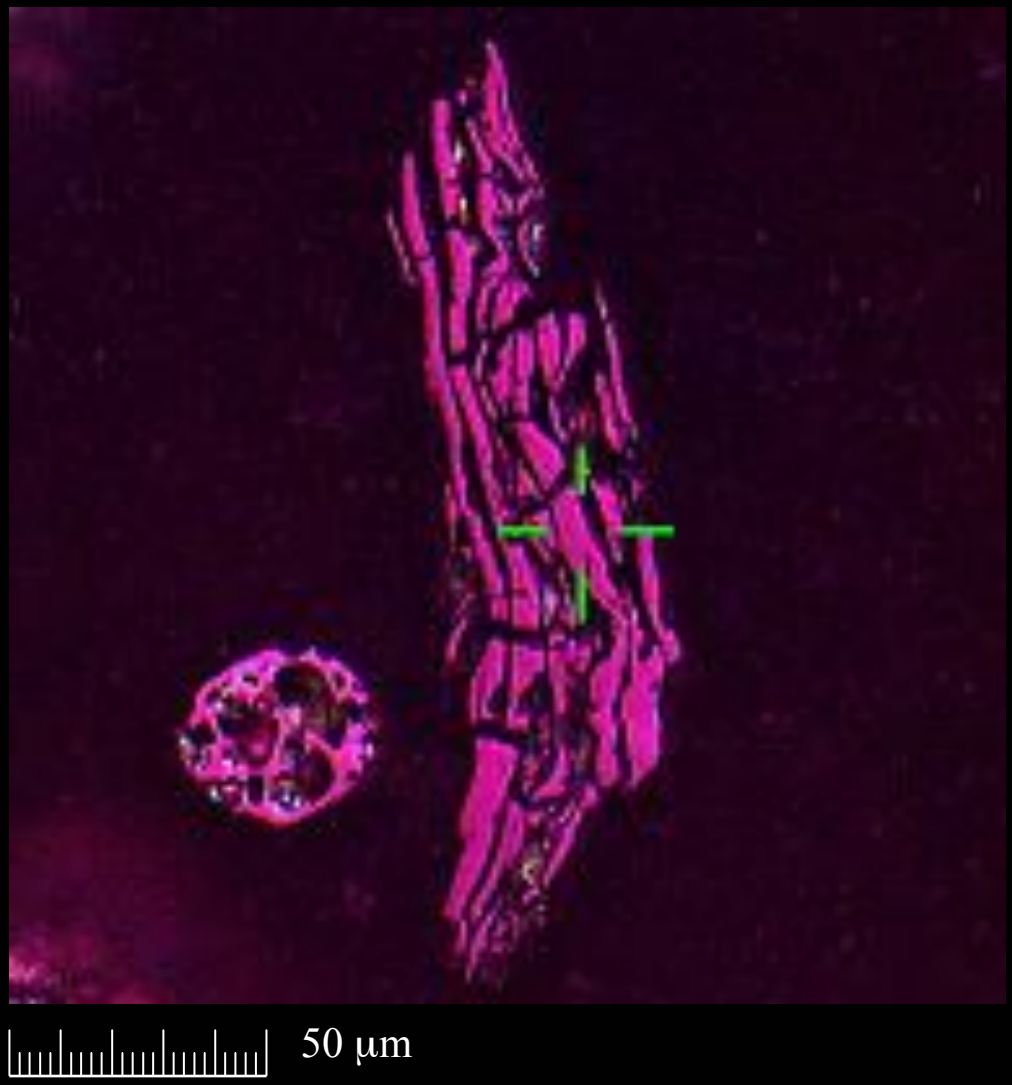


50 μm

Vitrinite devolatilizes by entering the combustion chamber yielding typically anisotropic cenospheric particles with small to medium size domains.

Good Luck!!

M1



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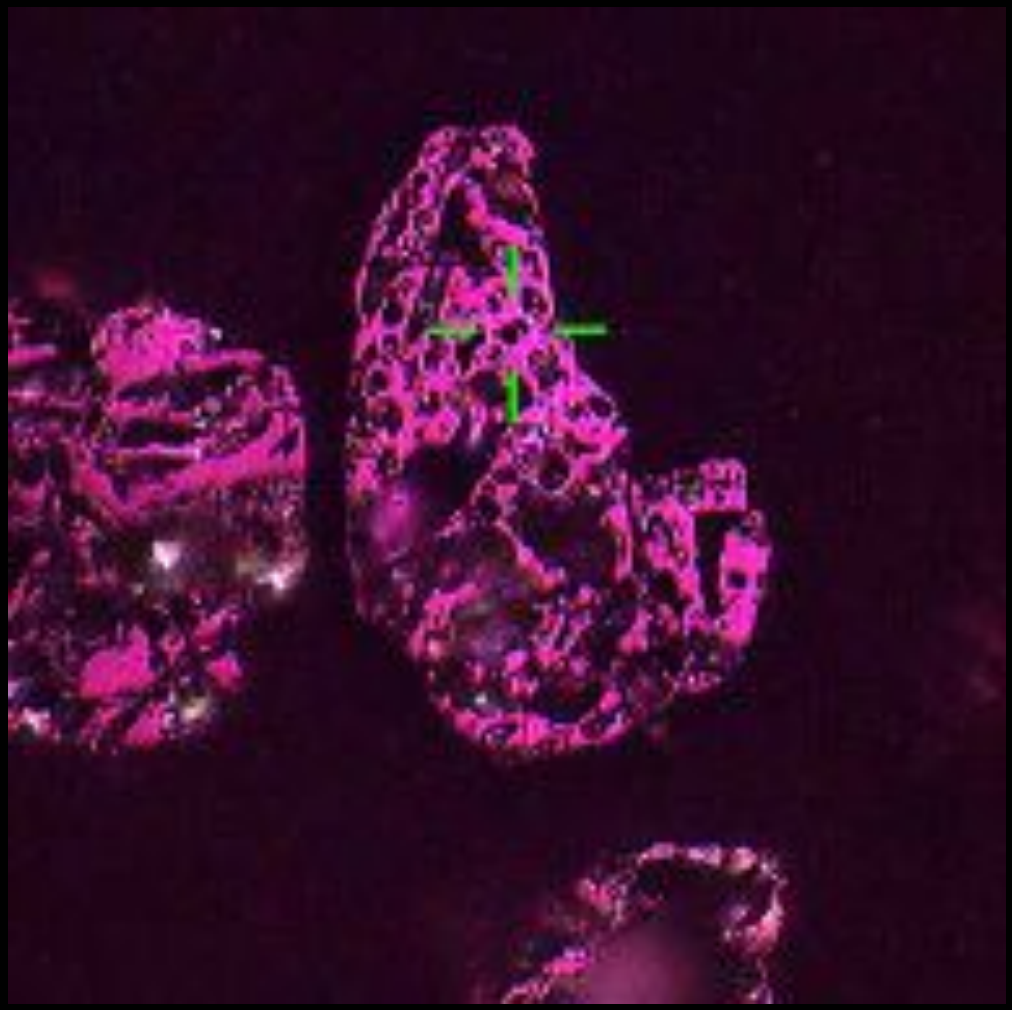

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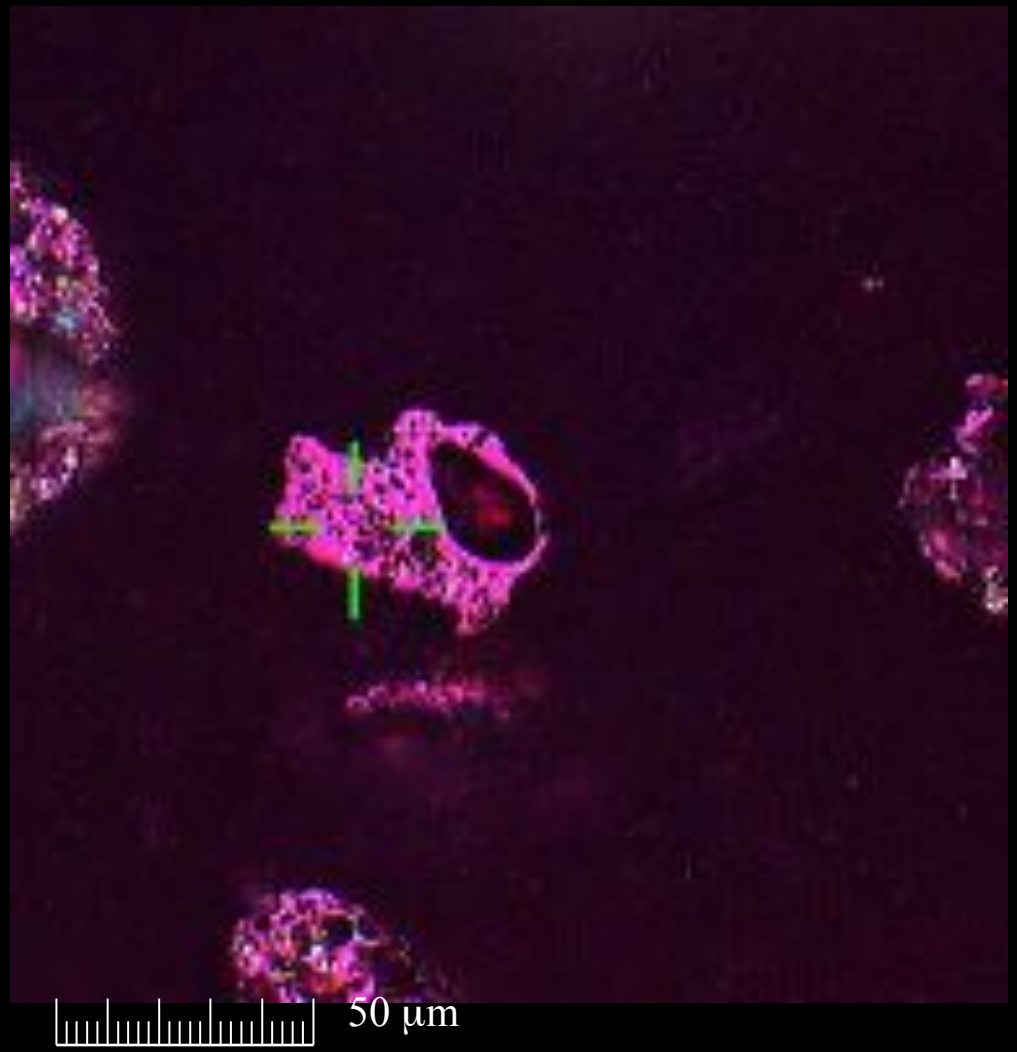

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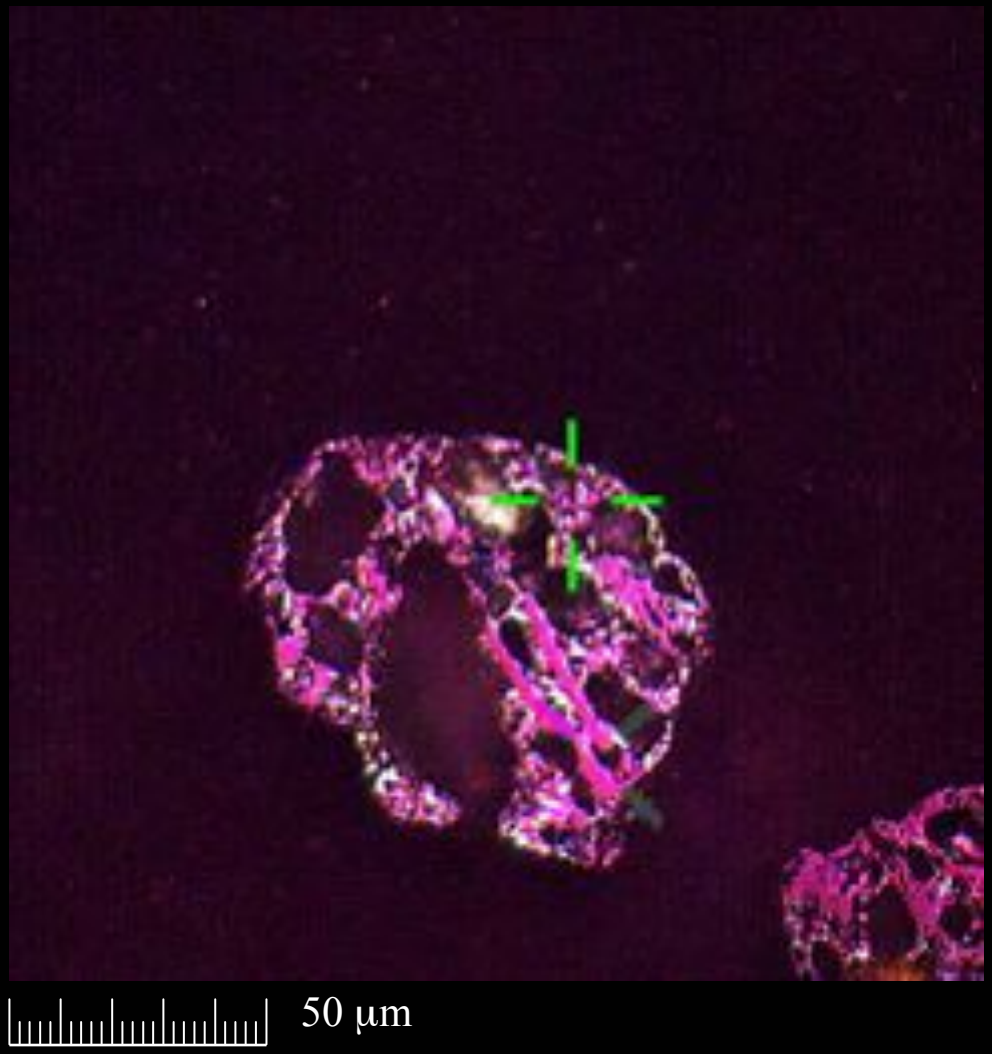

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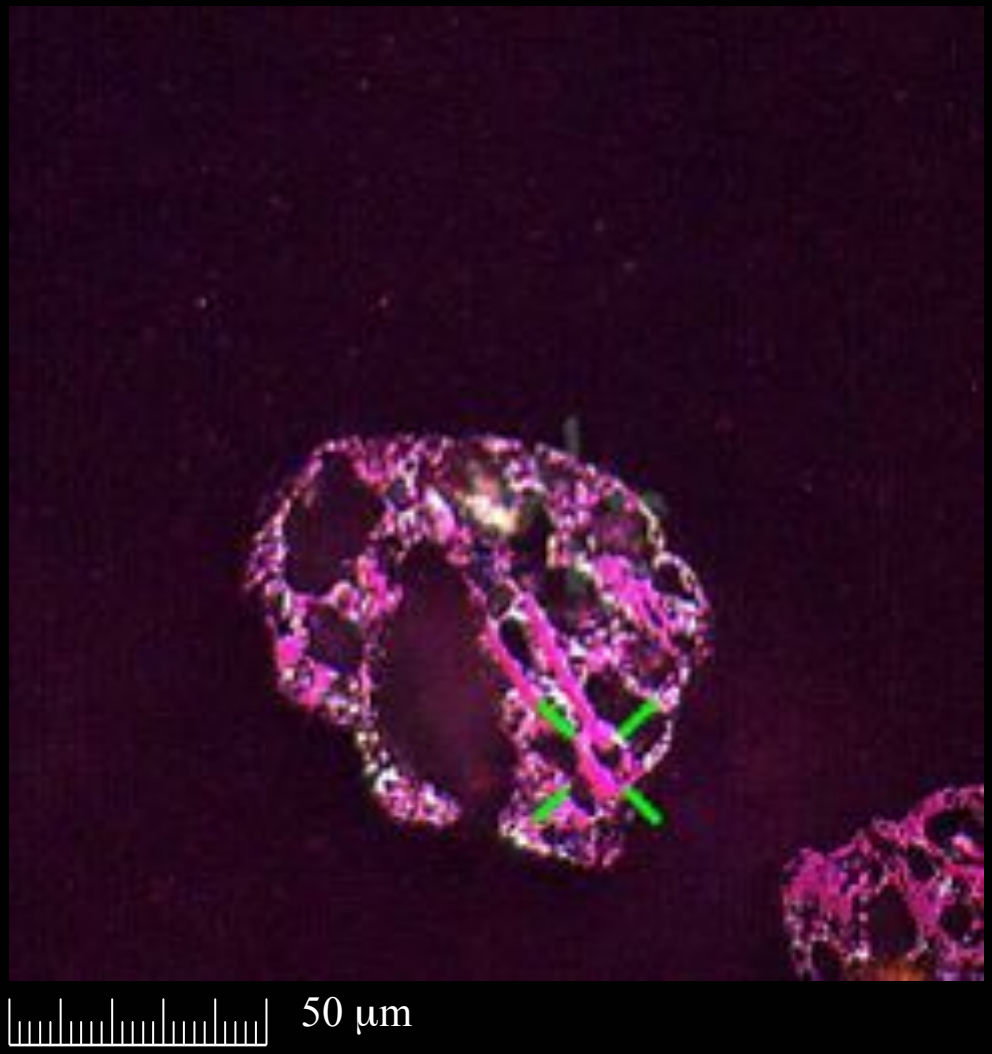

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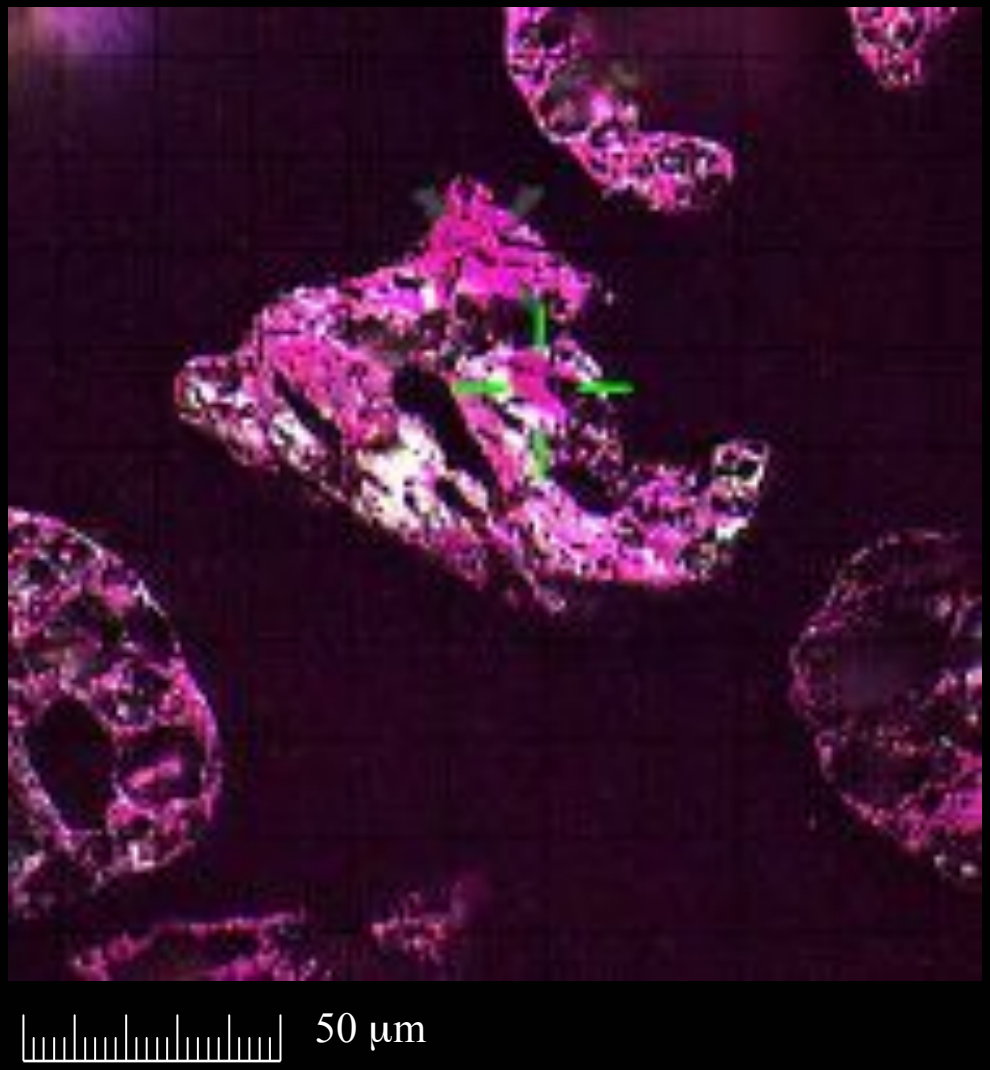

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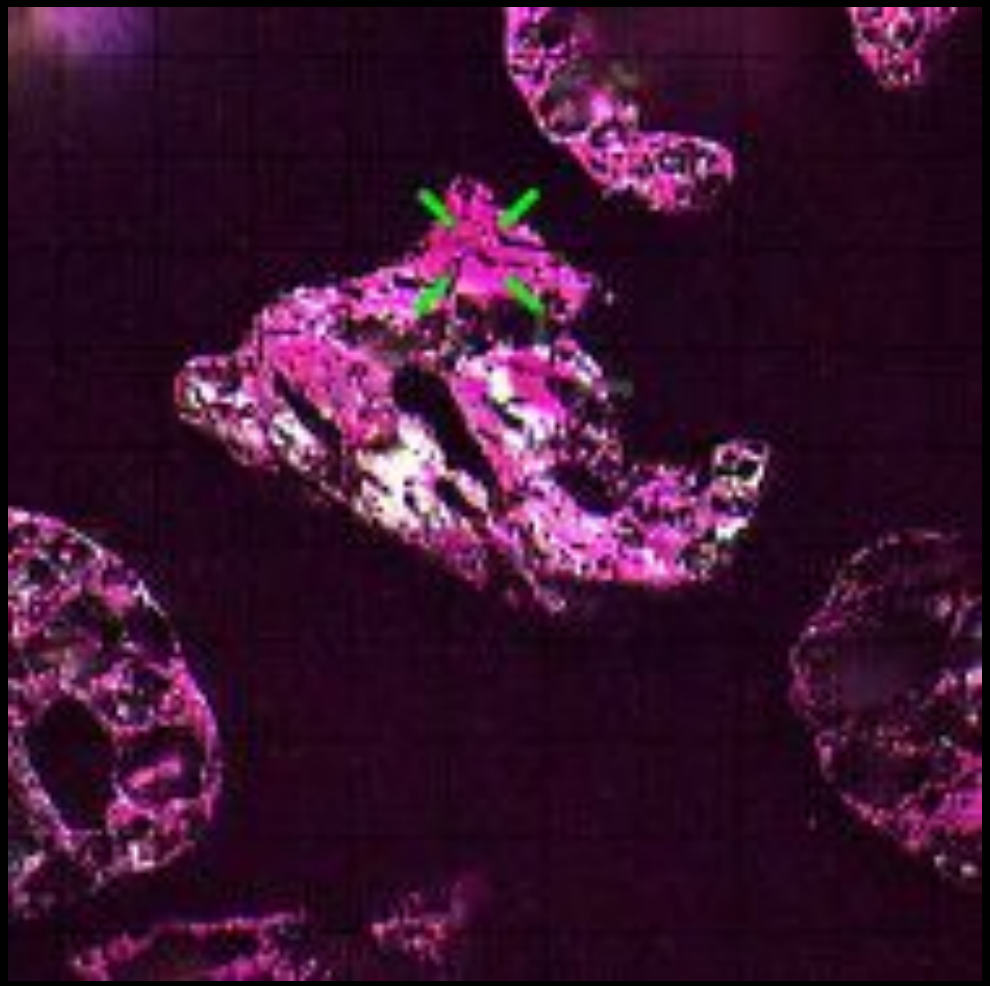

50 μm

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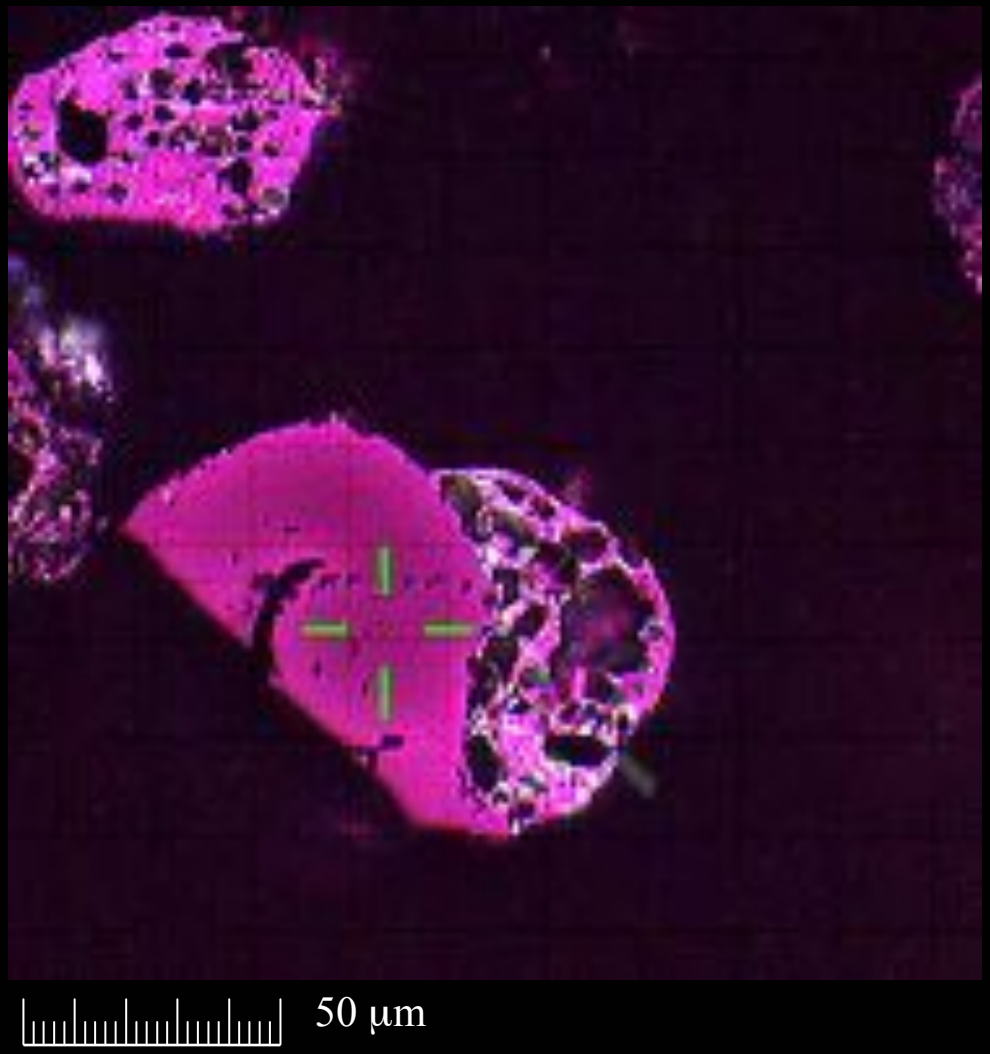

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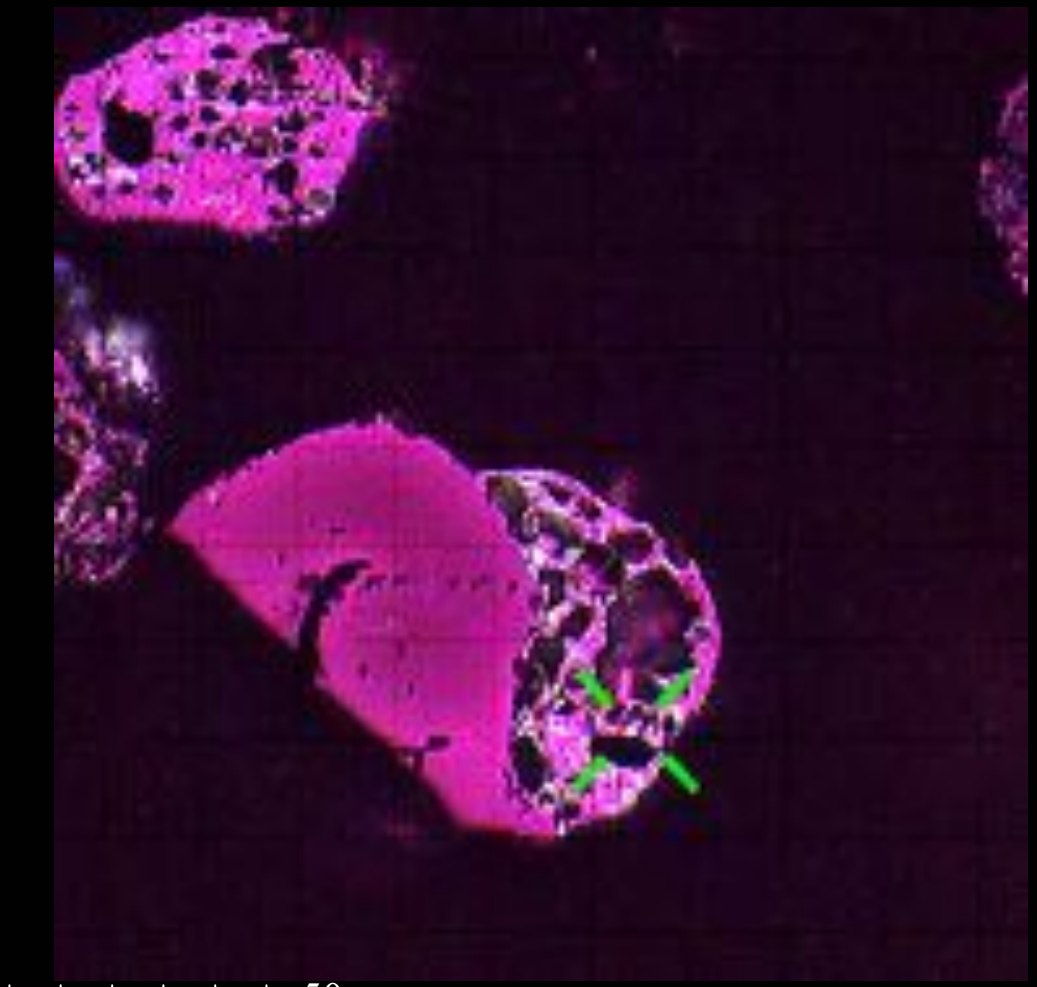

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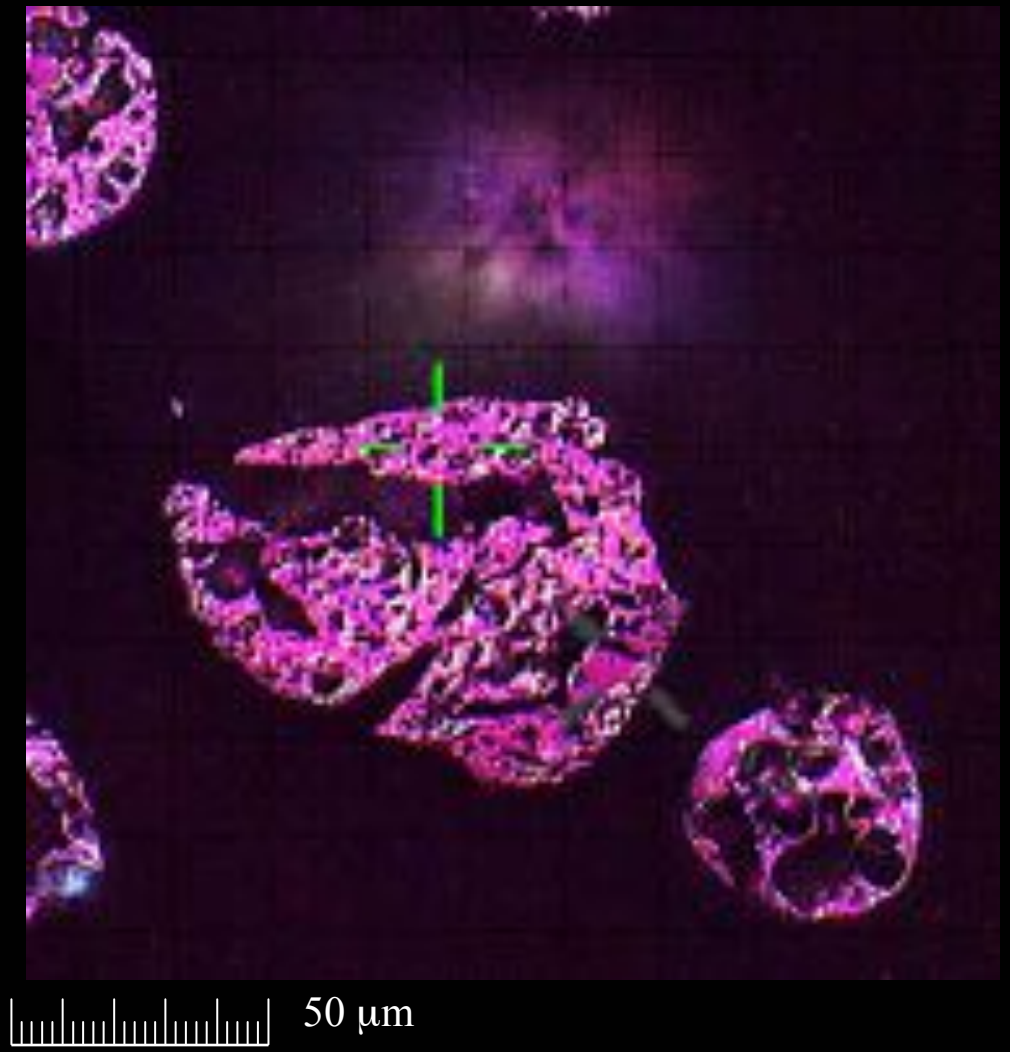

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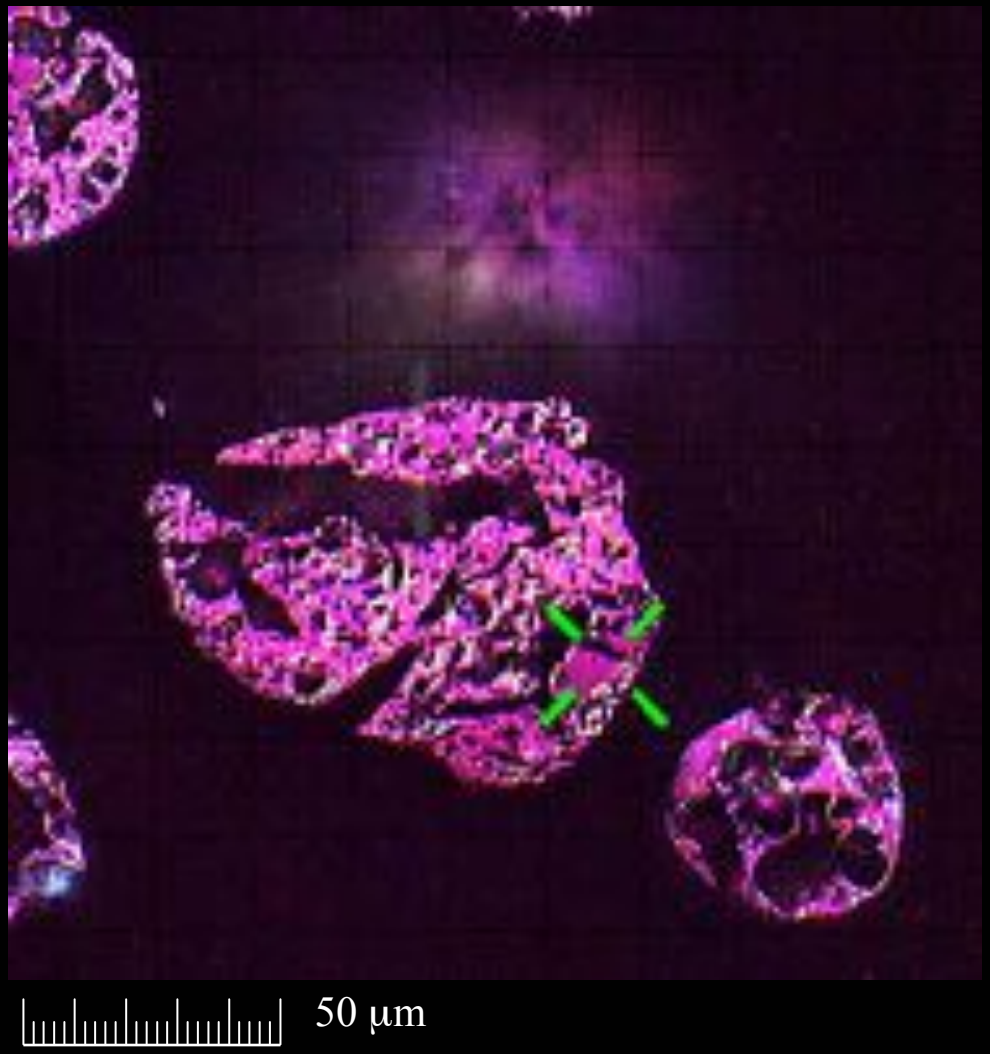

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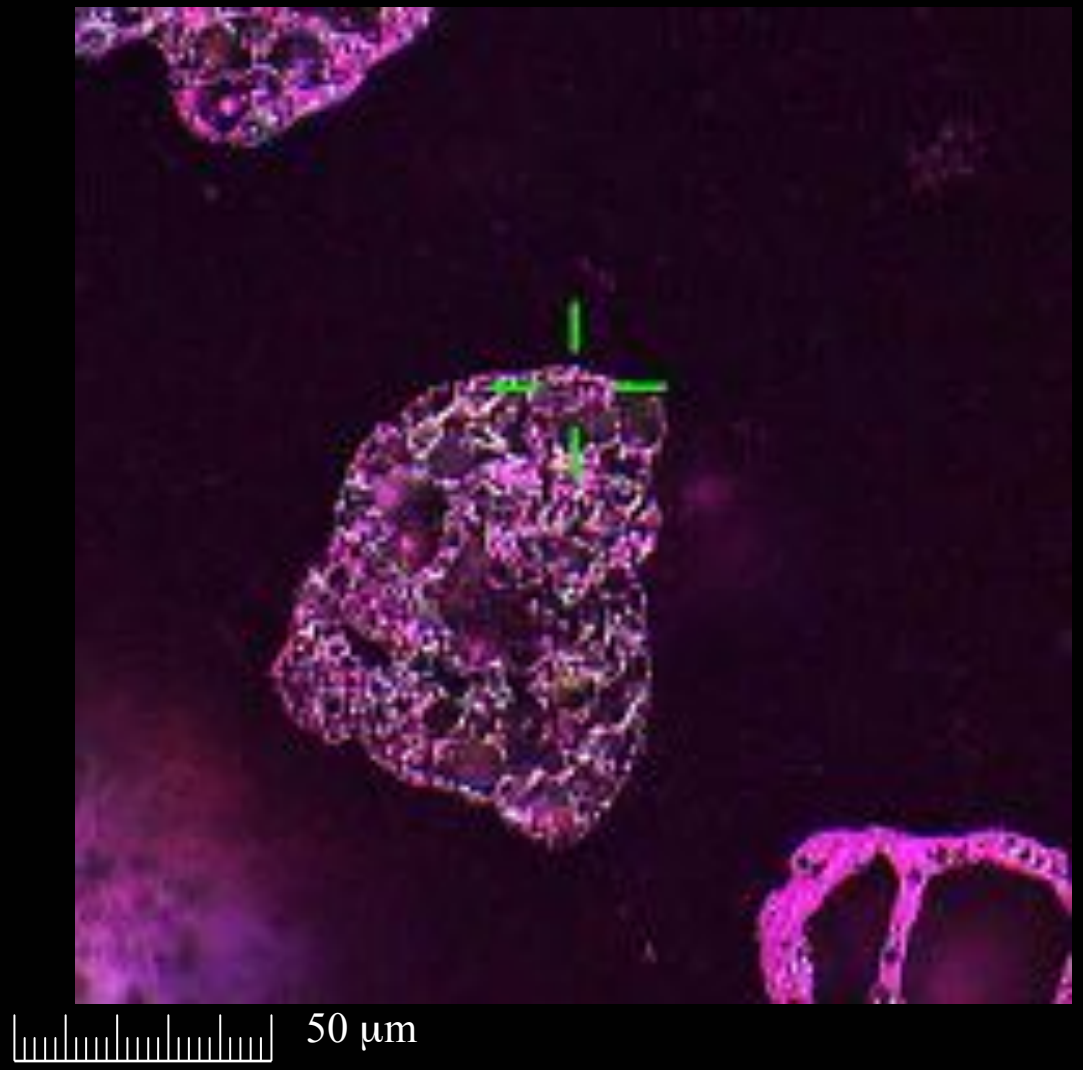

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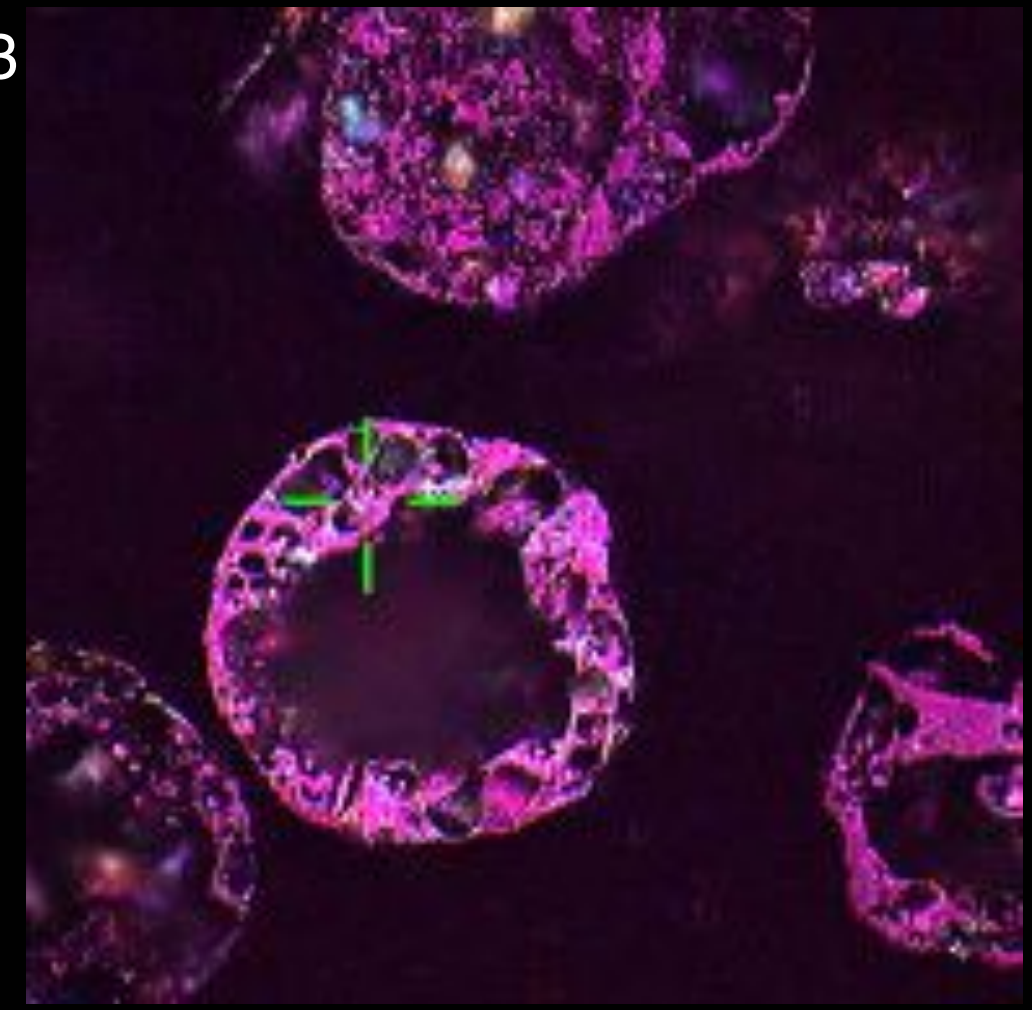

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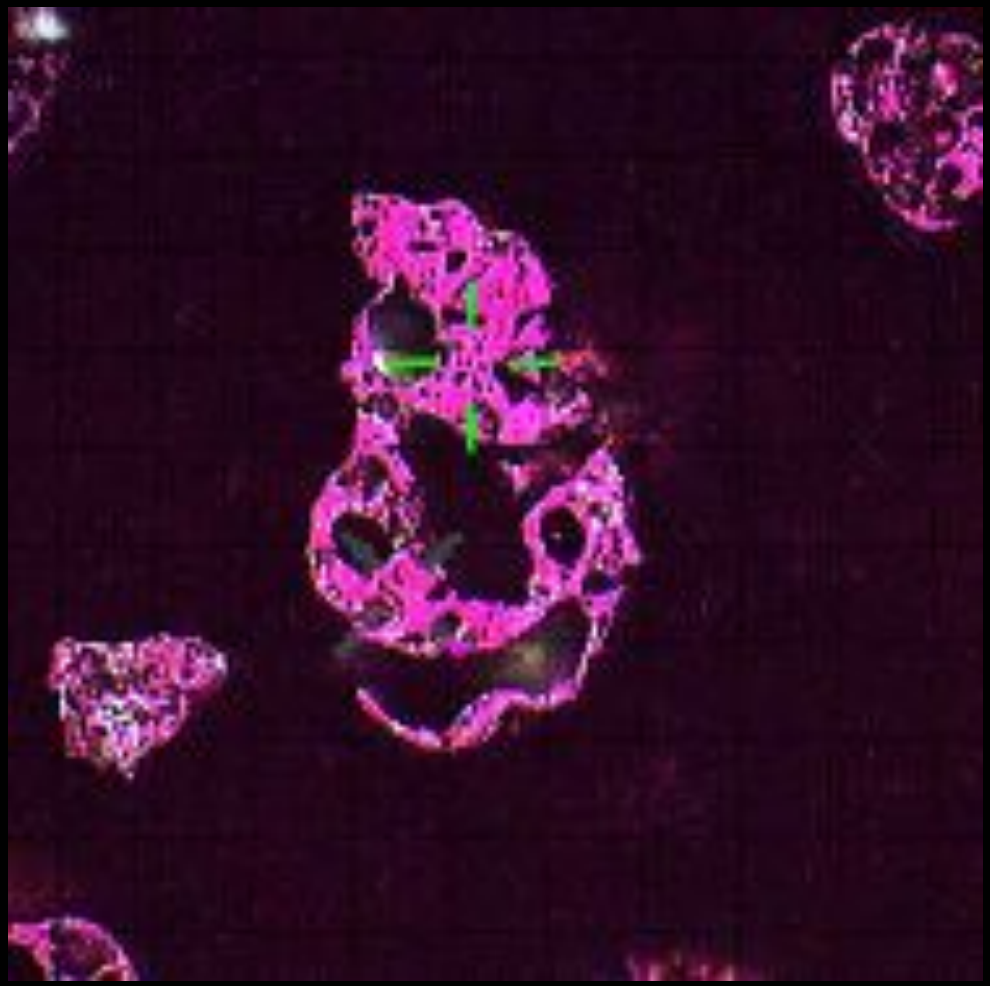

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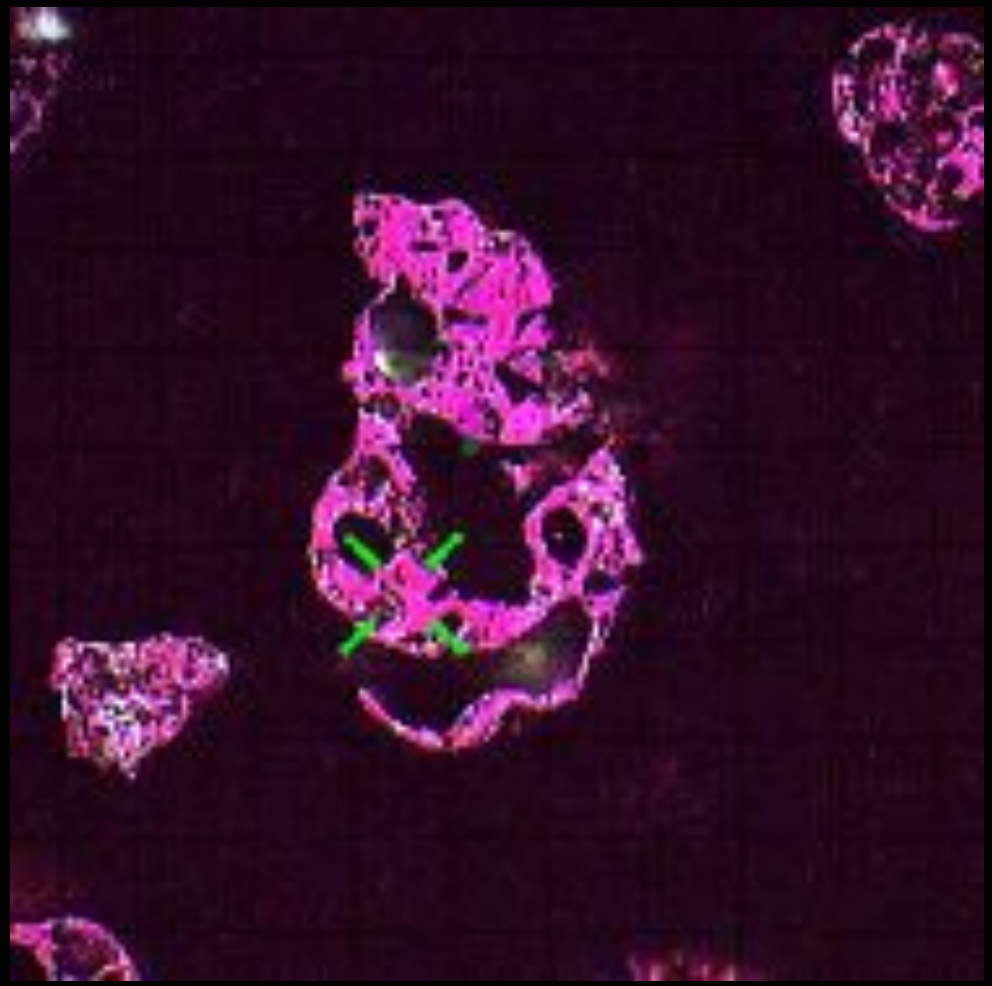

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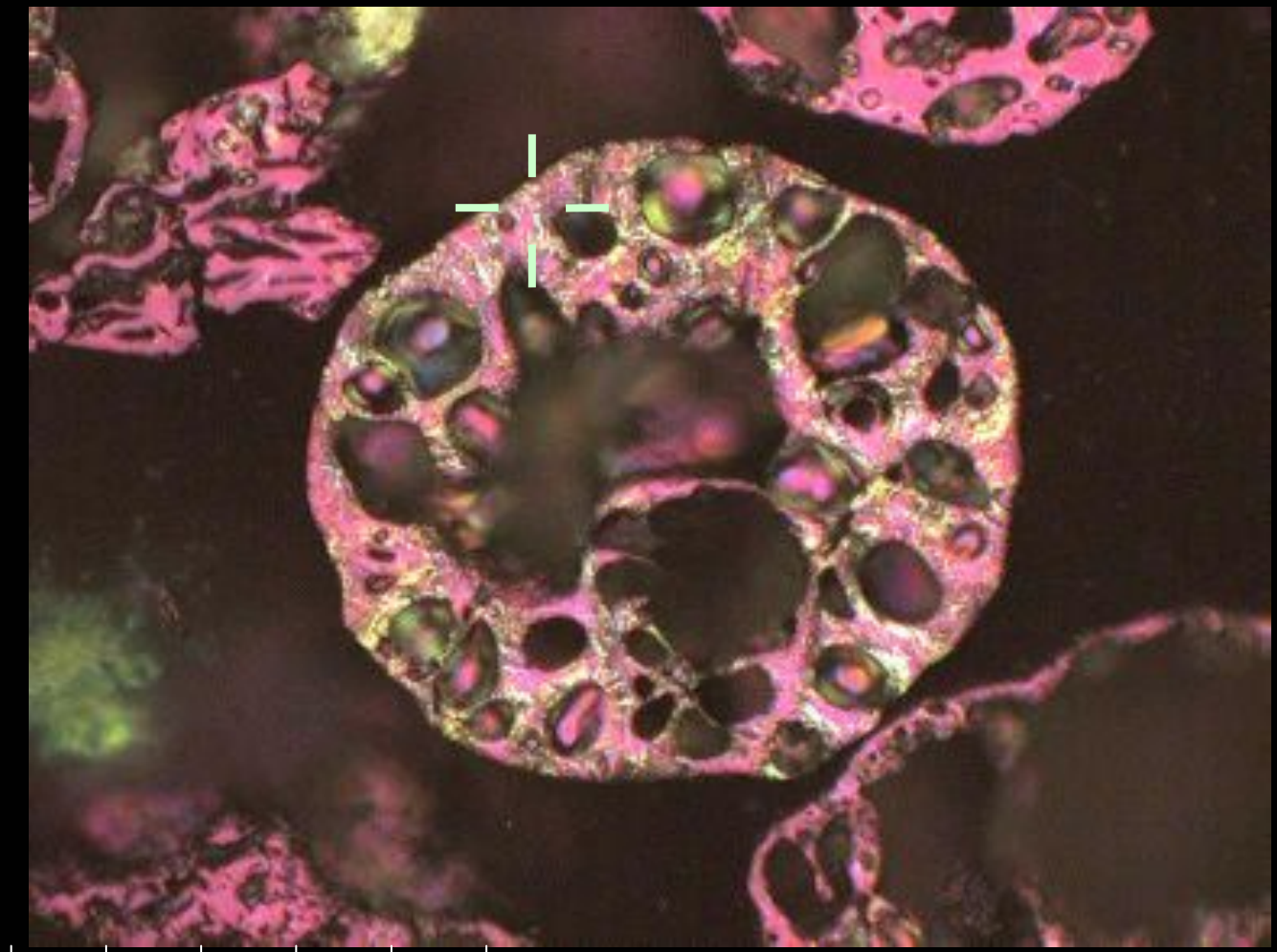

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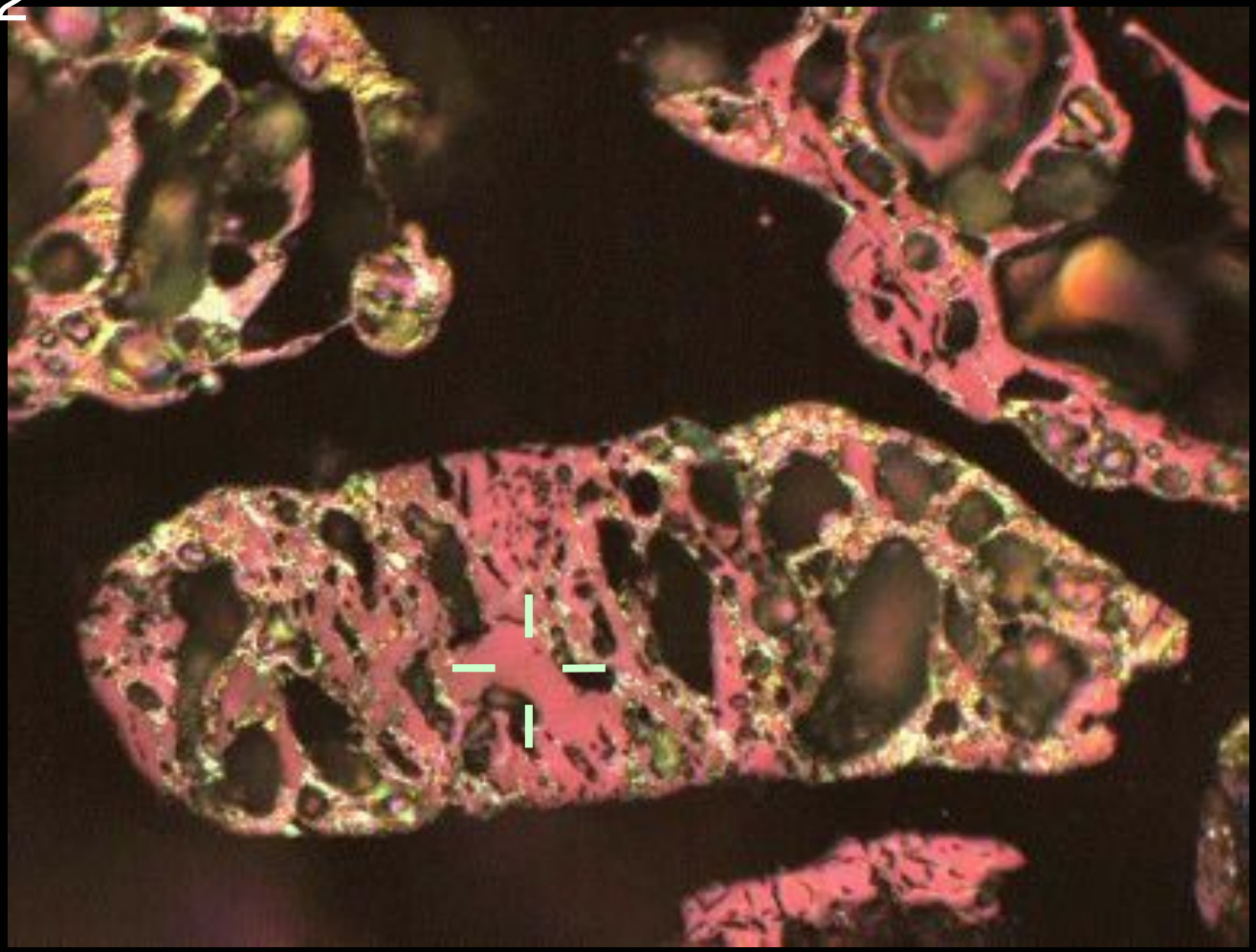

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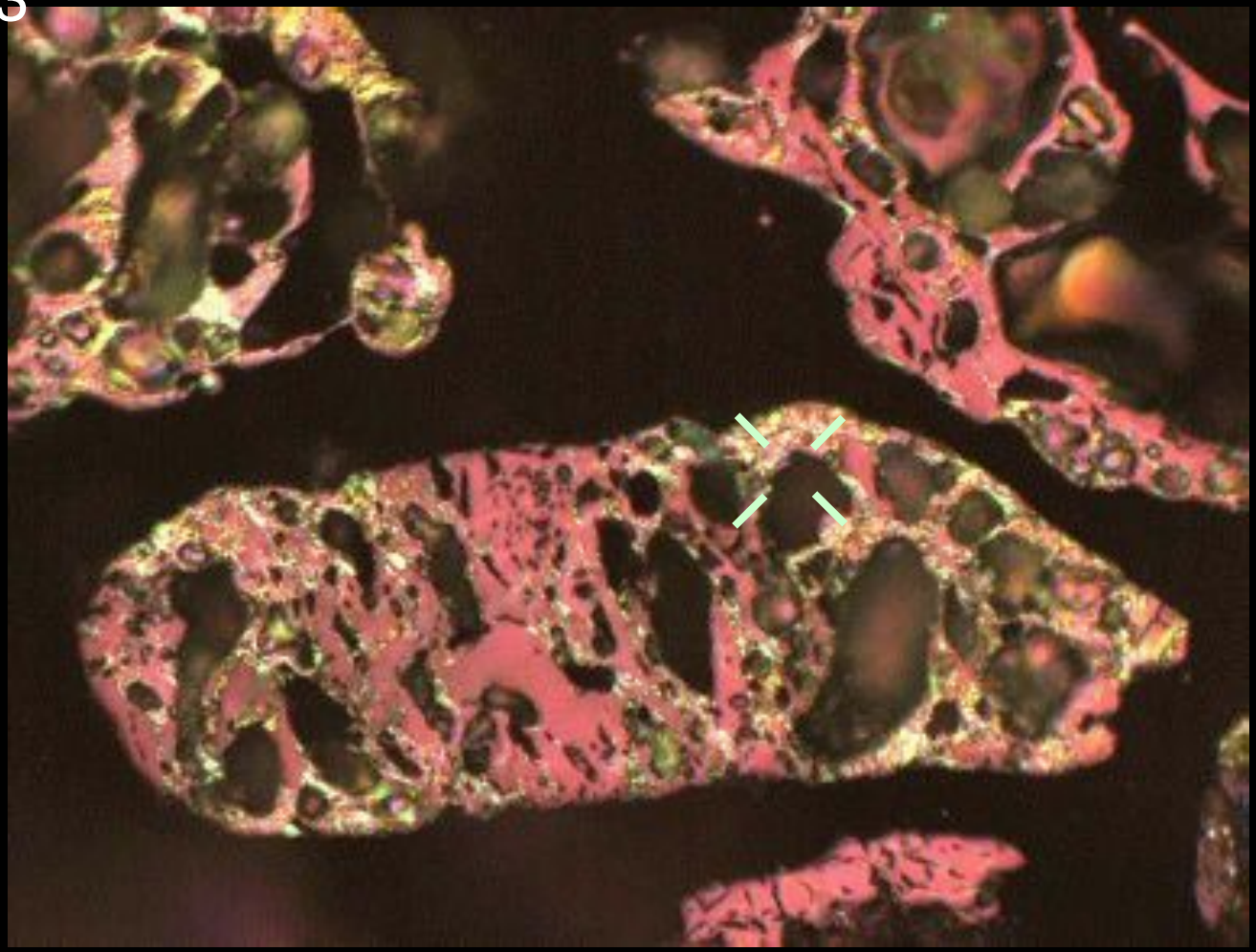

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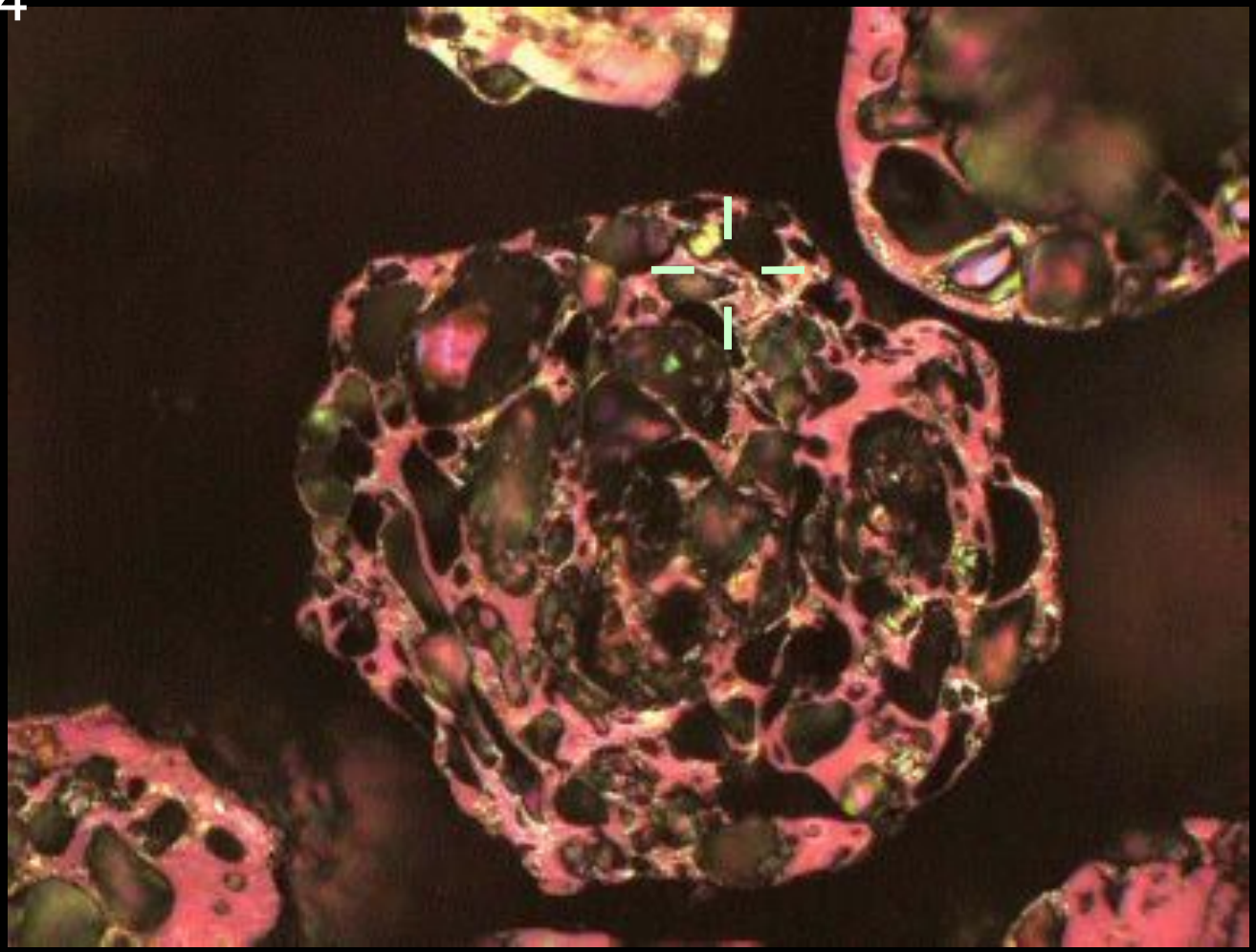

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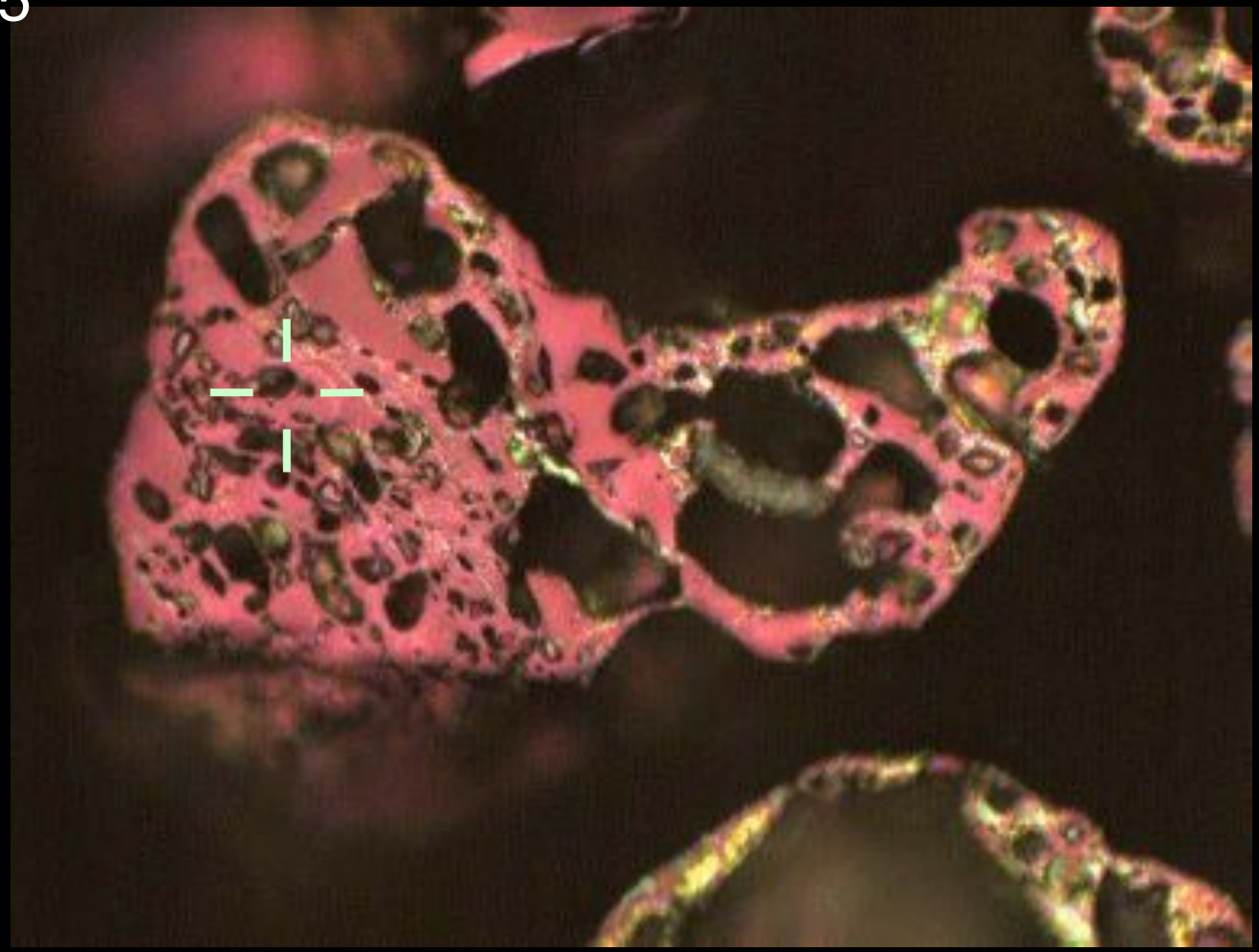

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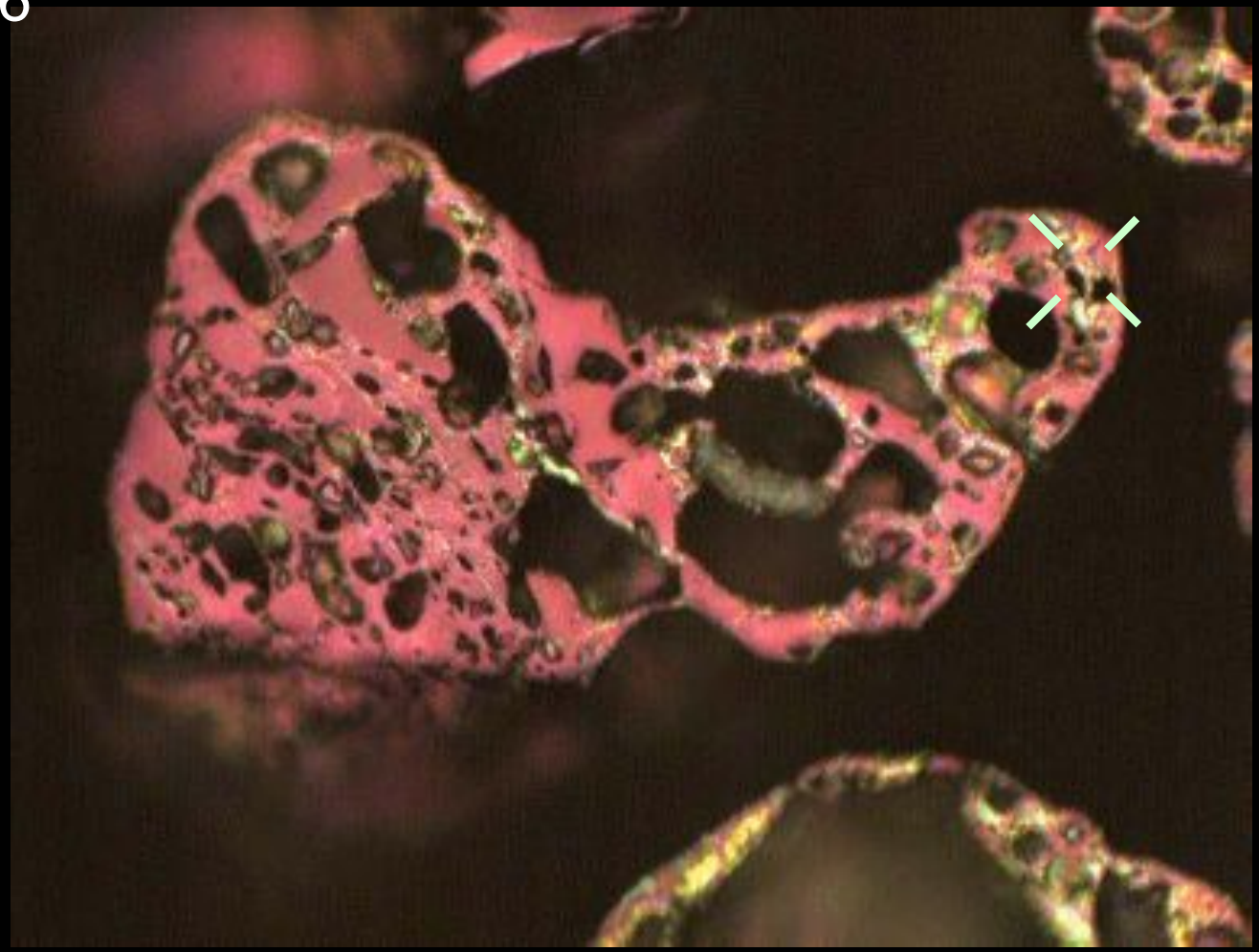

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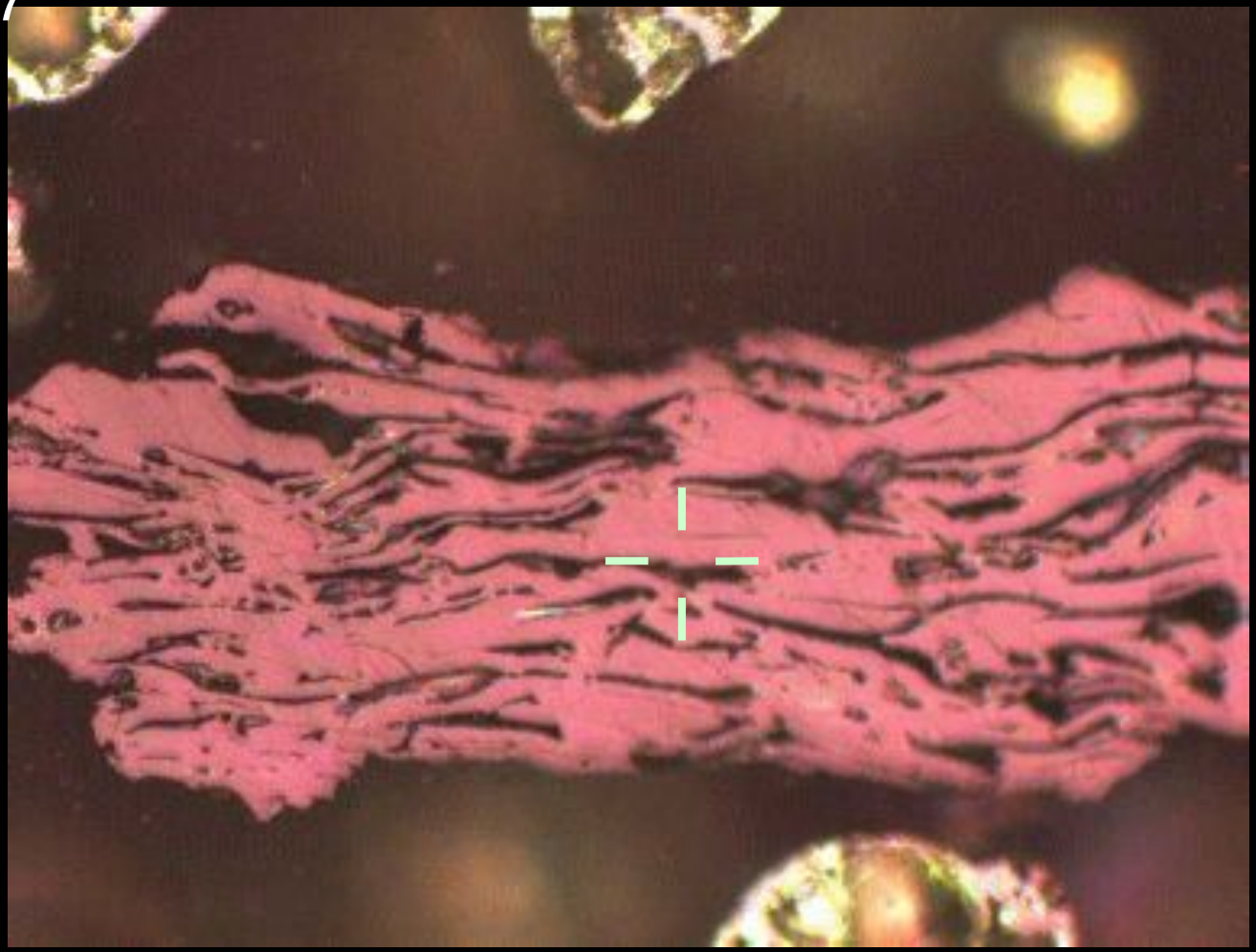

50 μm

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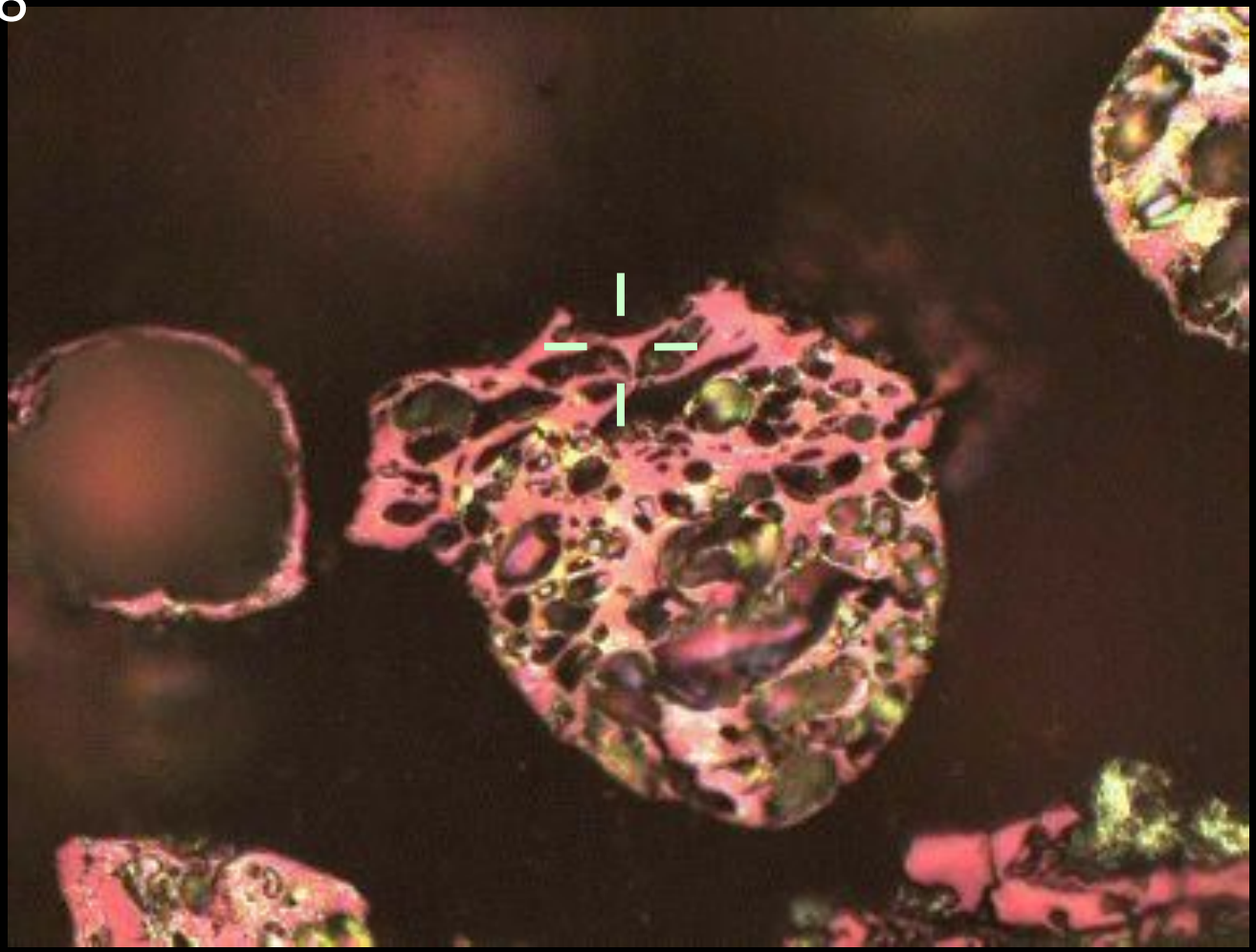

50 μm

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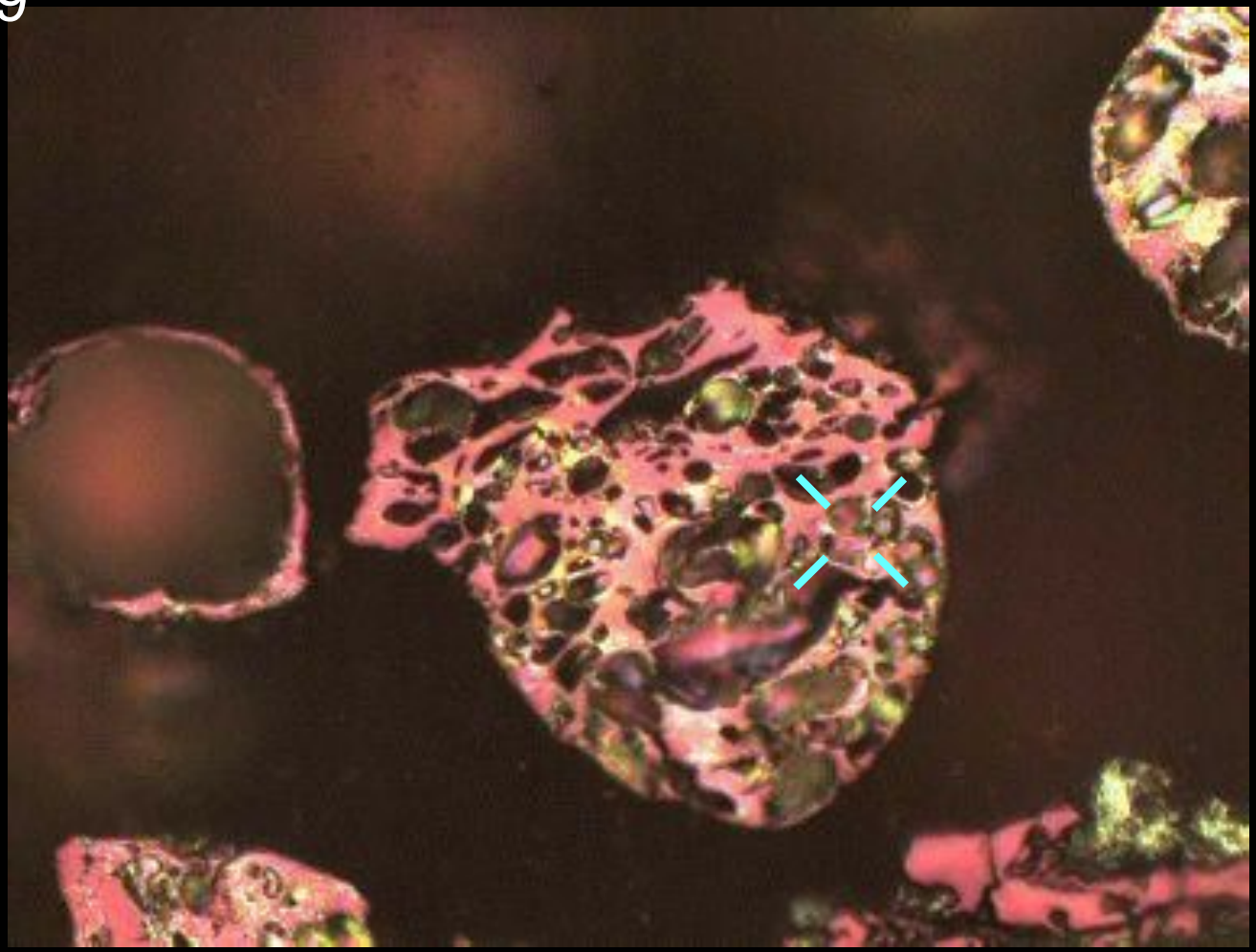

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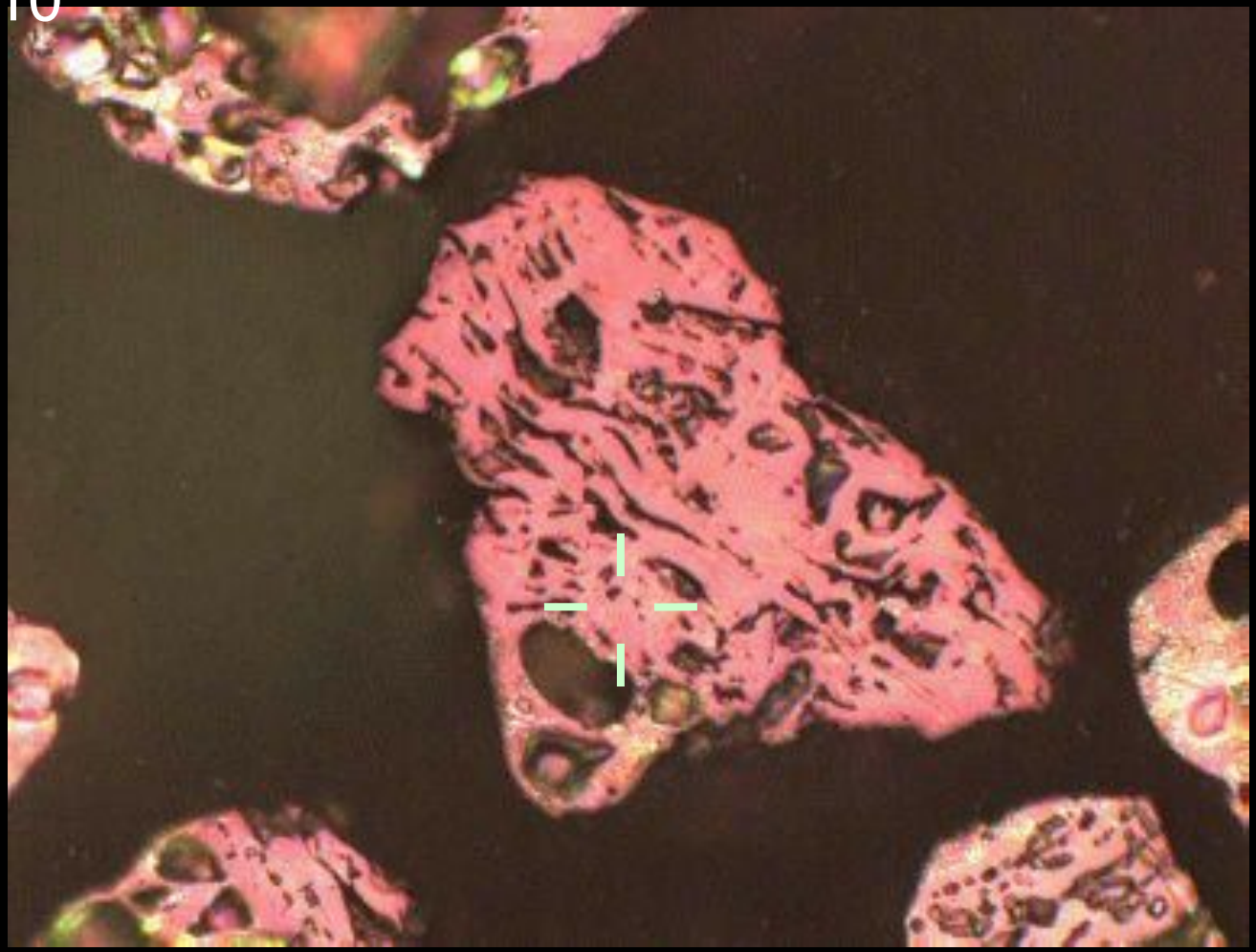

50 μm

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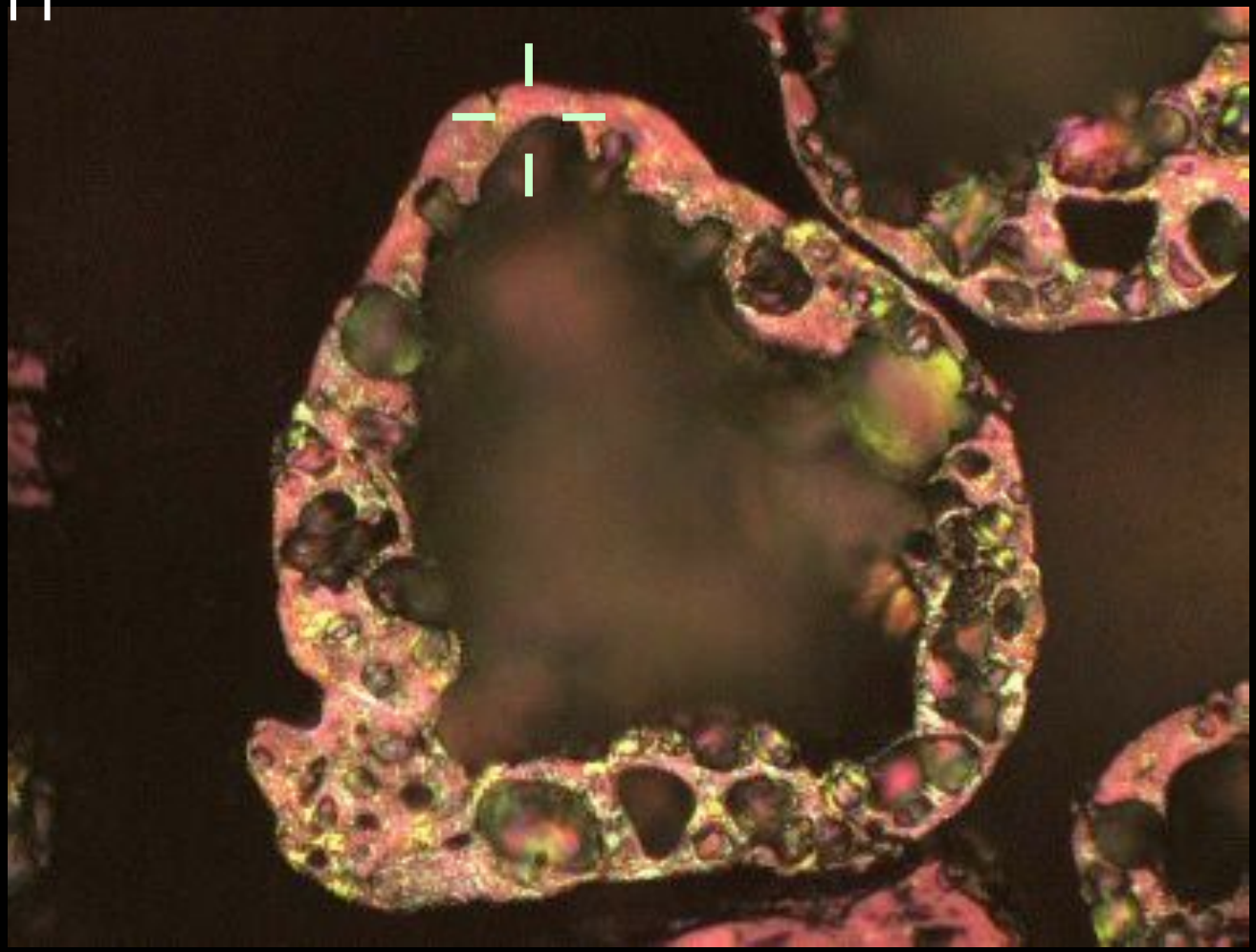

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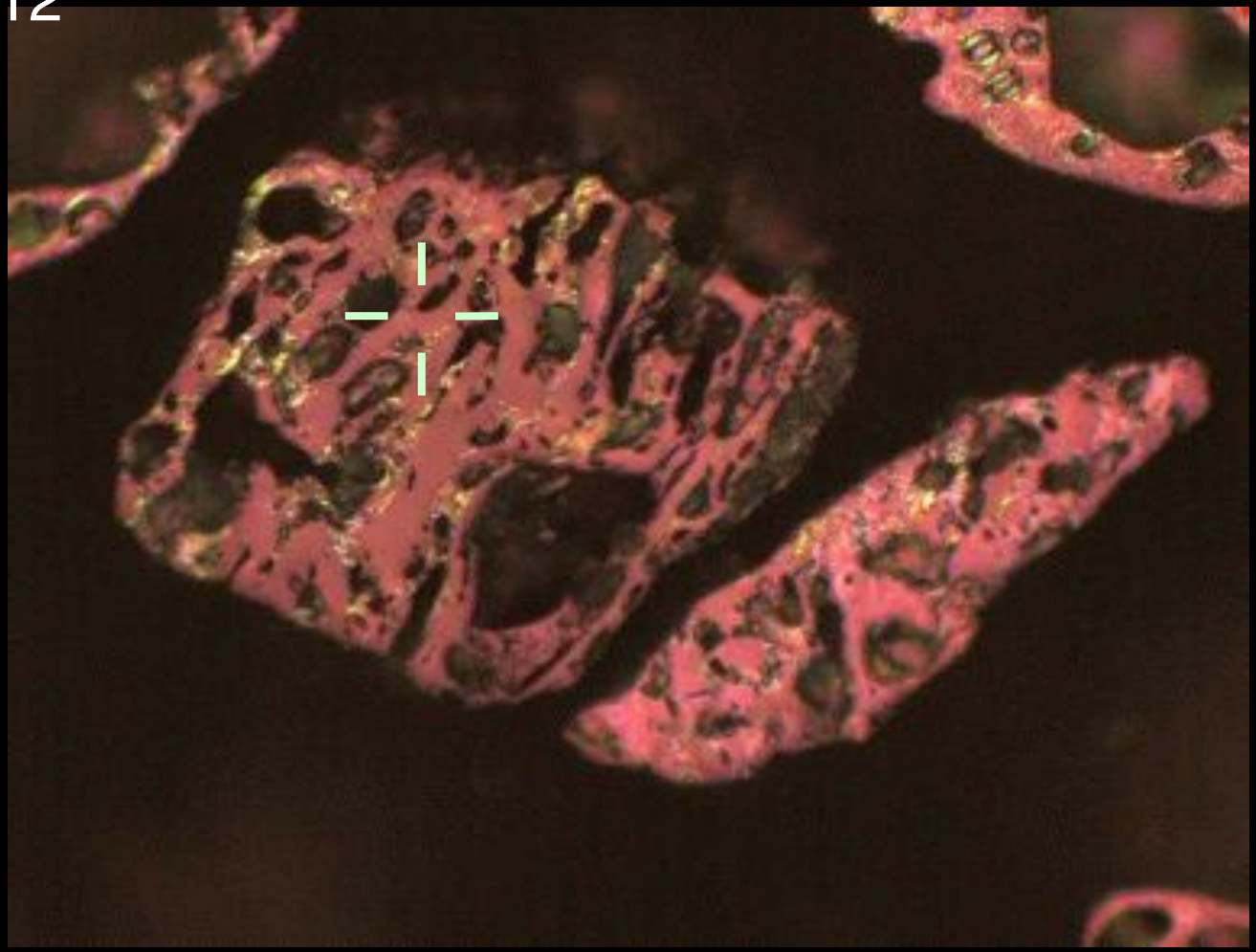

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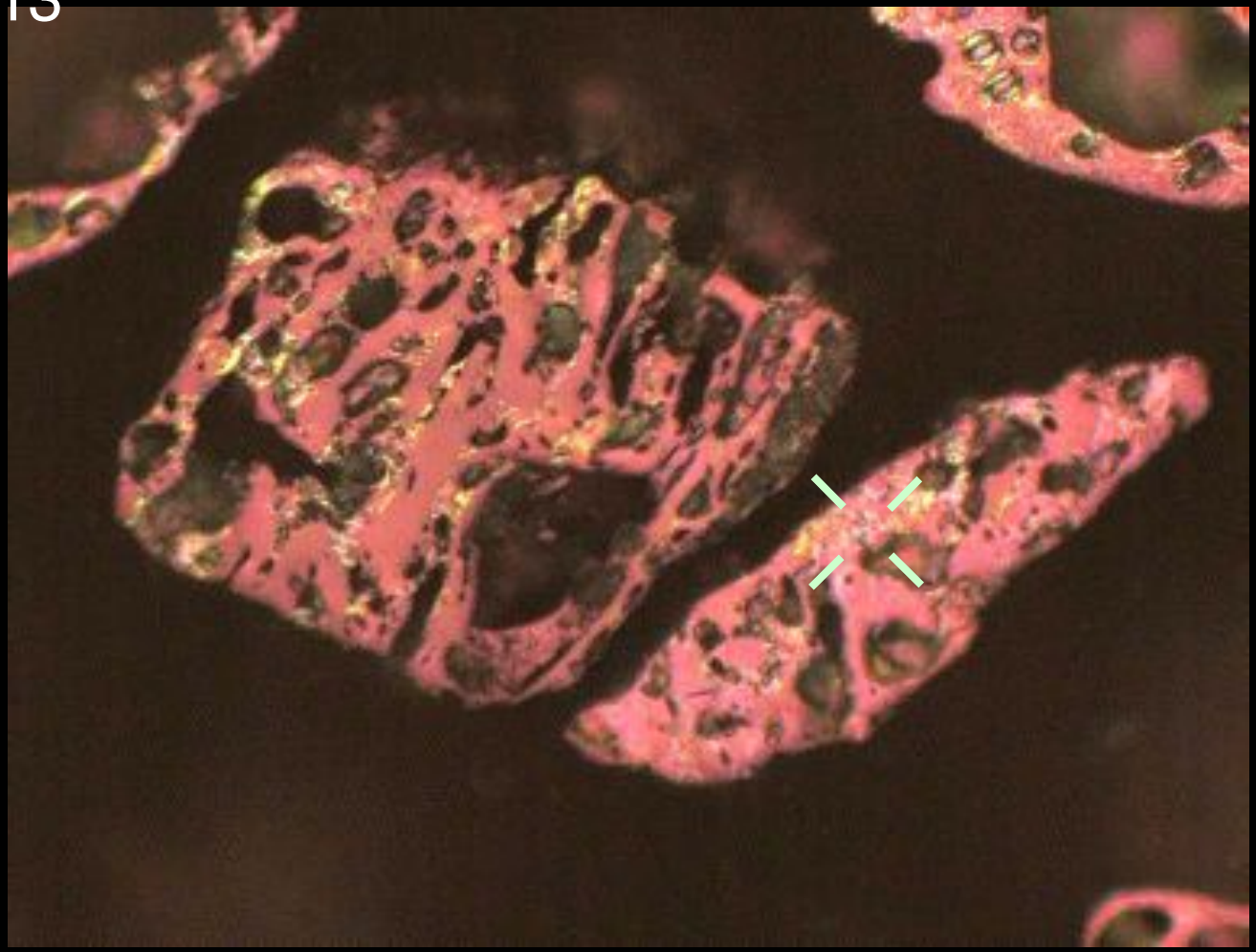

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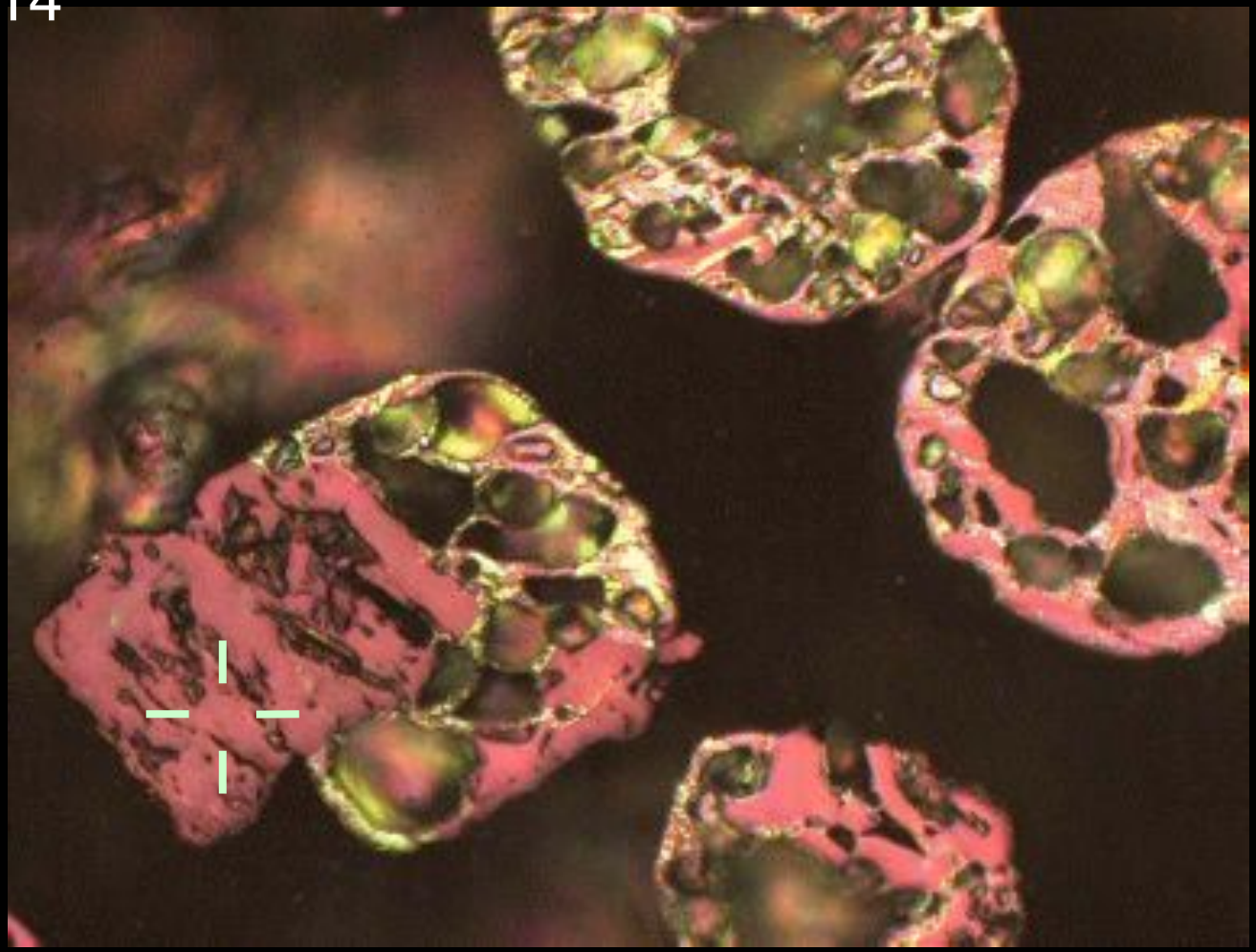

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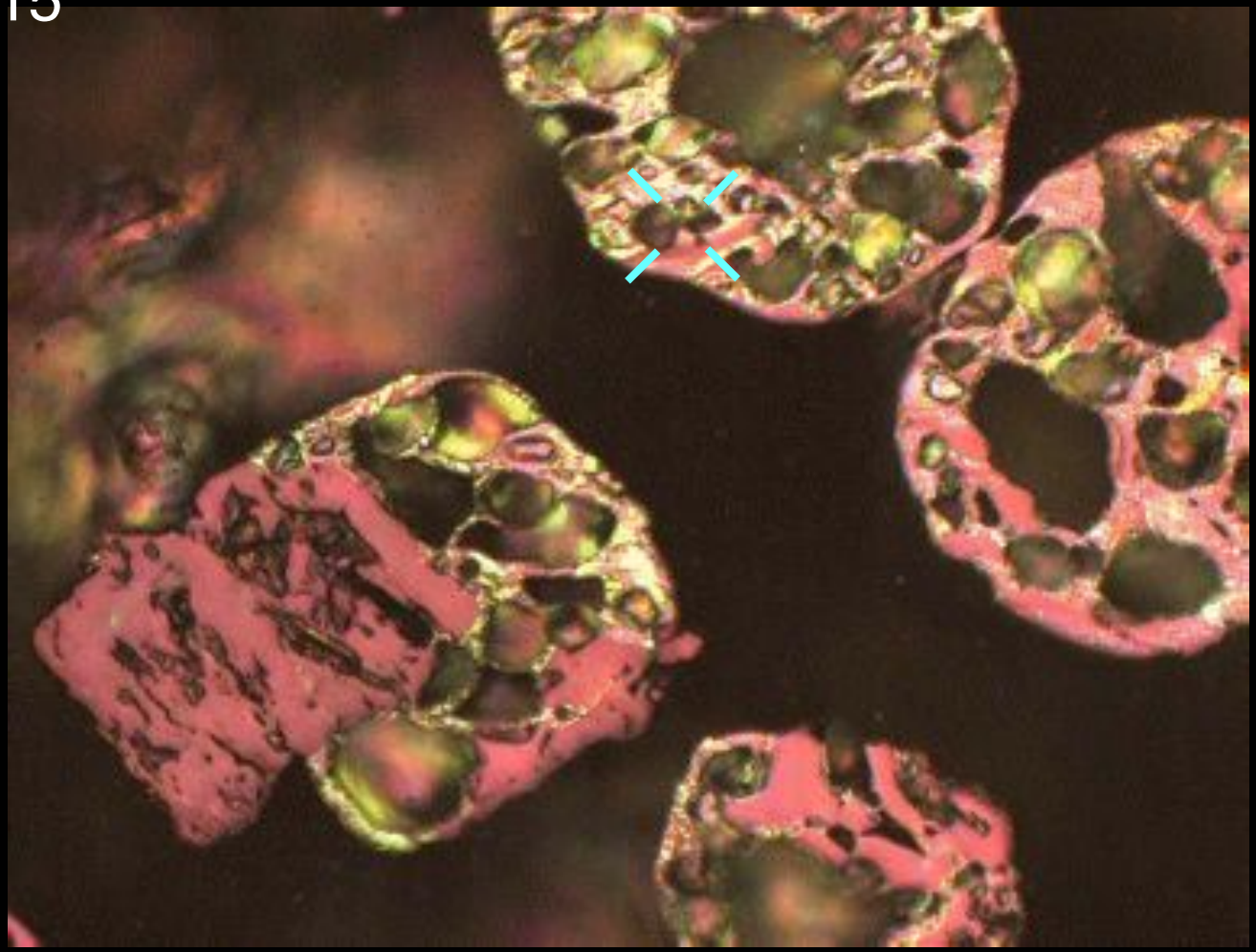

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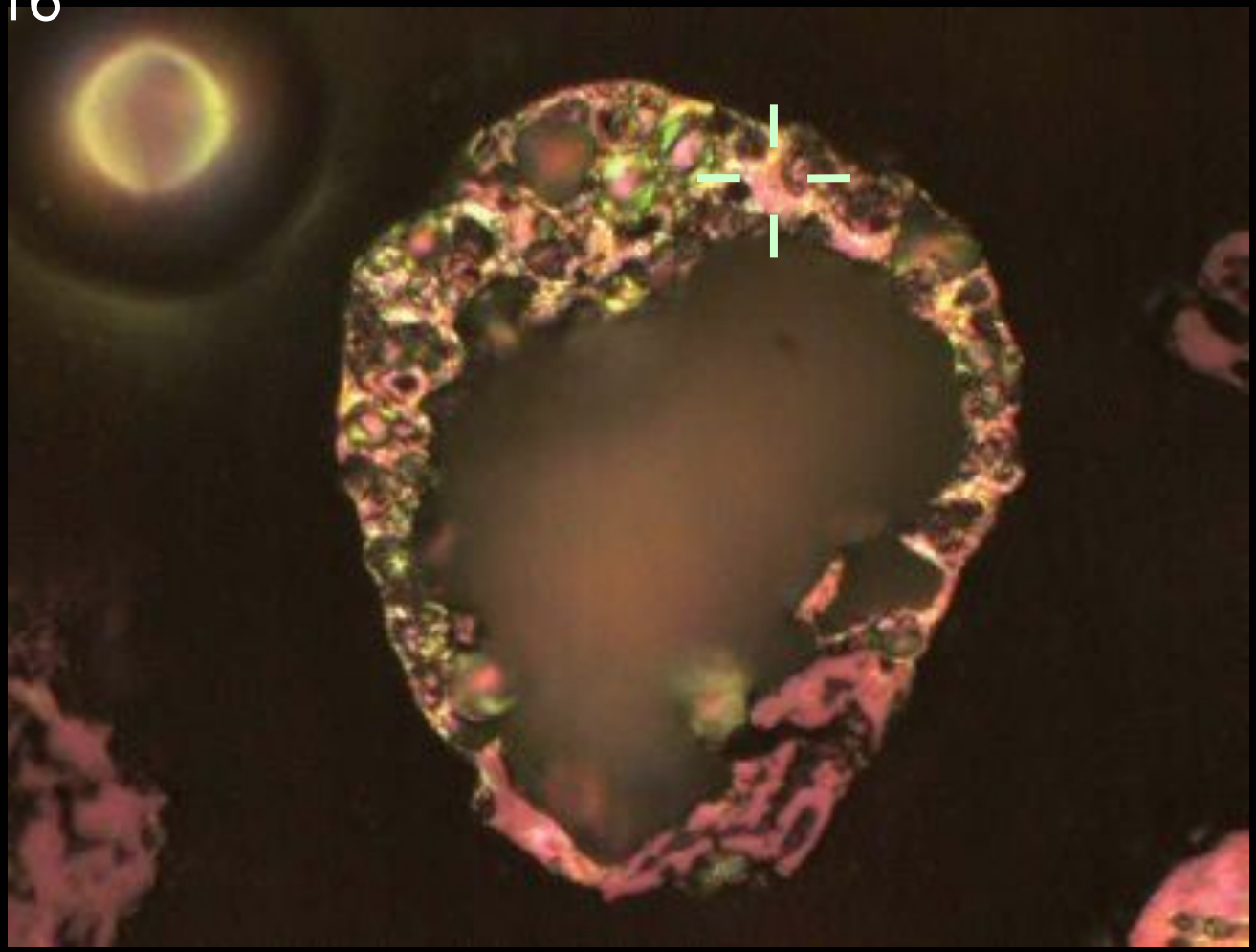

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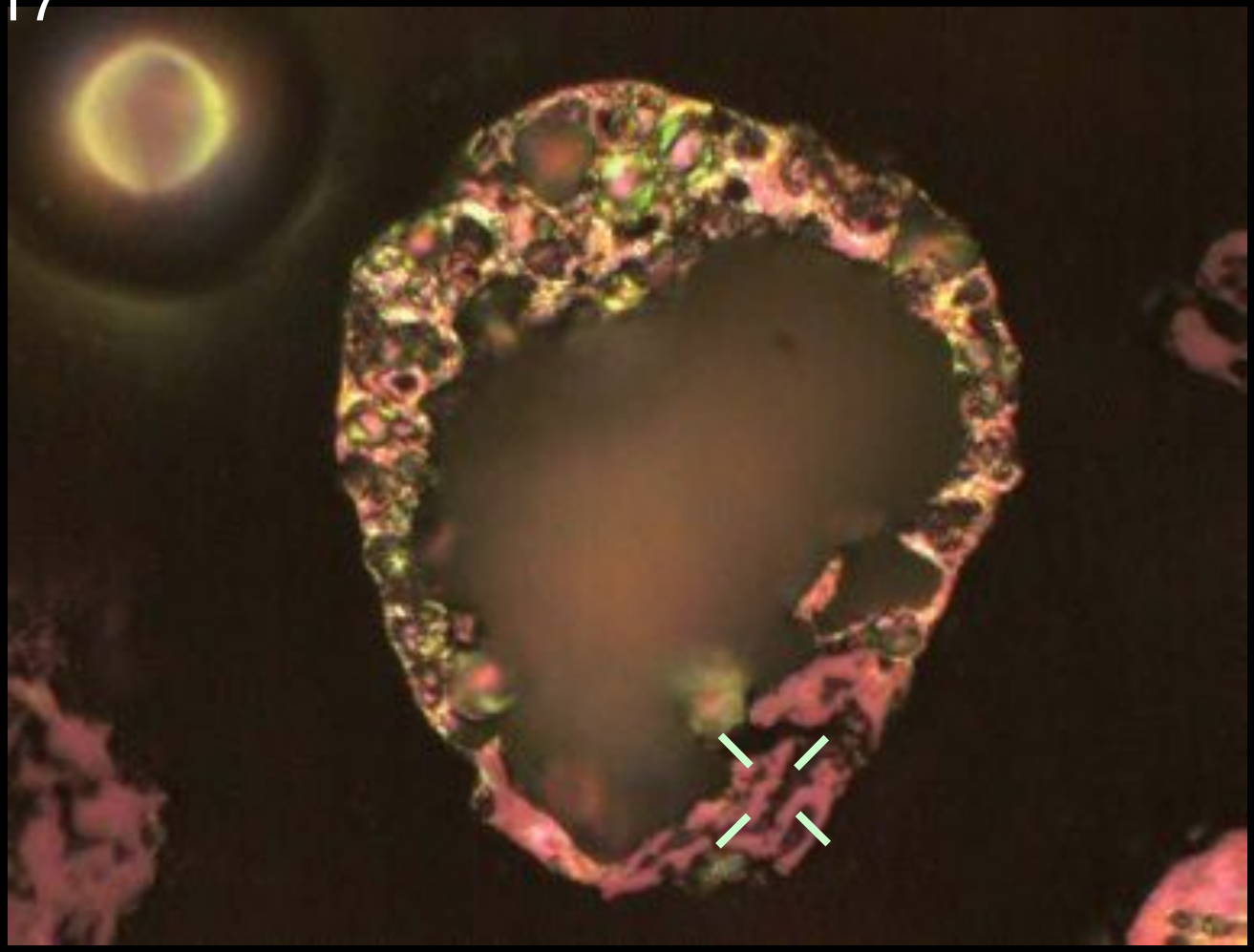

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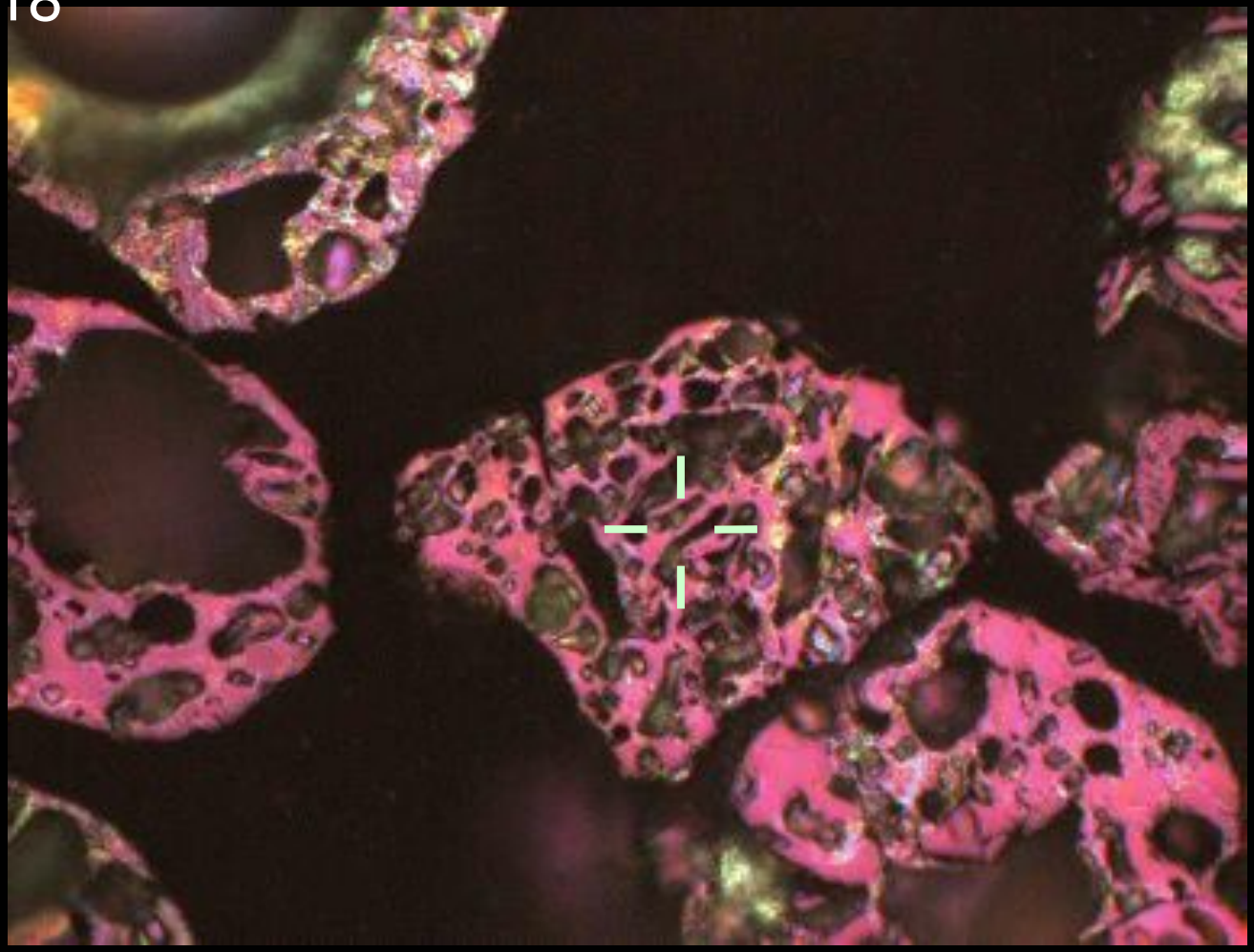

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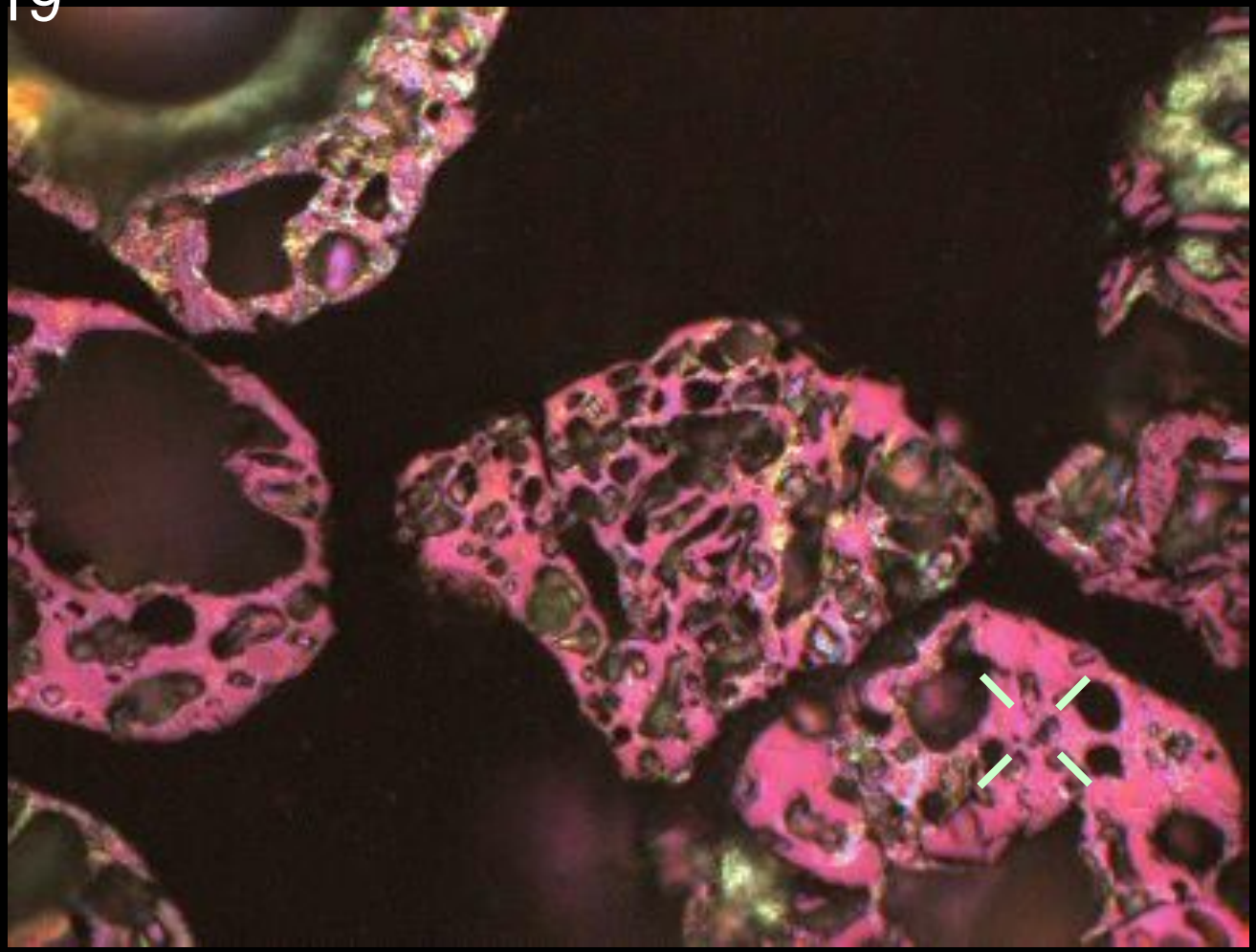

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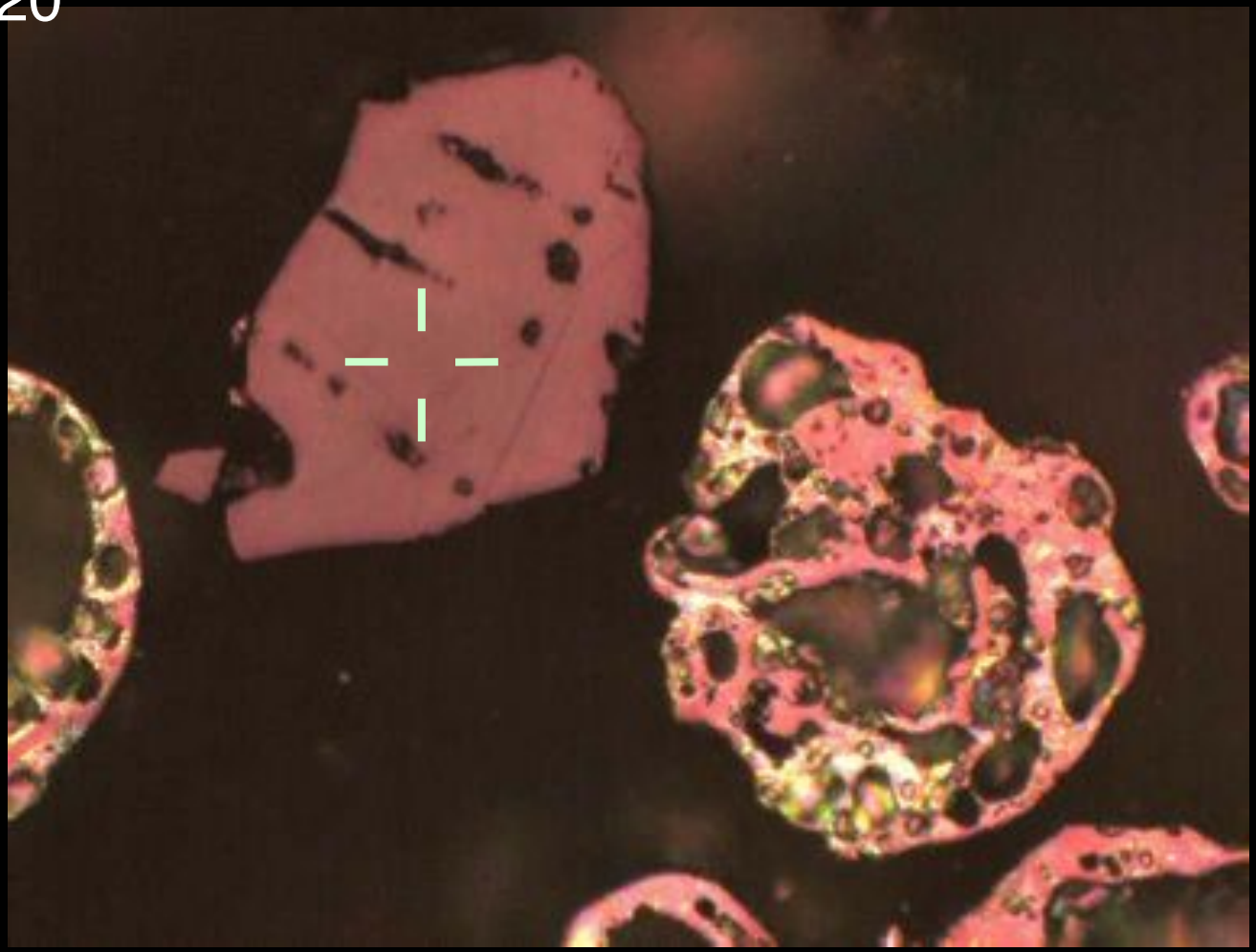

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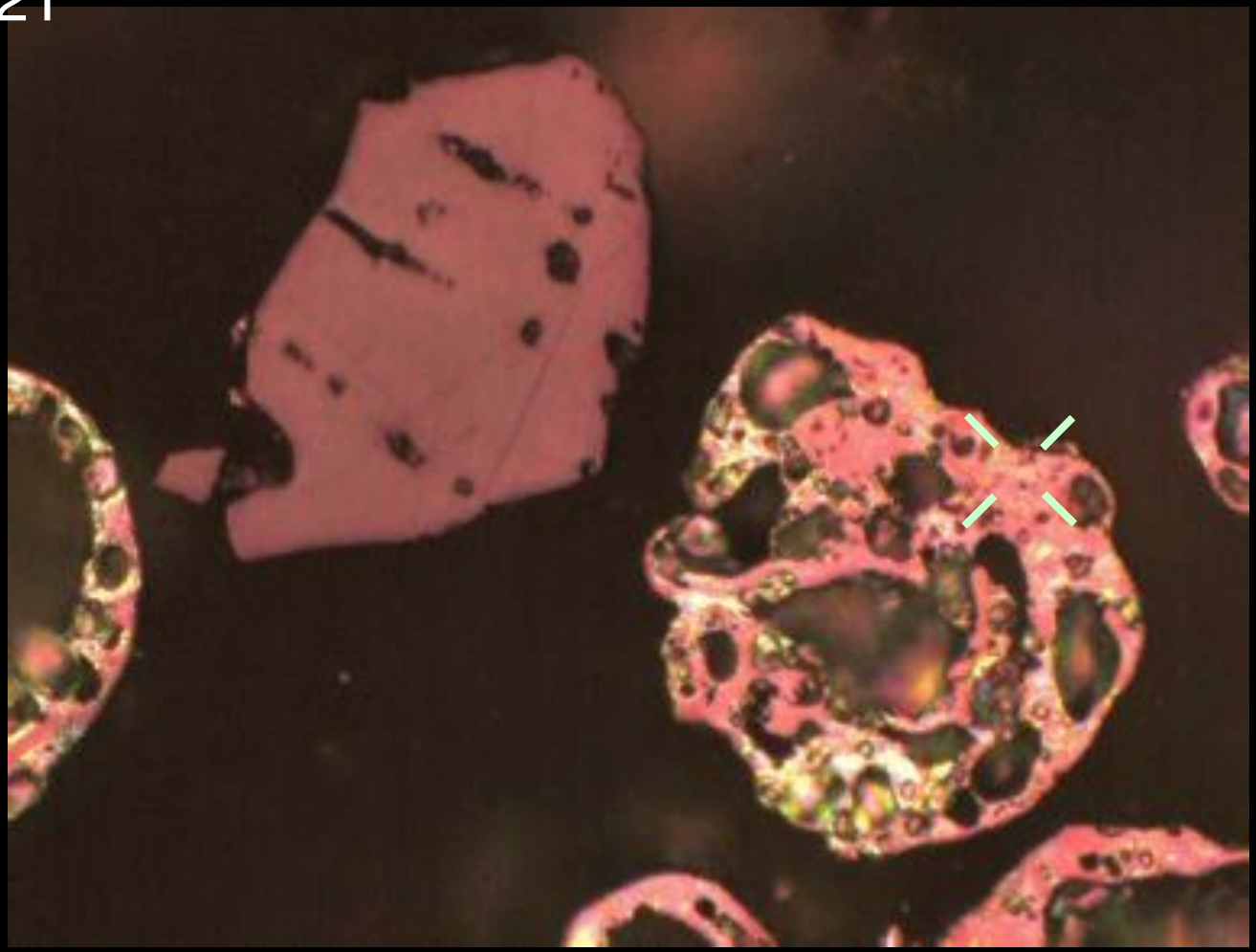

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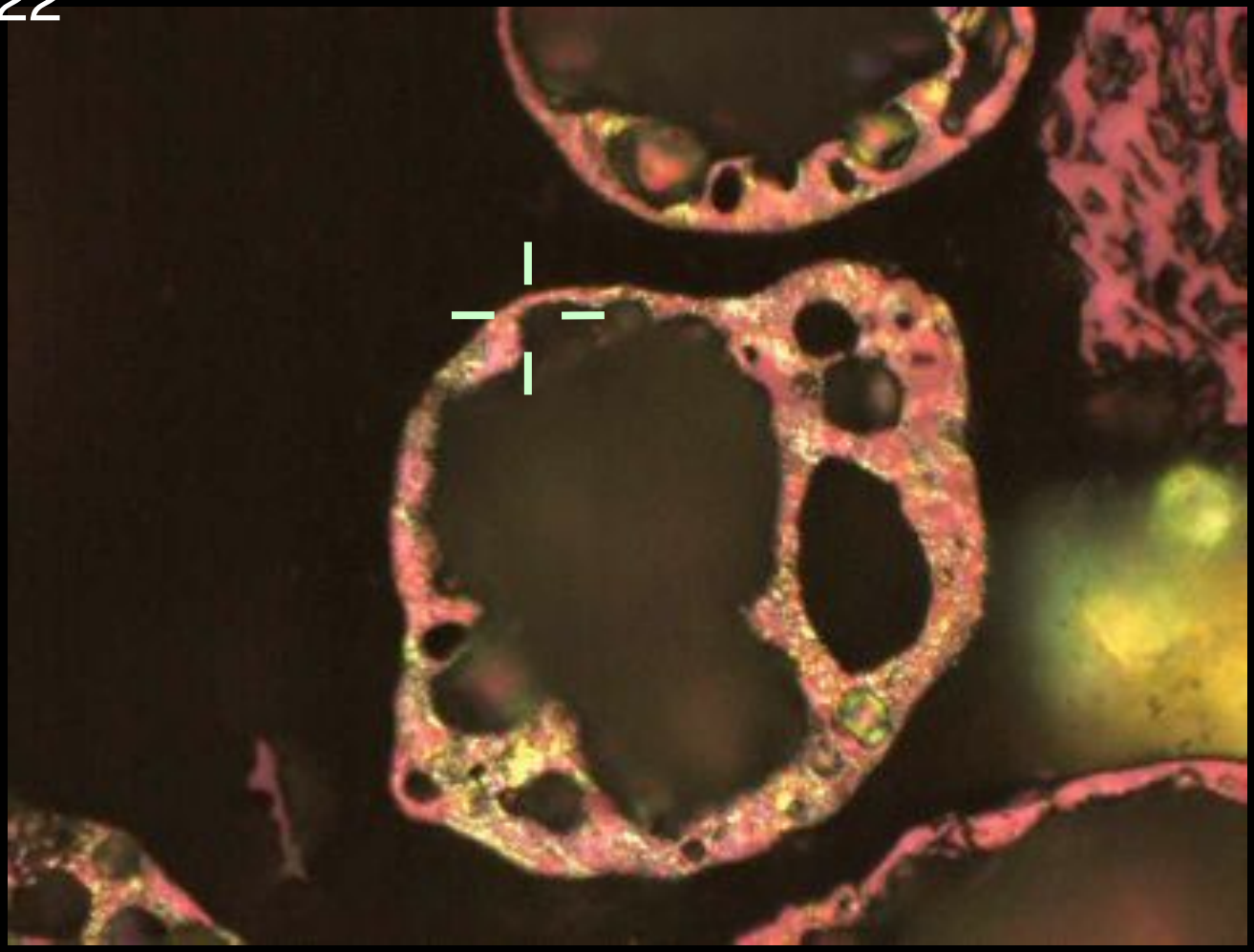

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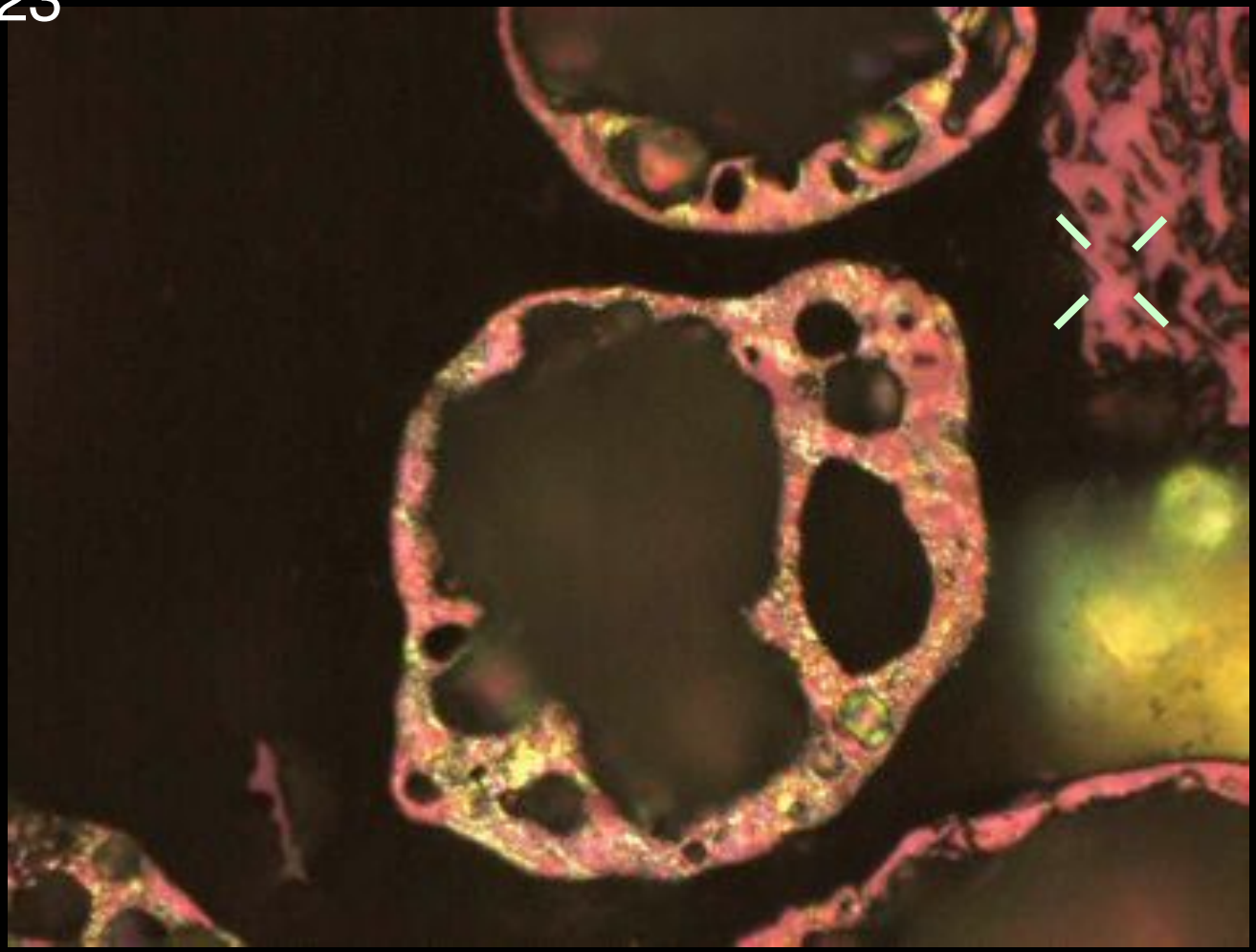

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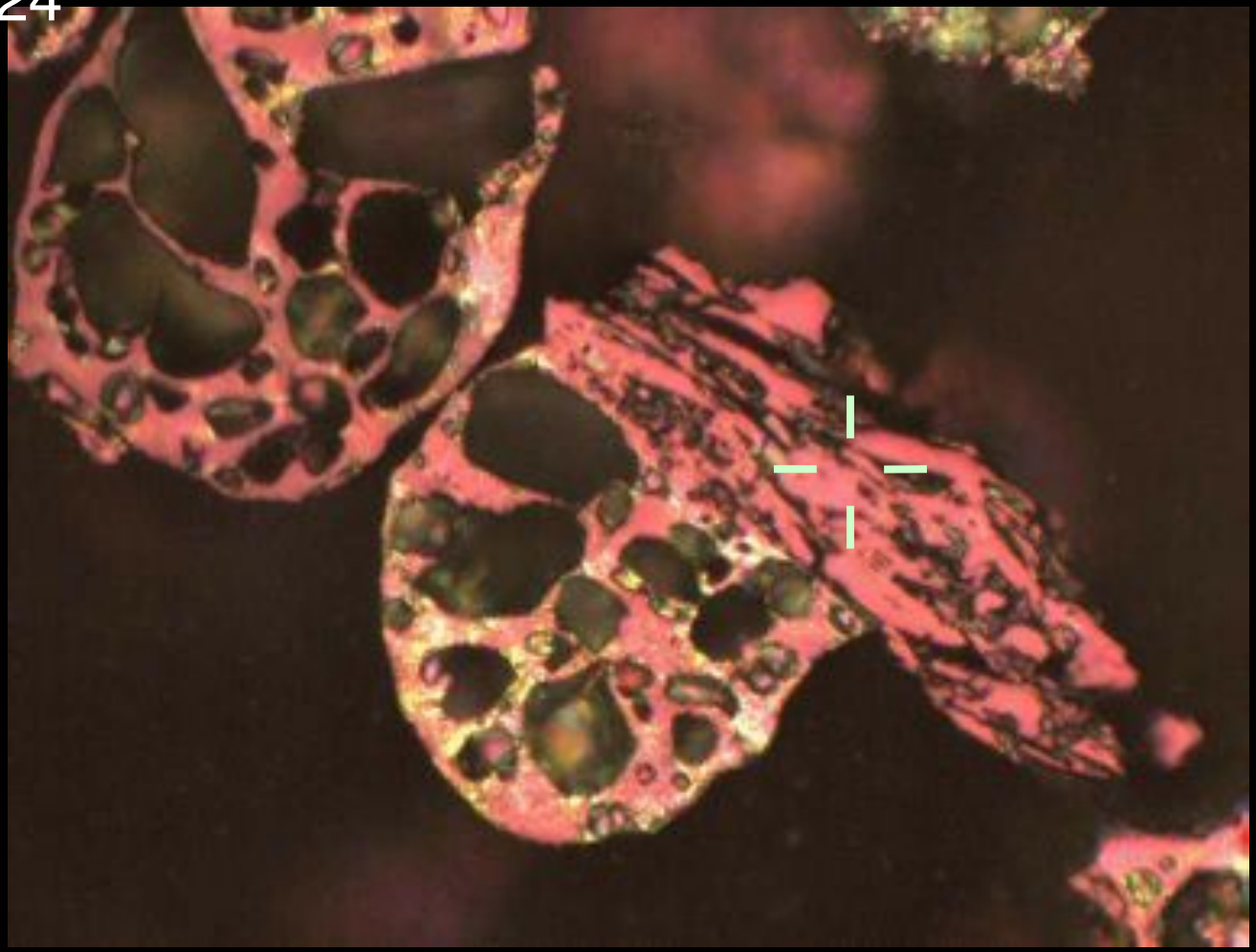

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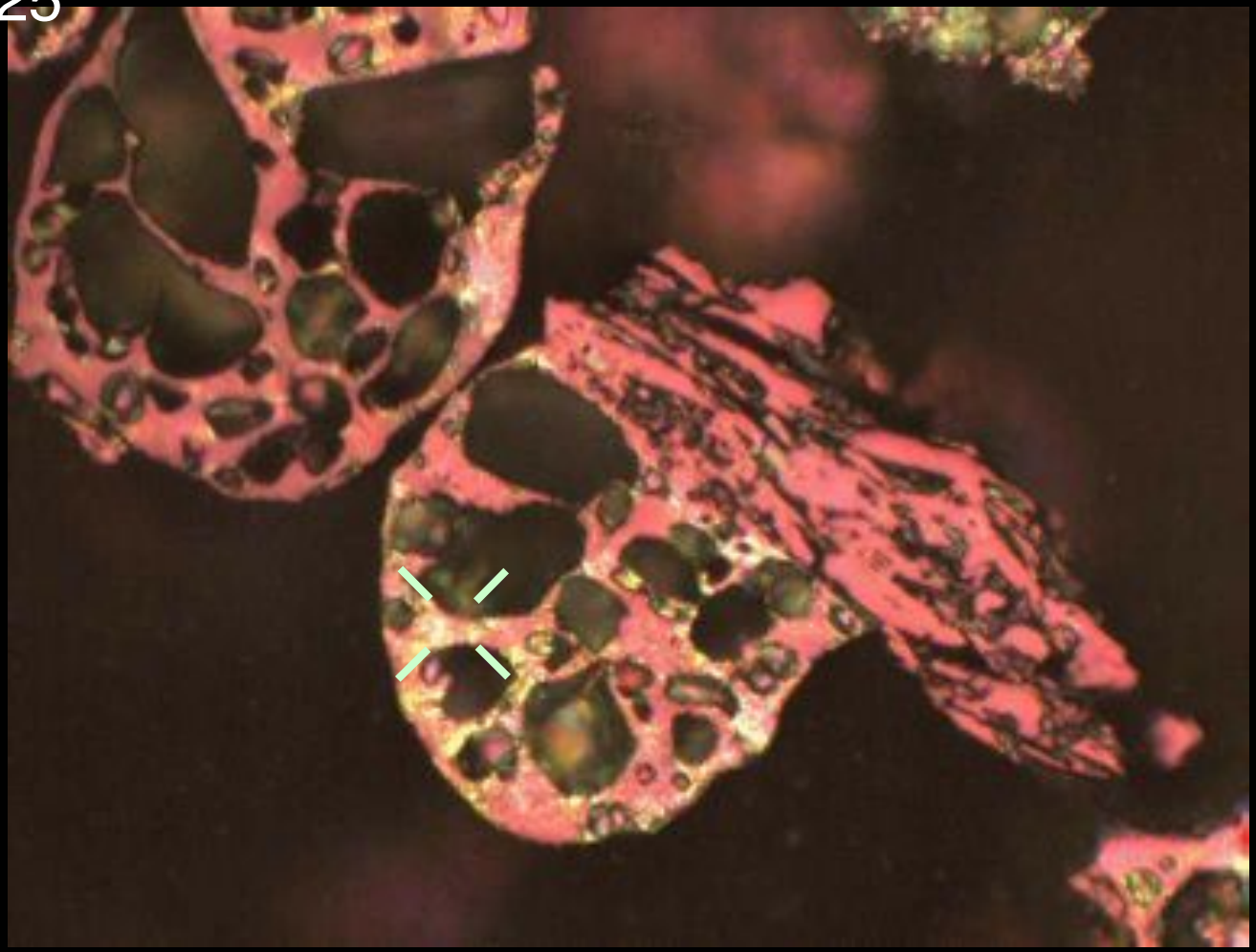

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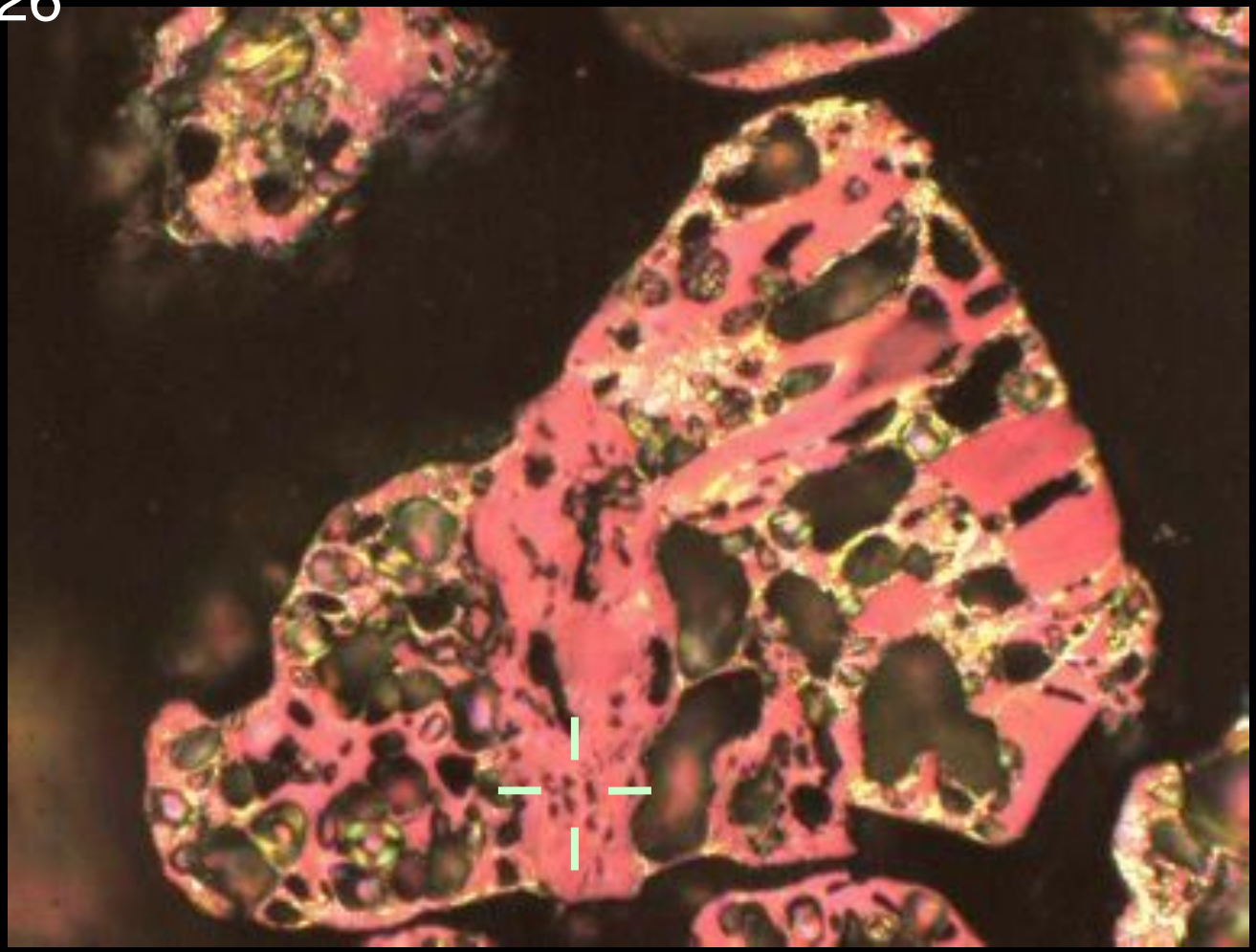

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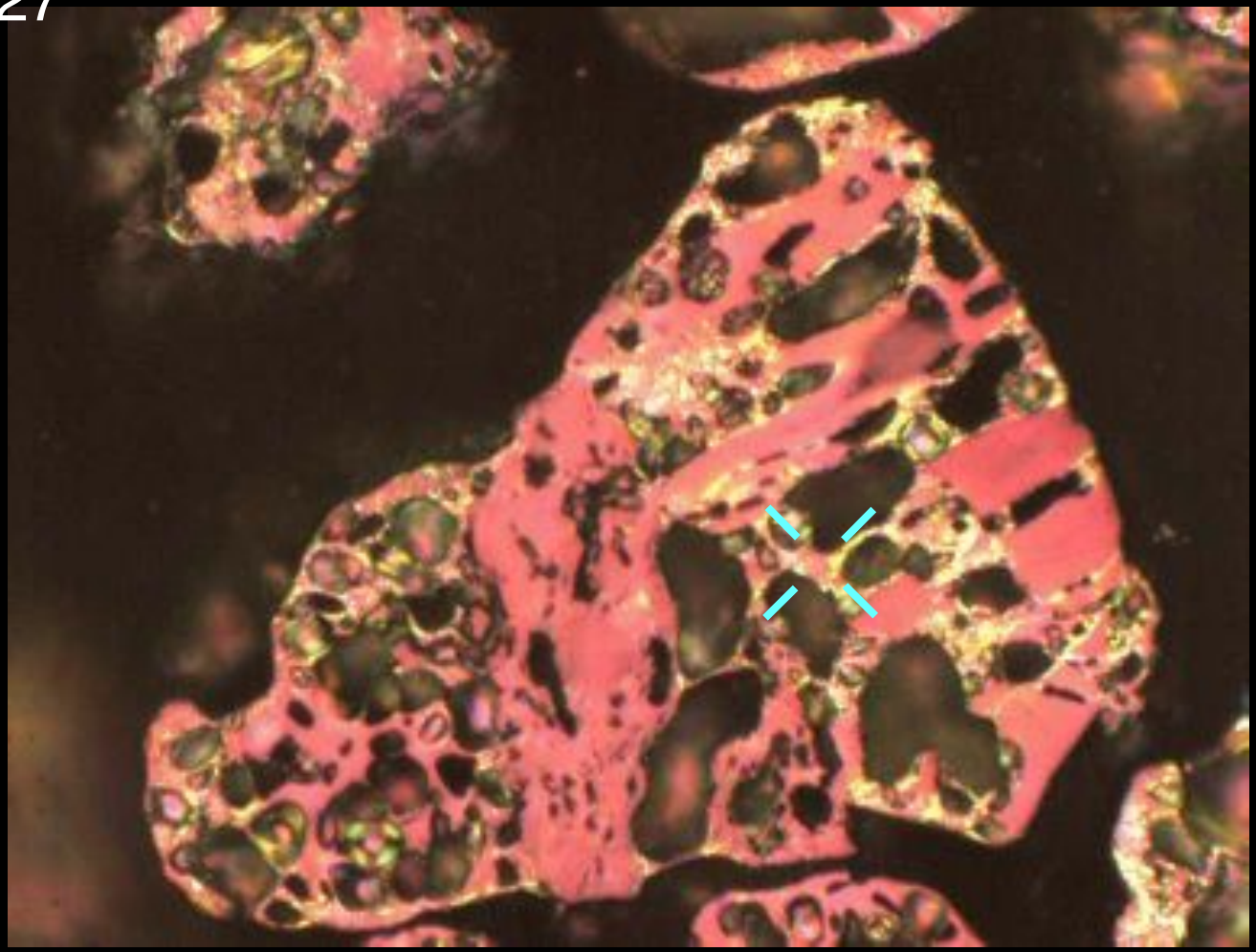

50 μm

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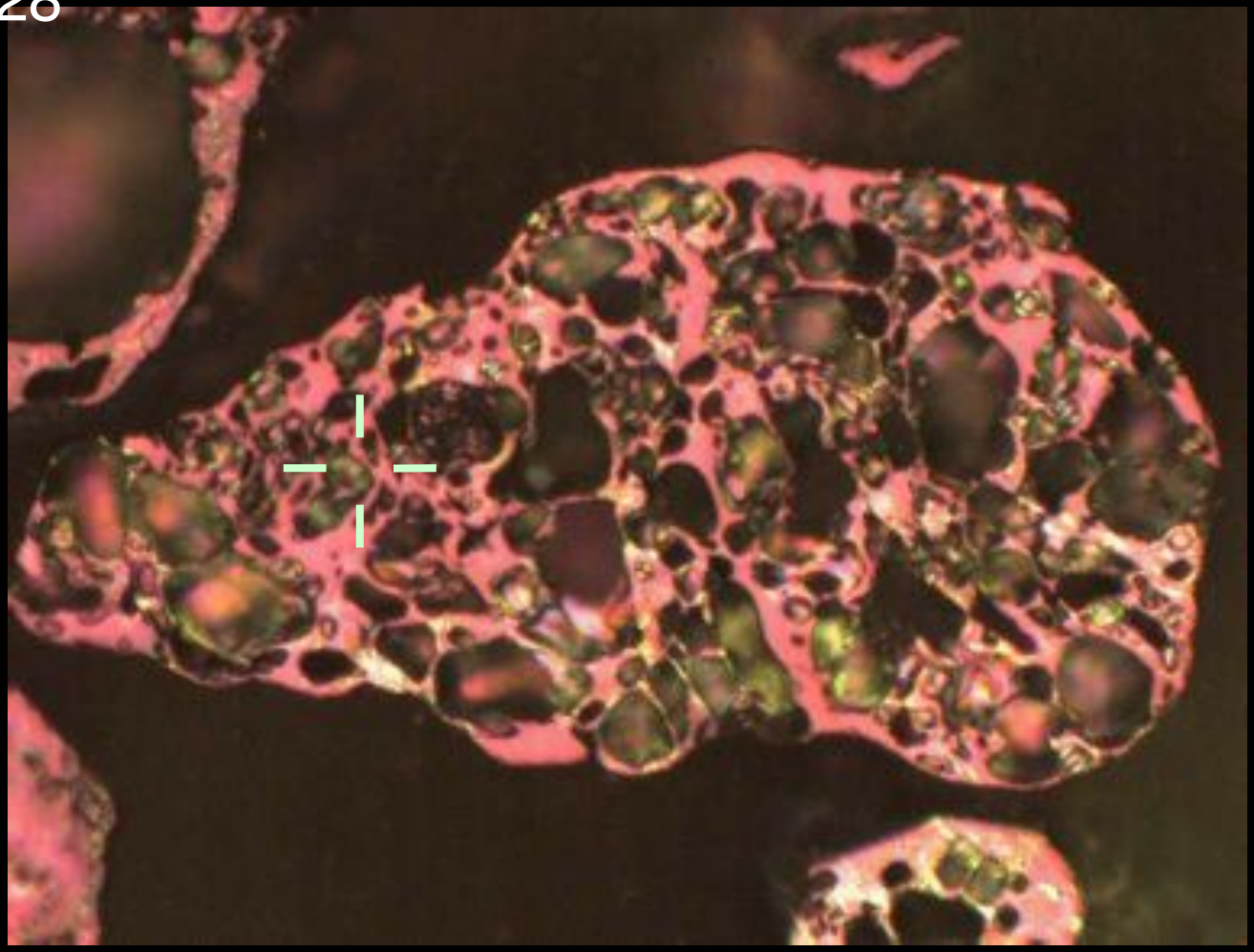

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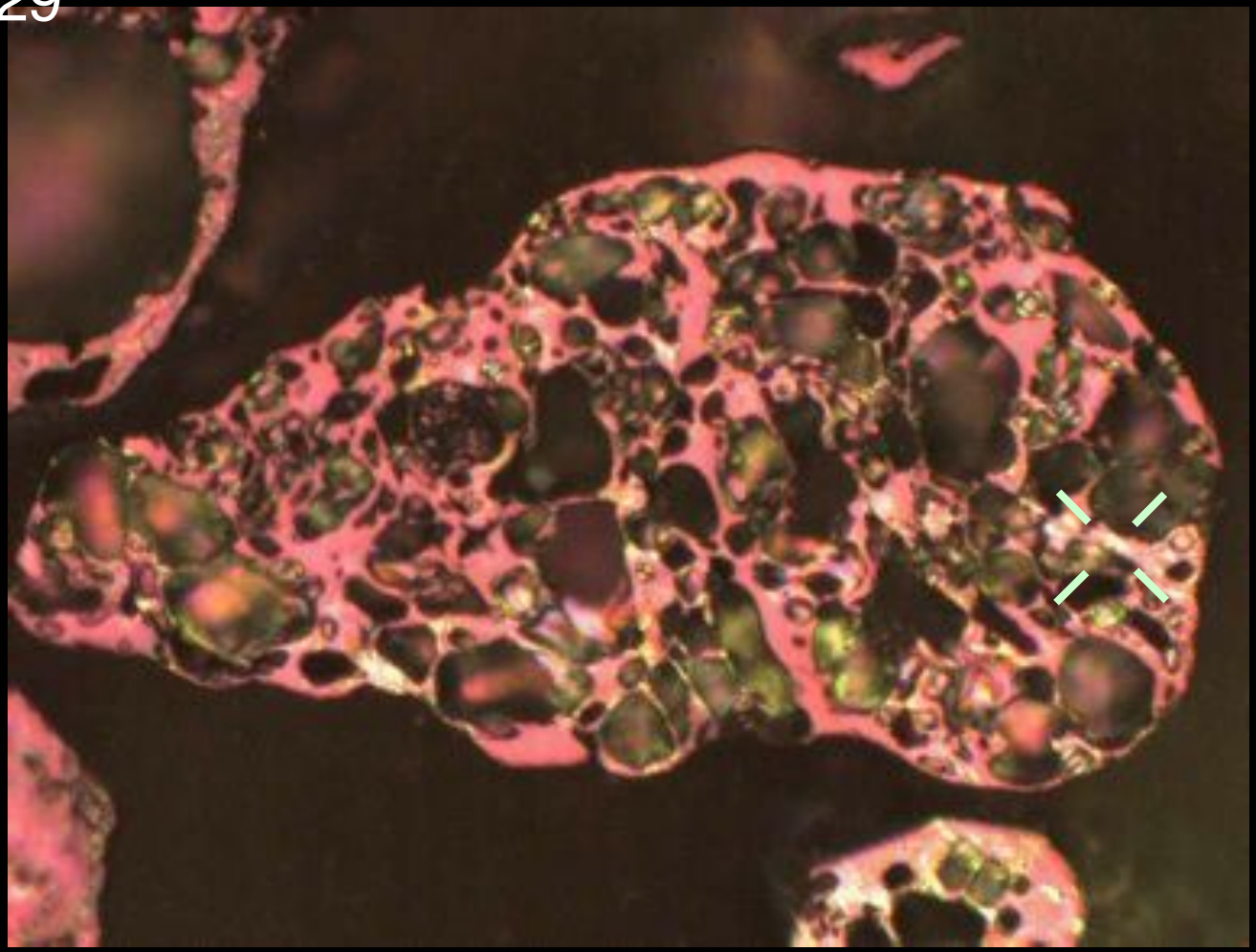

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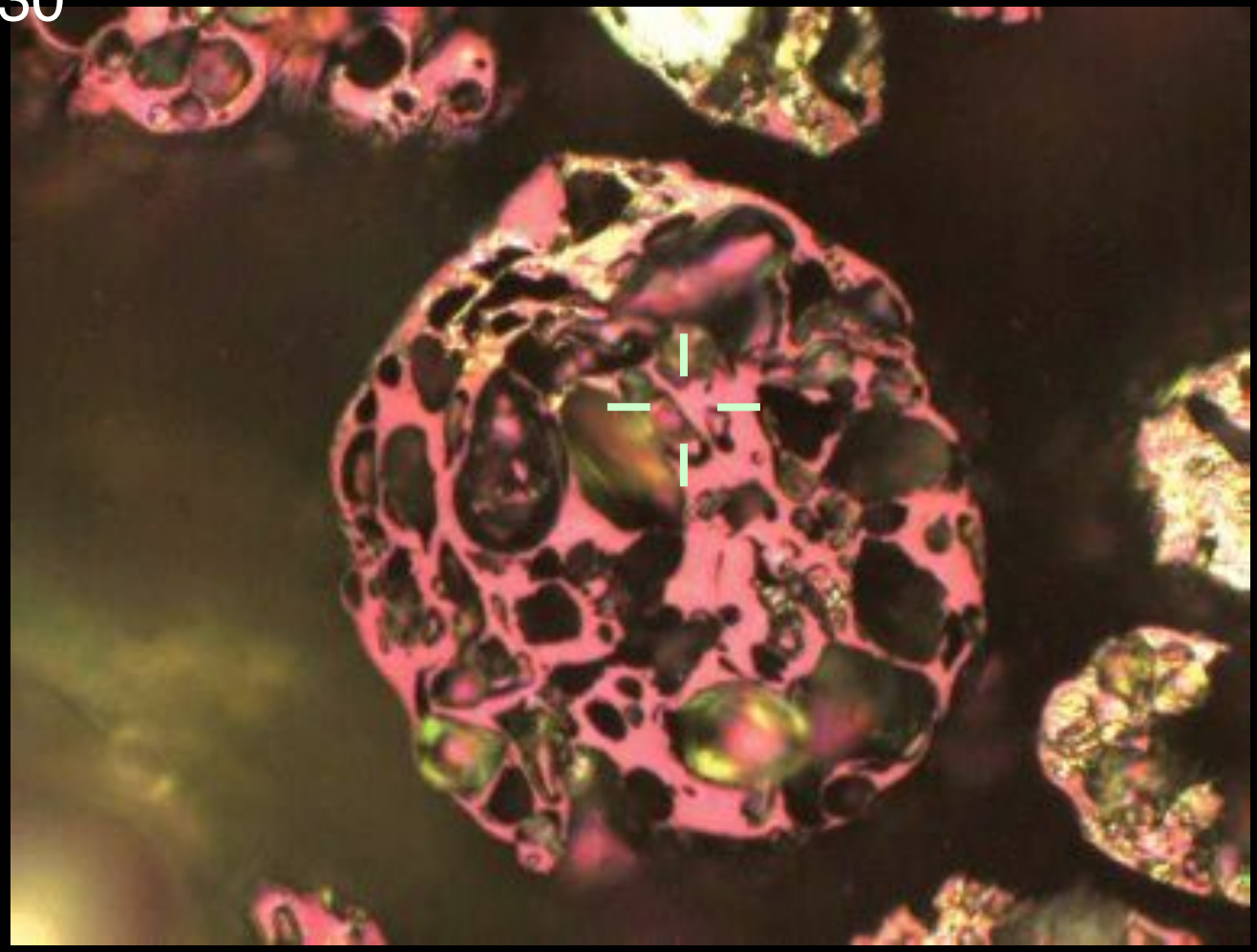

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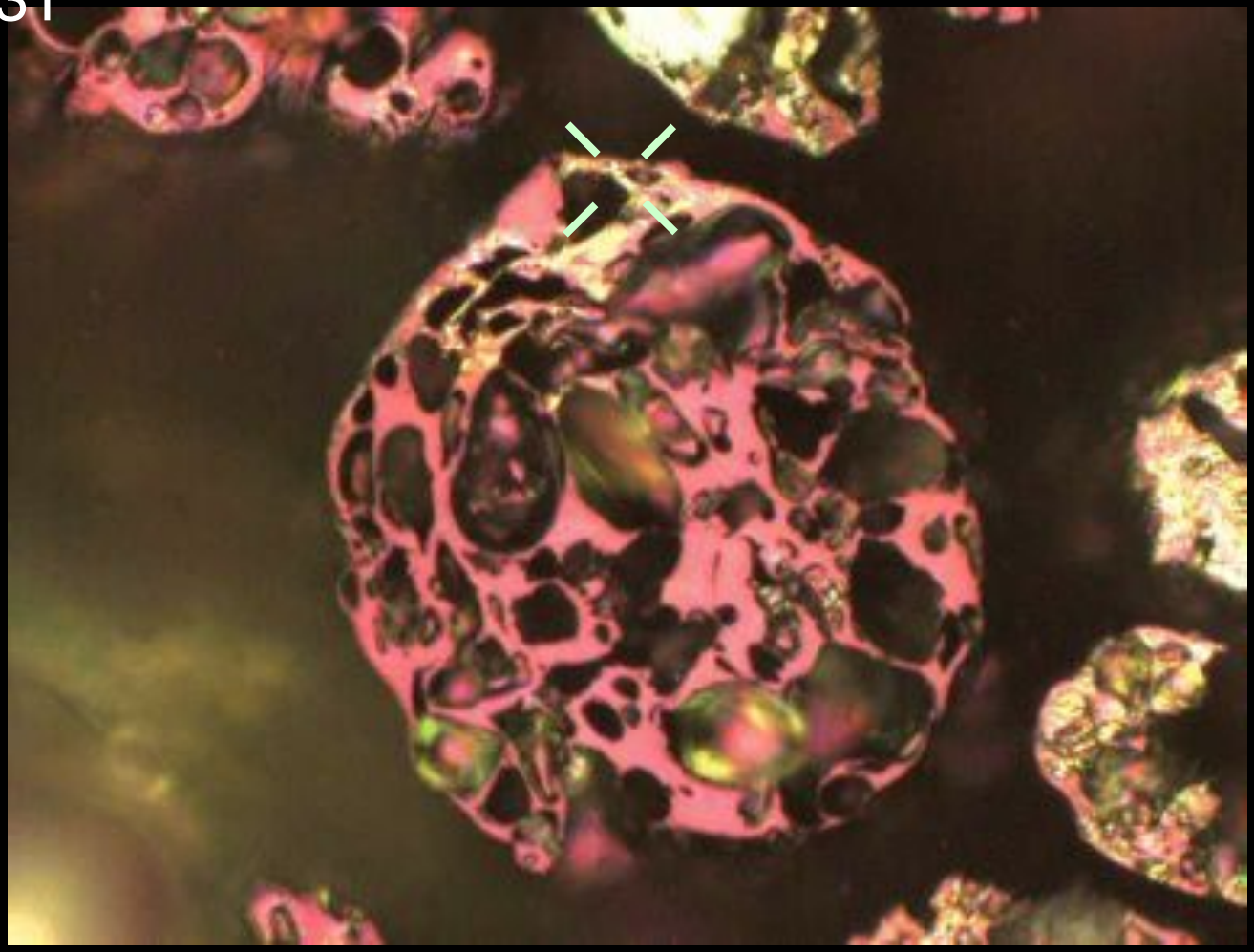

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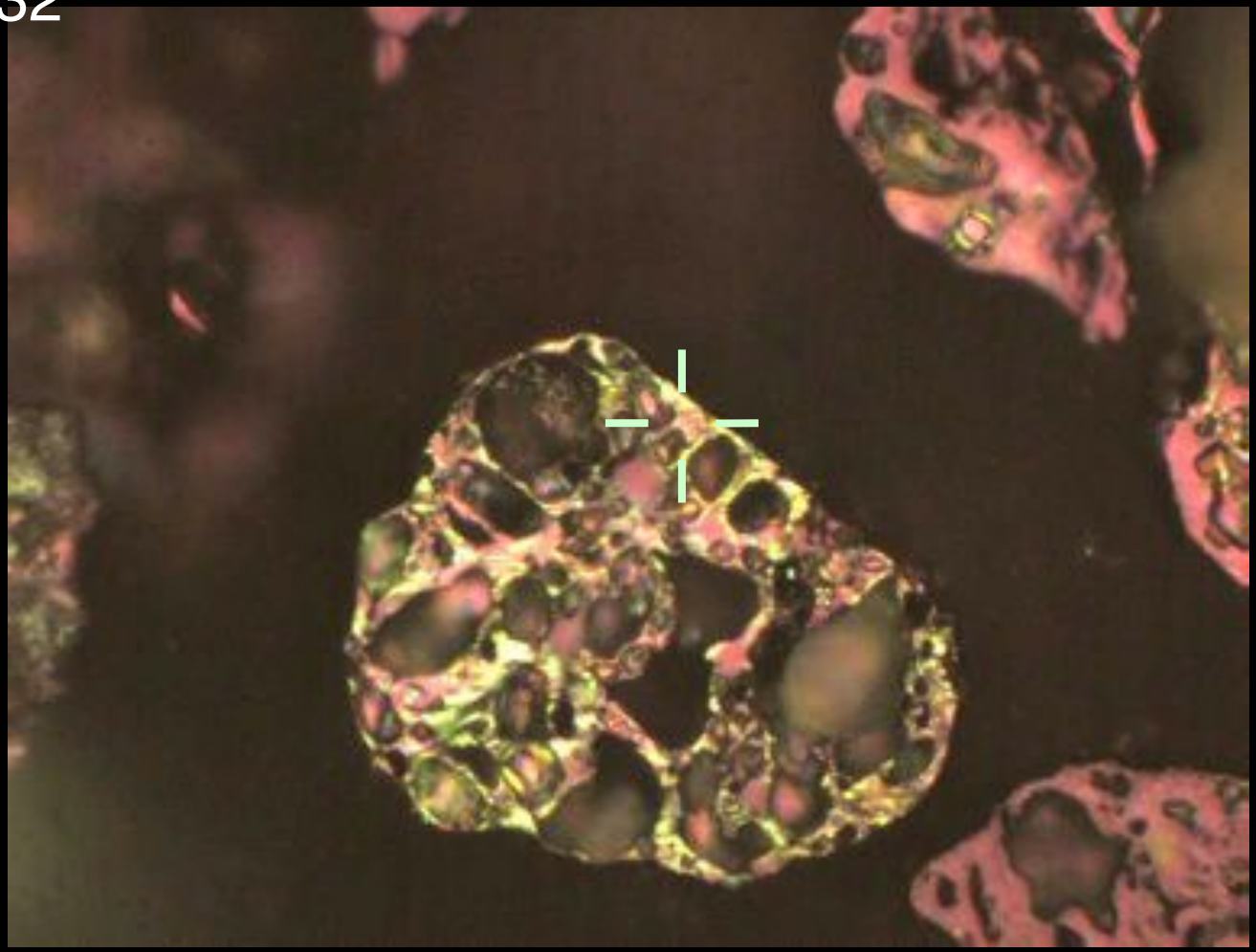

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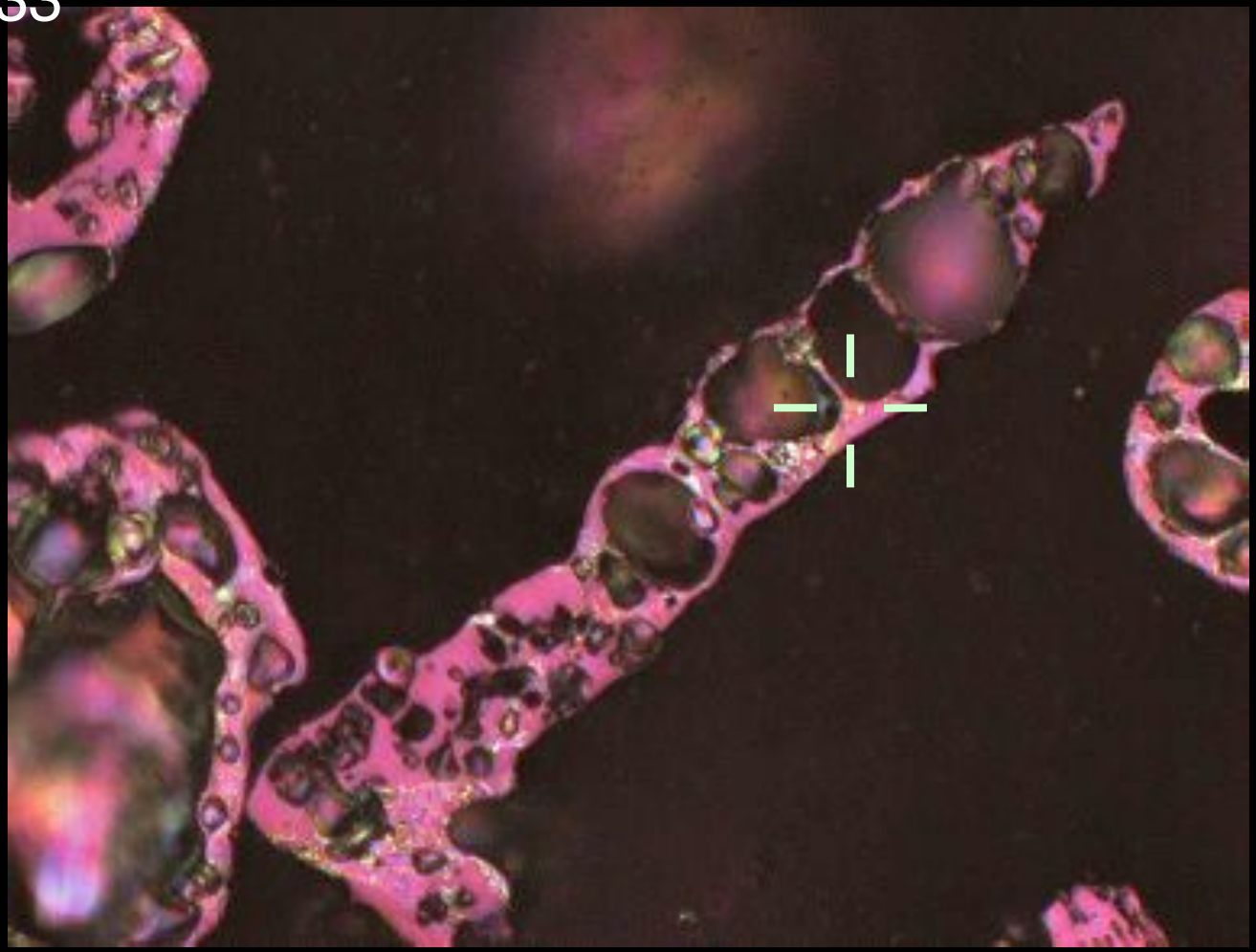

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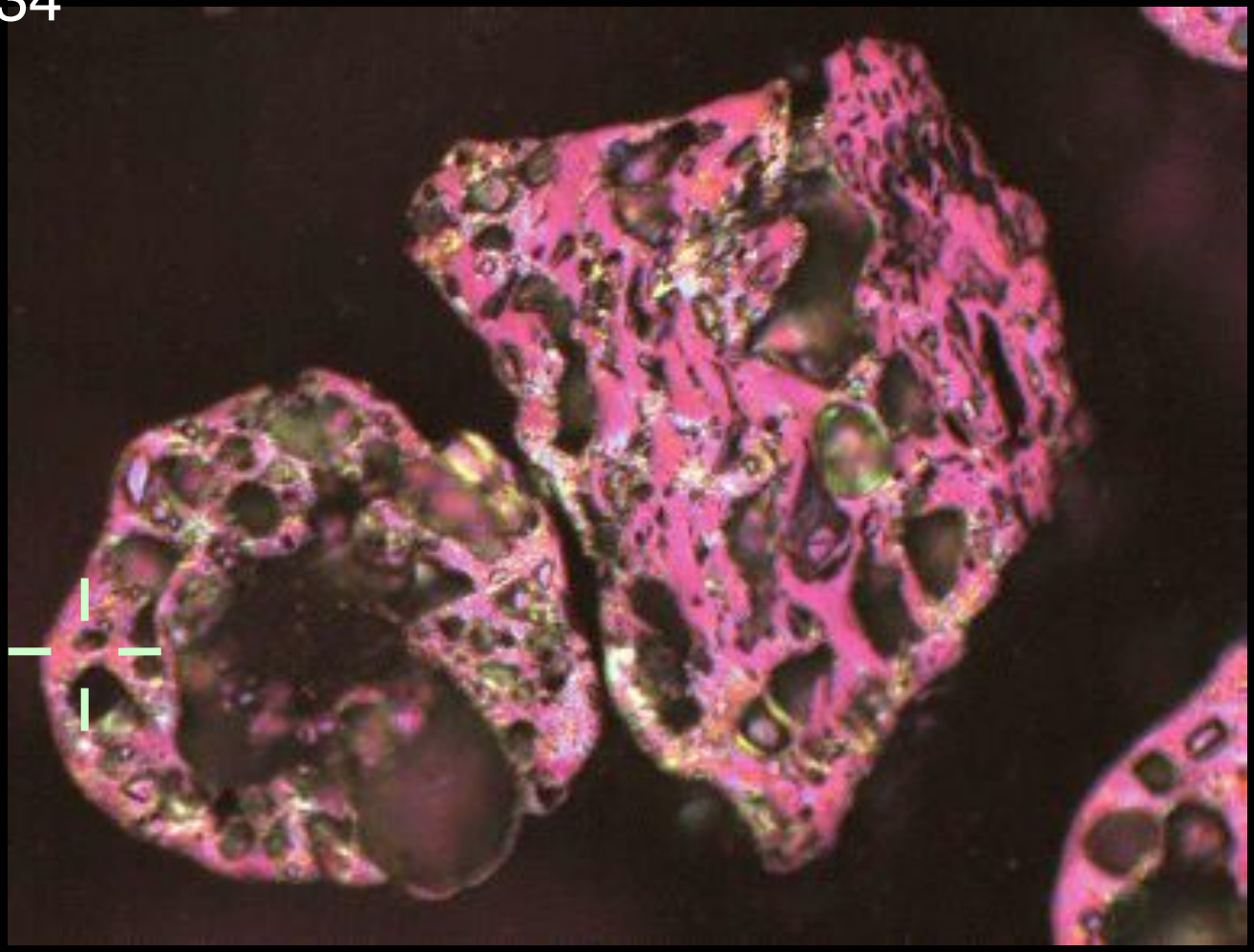
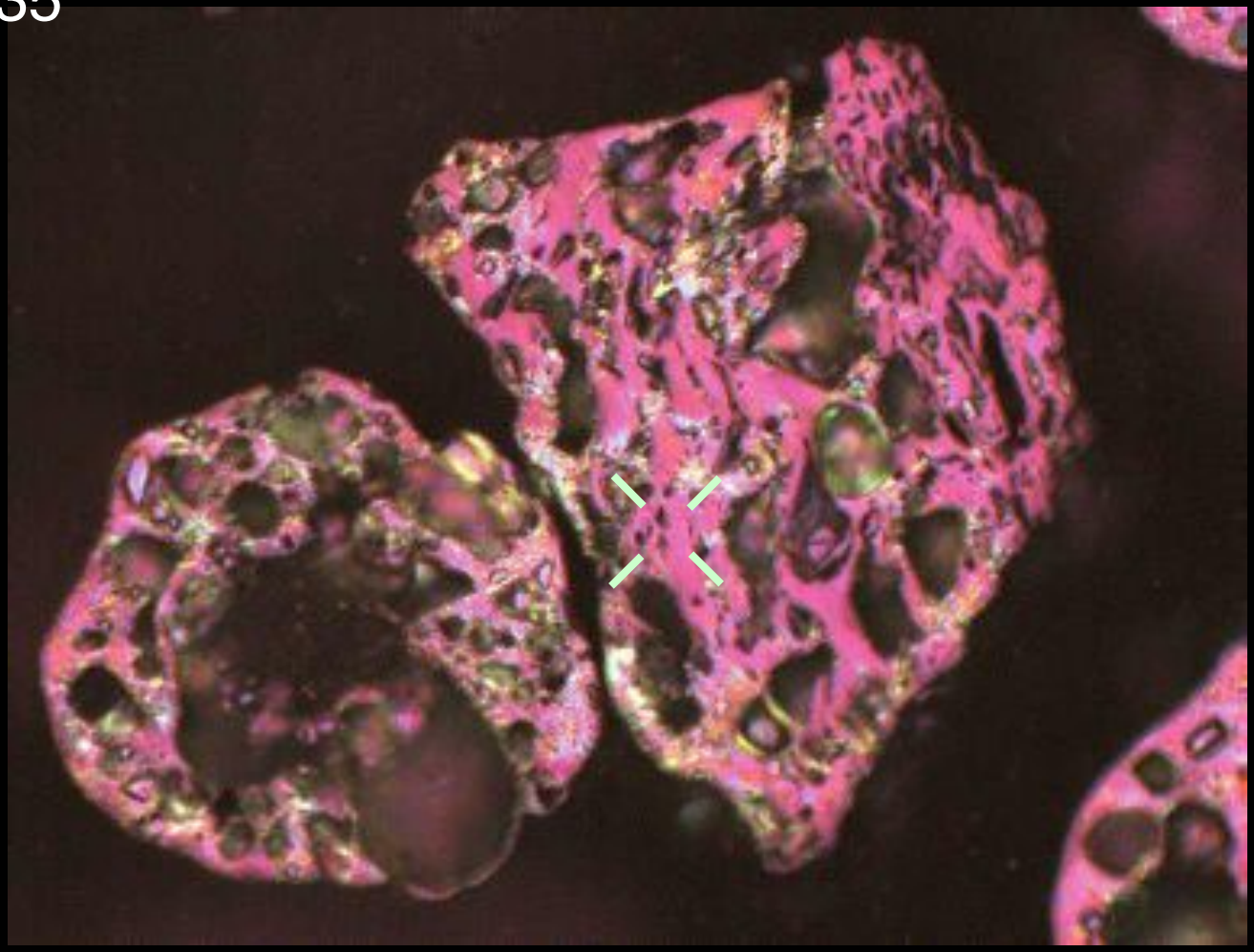


B35



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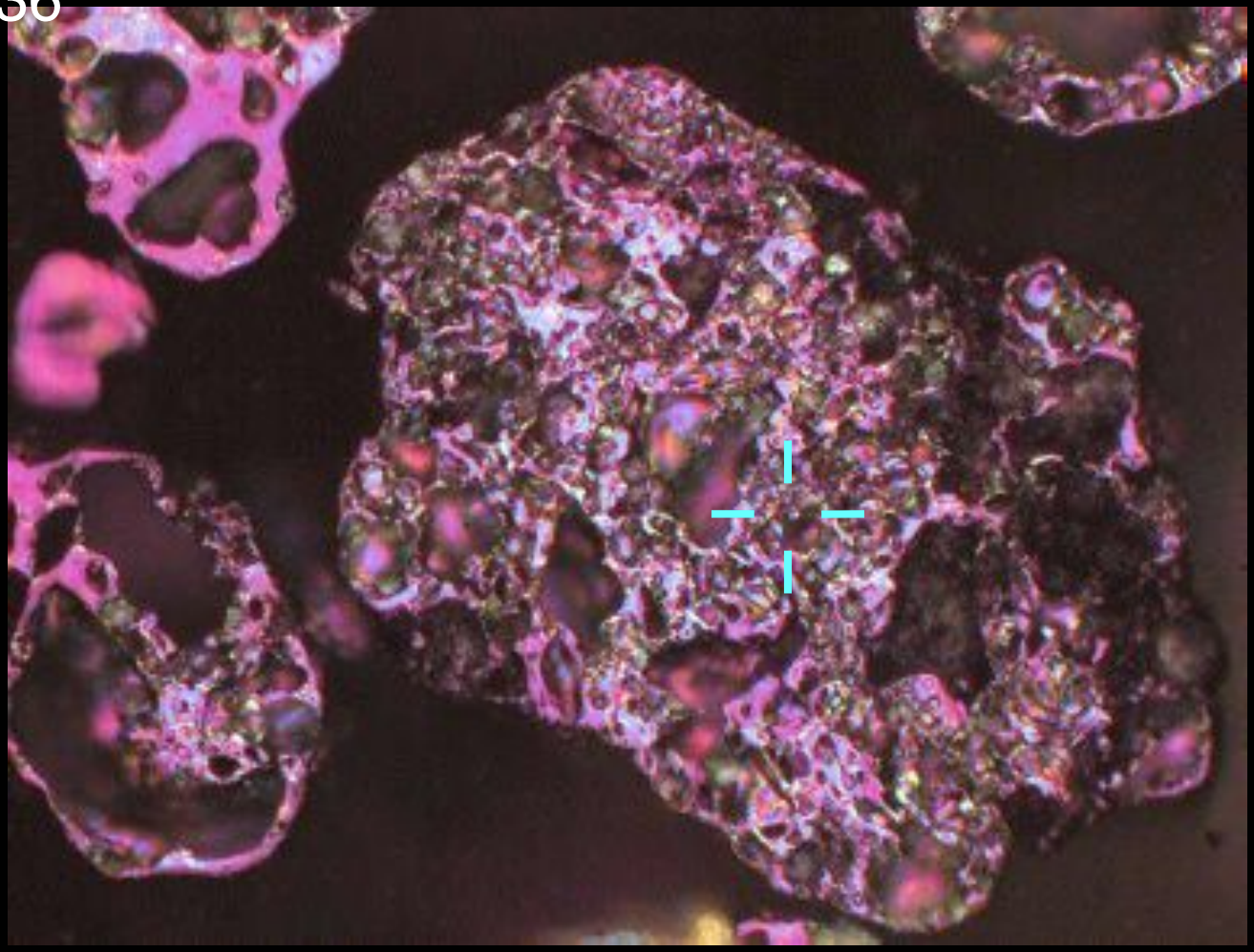
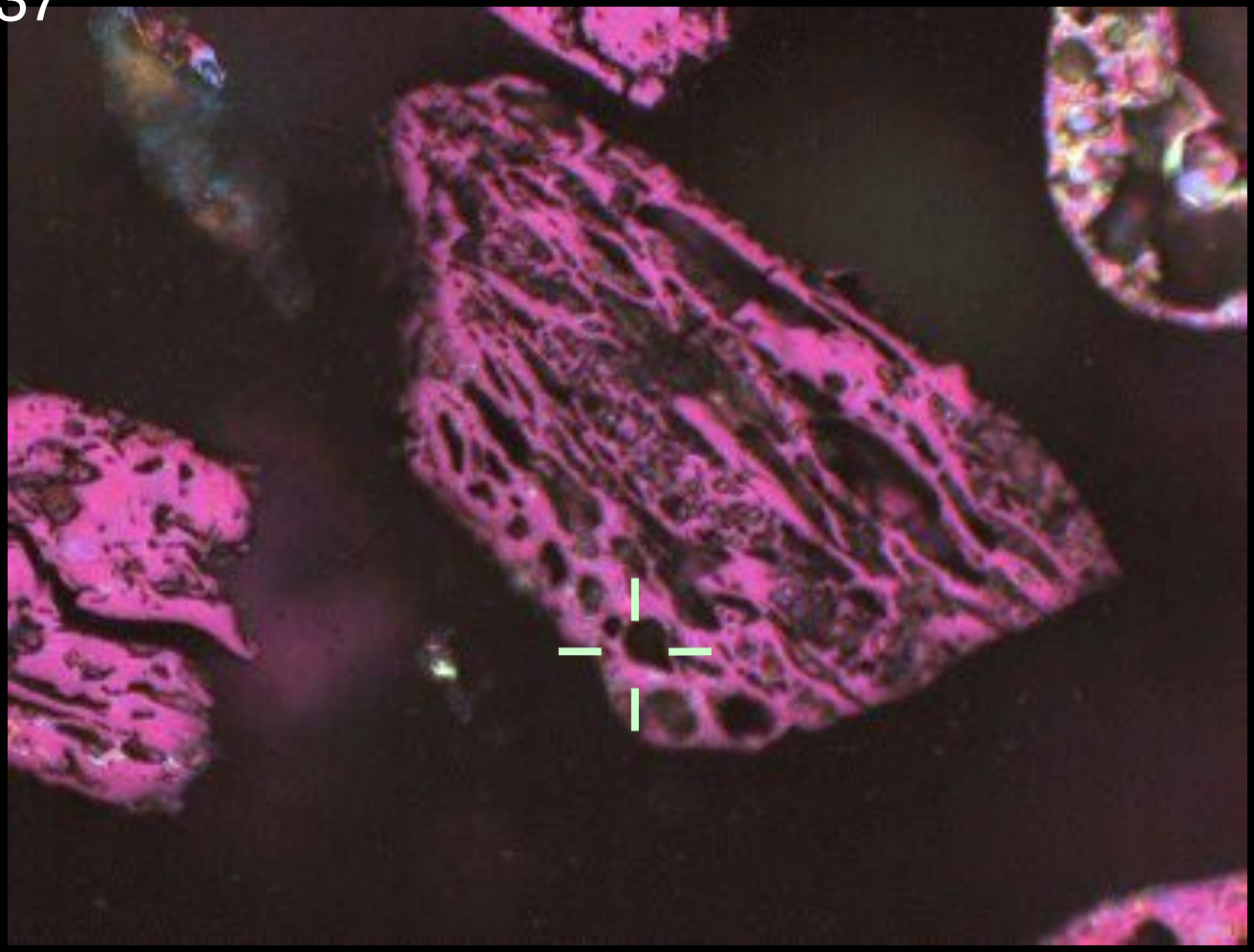


B37



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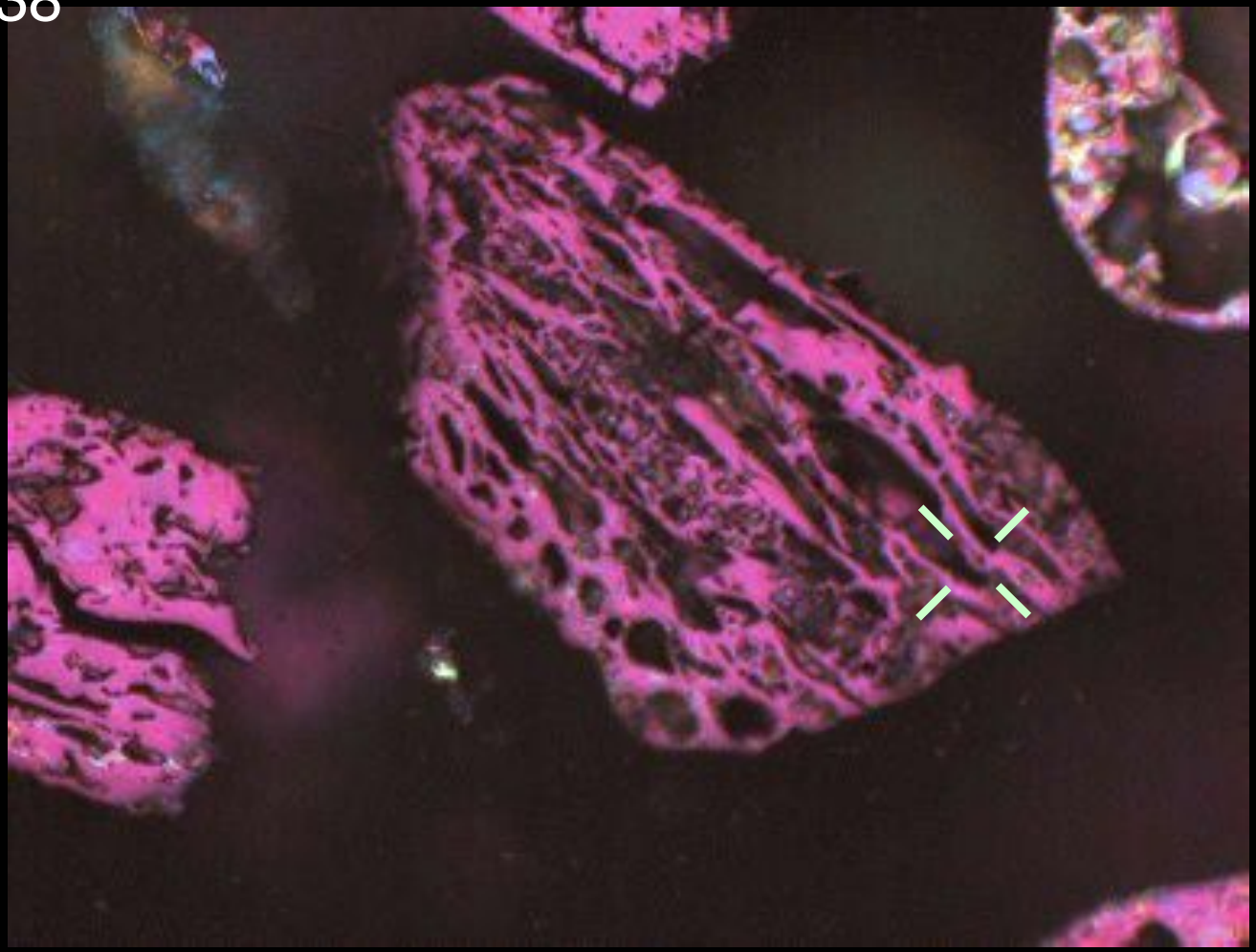
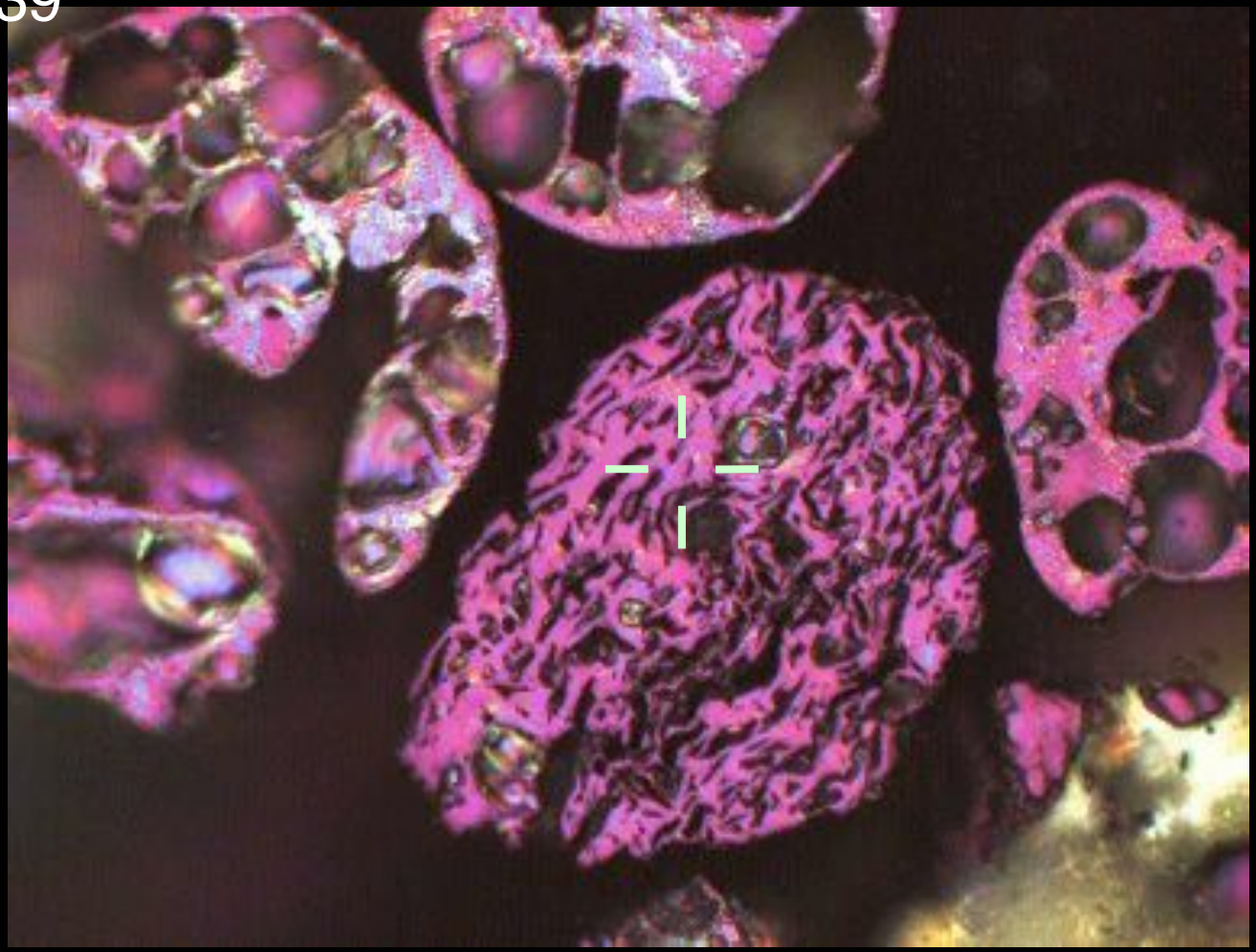
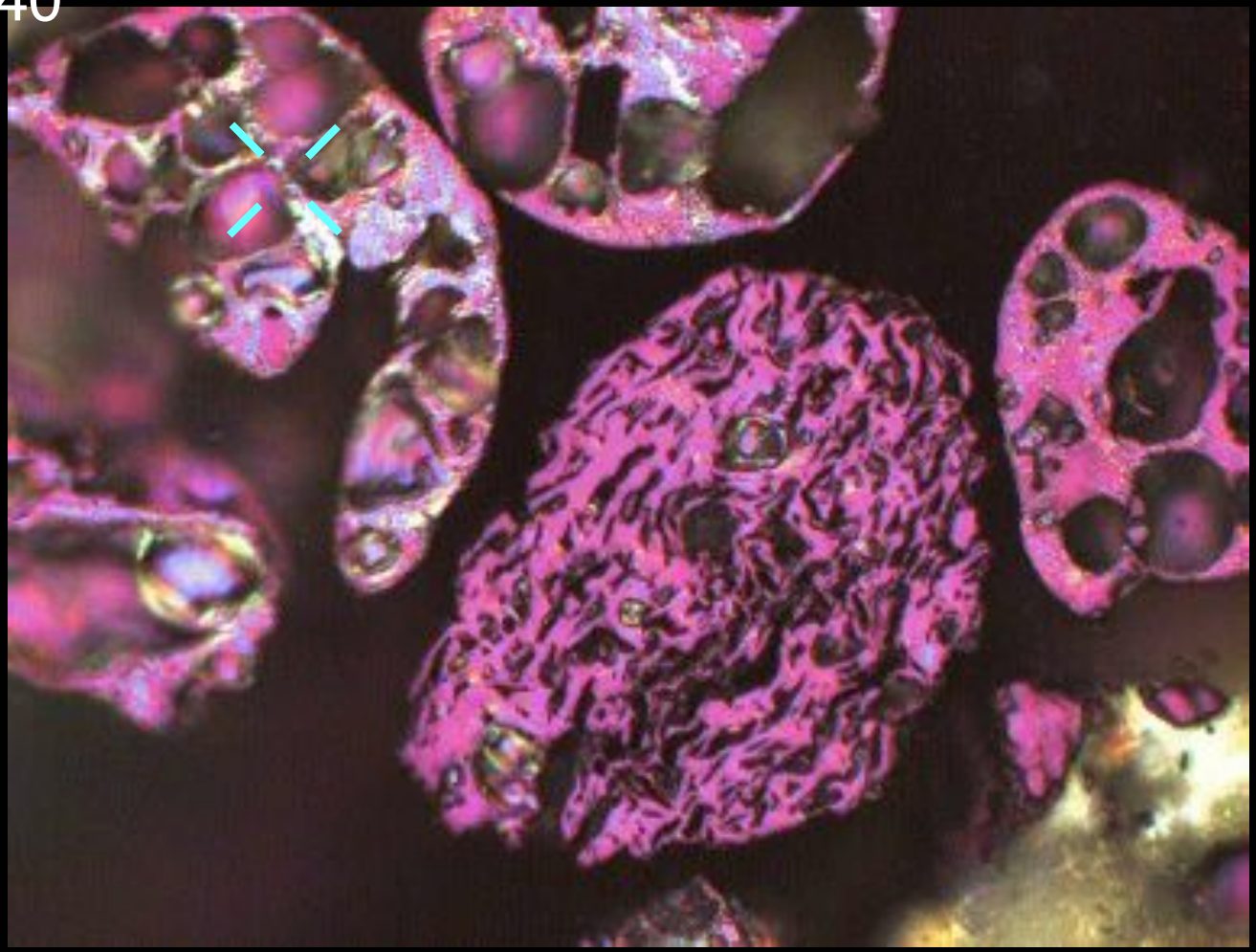


B39



50 μm

B40



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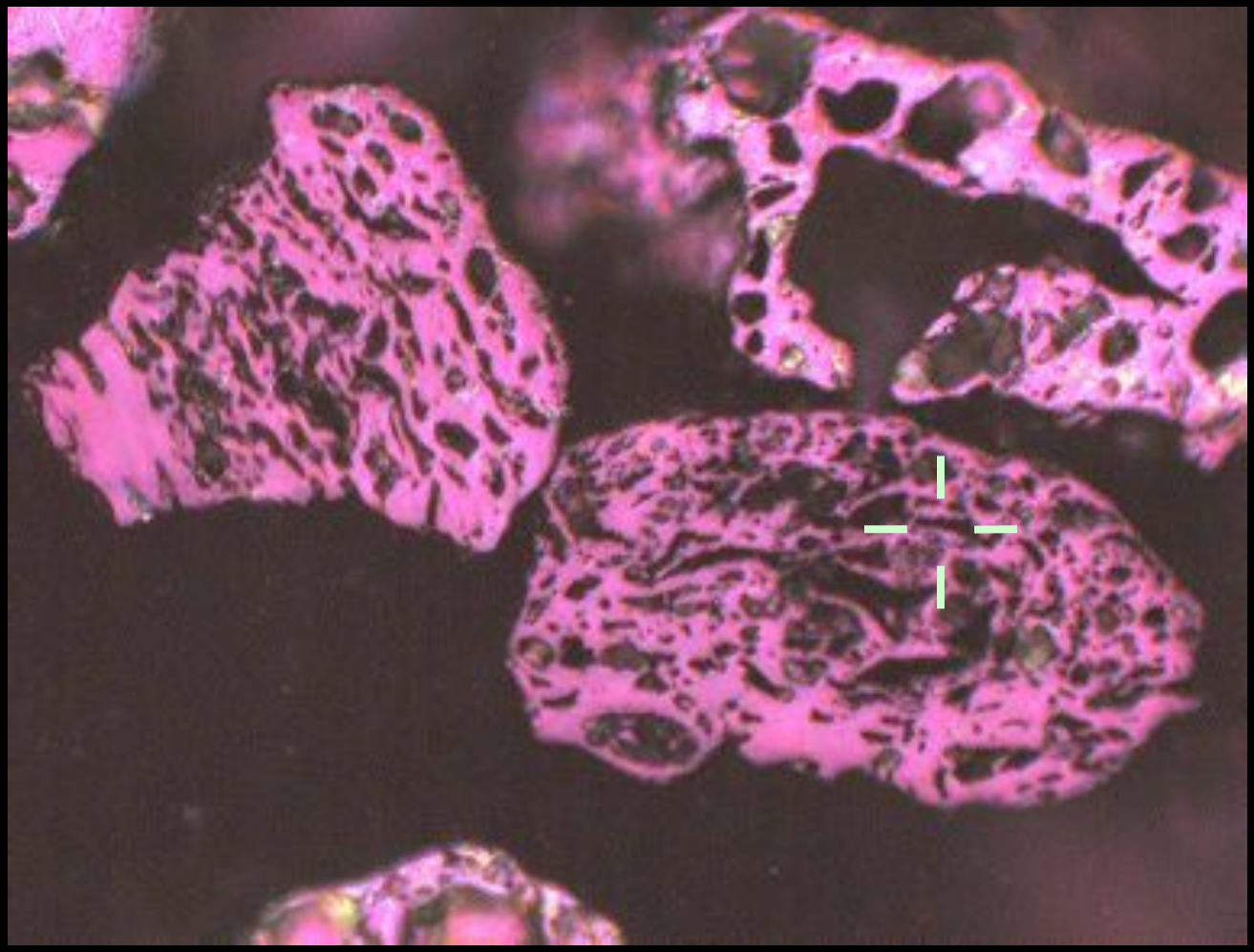

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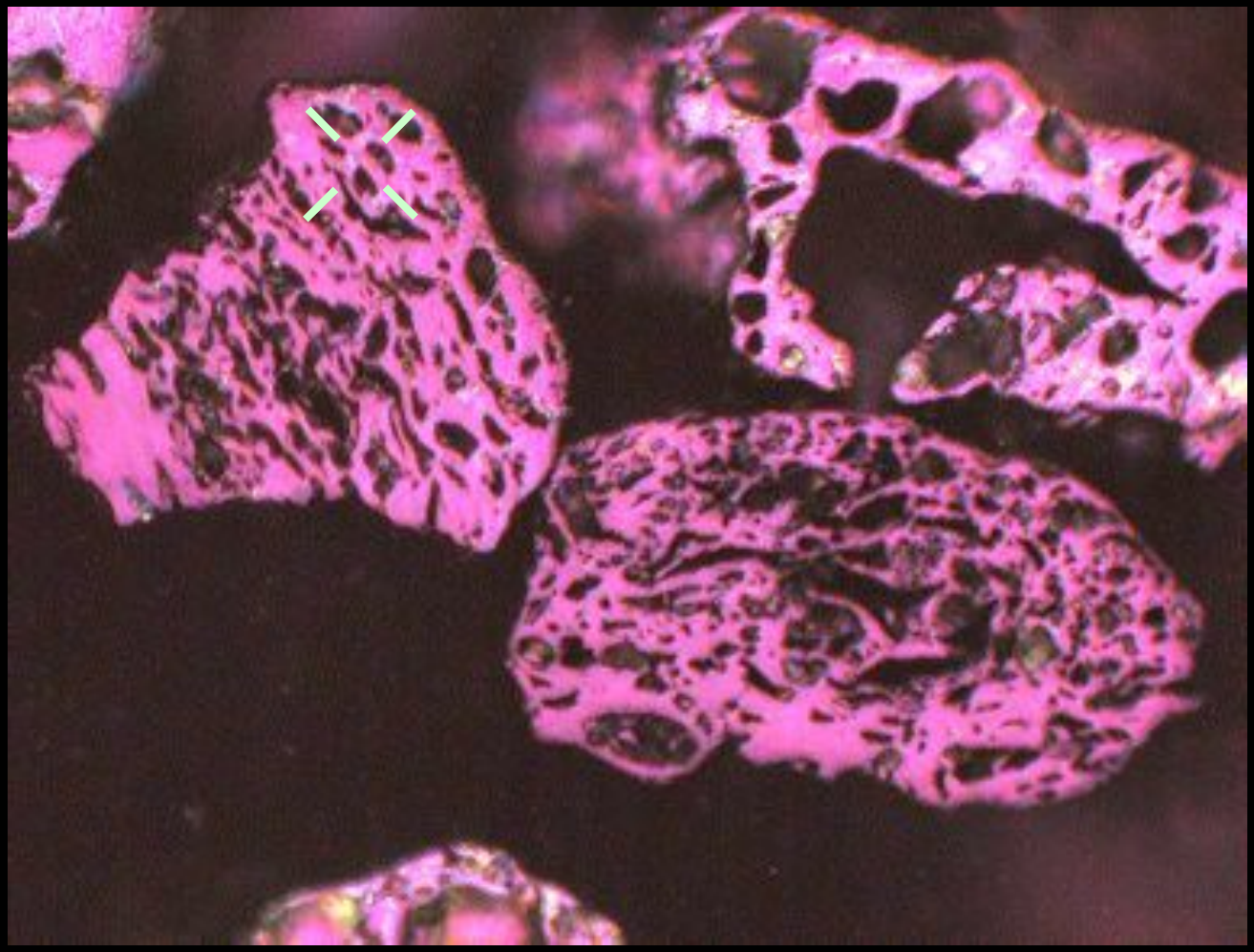

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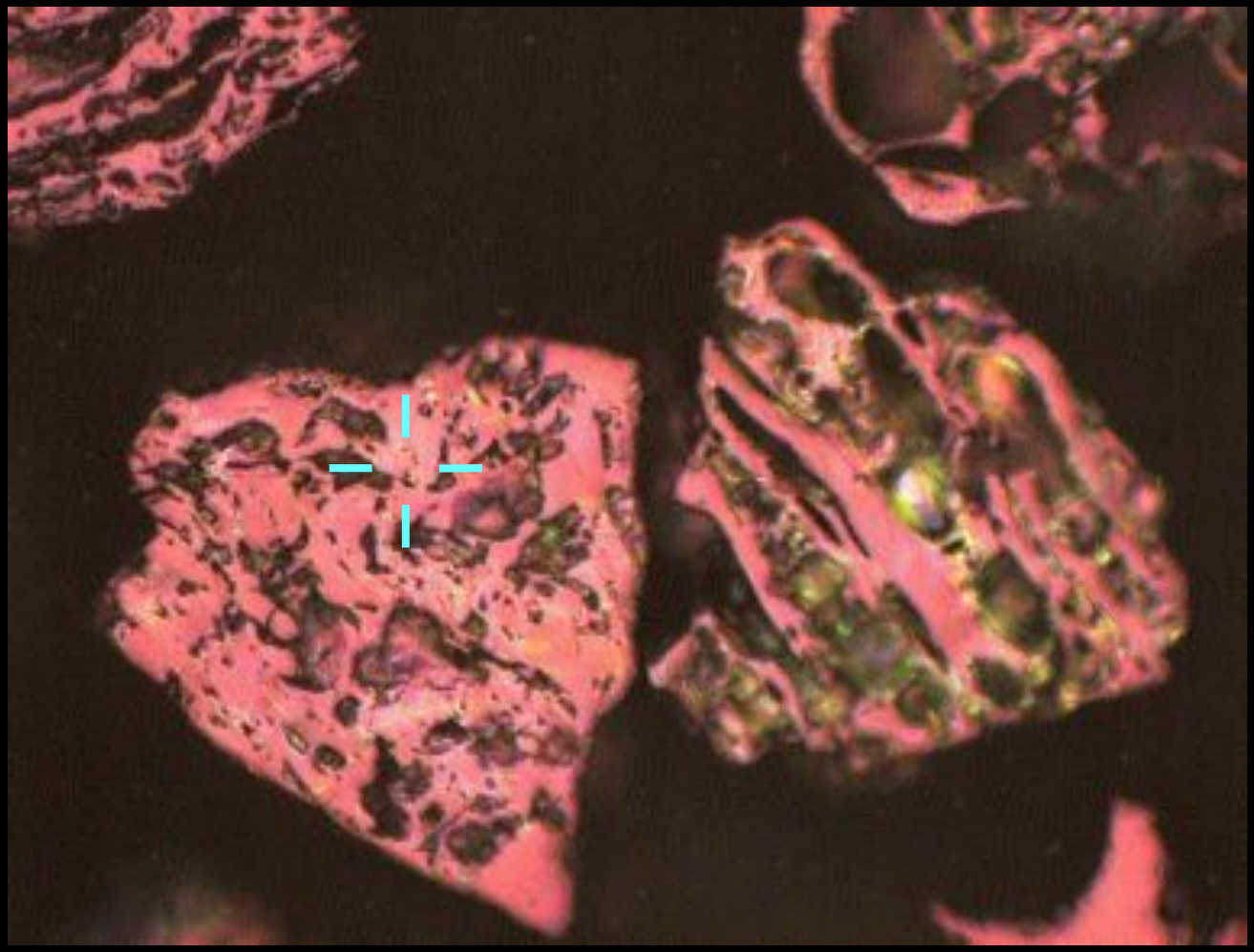
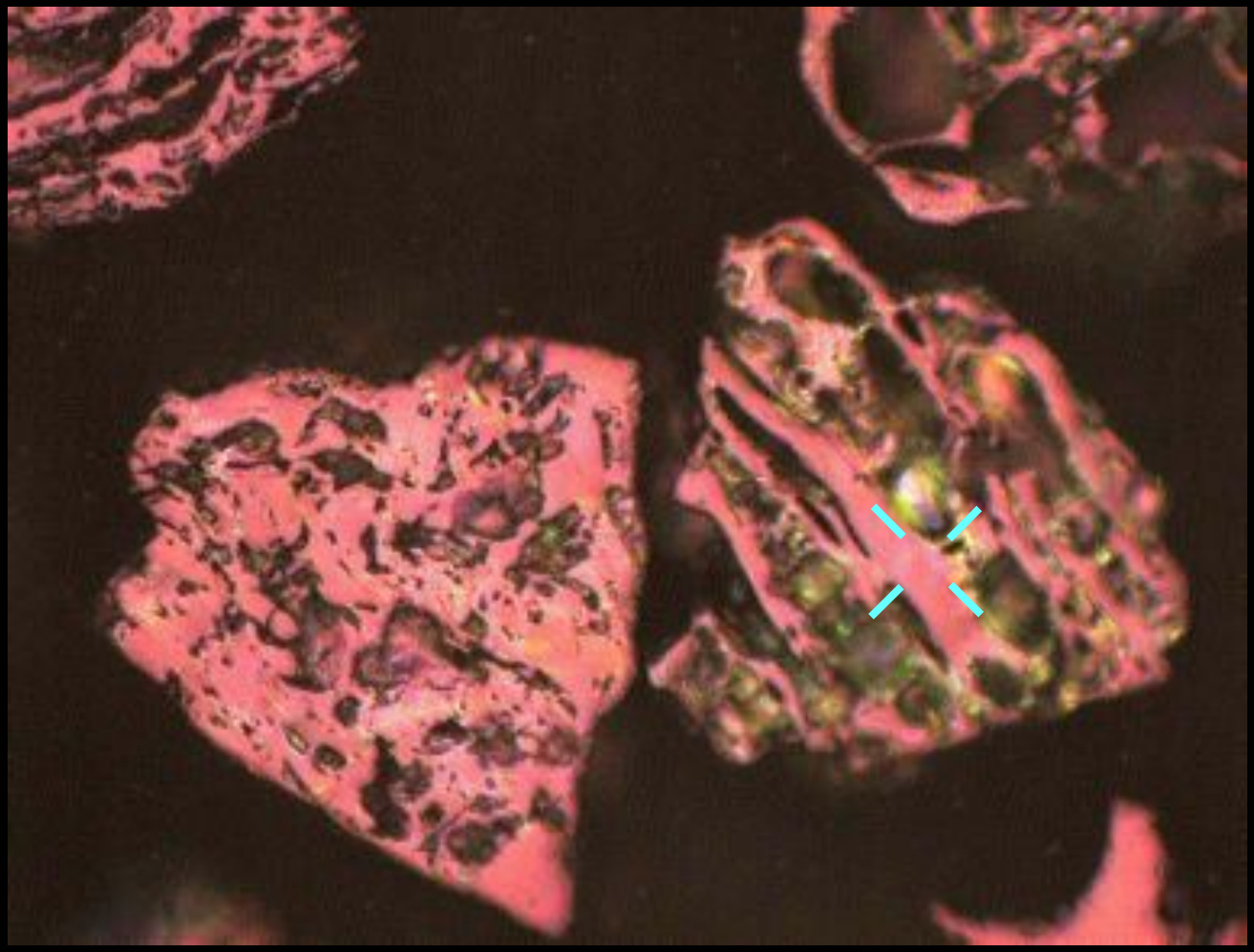


B44



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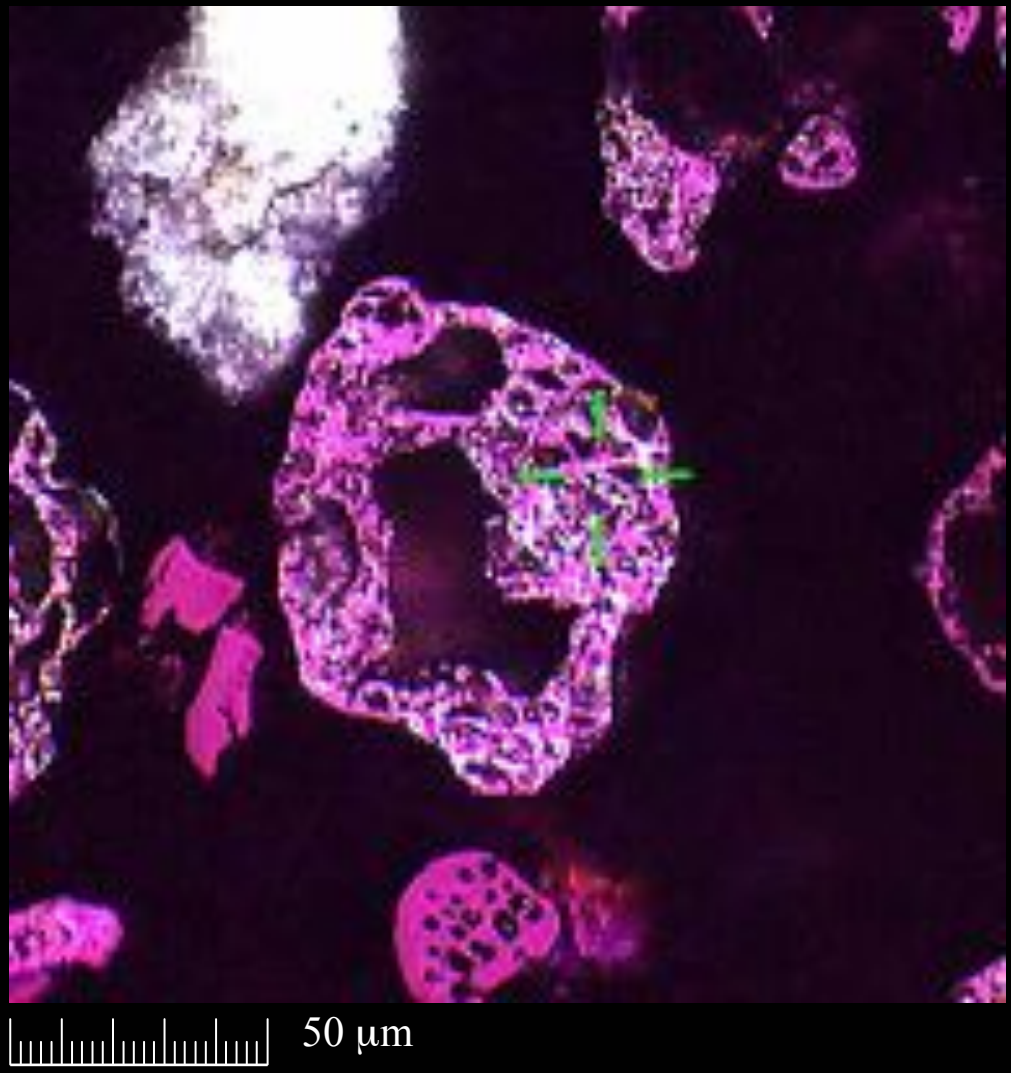

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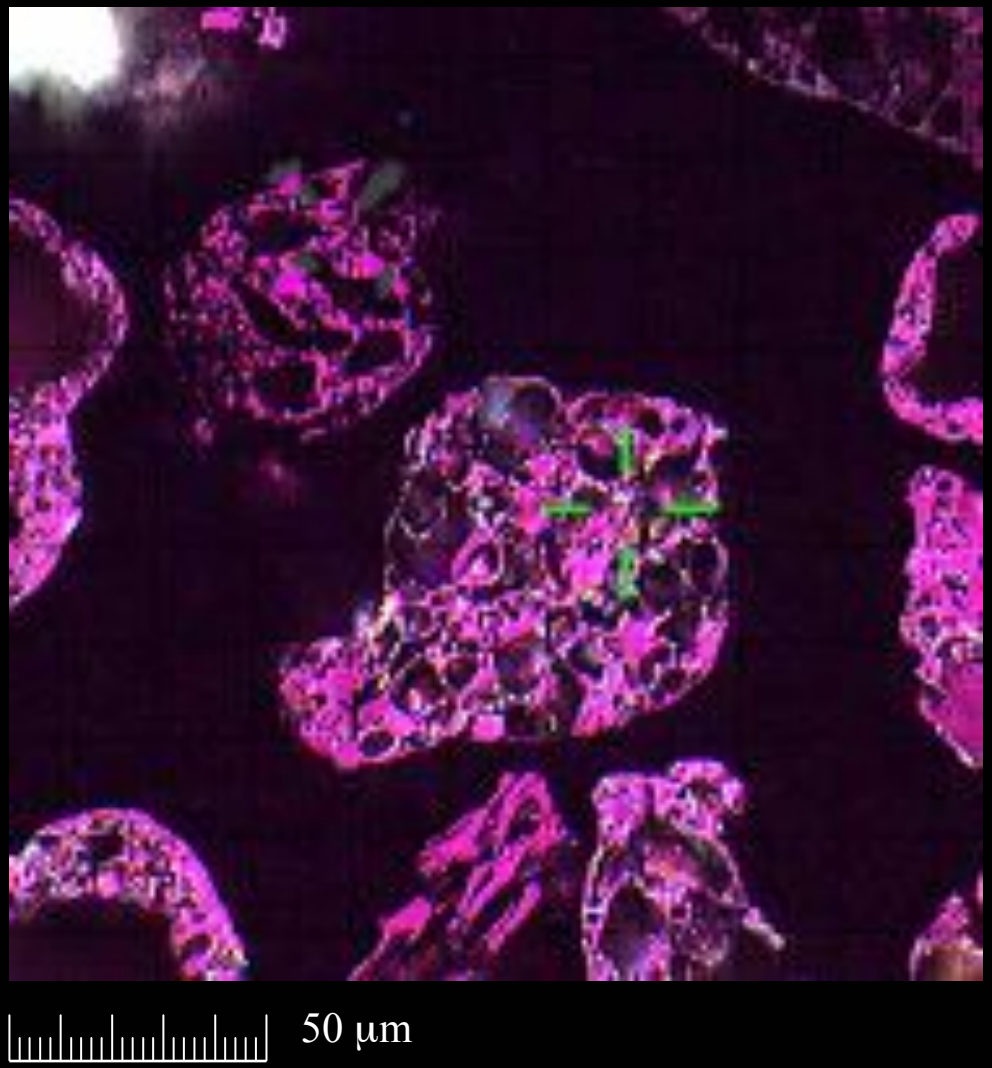

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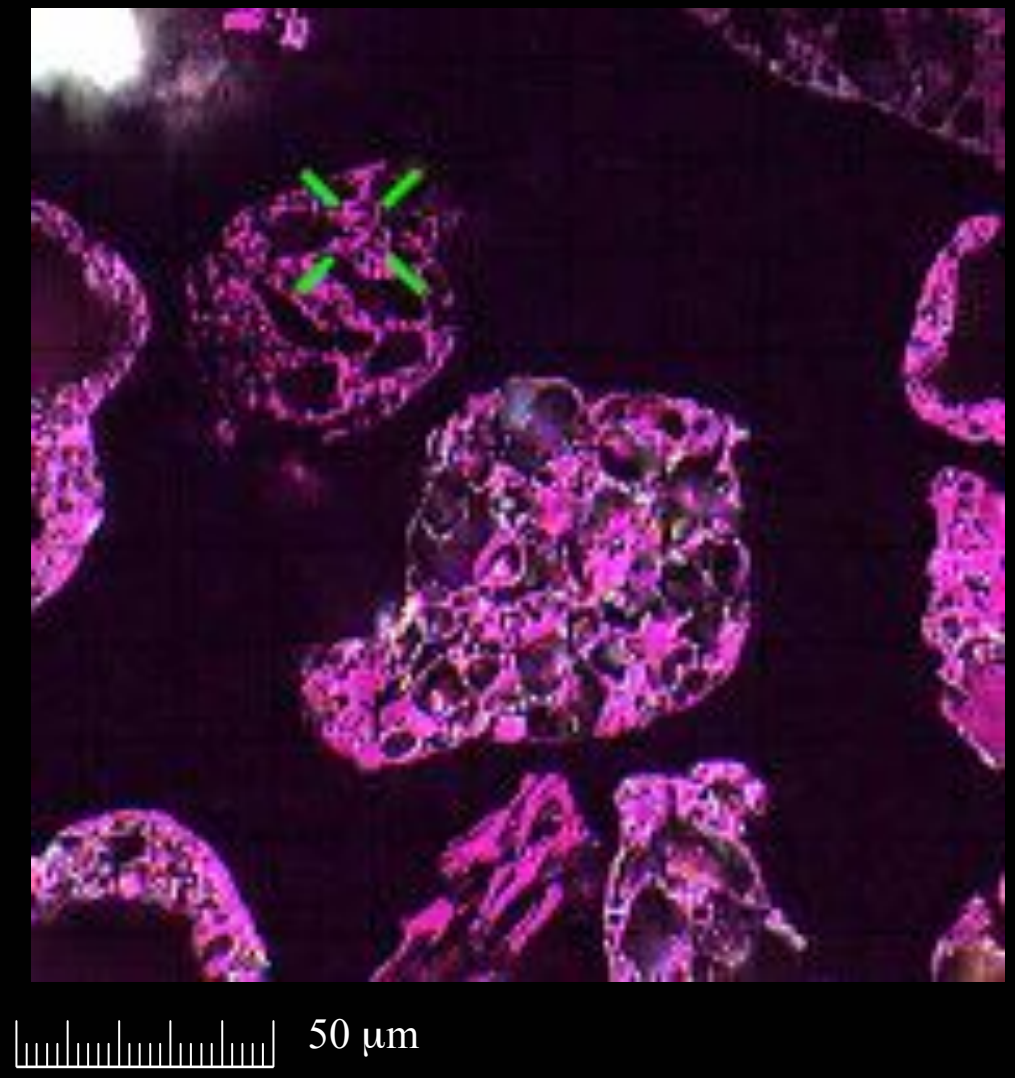

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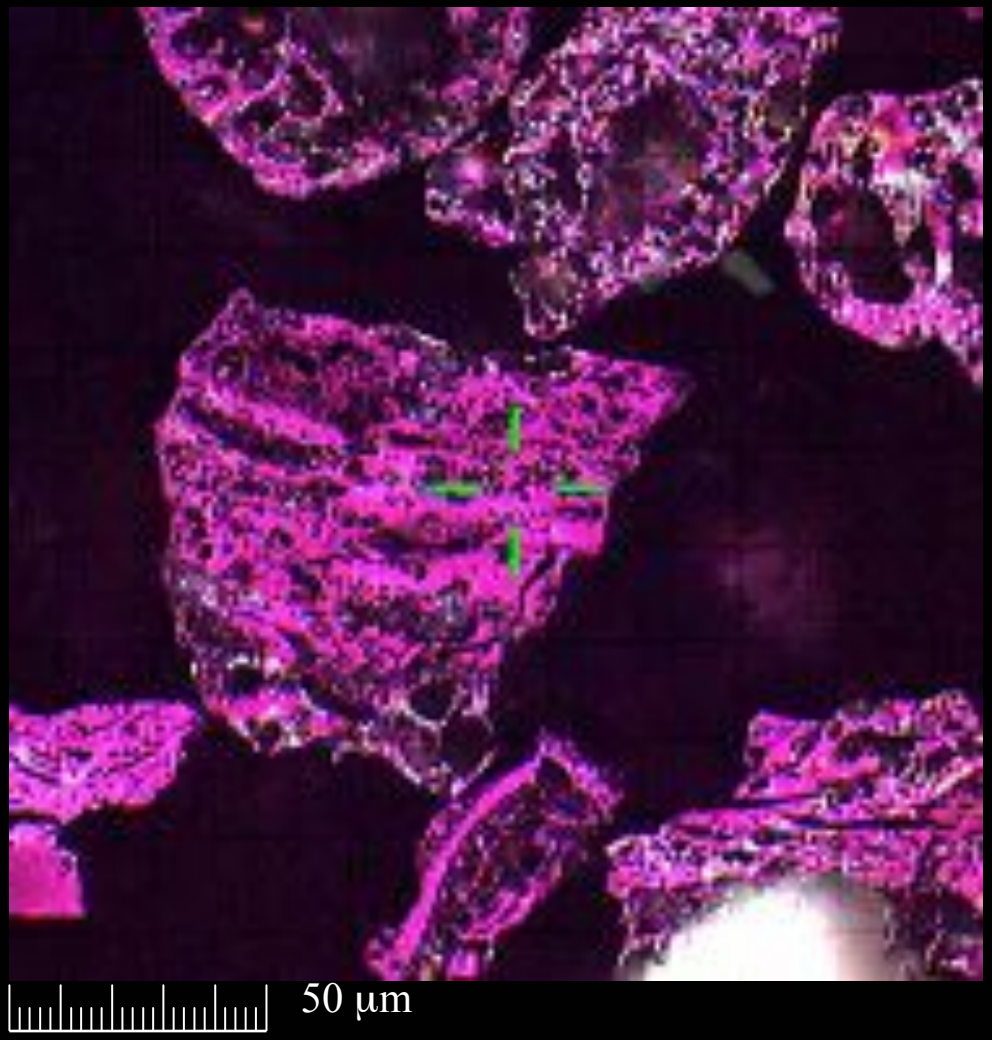

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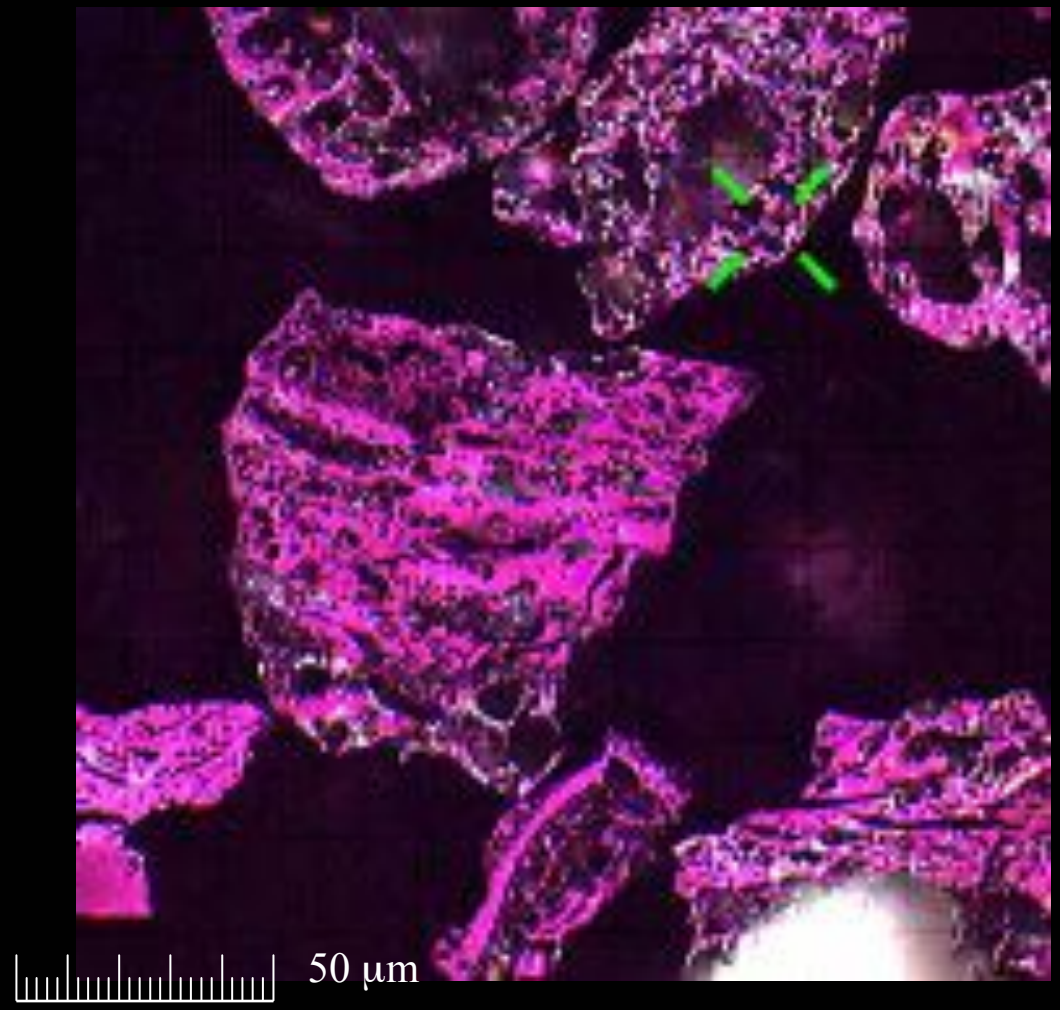

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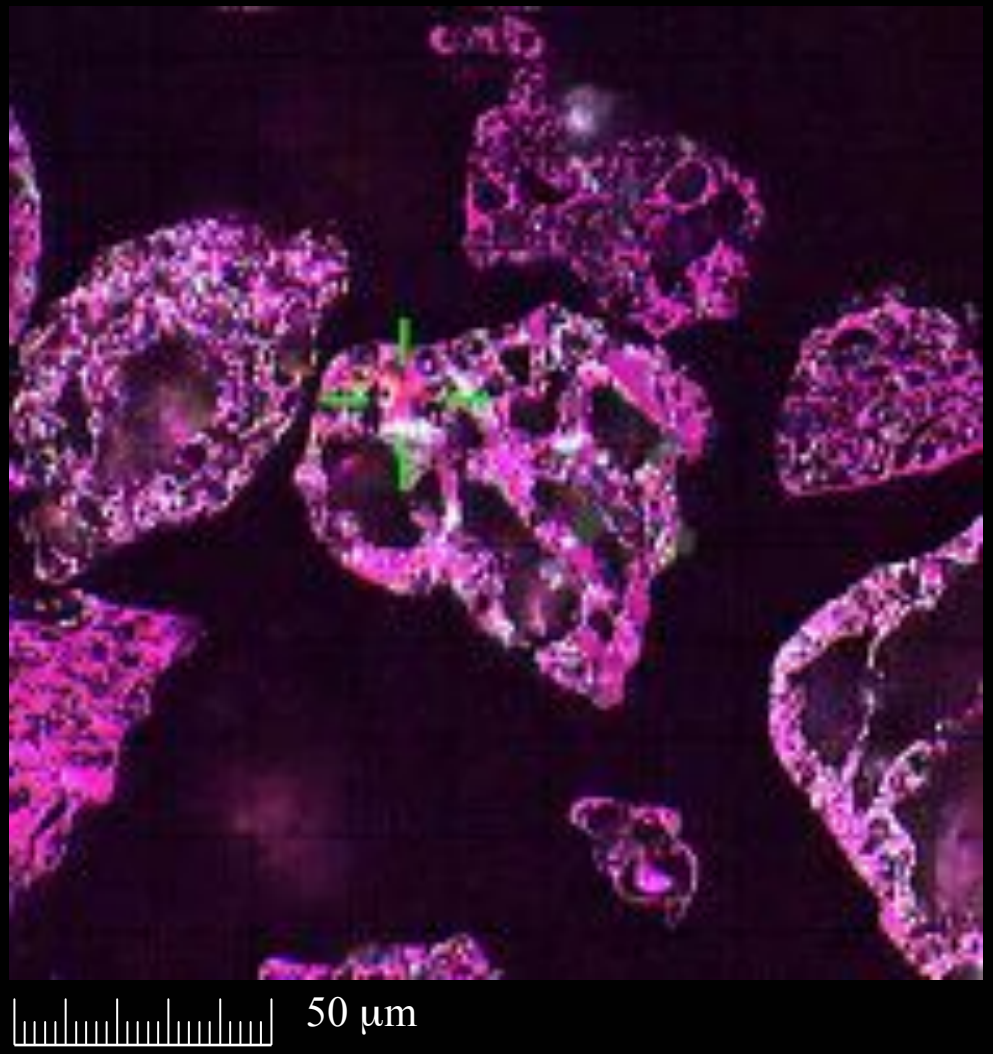

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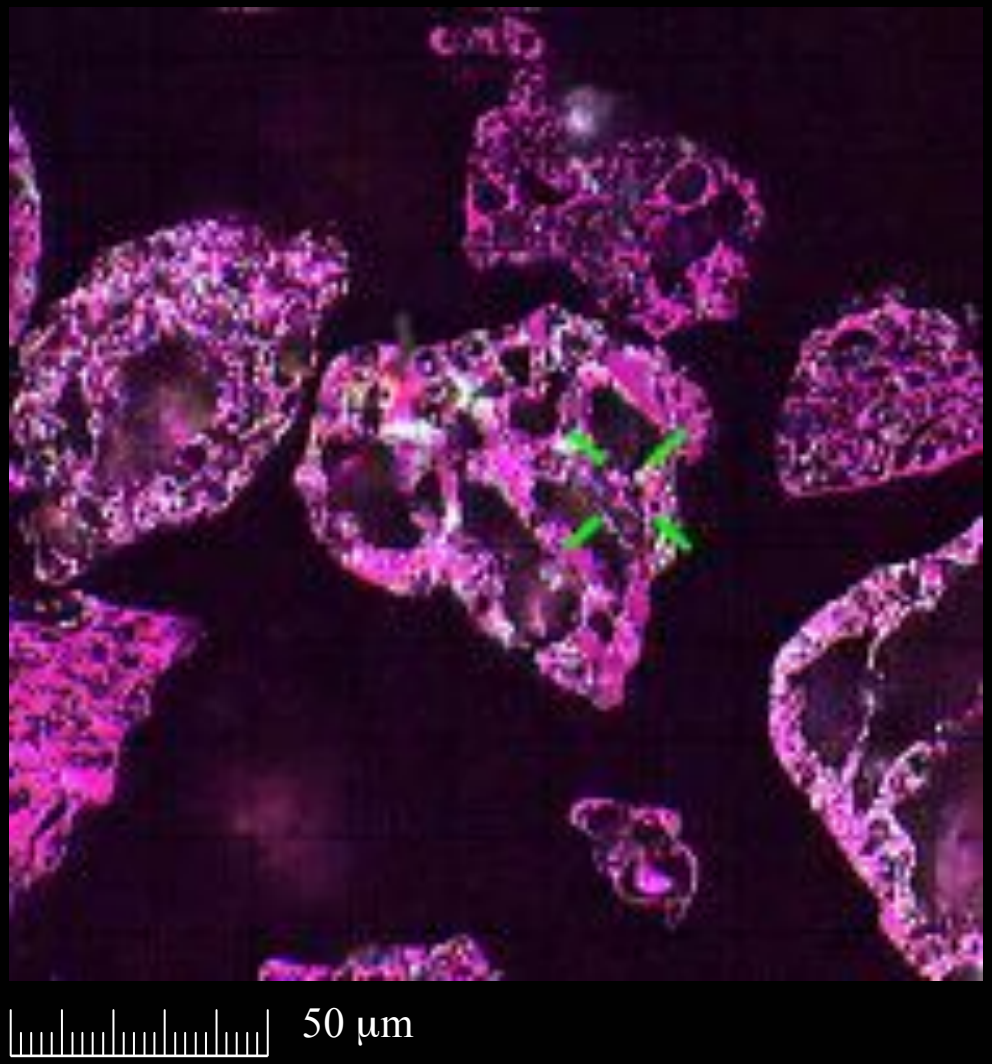
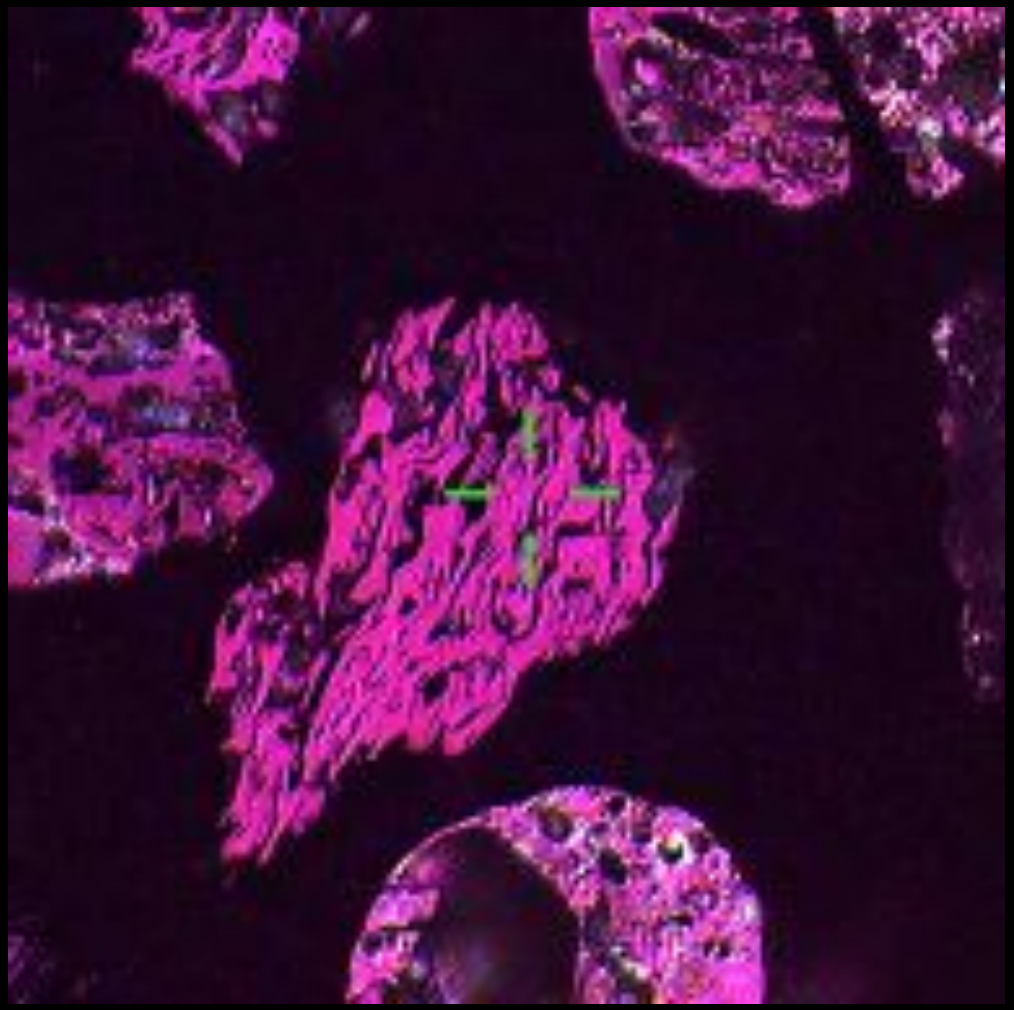


L8



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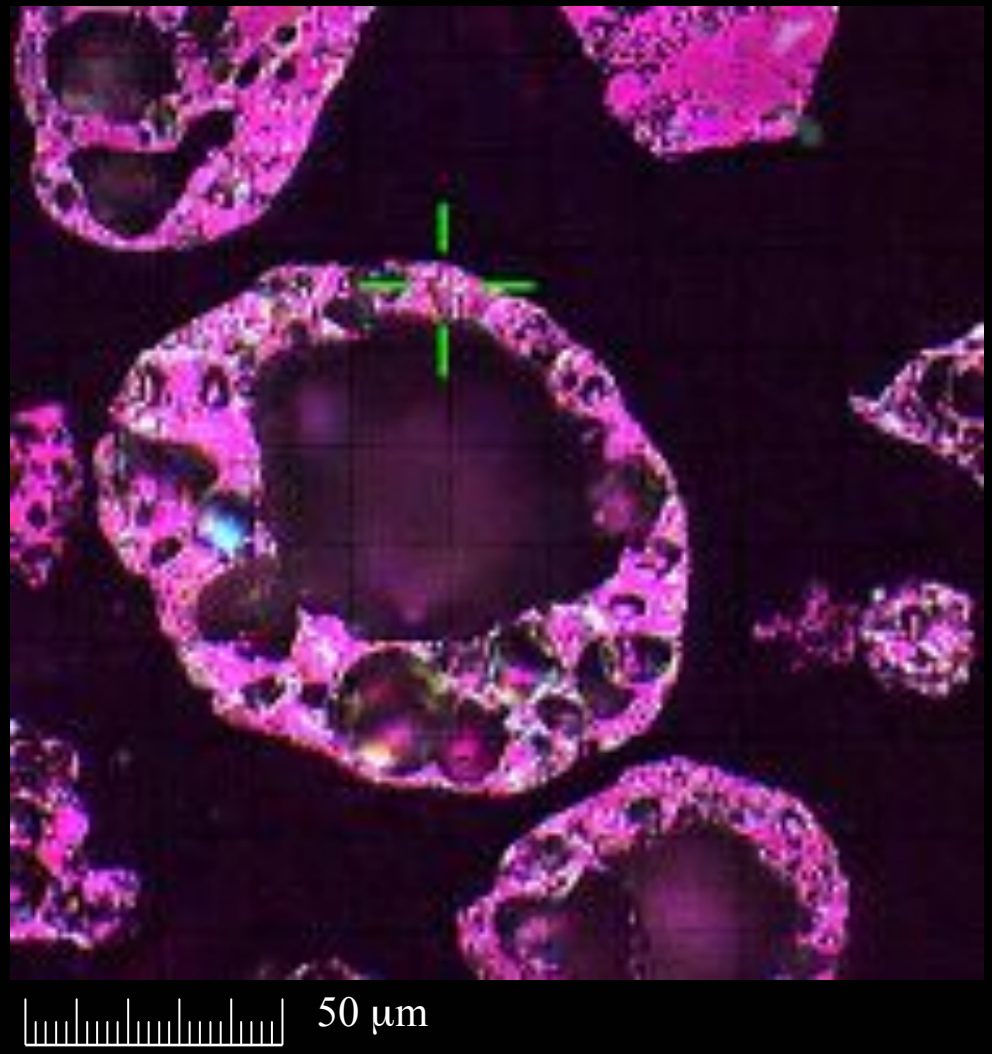

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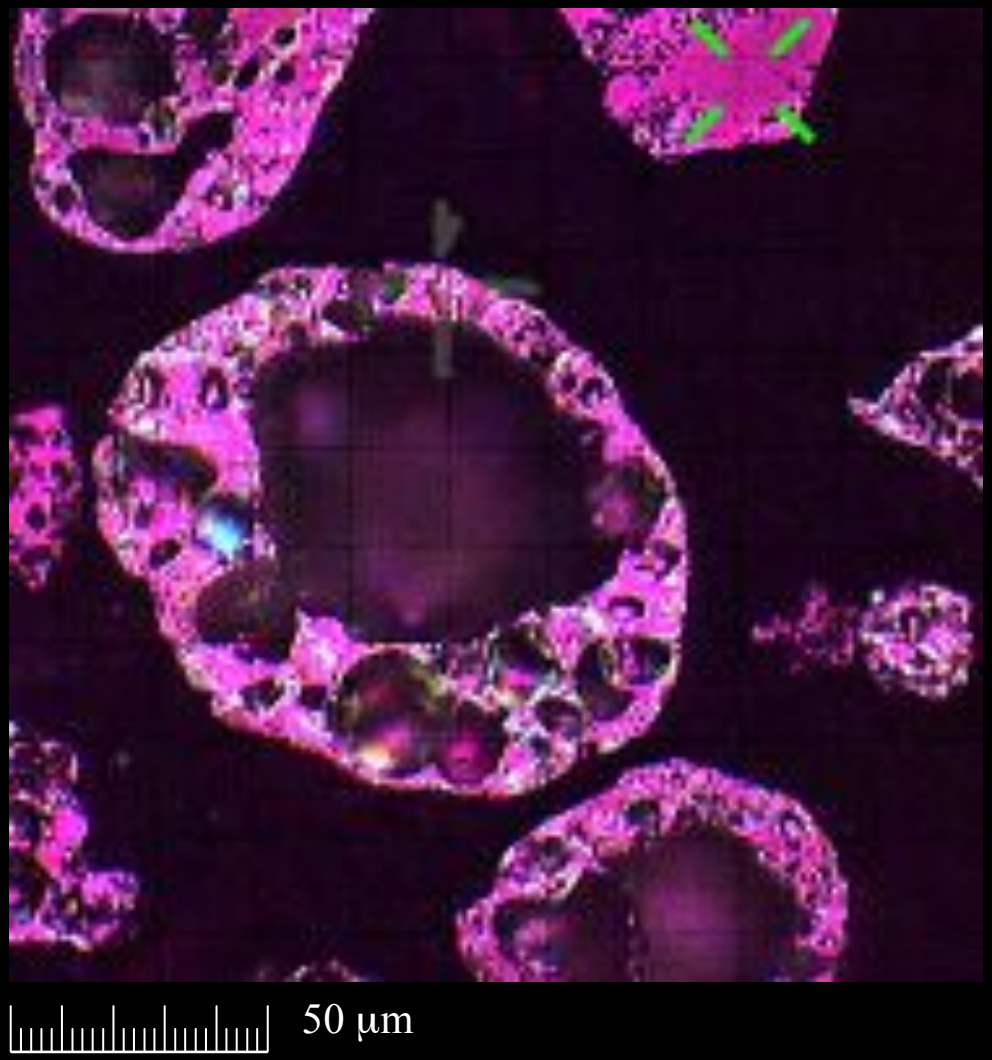

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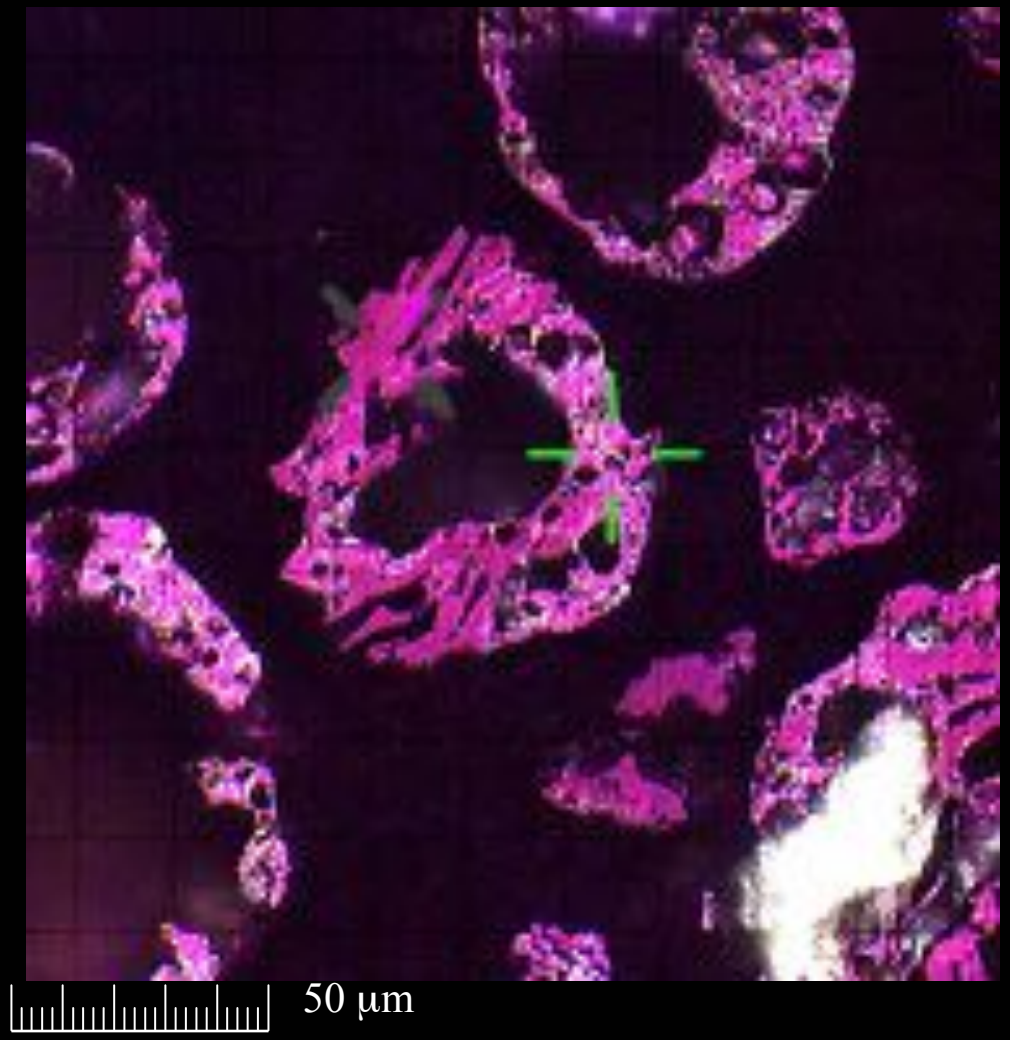

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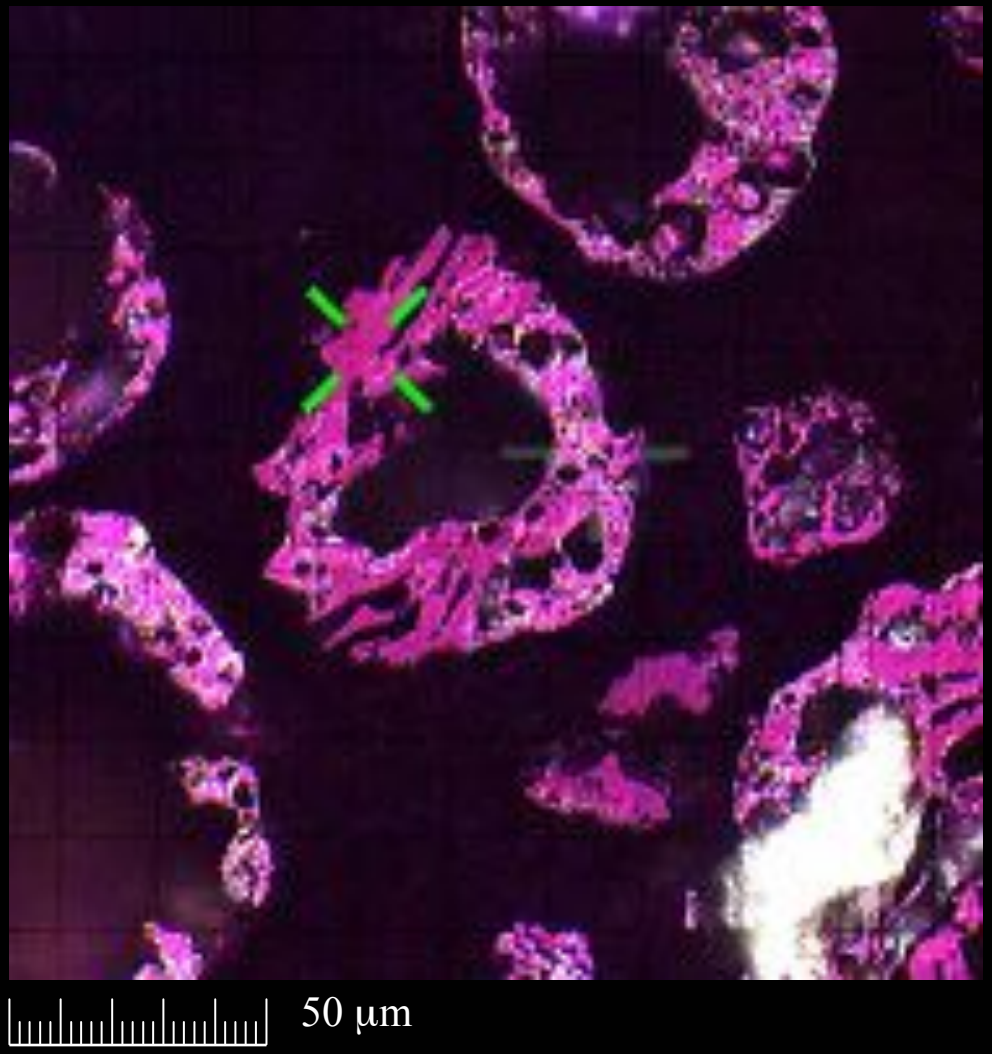

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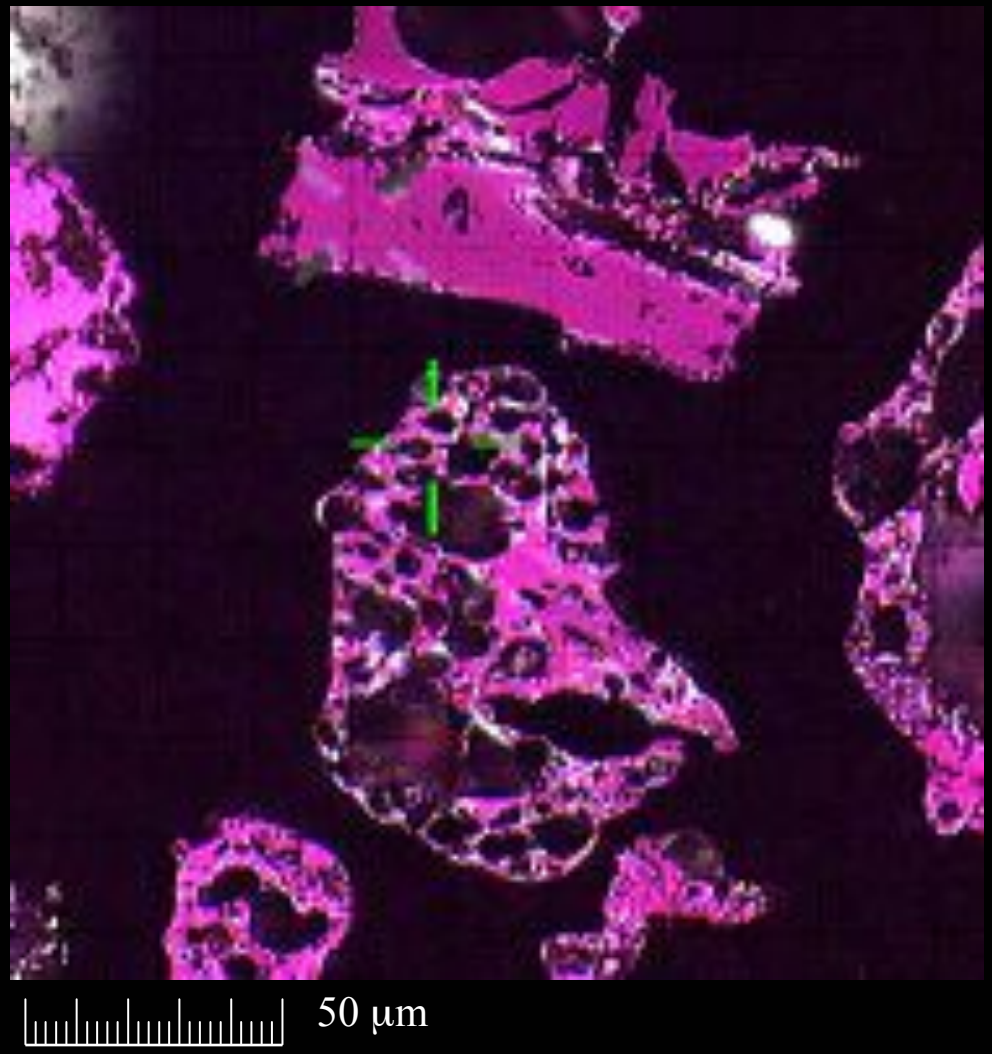

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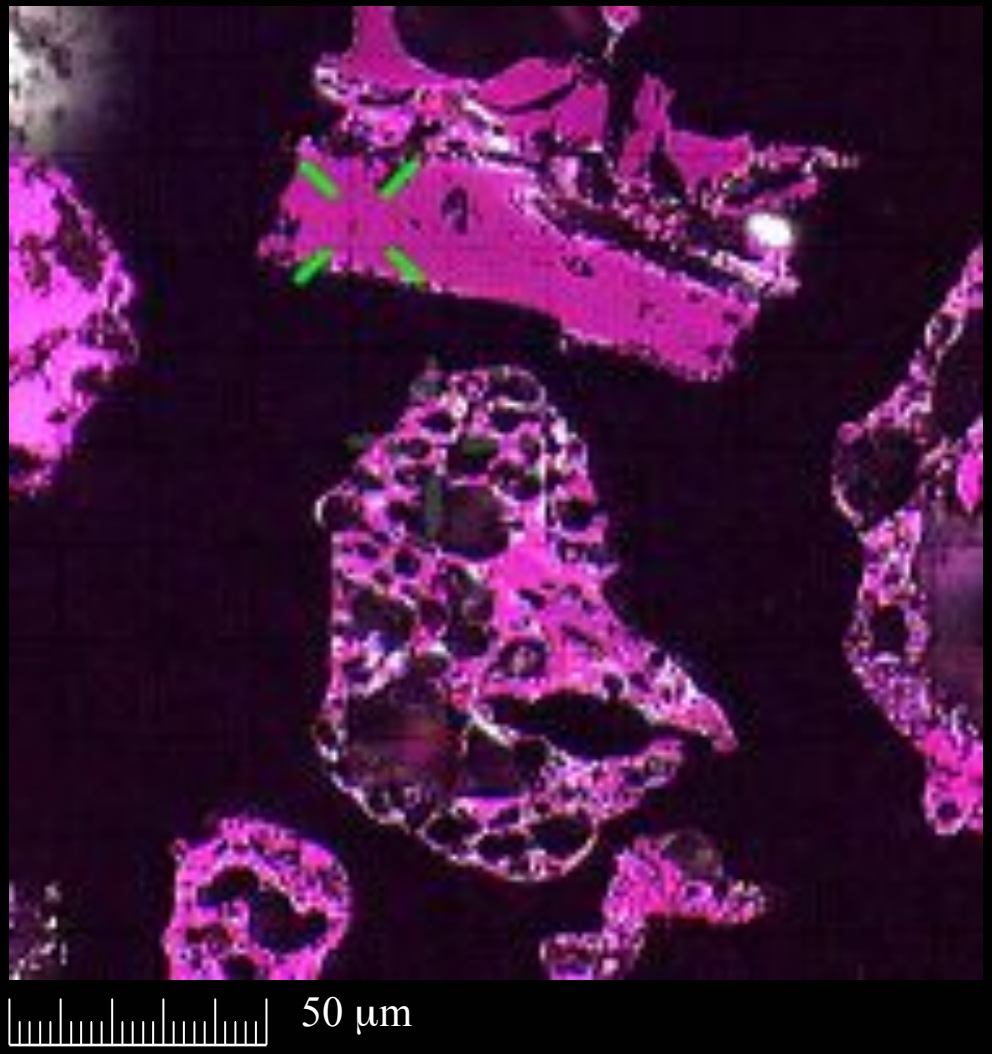

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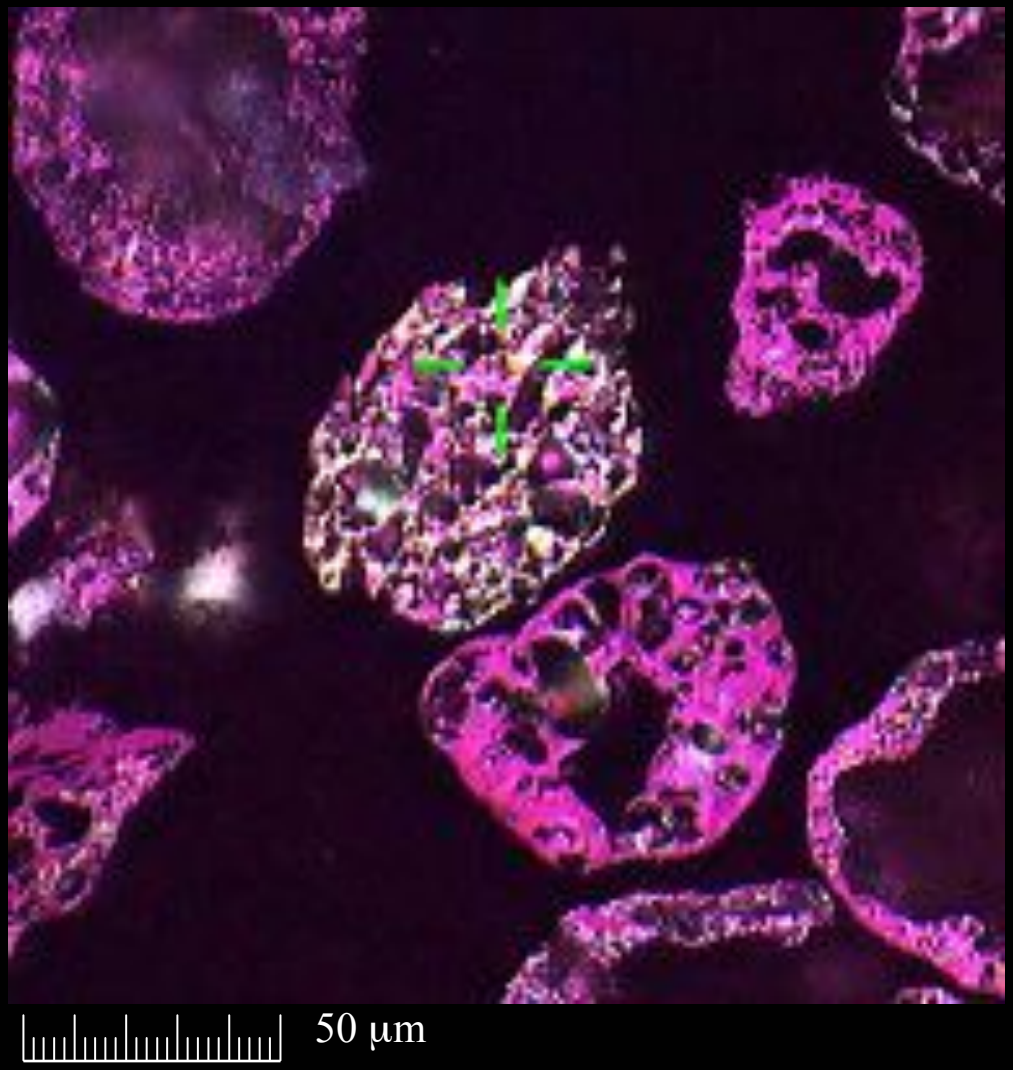

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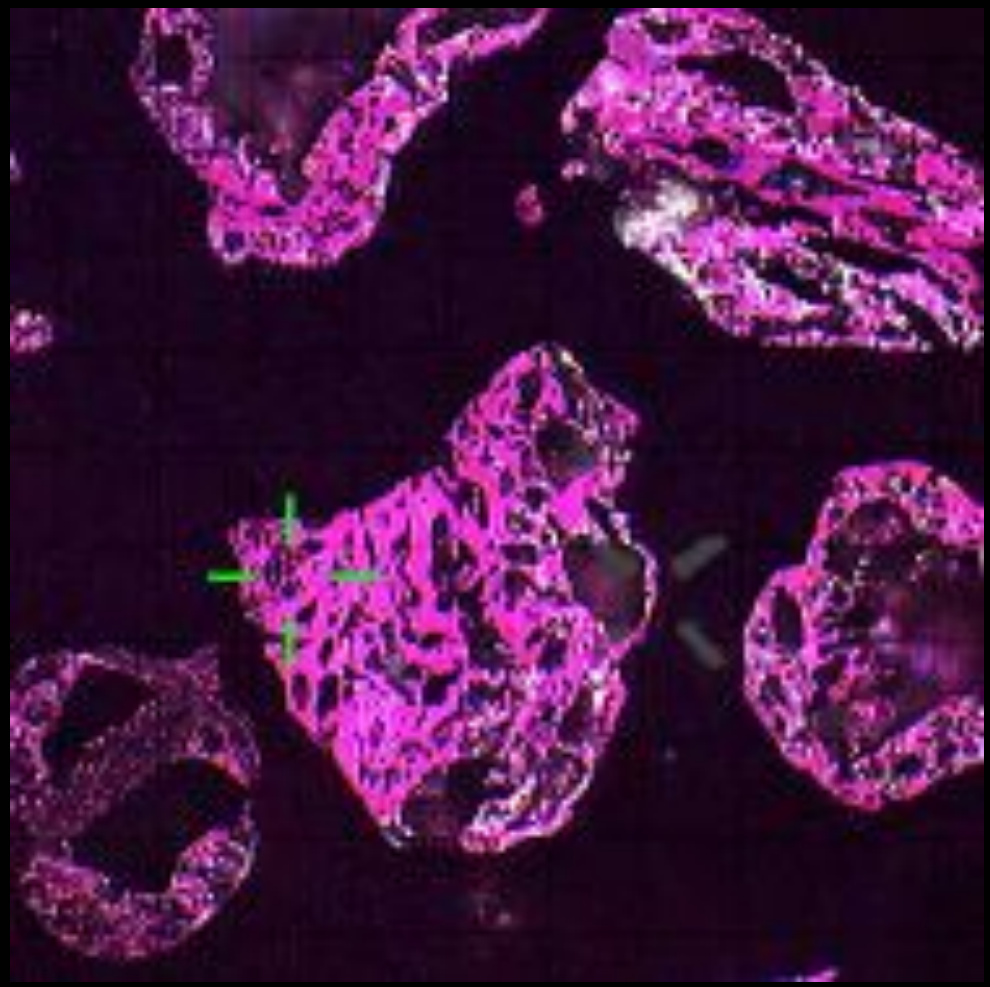

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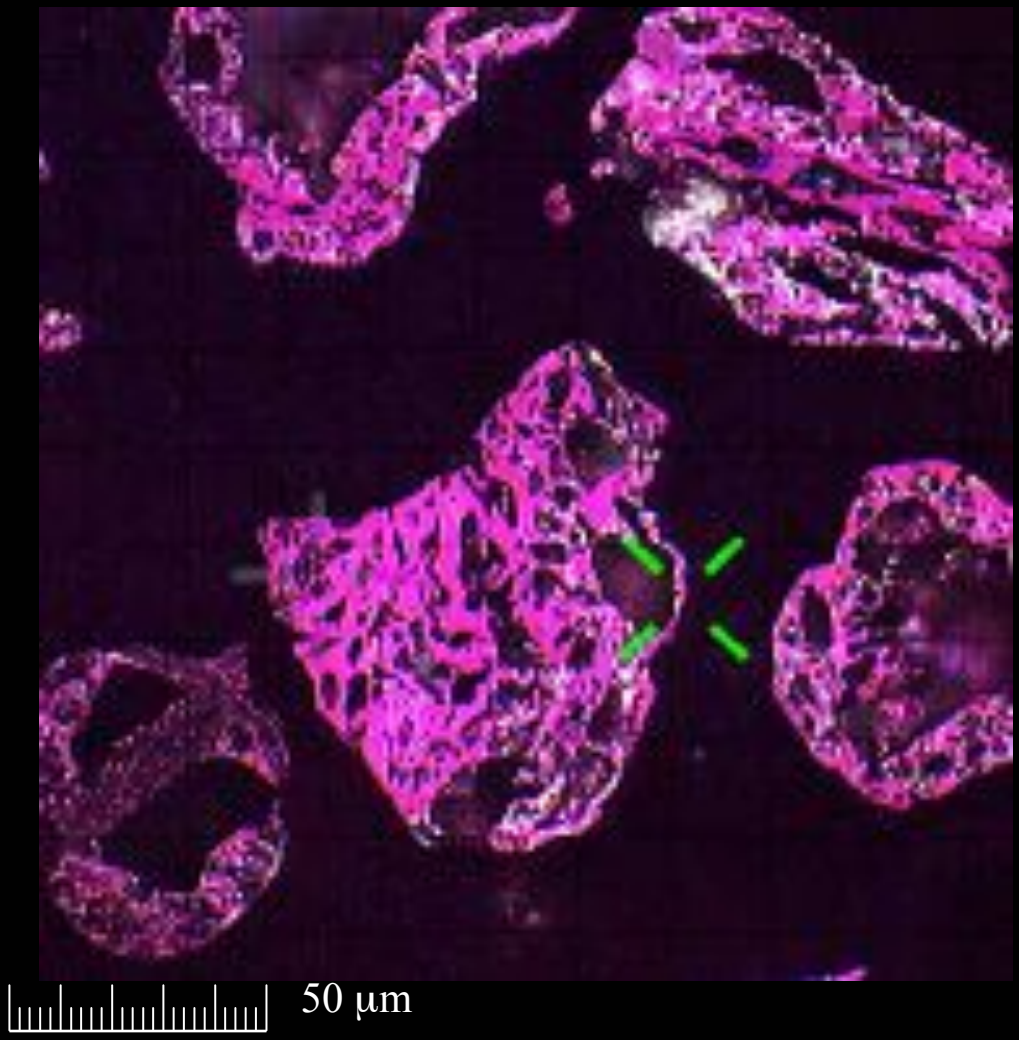

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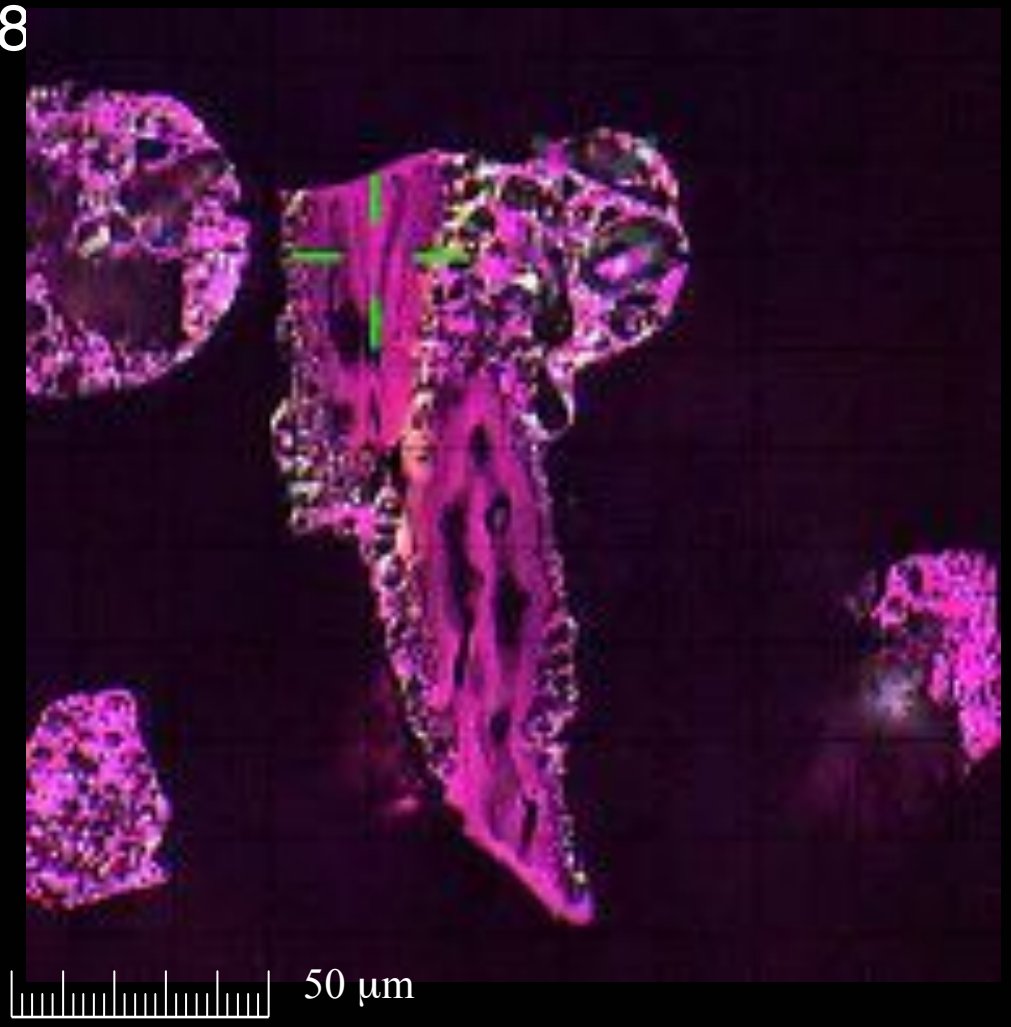

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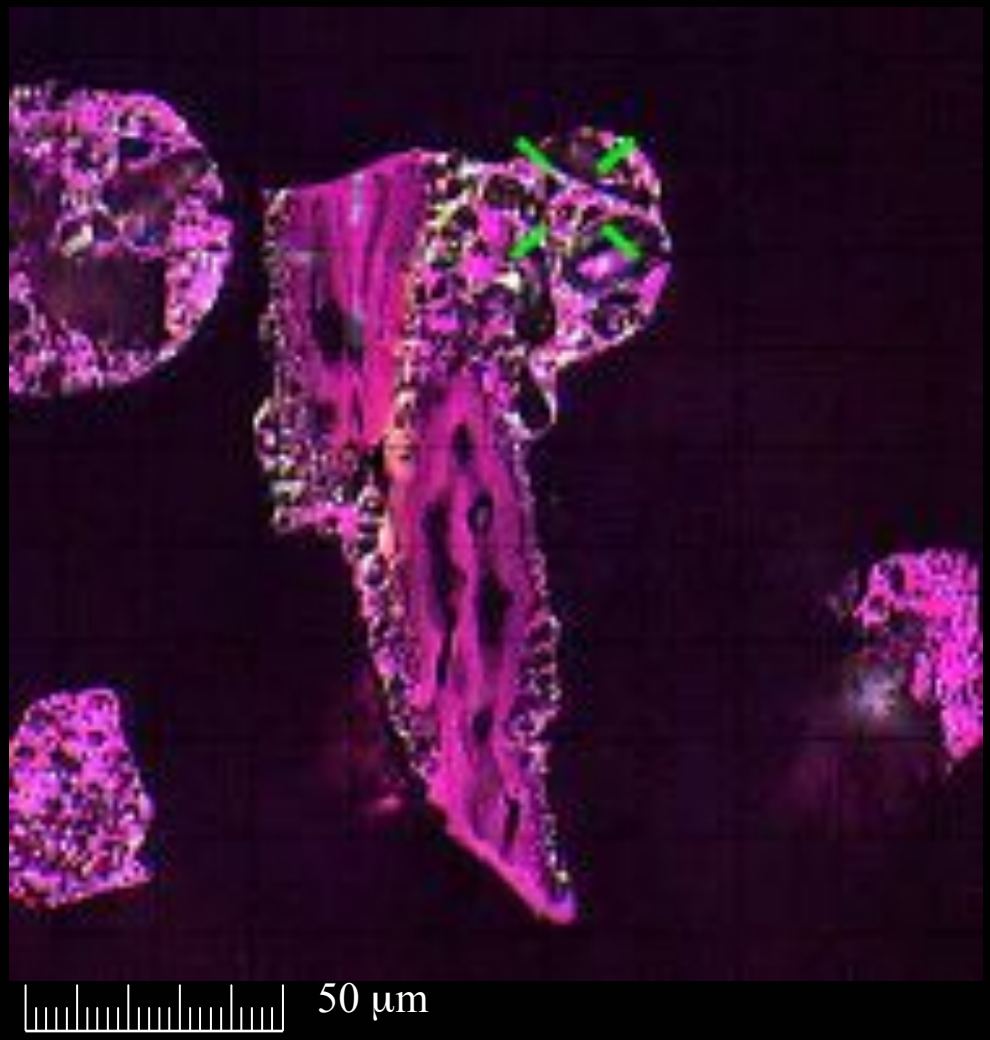

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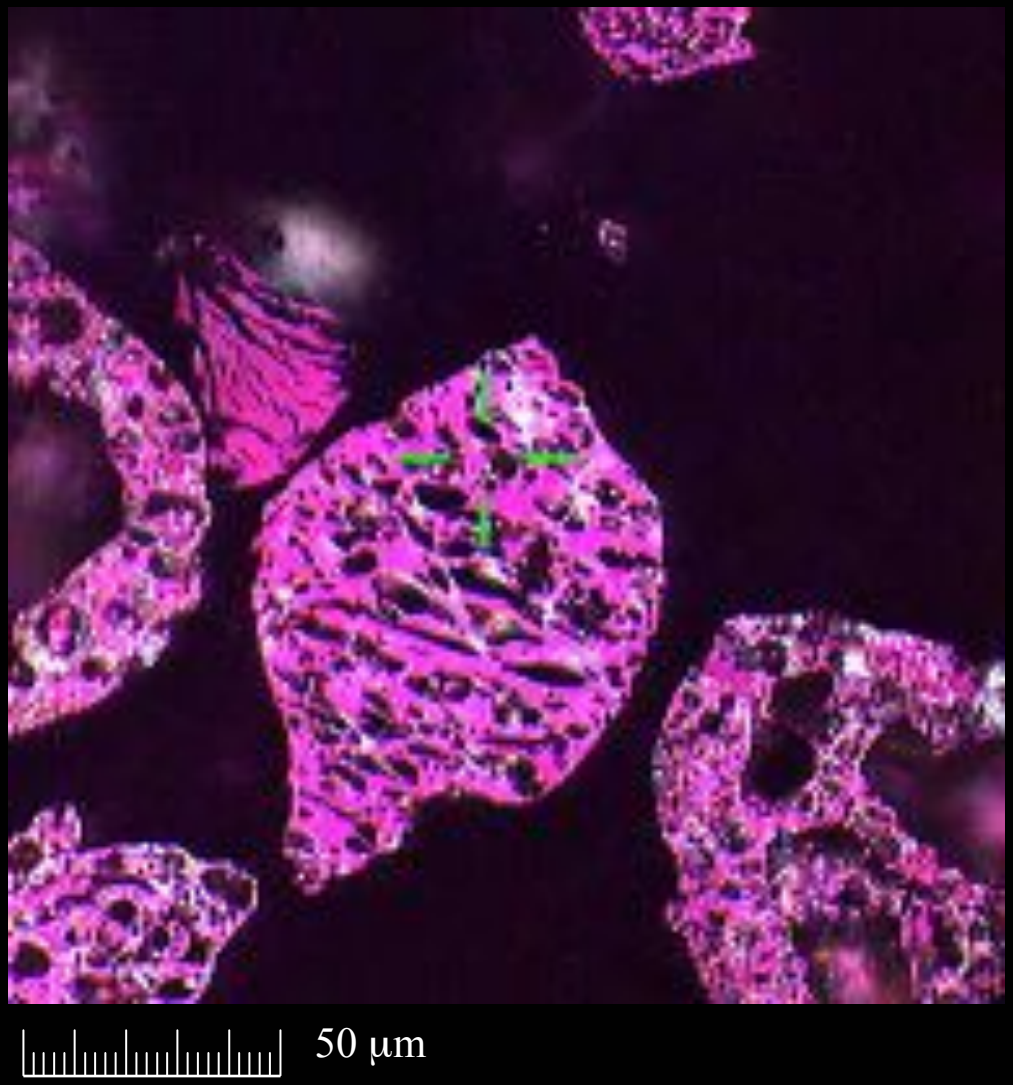

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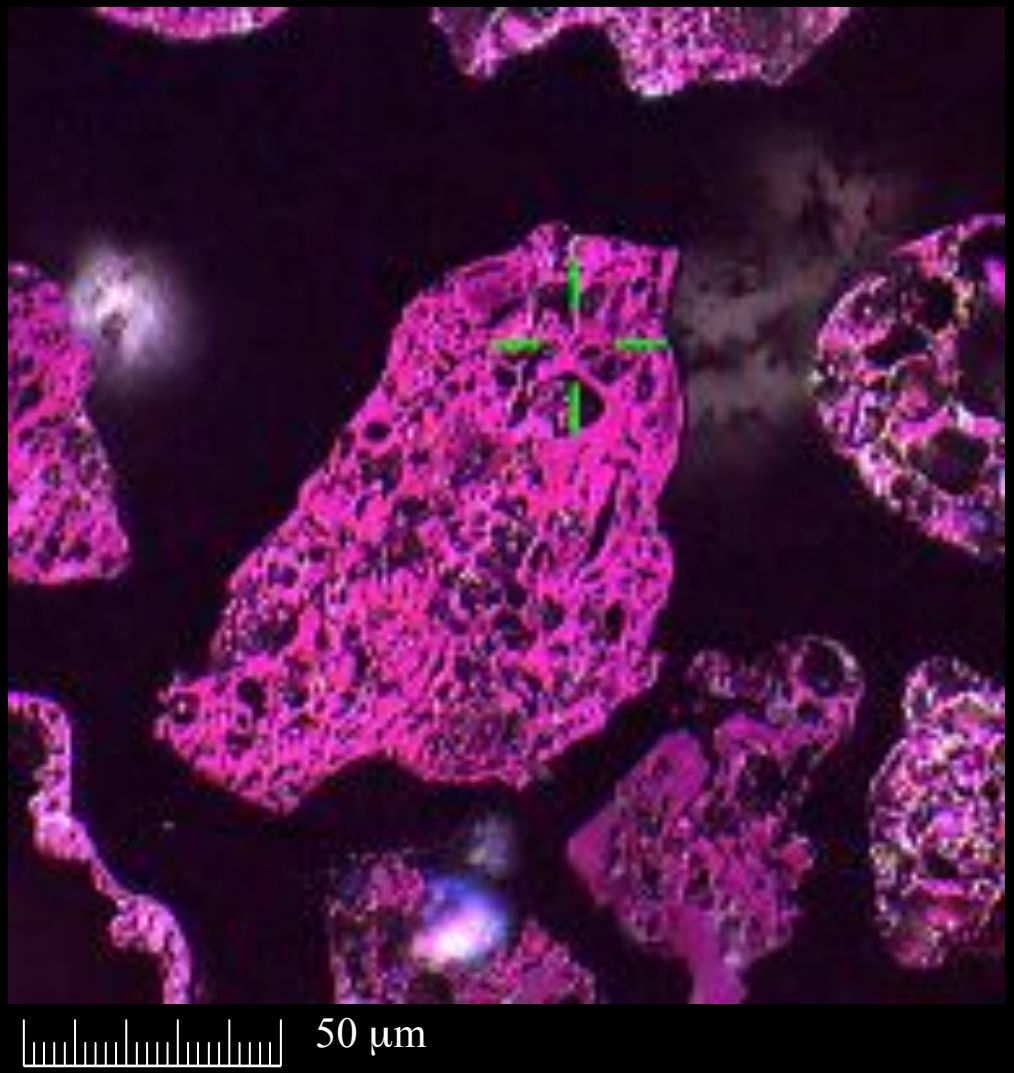

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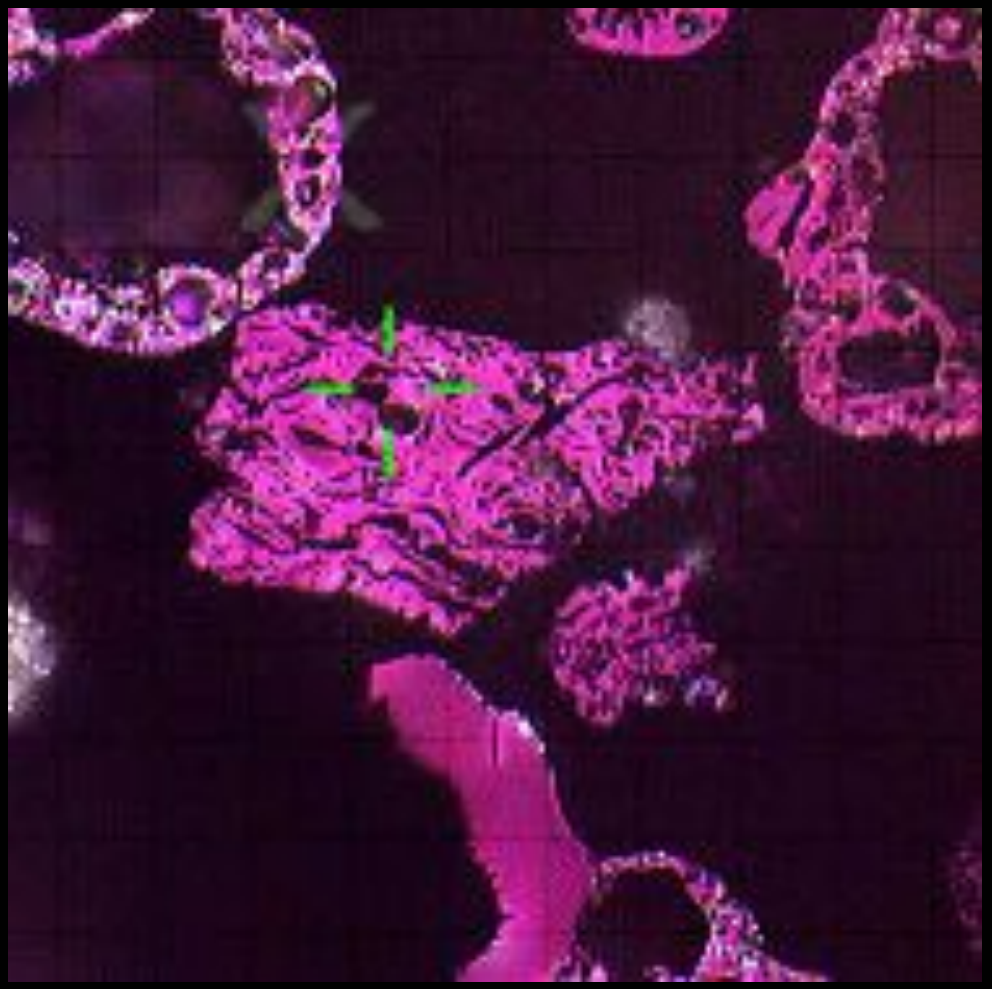

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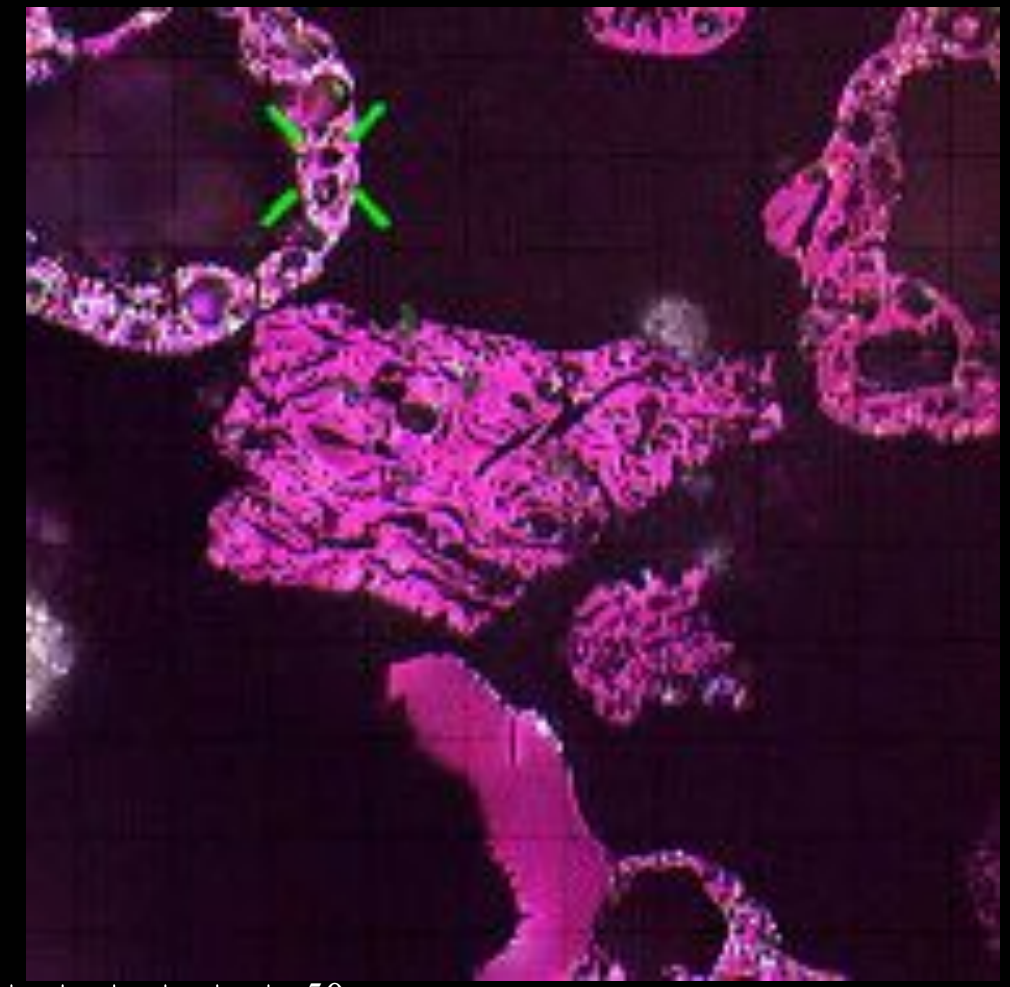

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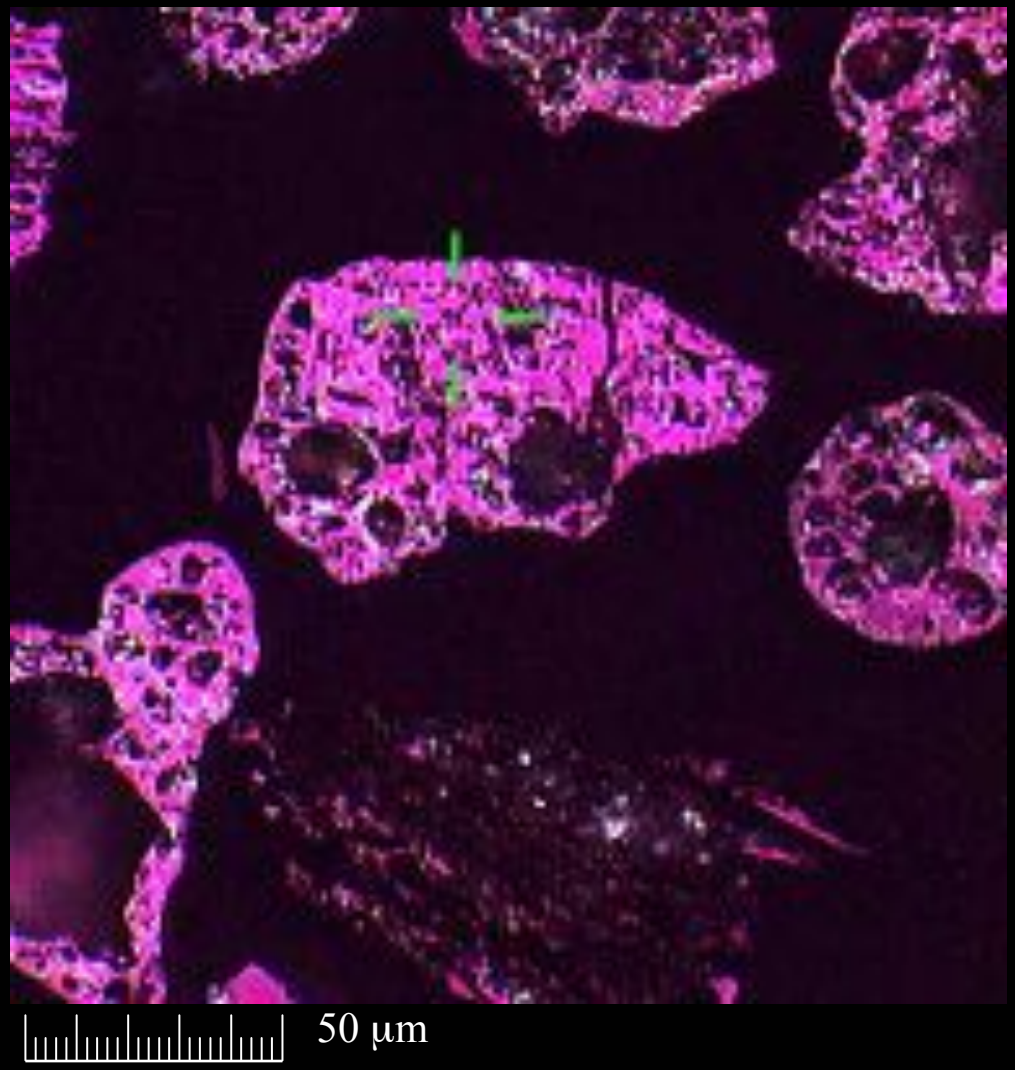

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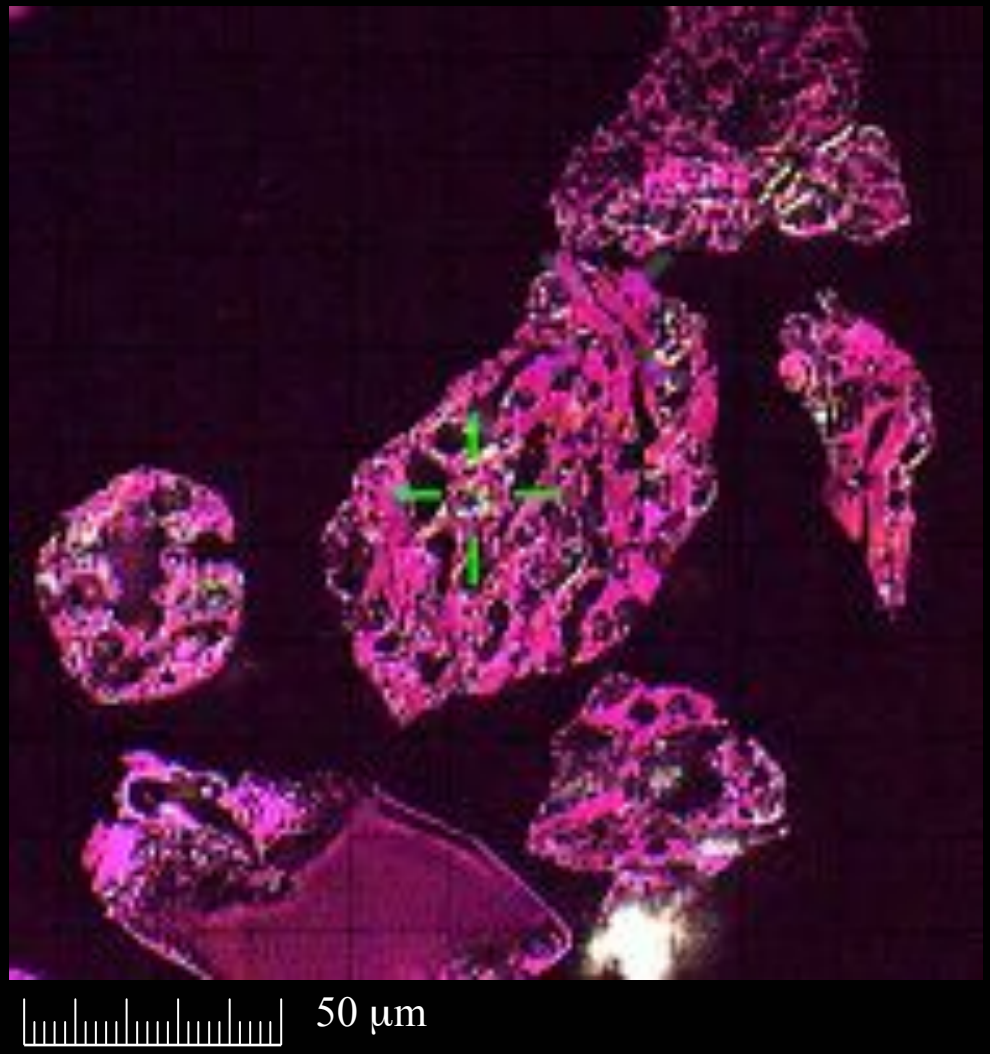

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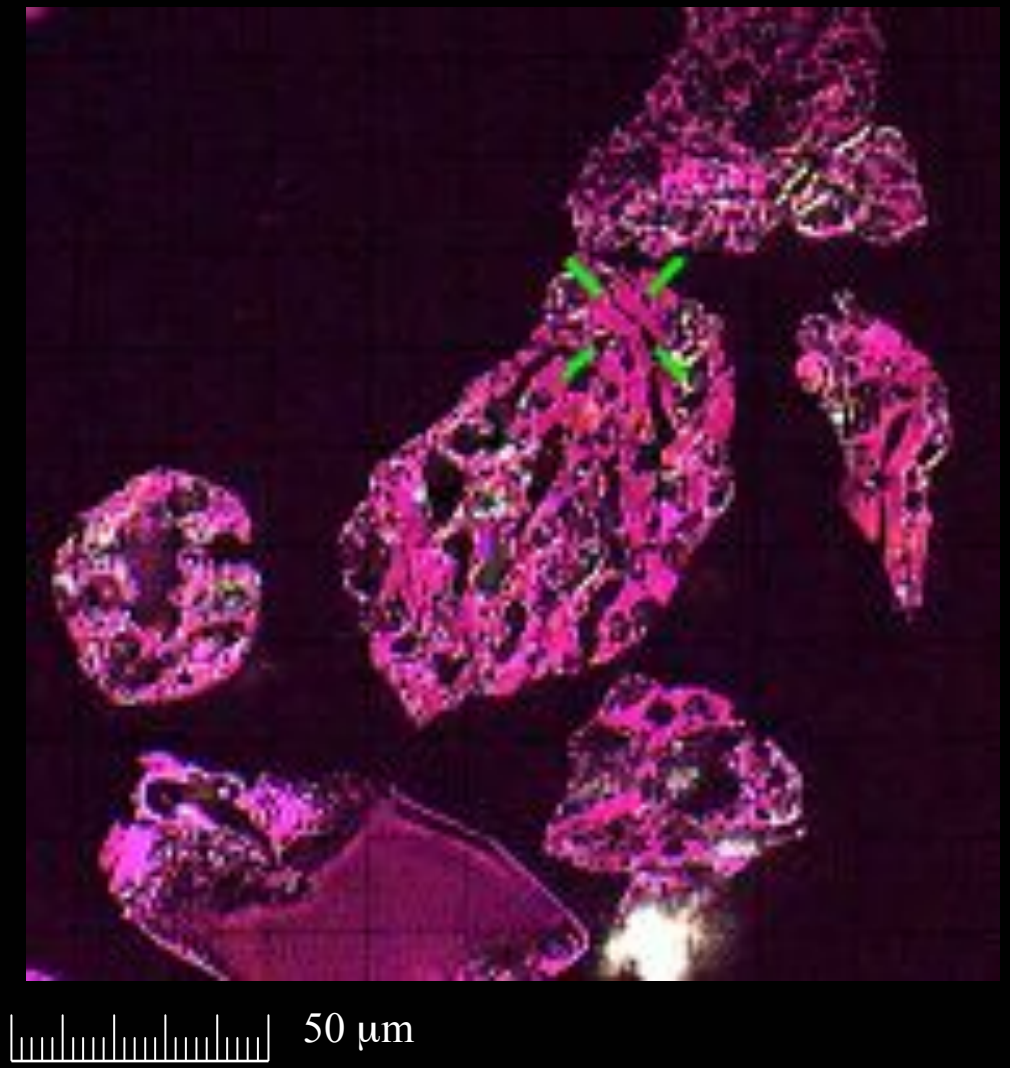

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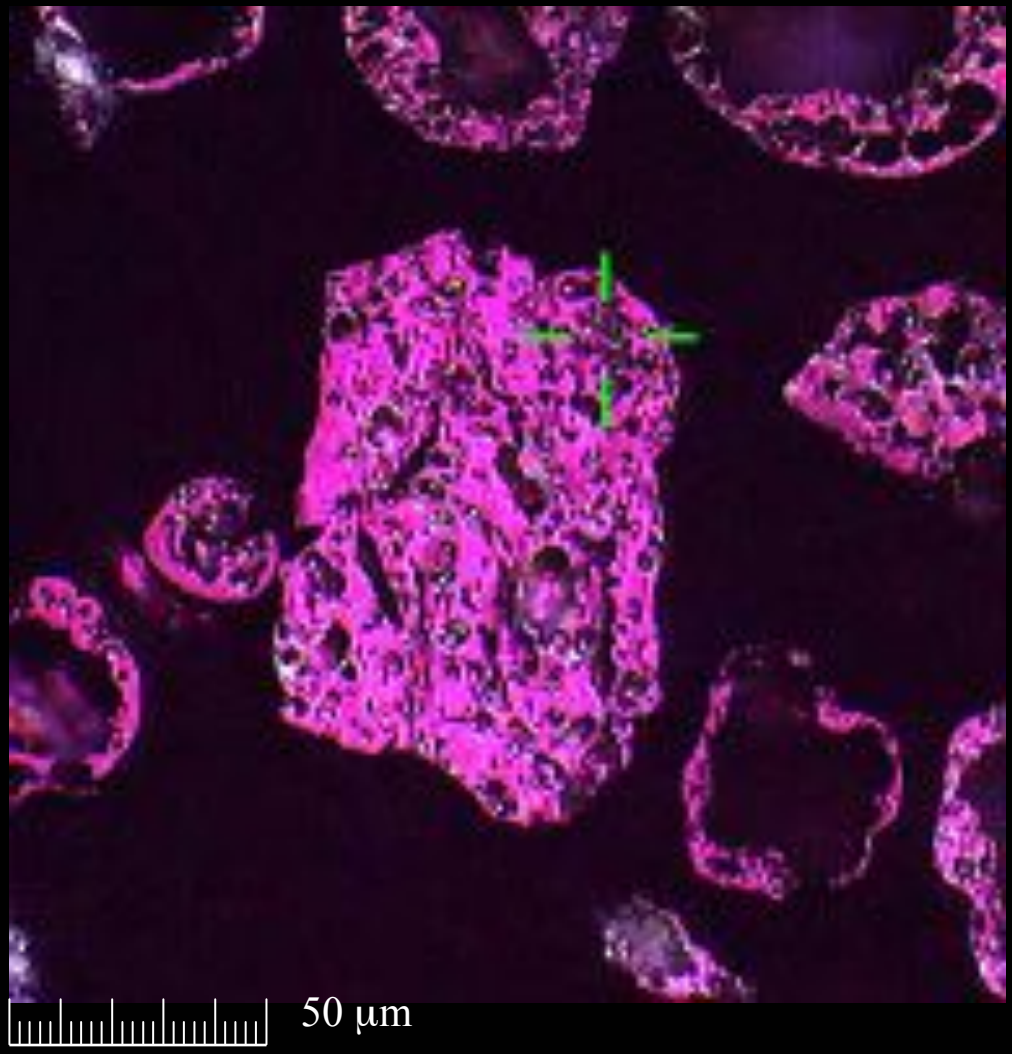

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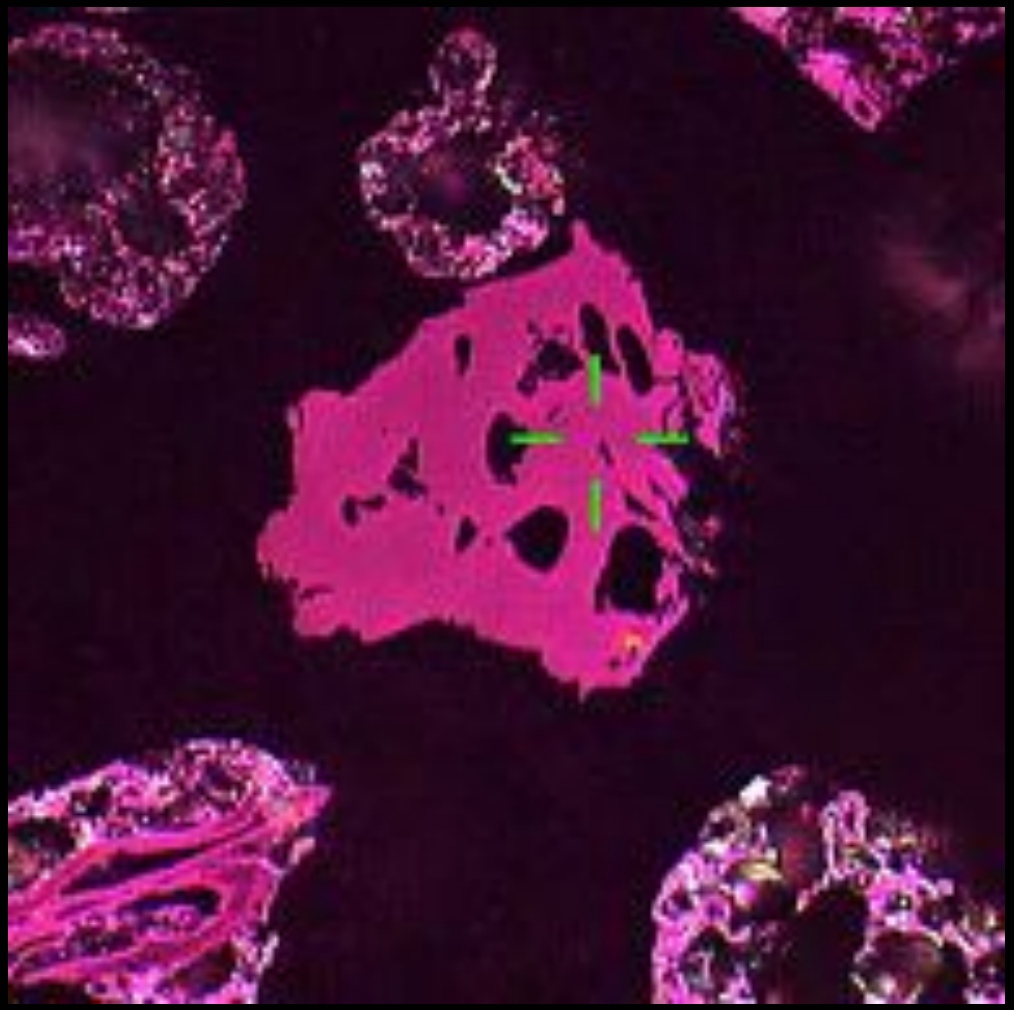

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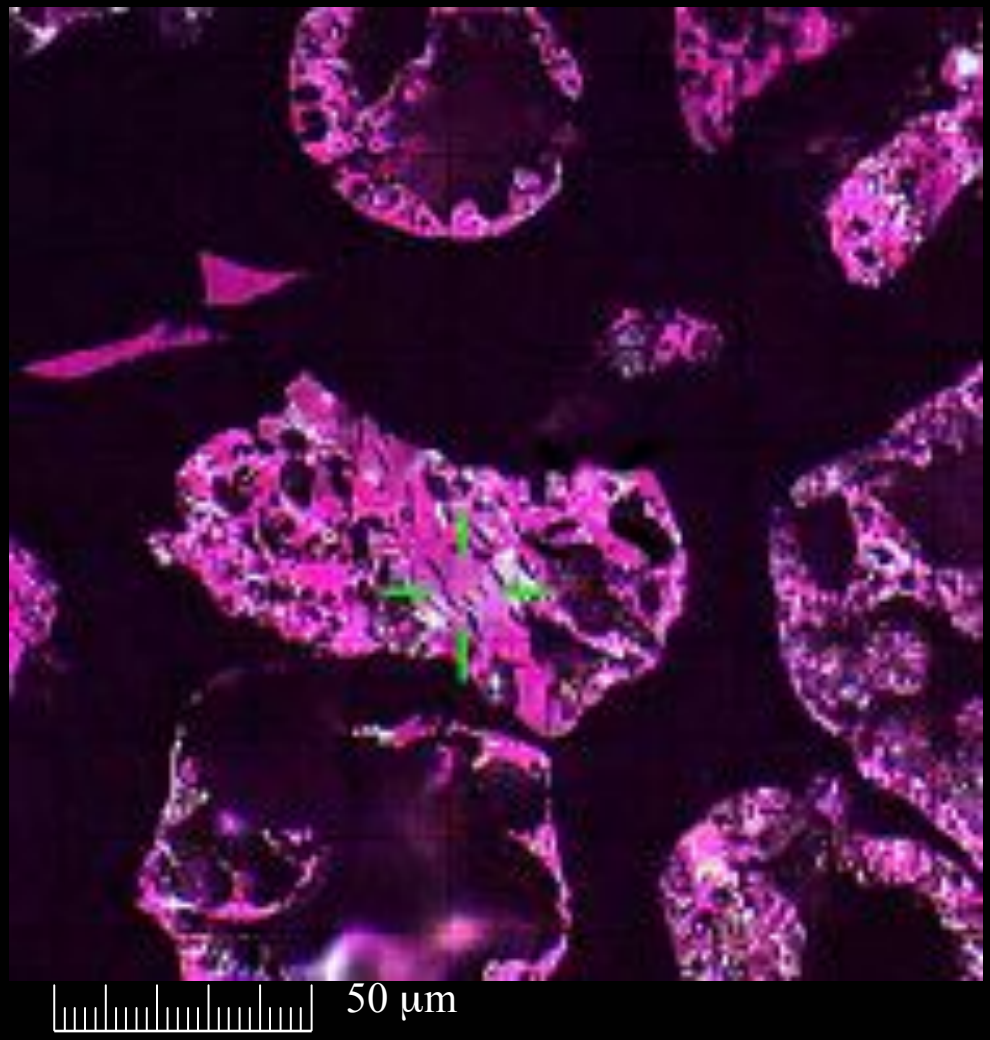

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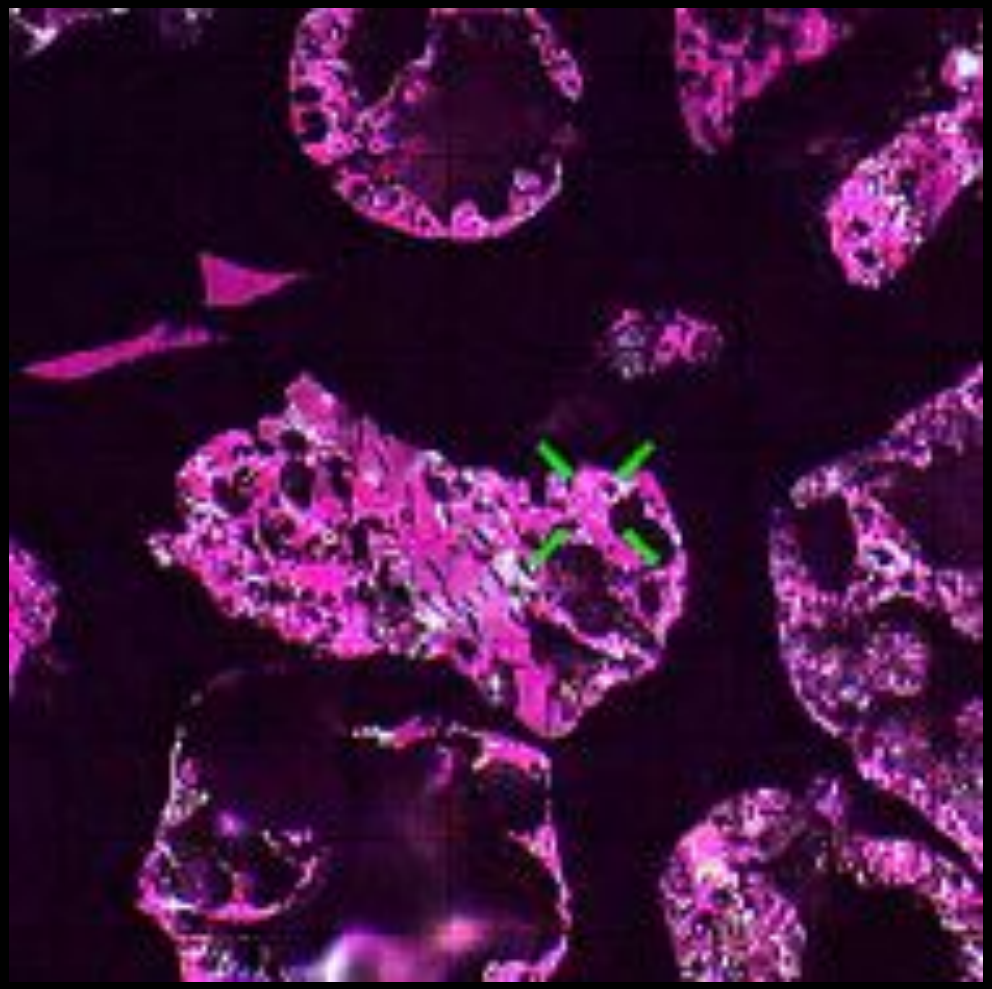

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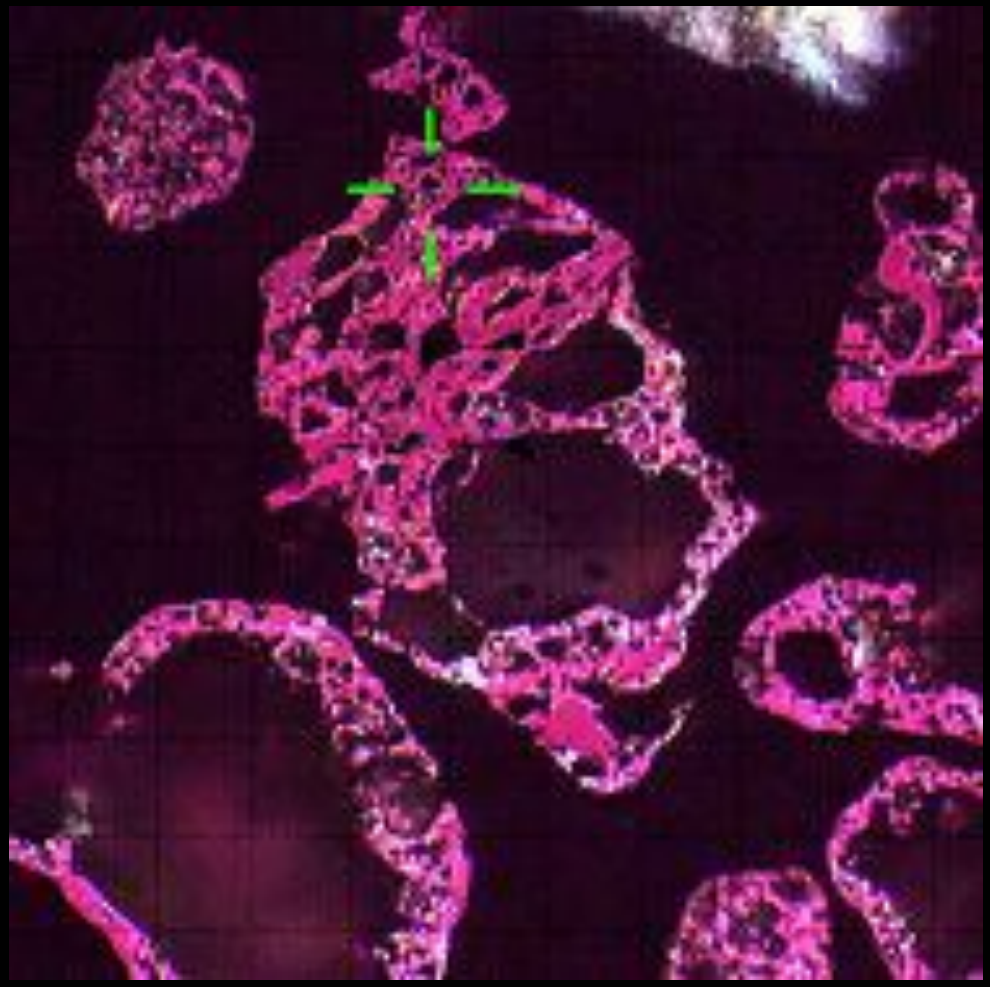
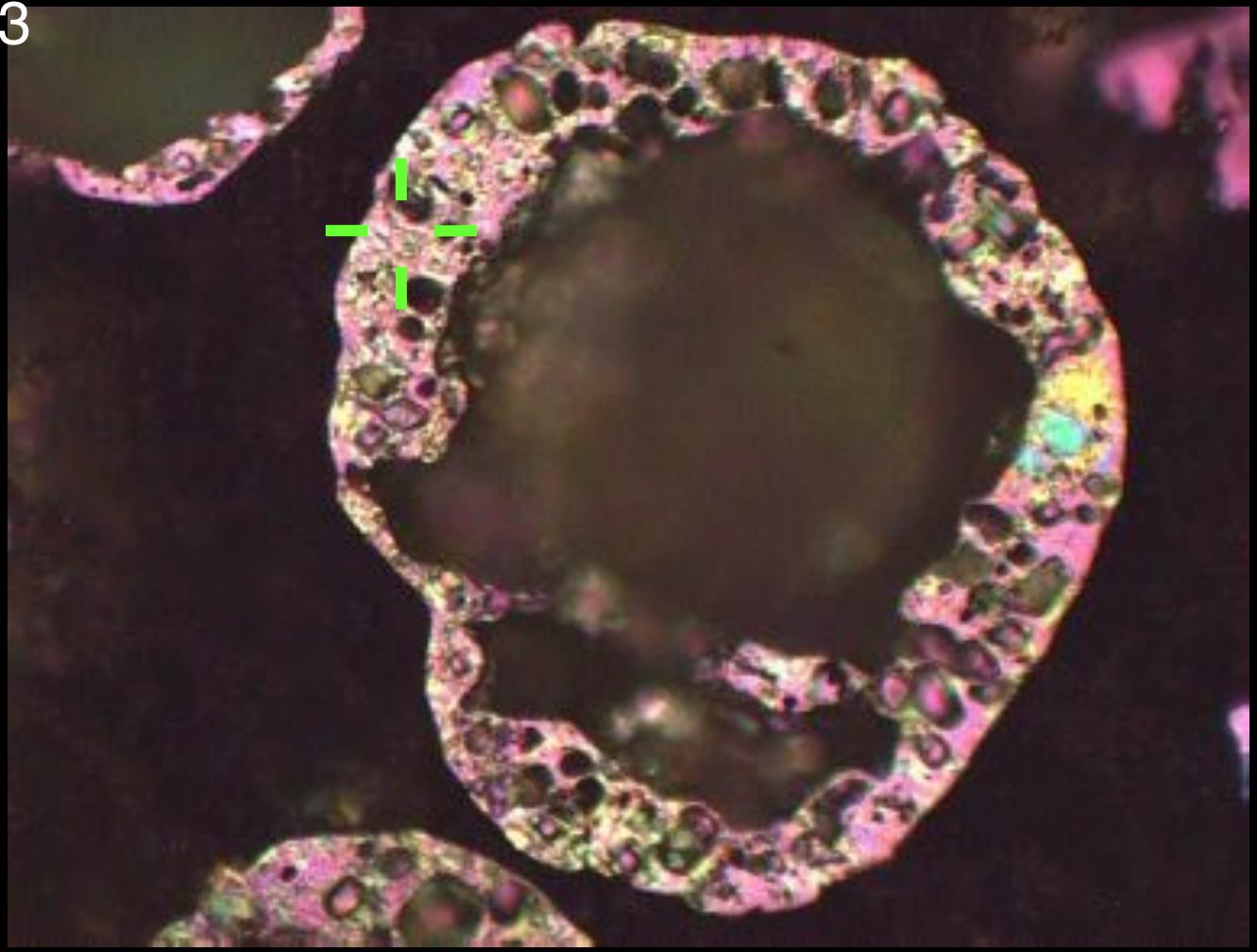


L32

L33



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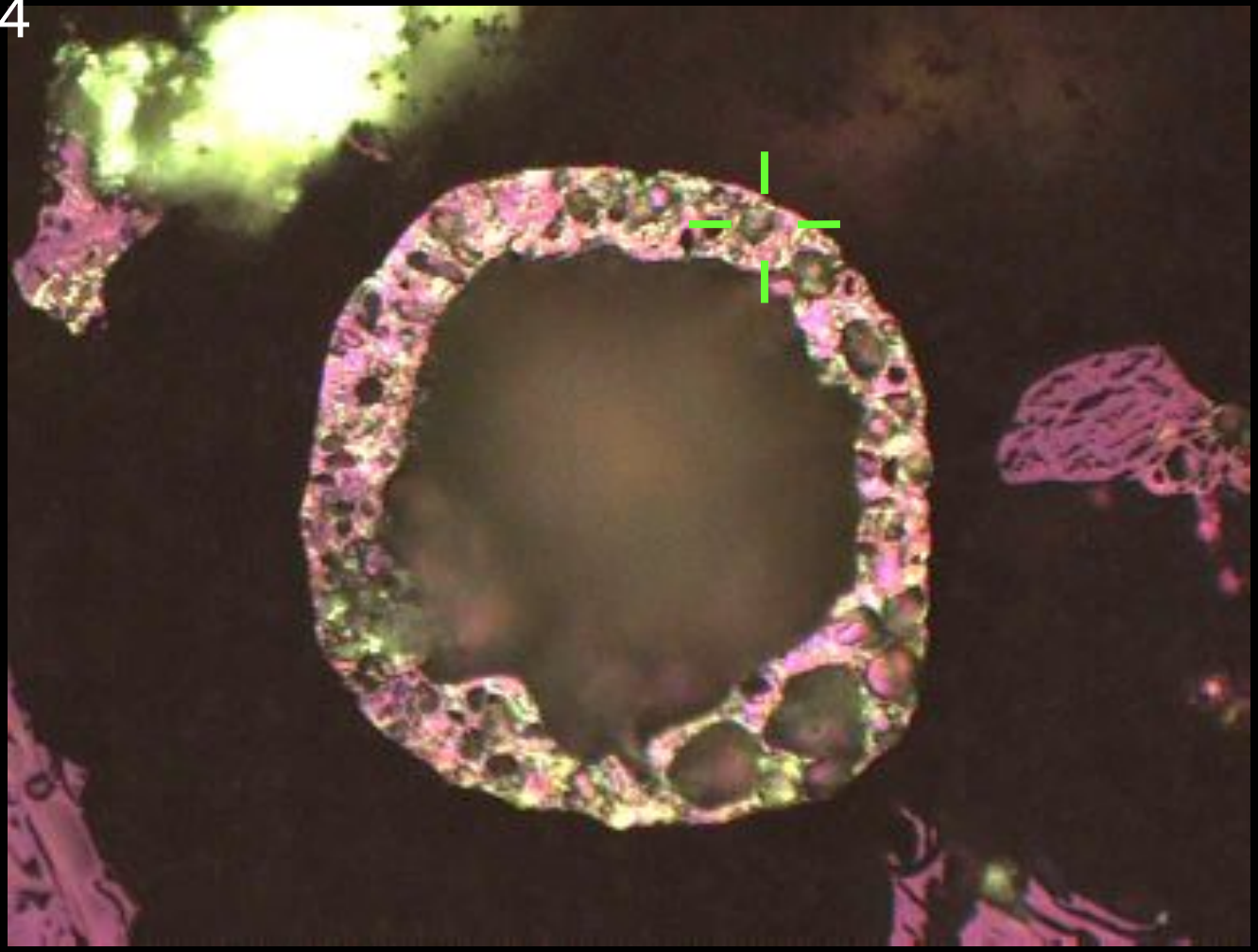

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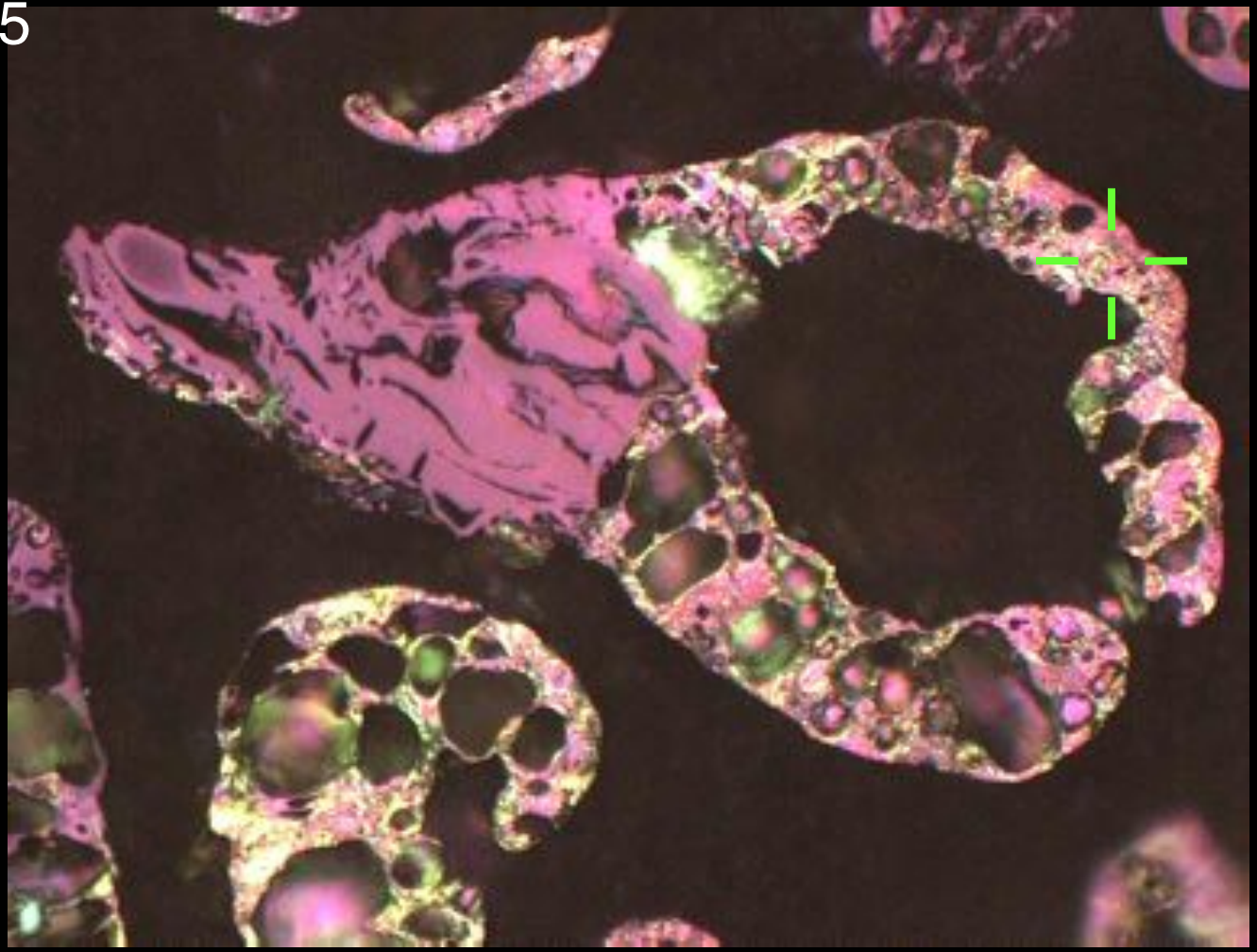

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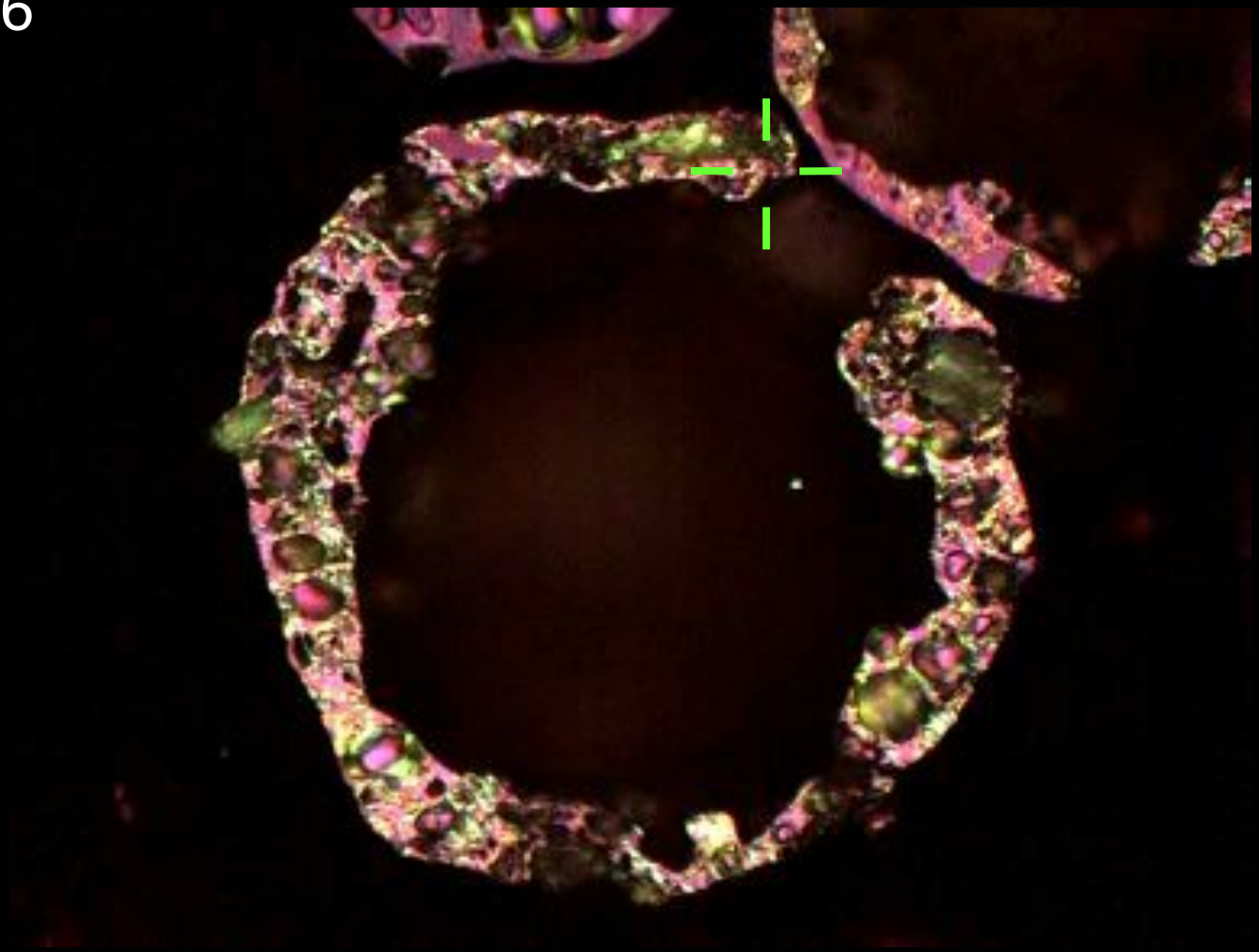

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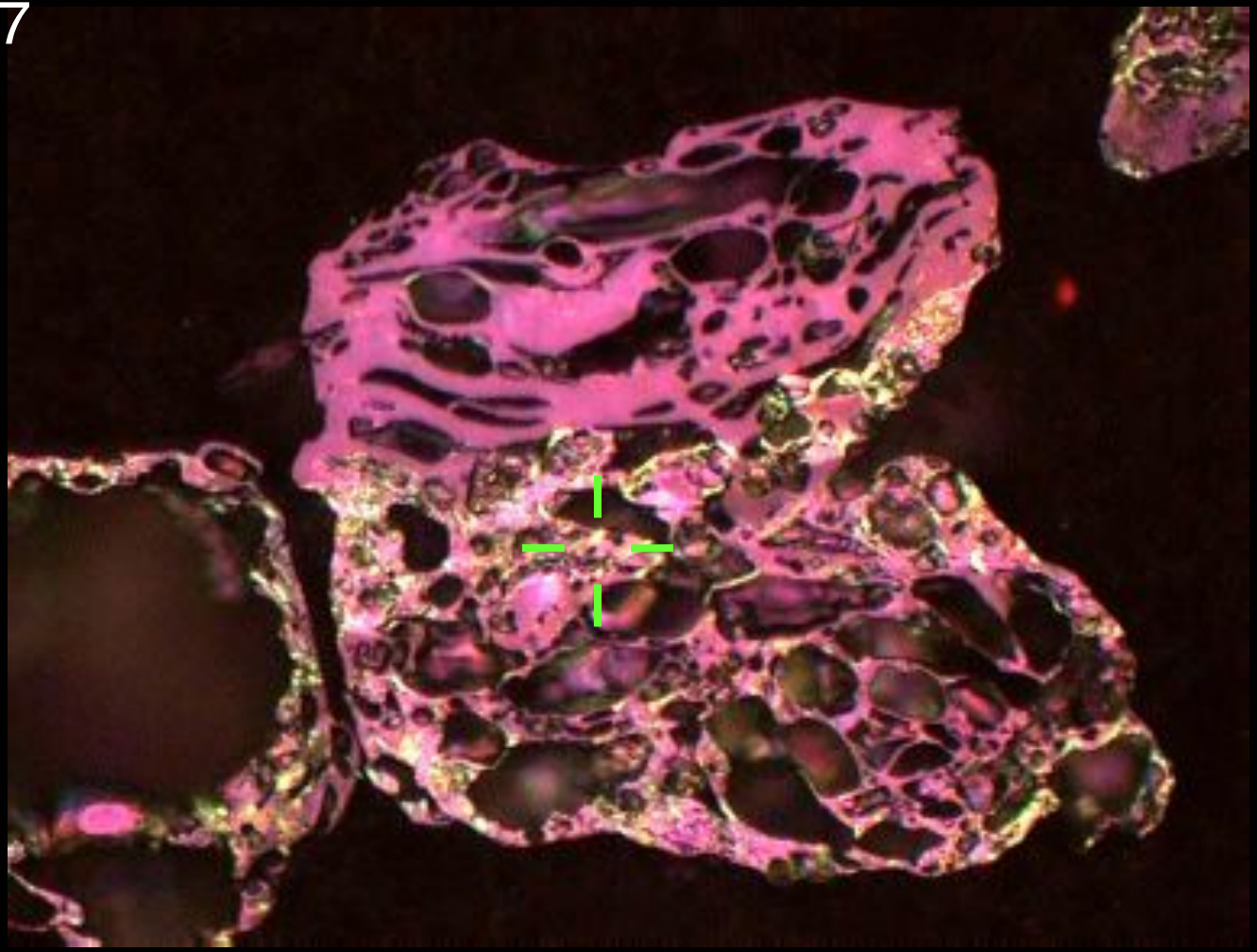

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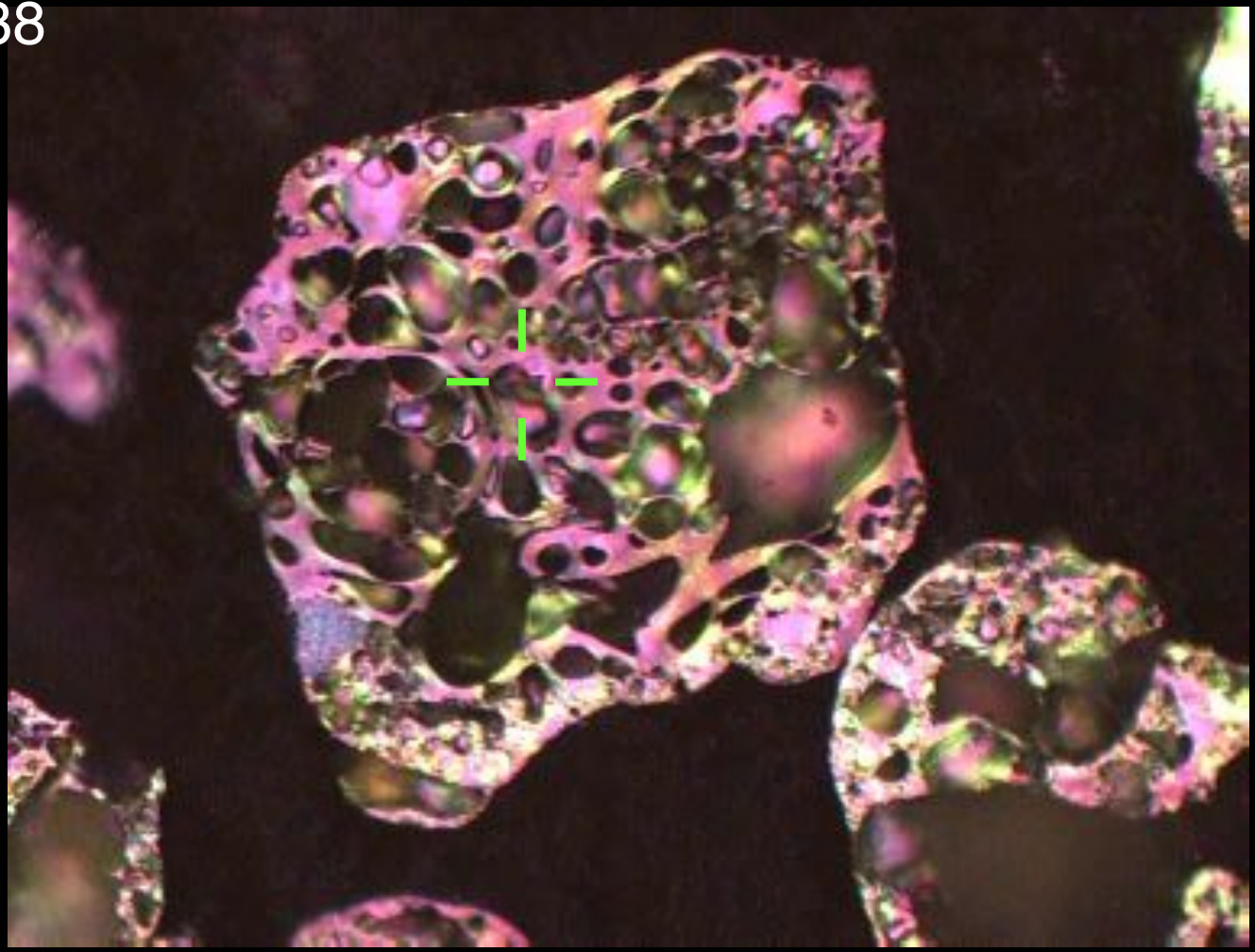

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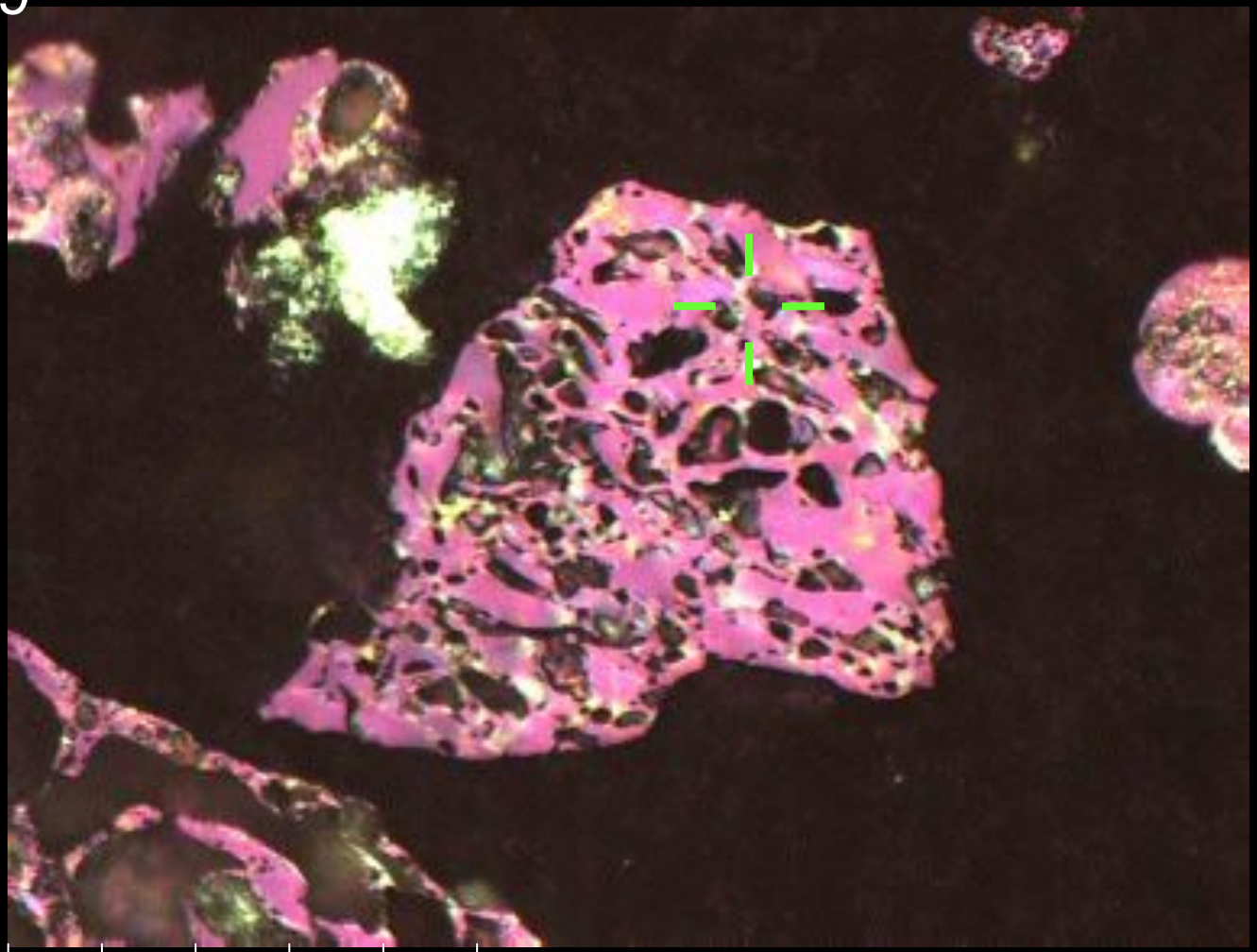

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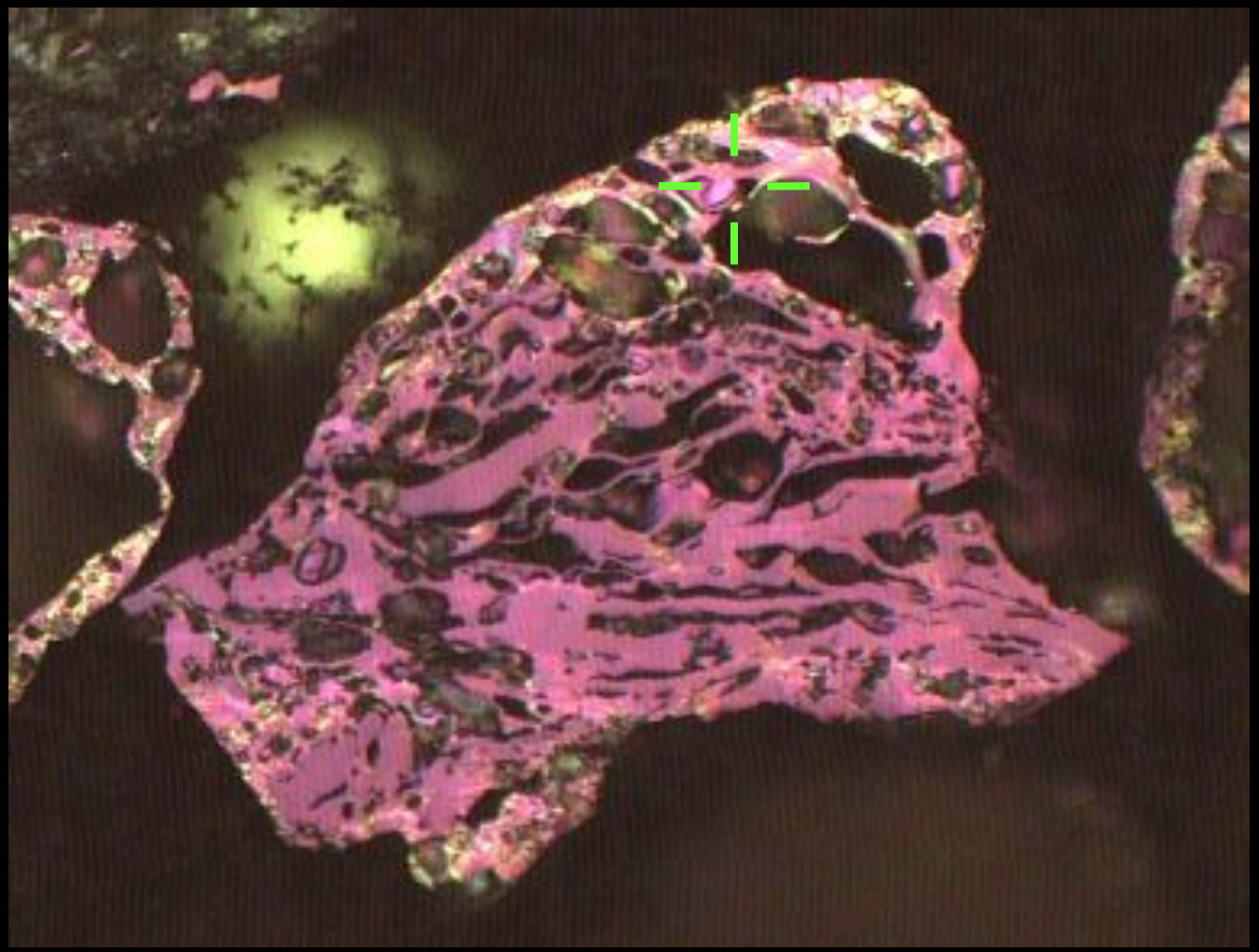
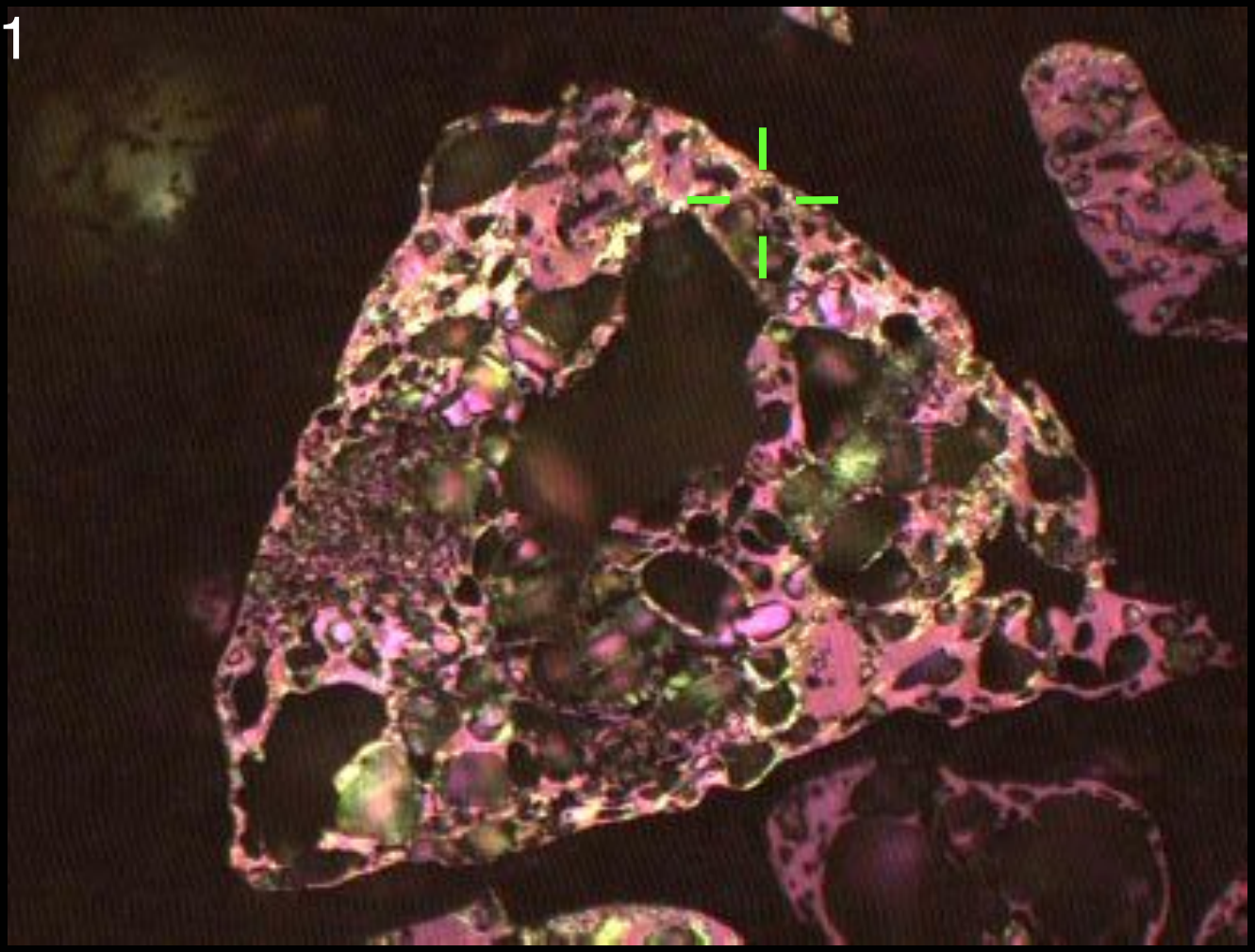


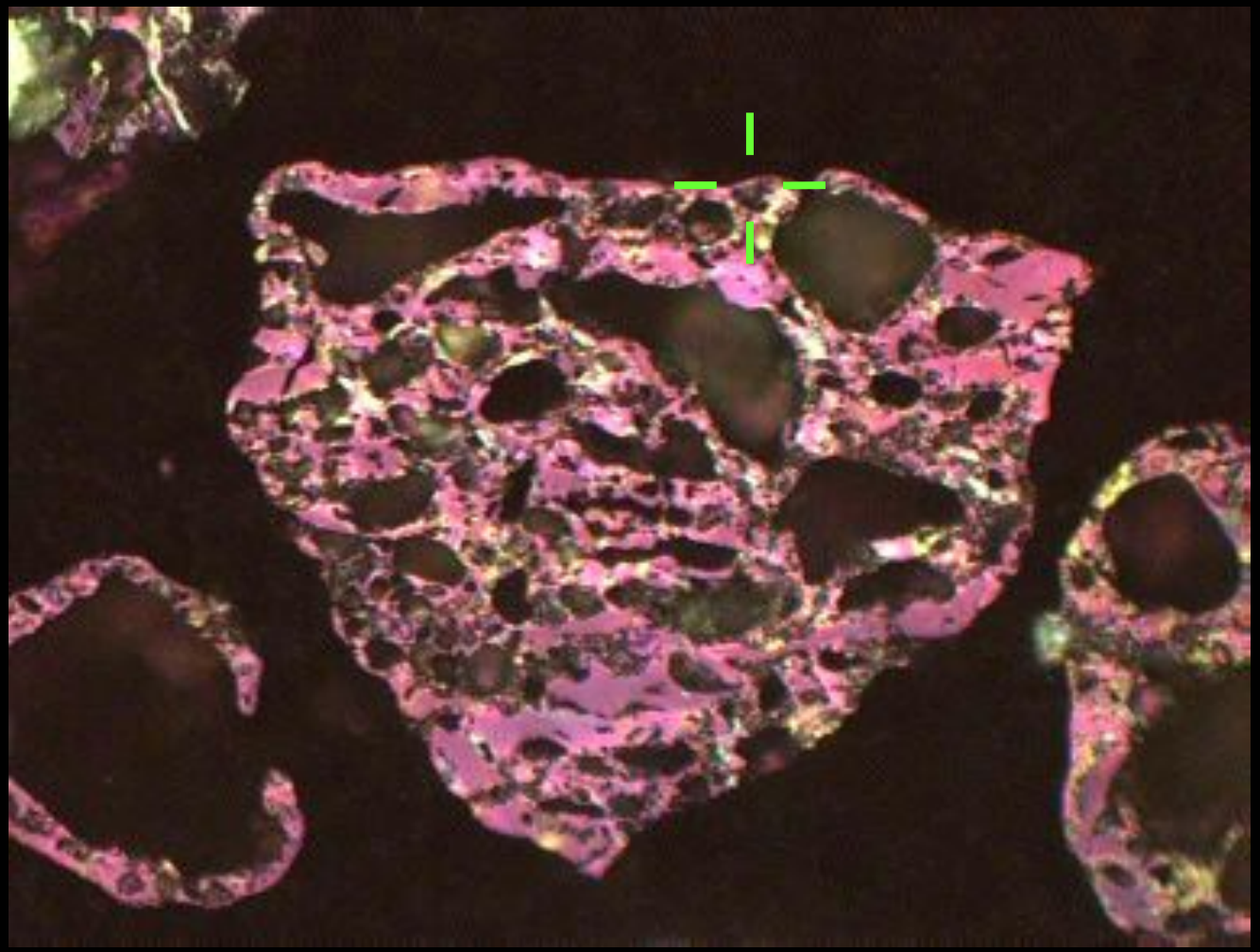
50 μm

L41

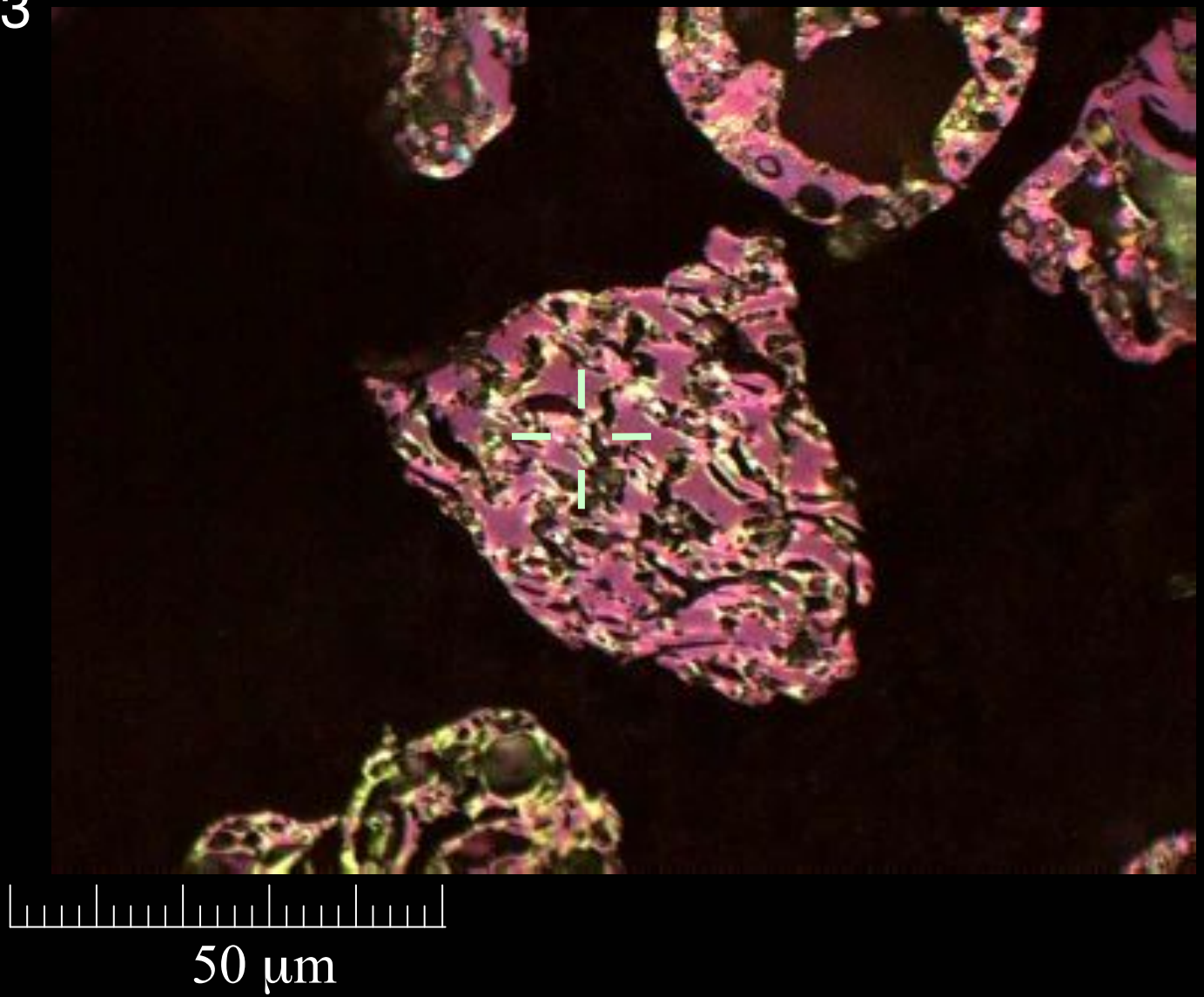


50 μm

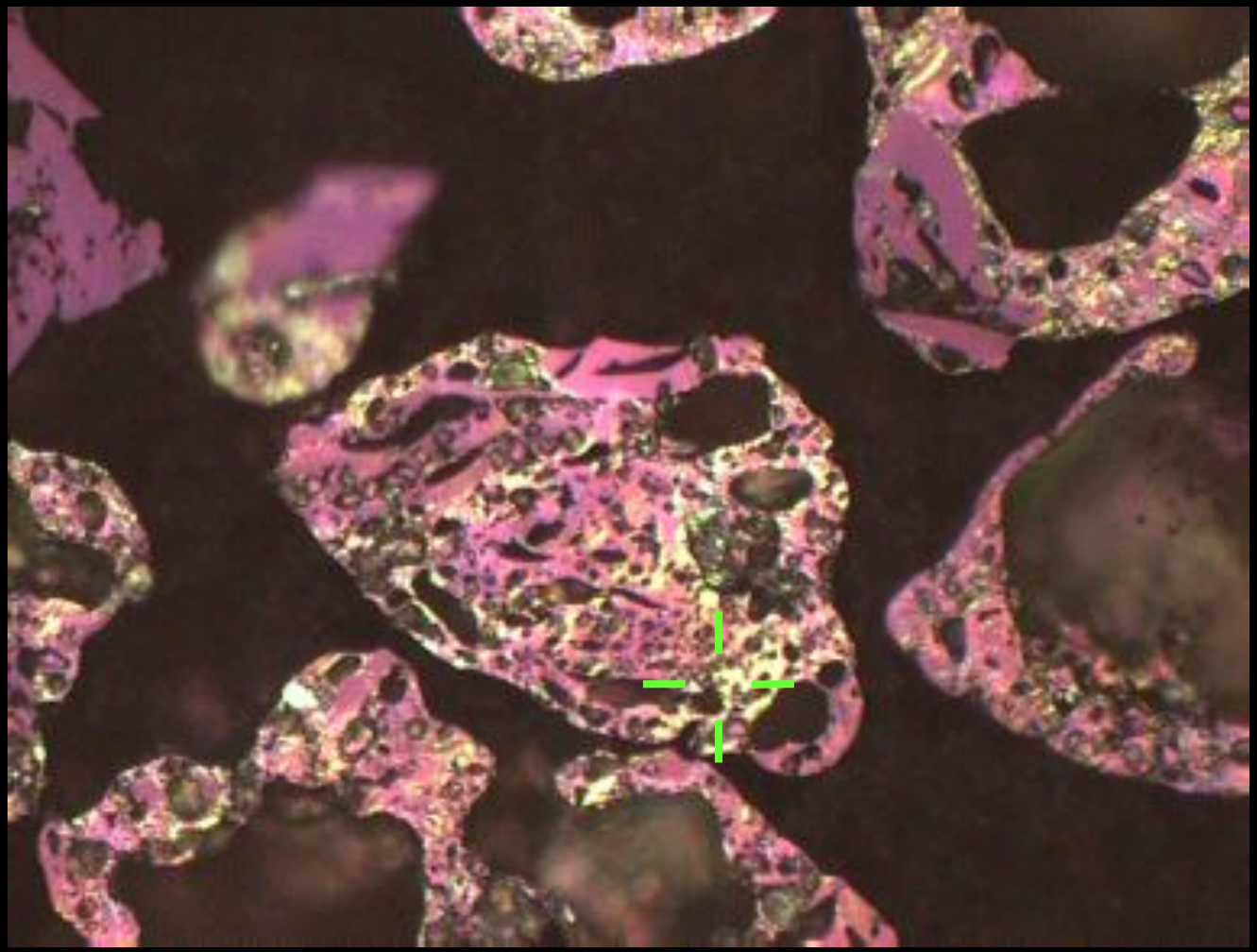
L42



L43



L44



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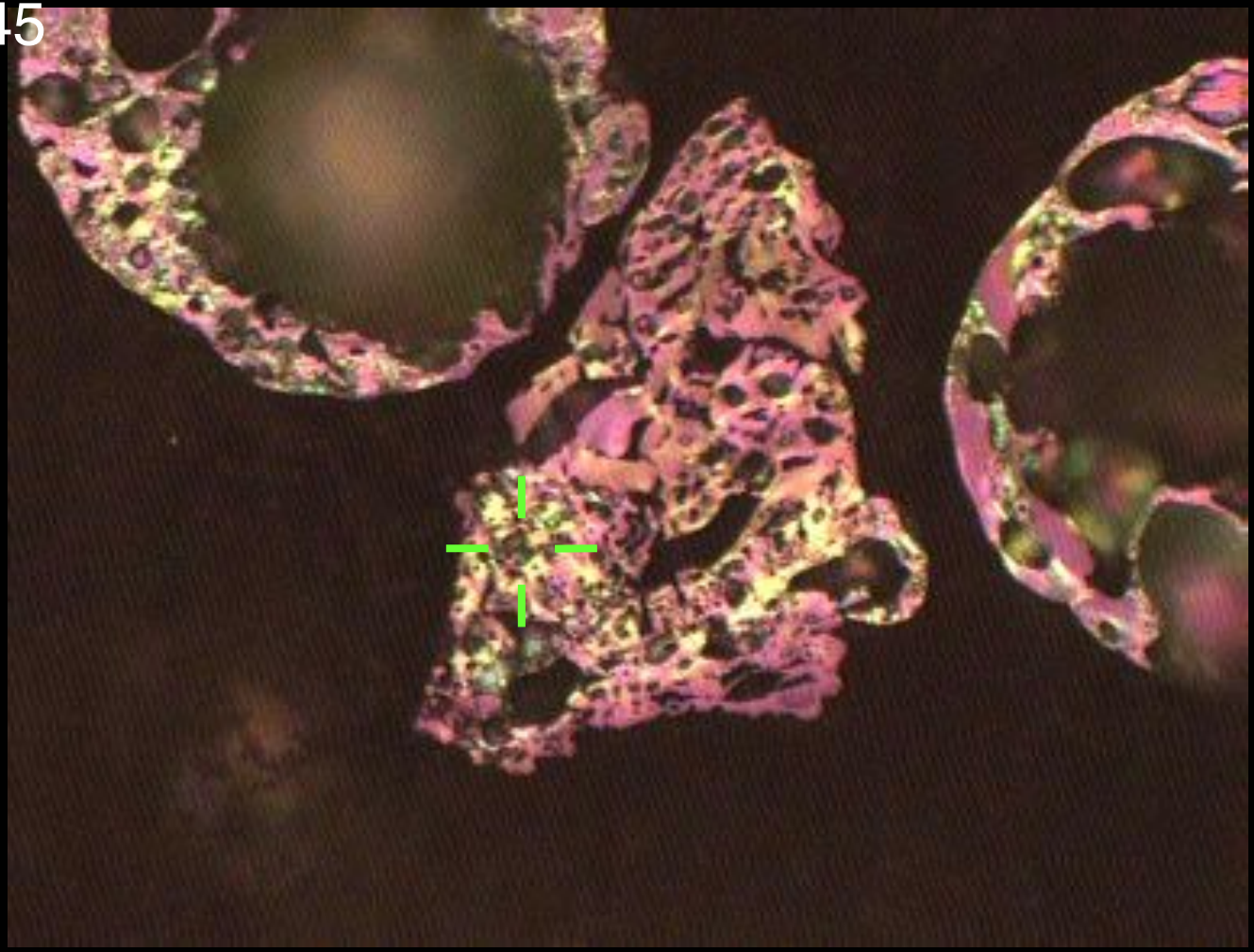
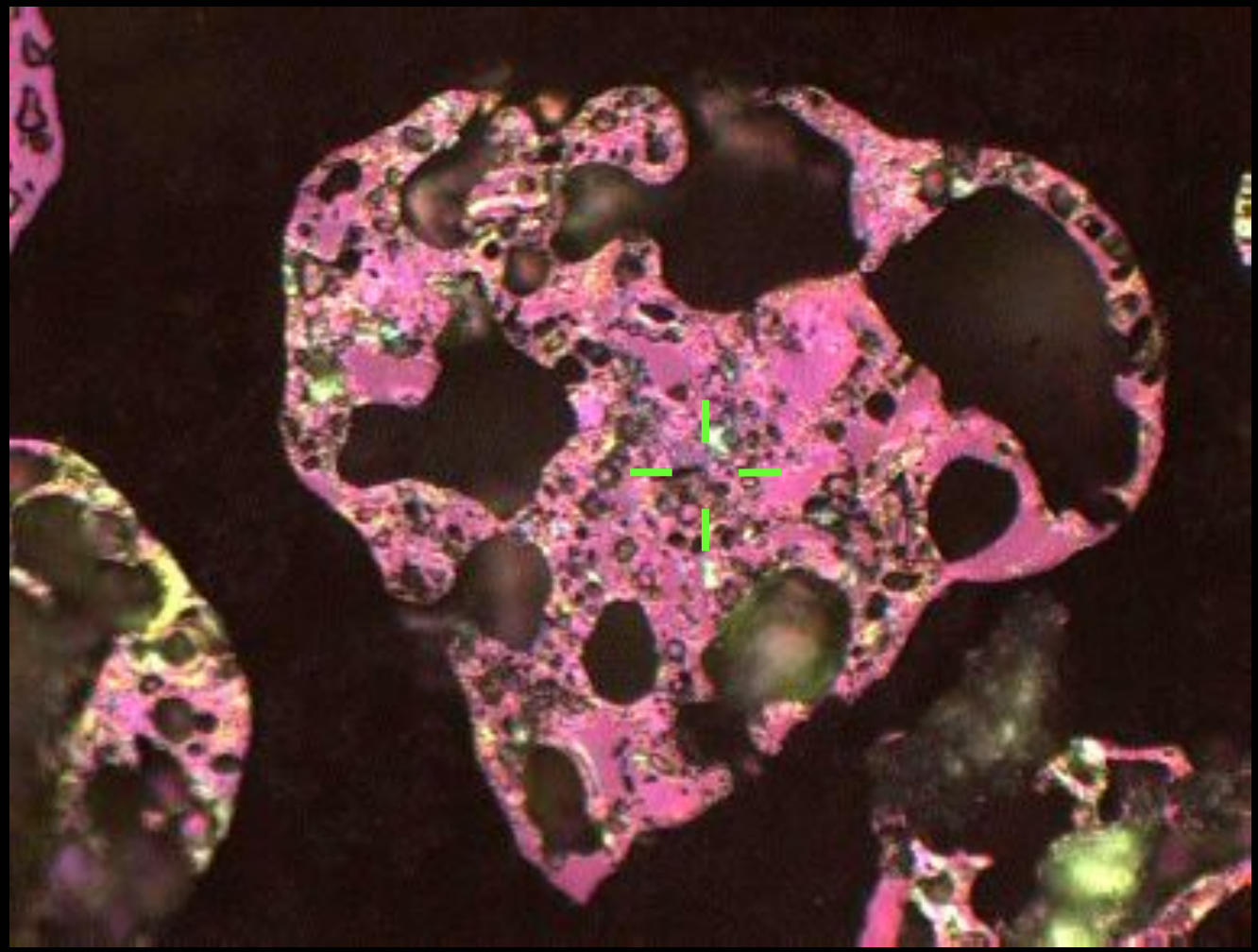
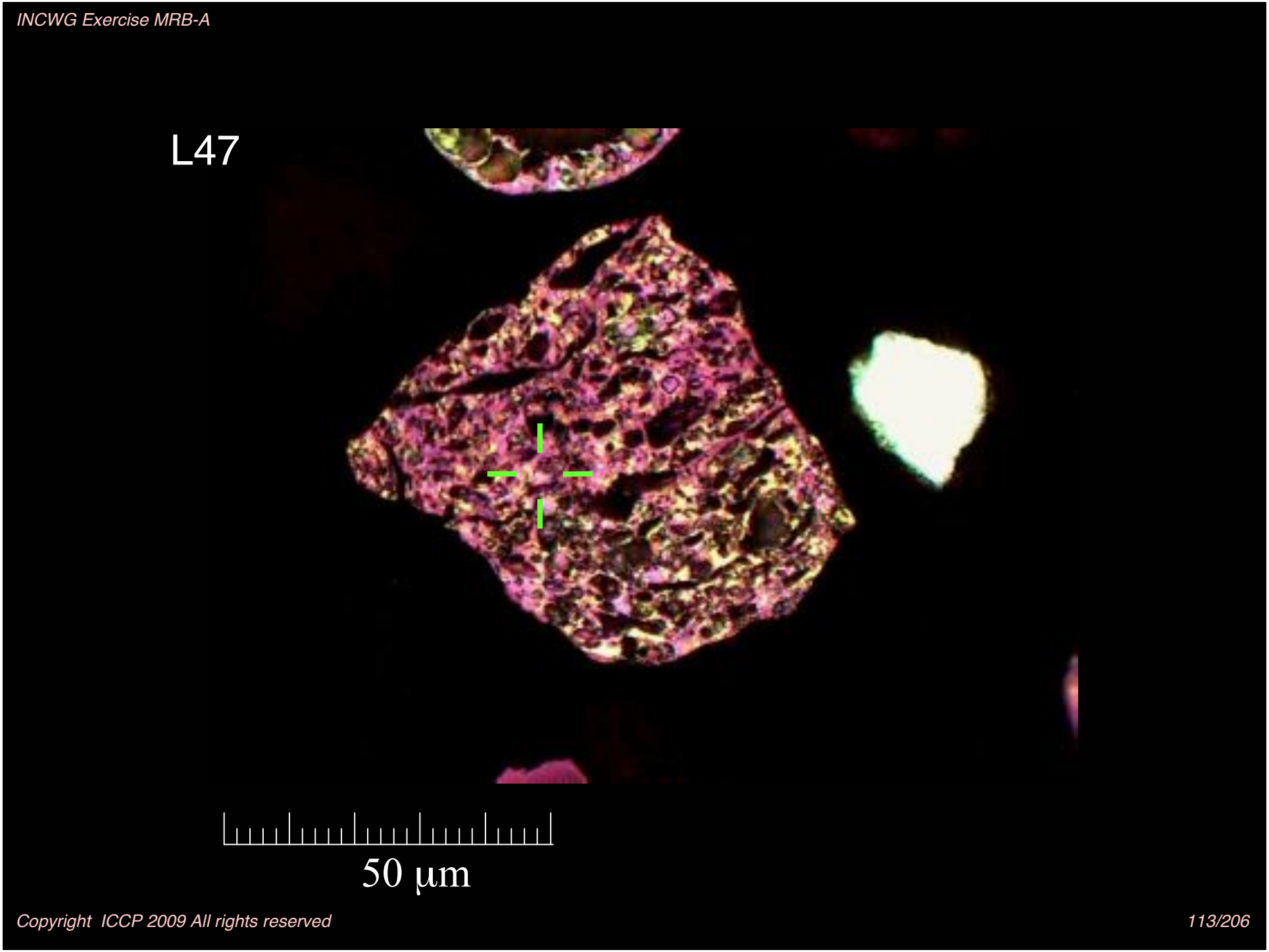
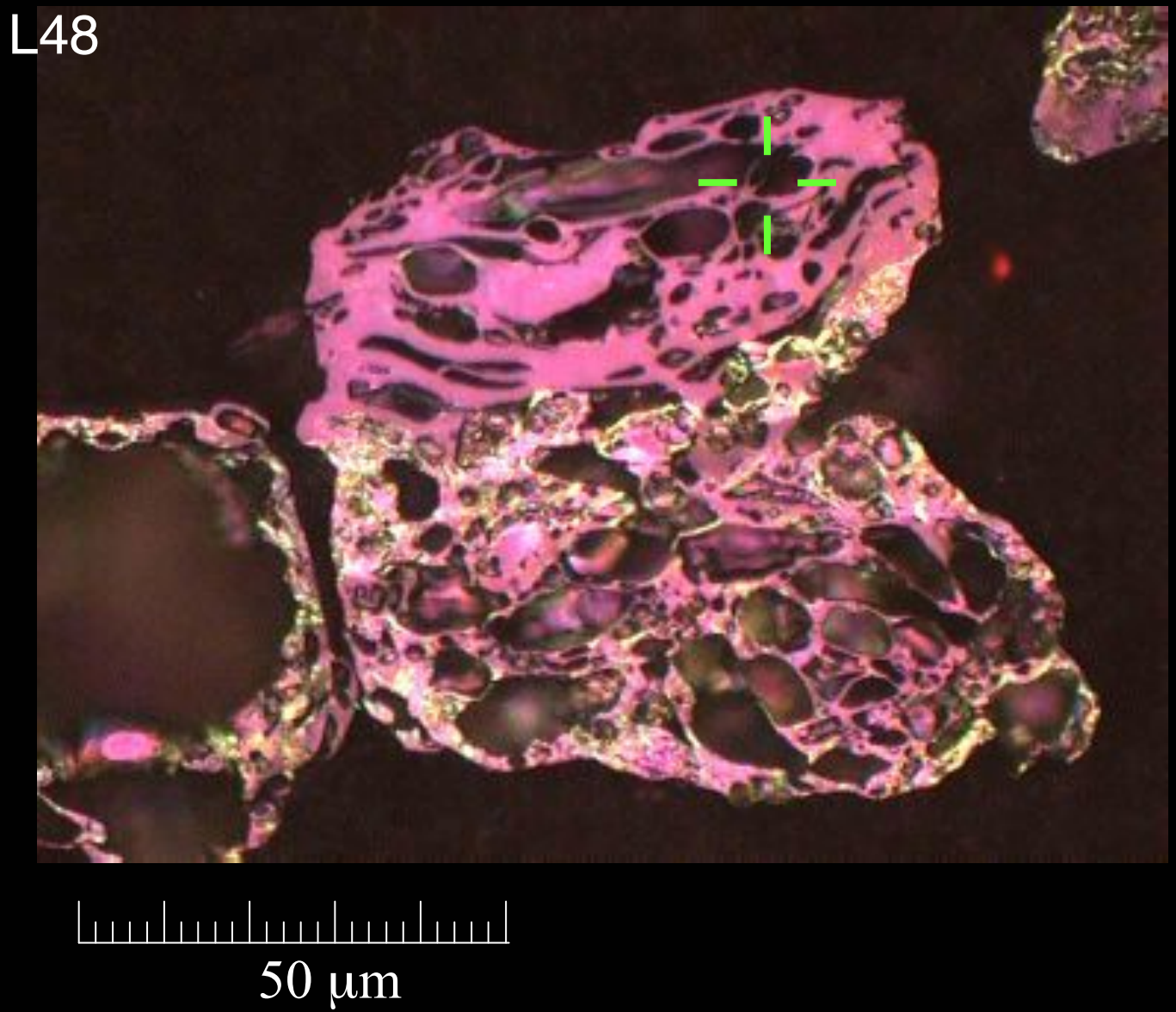


50 μm

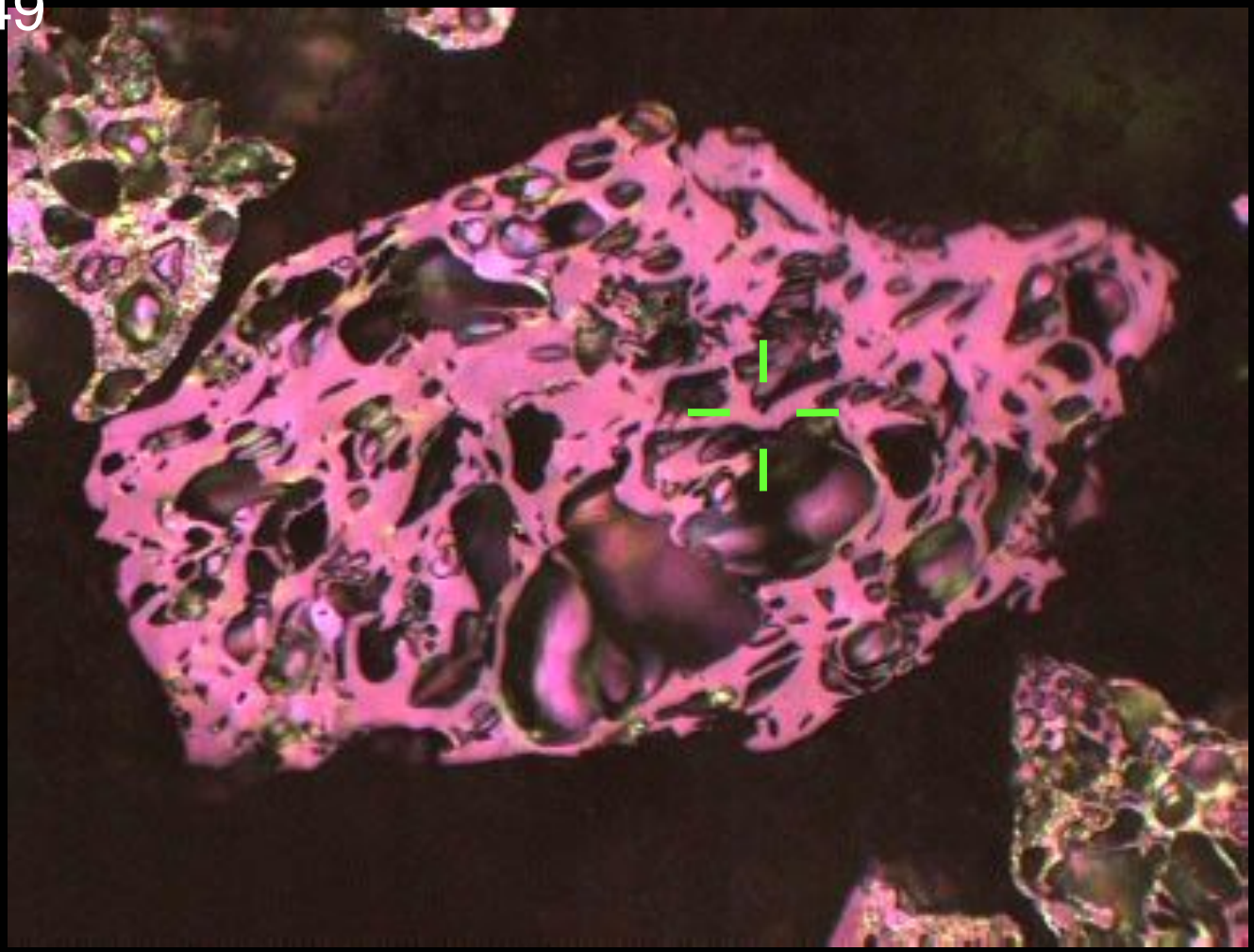
L46





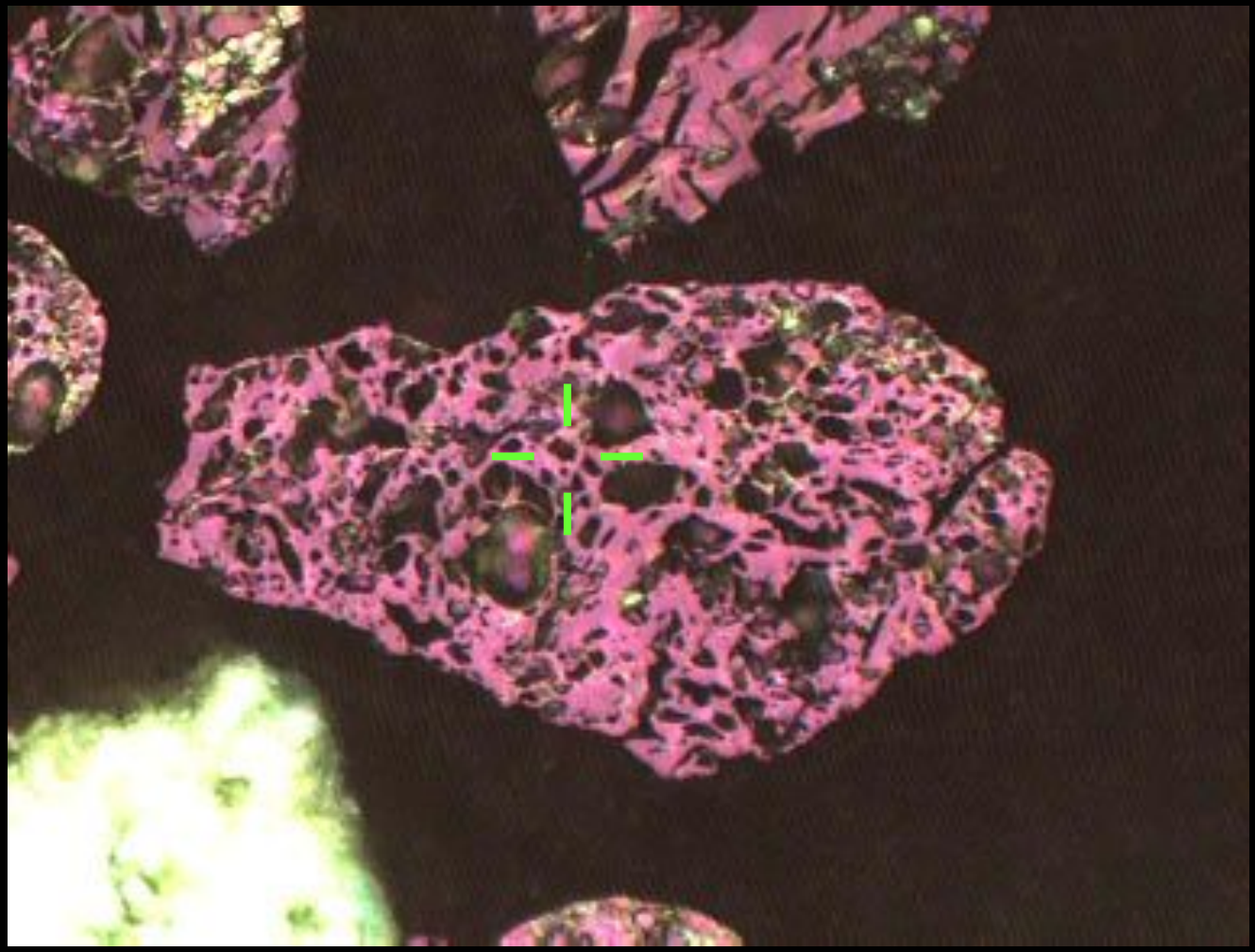


L49



50 μm

L50



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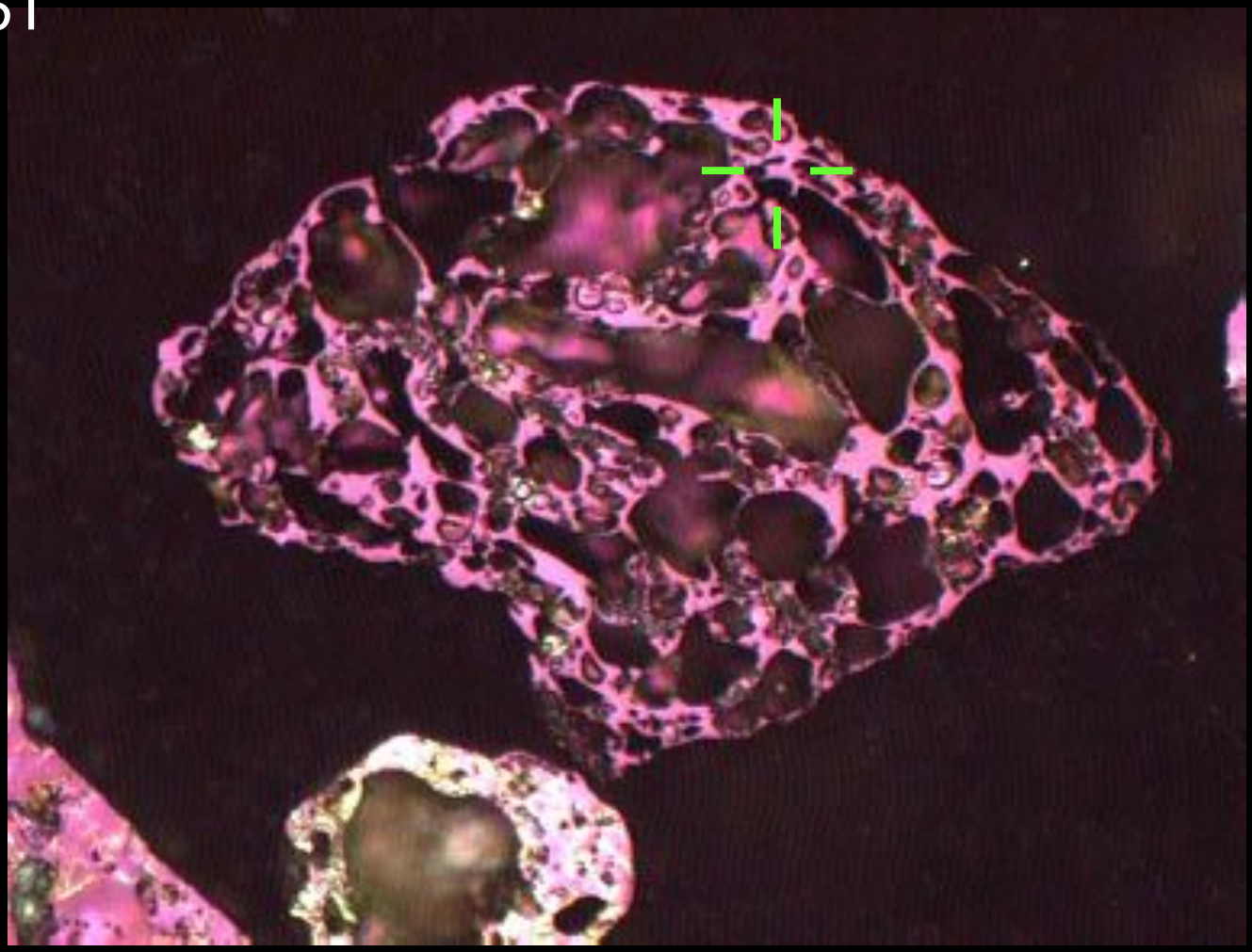
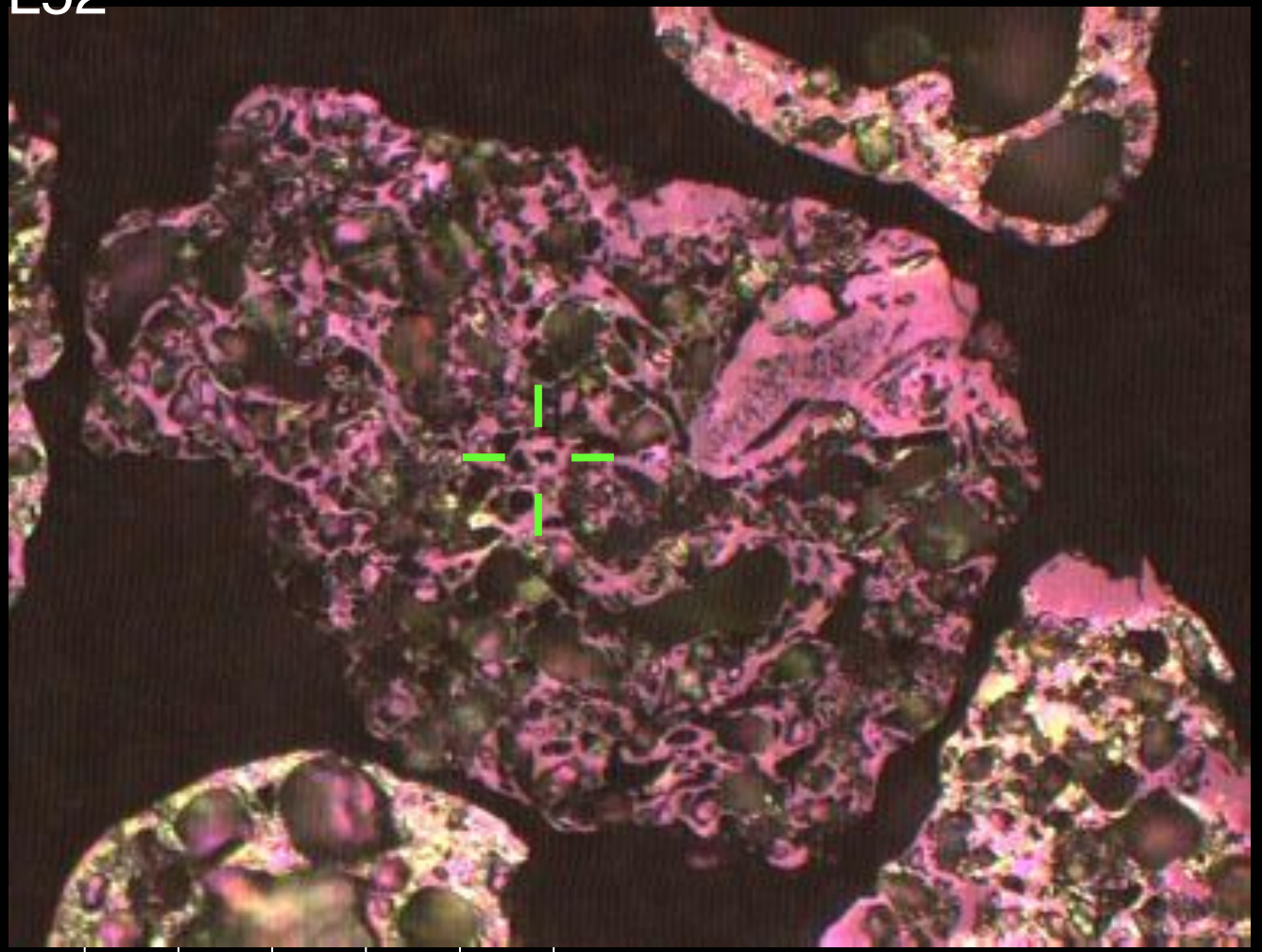
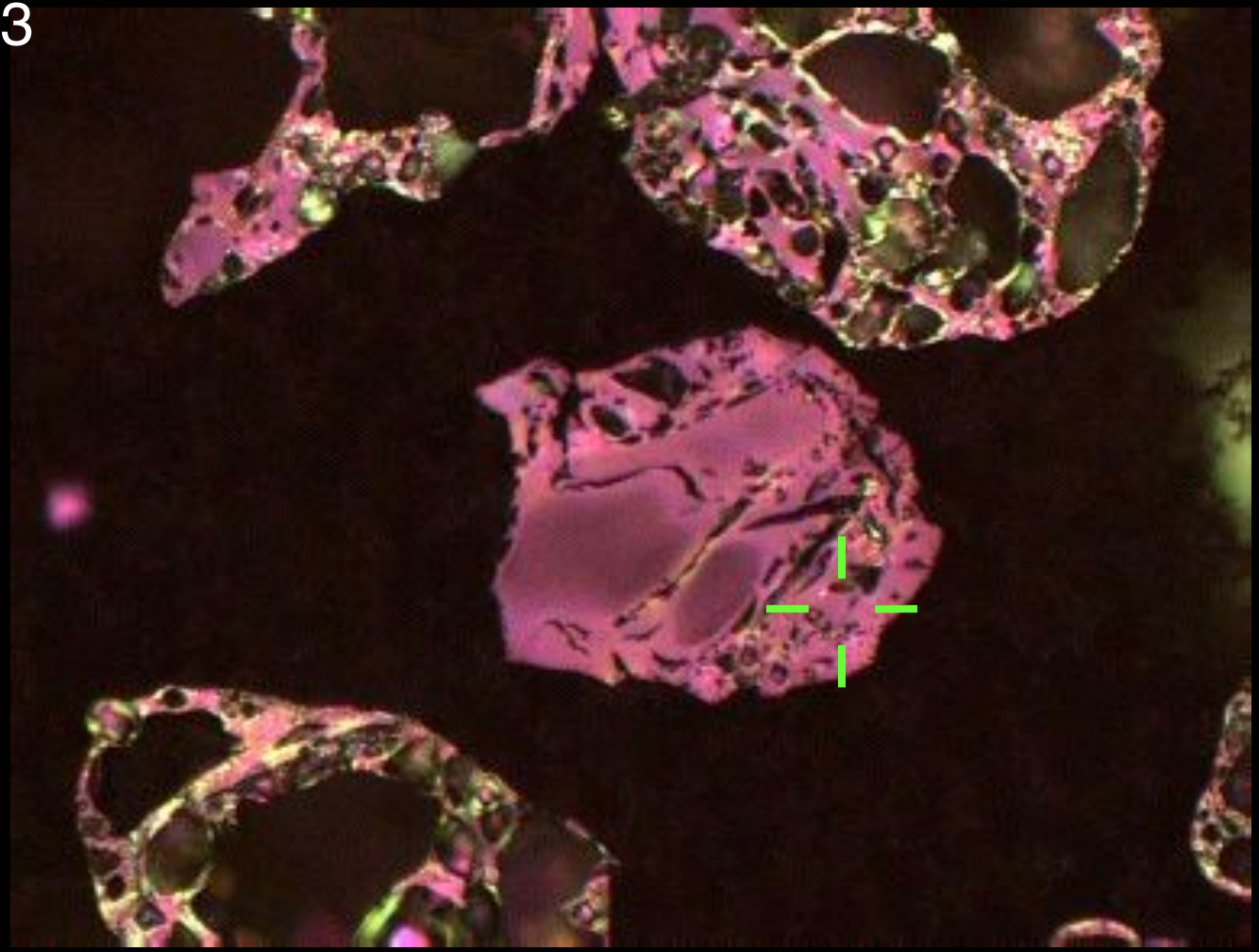
L51



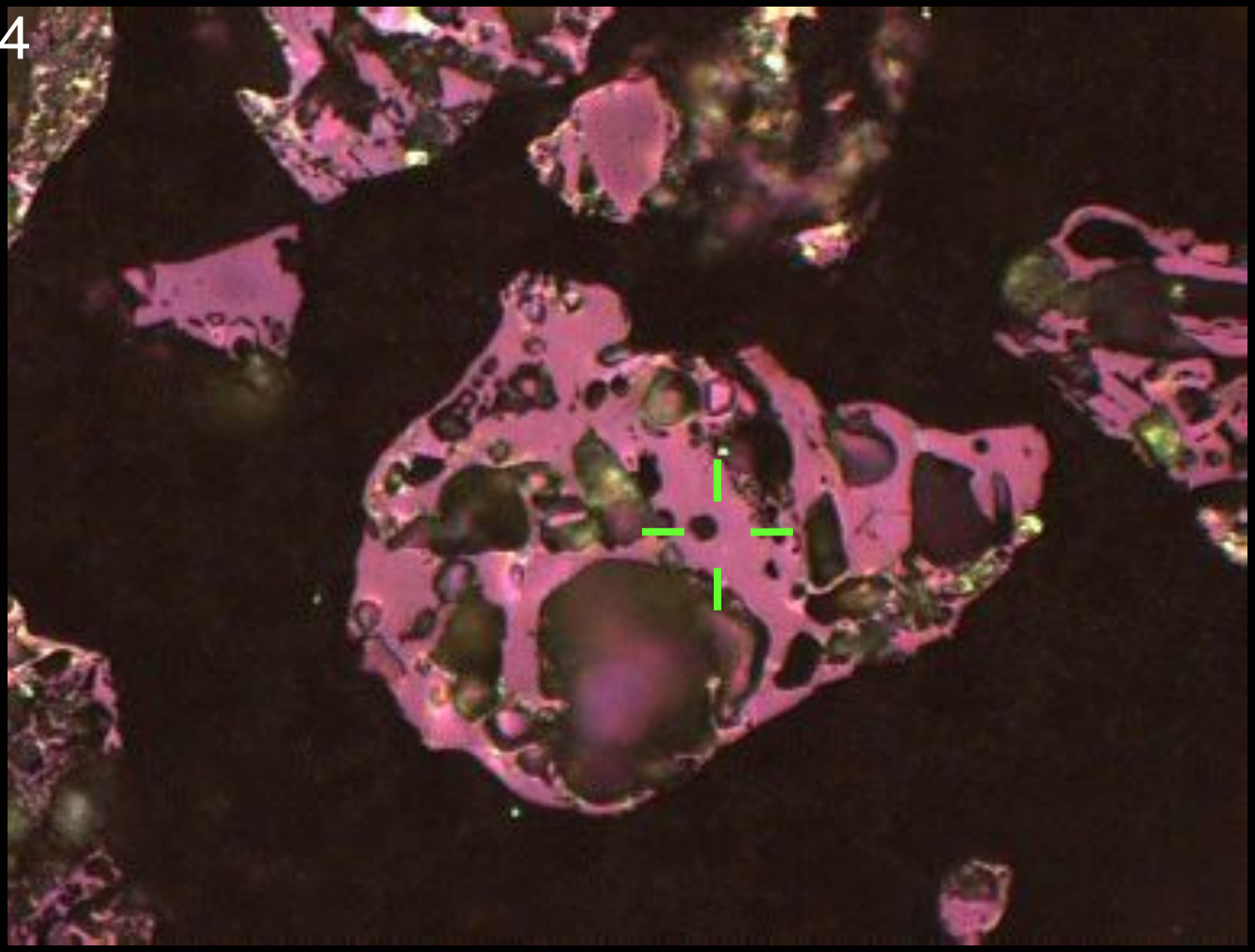
L52



L53

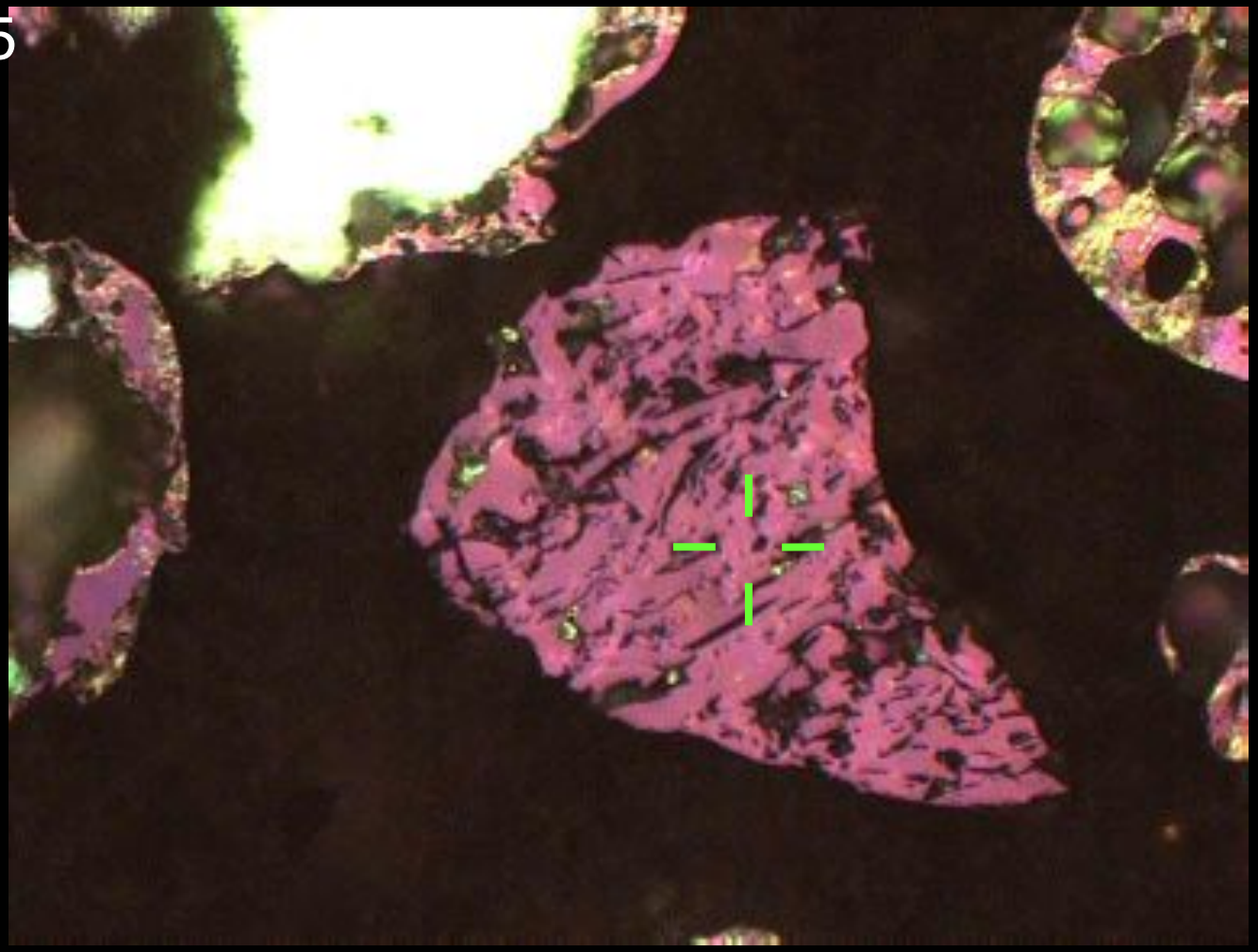


L54



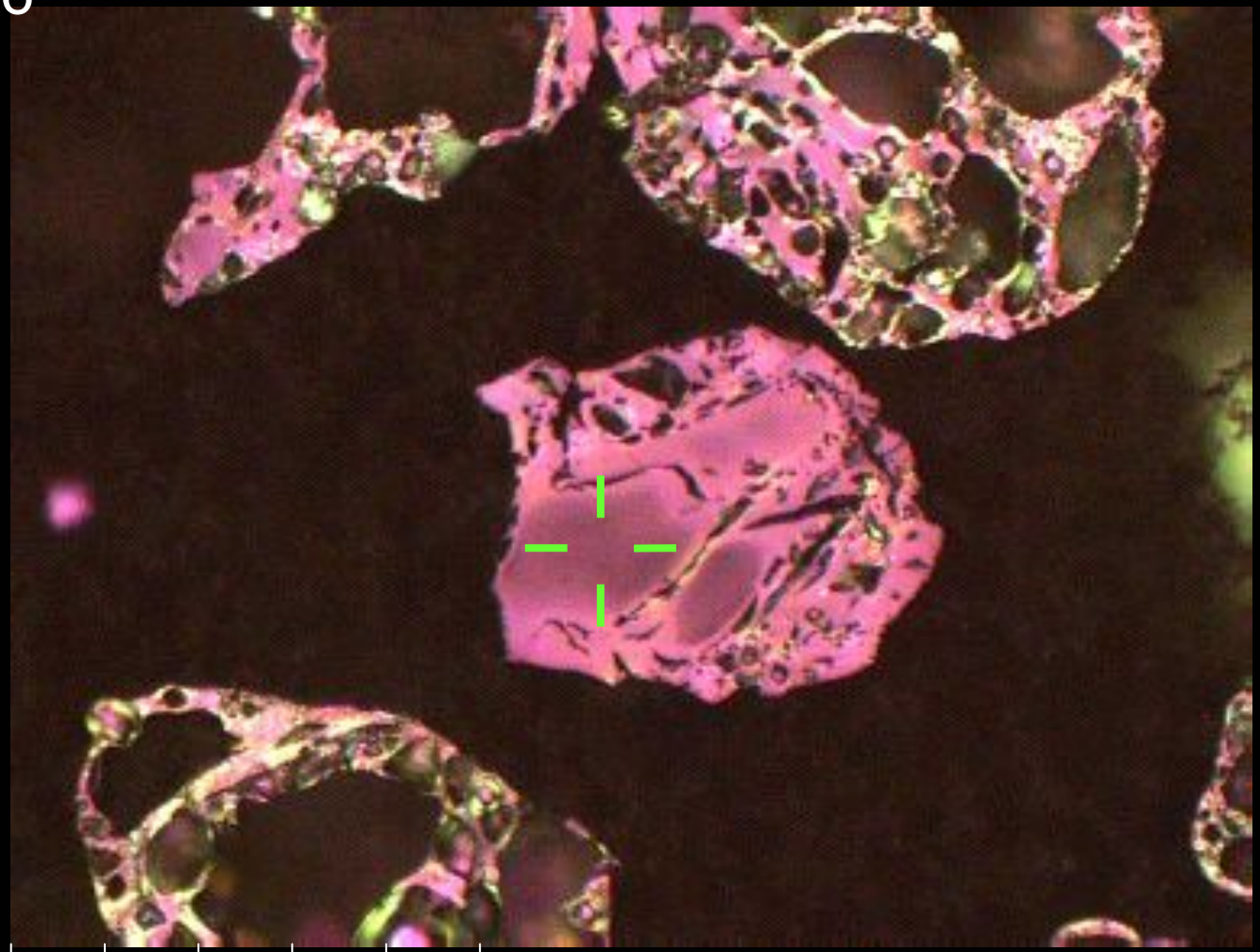
50 μm

L55

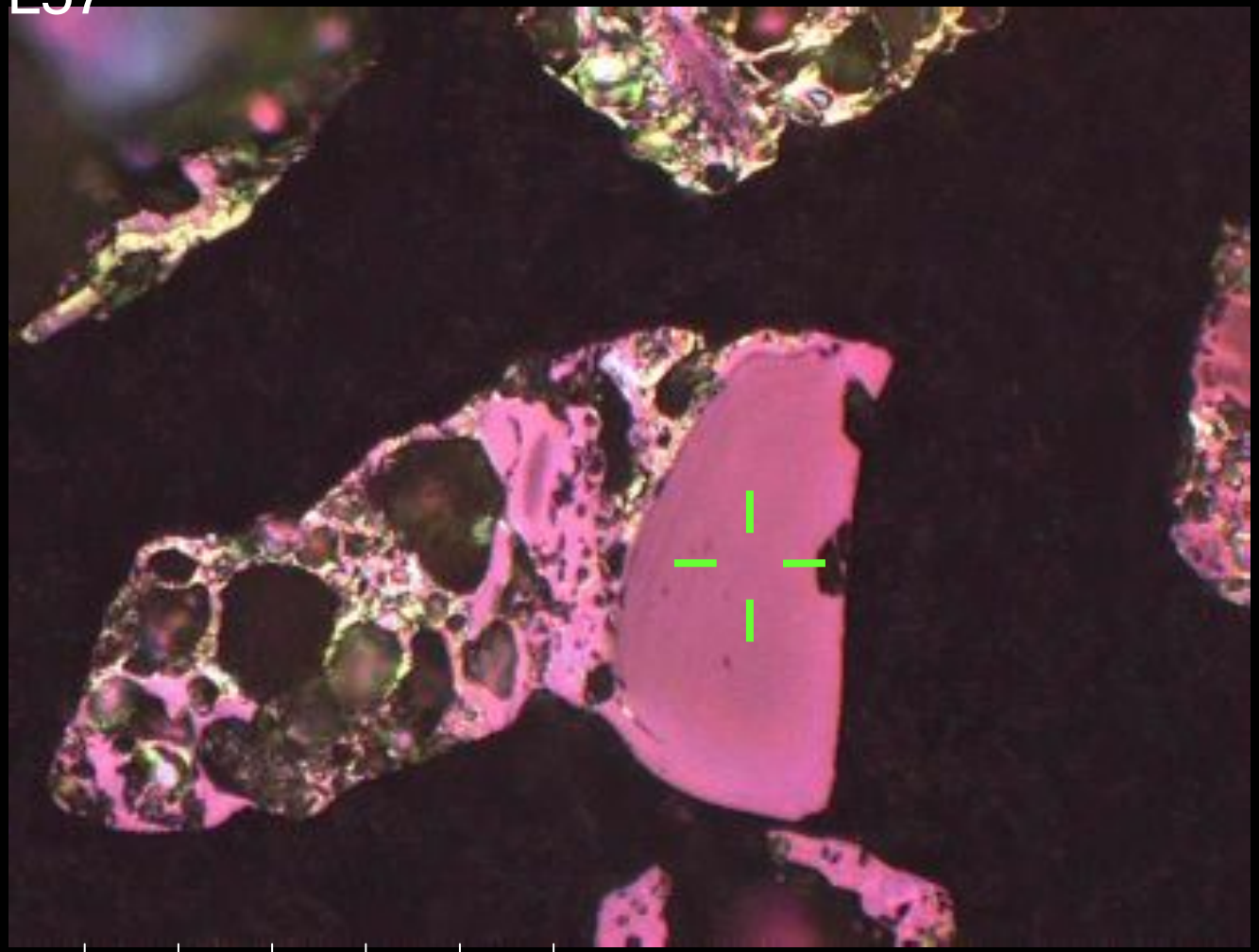


50 μm

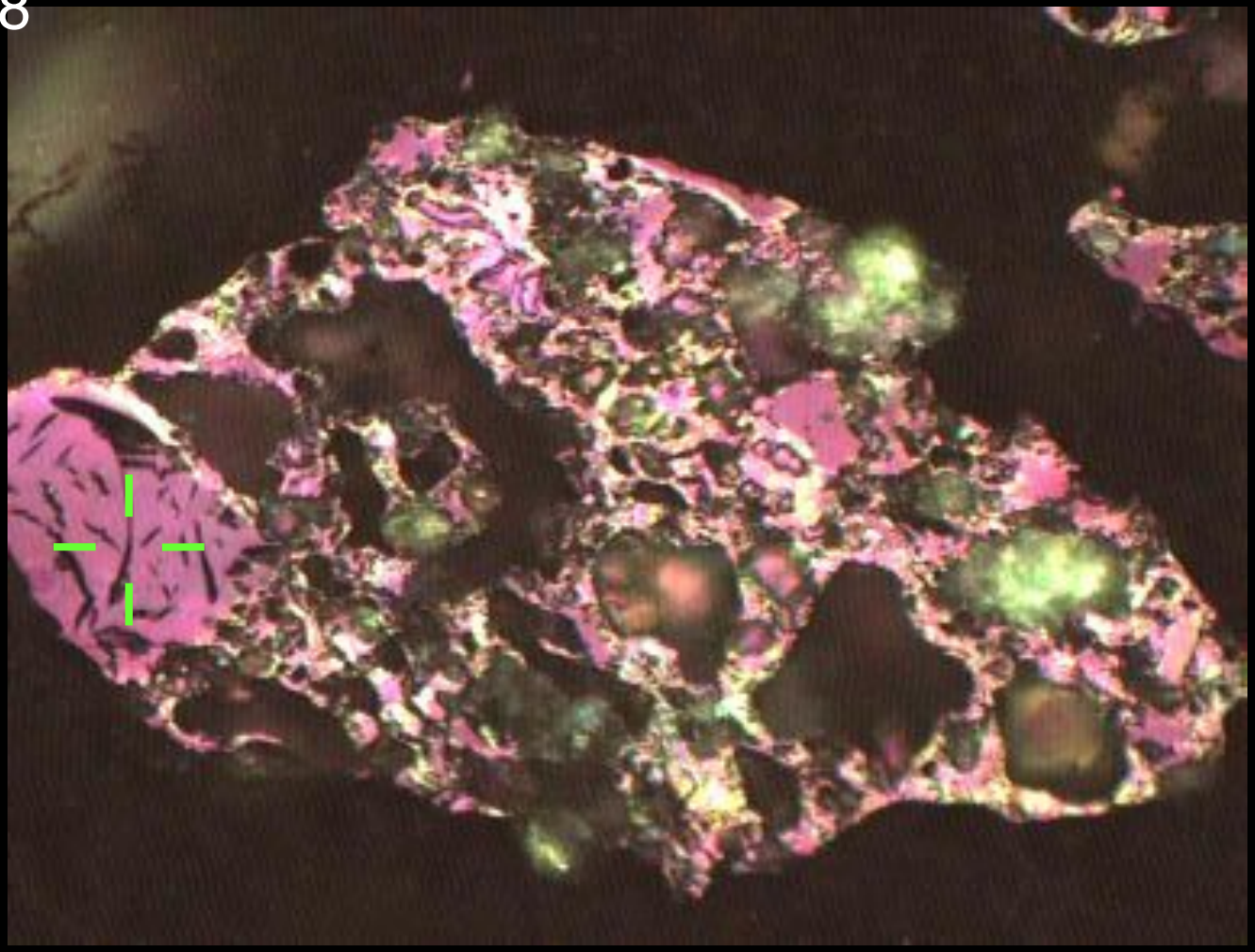
L56



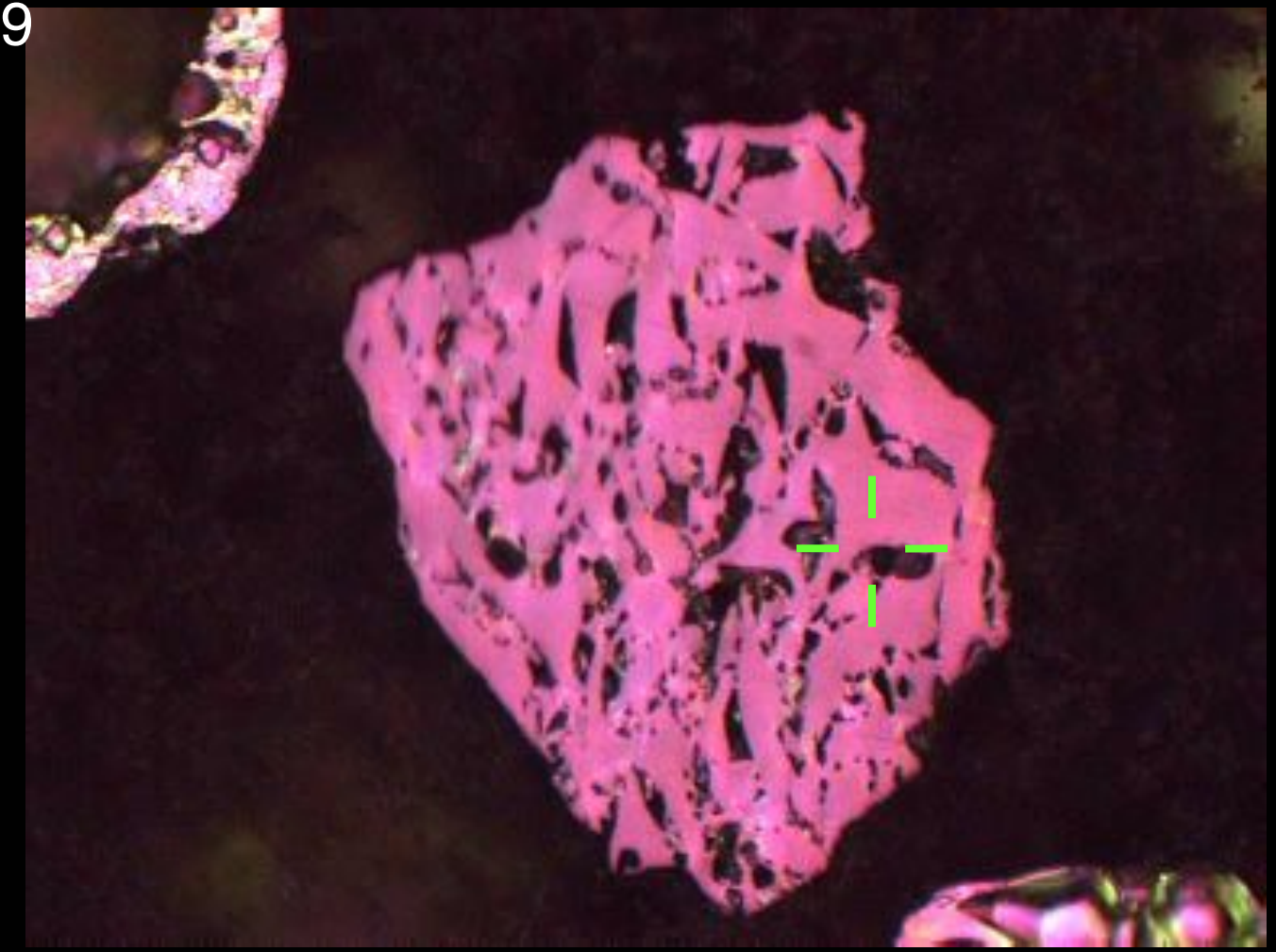
L57



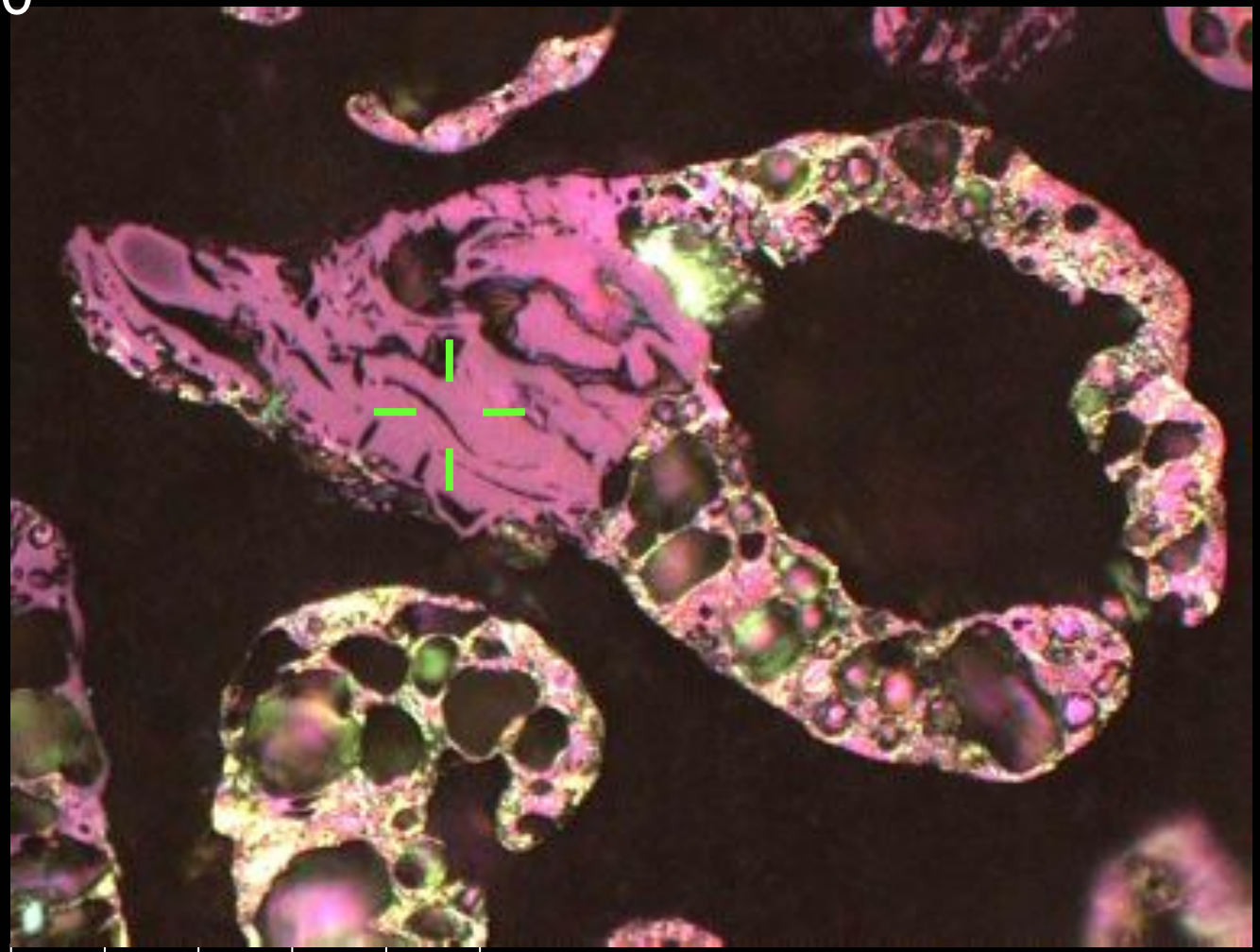
L58



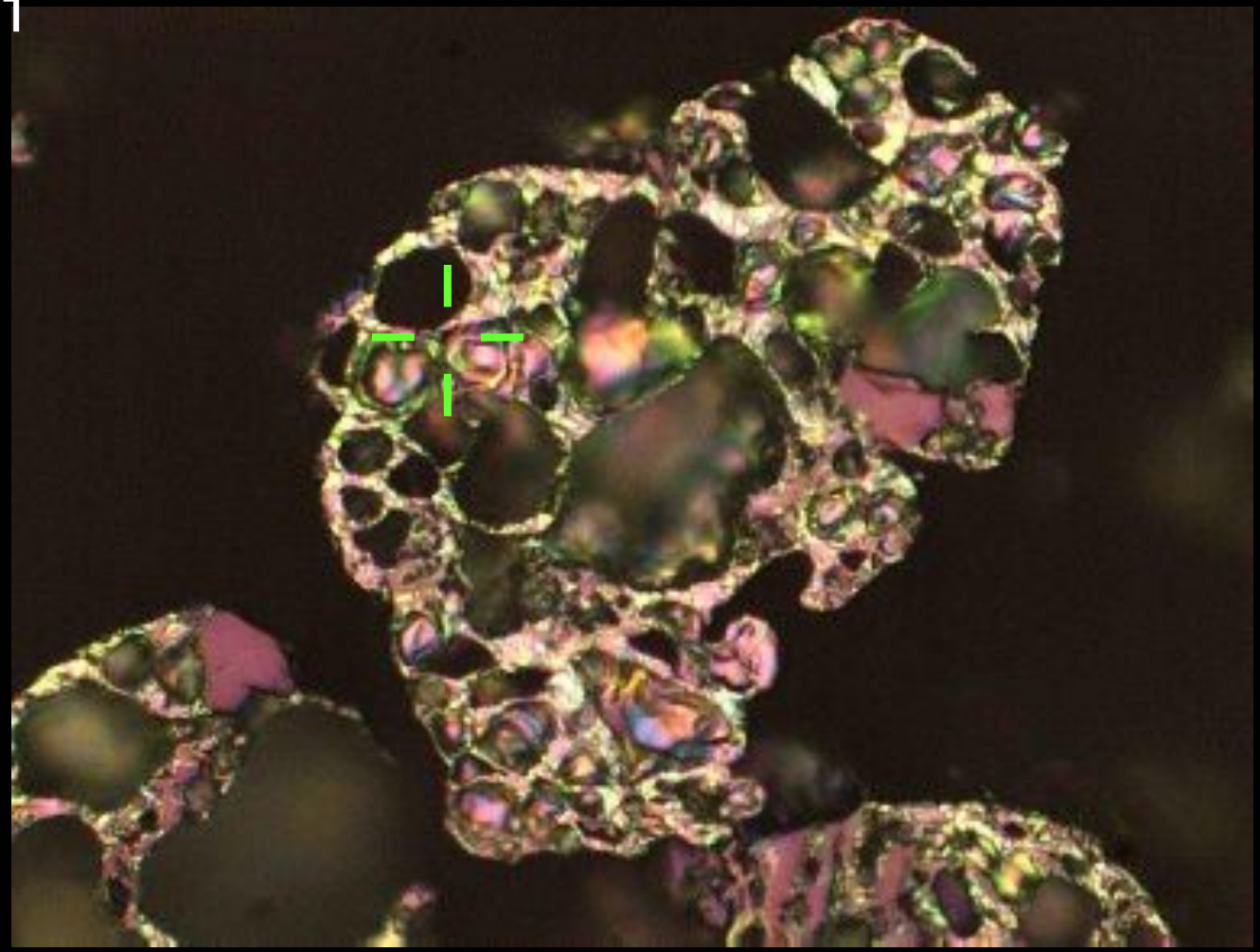
L59



L60

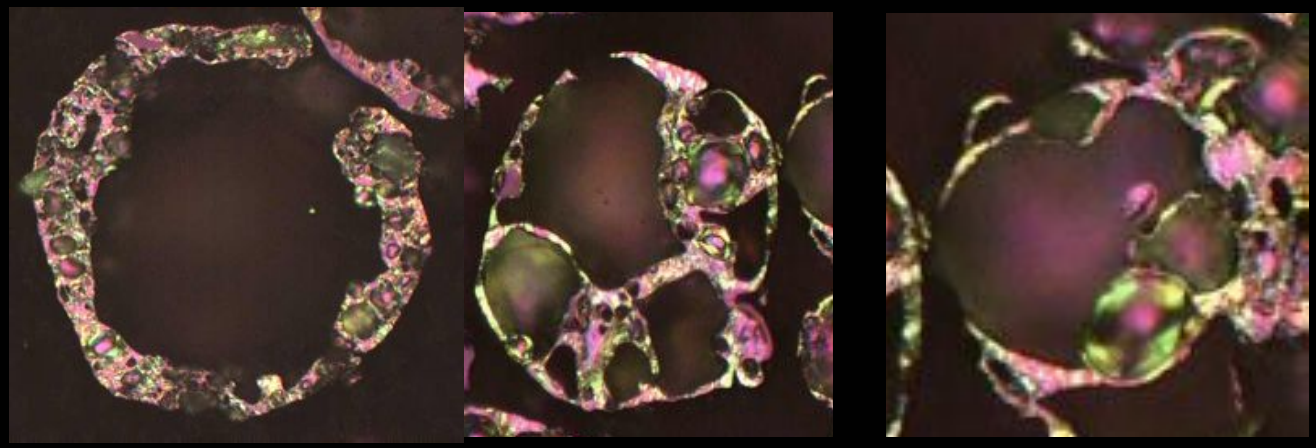


L61



As you cannot have a look of the sample to figure out how typical vitrinite-derived material looks like, below there are some images showing selected views of vitrinite-derived material in the Bituminous A coal chars

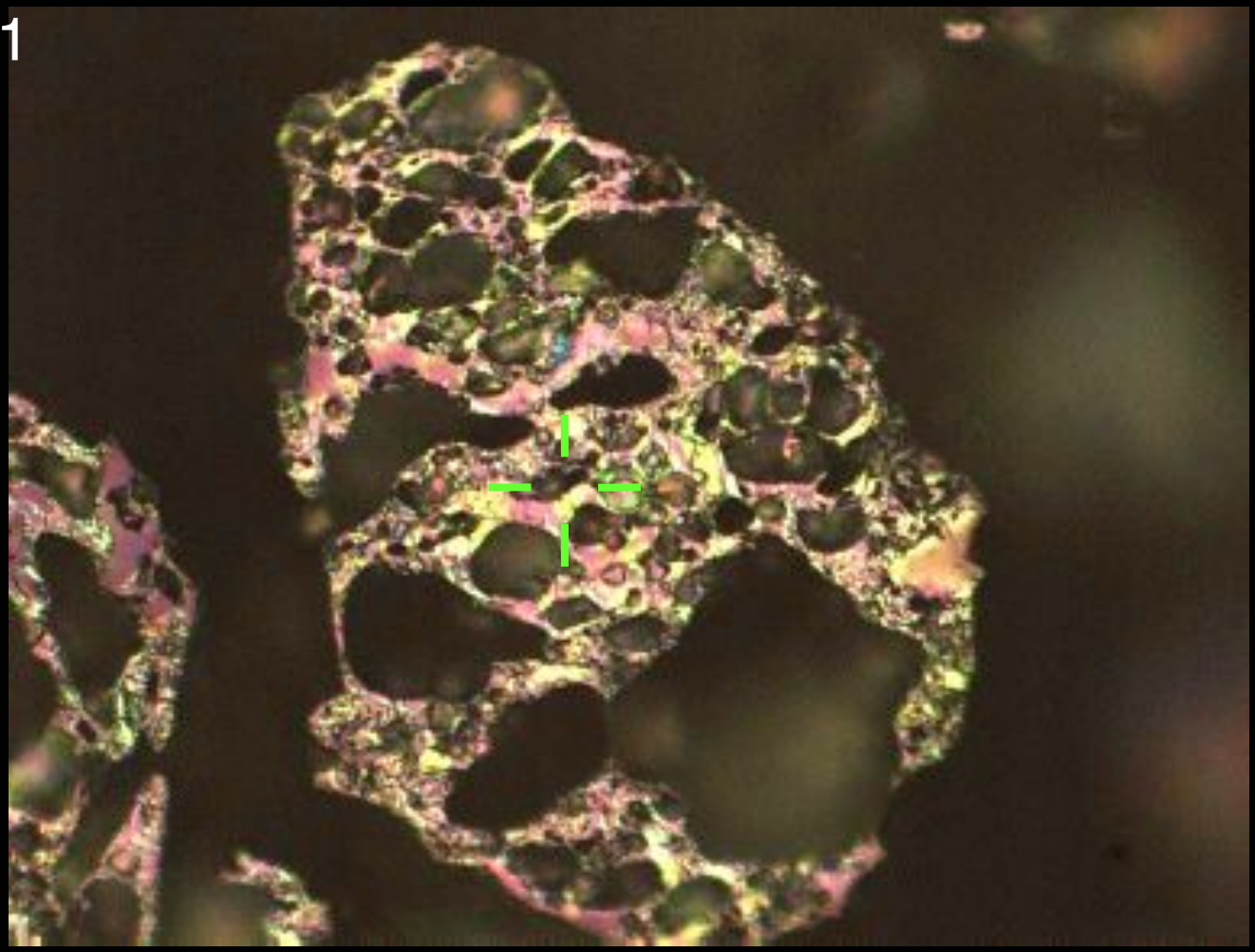
Vitrinite-derived material in Bituminous A (Rr=1.4-2.0%) coals (sample P &T)



Vitrinite by entering the combustion chamber generating anisotropic cenospheric particles with well-developed domains, the higher the reflectance the larger the domains

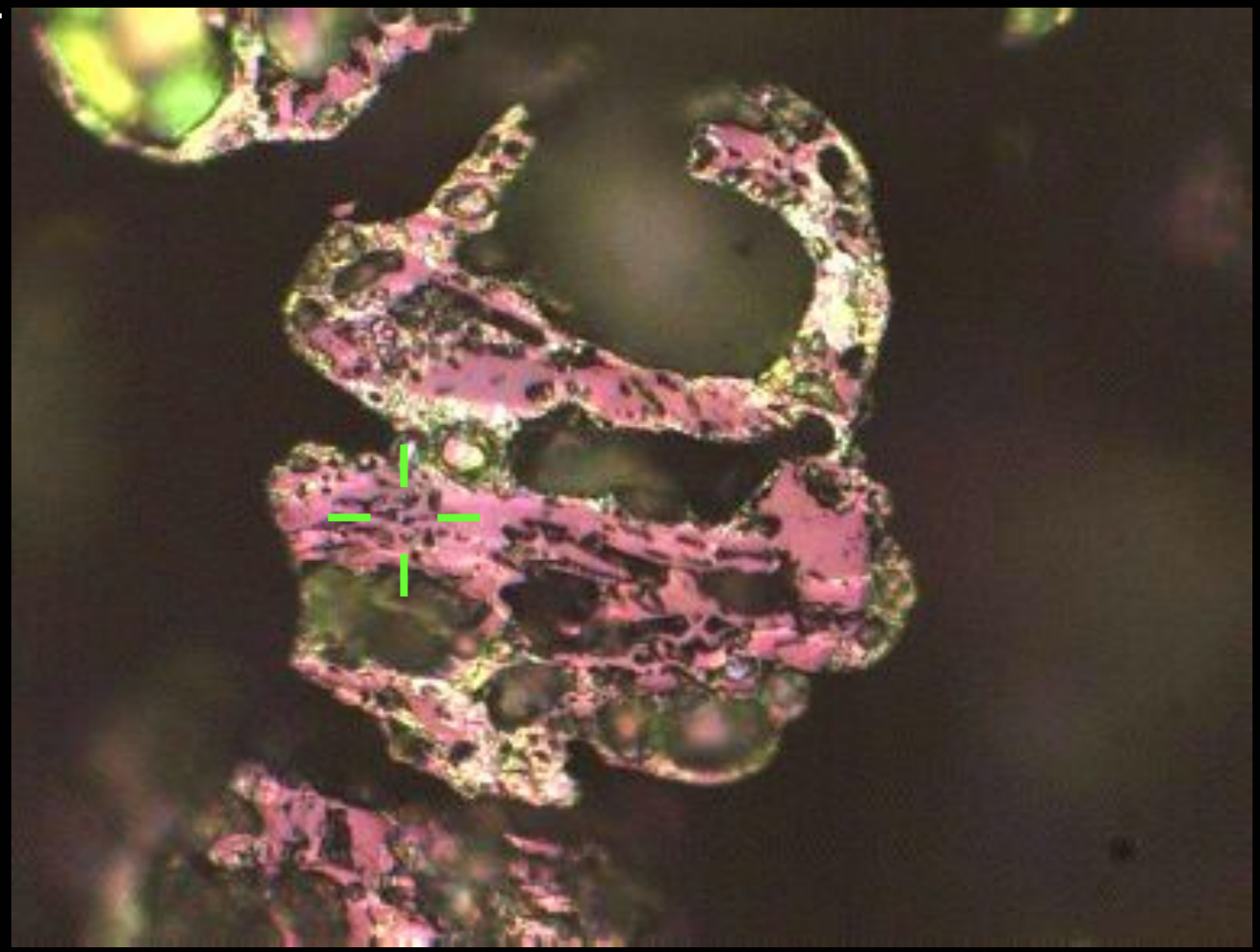
Good Luck!!

P1

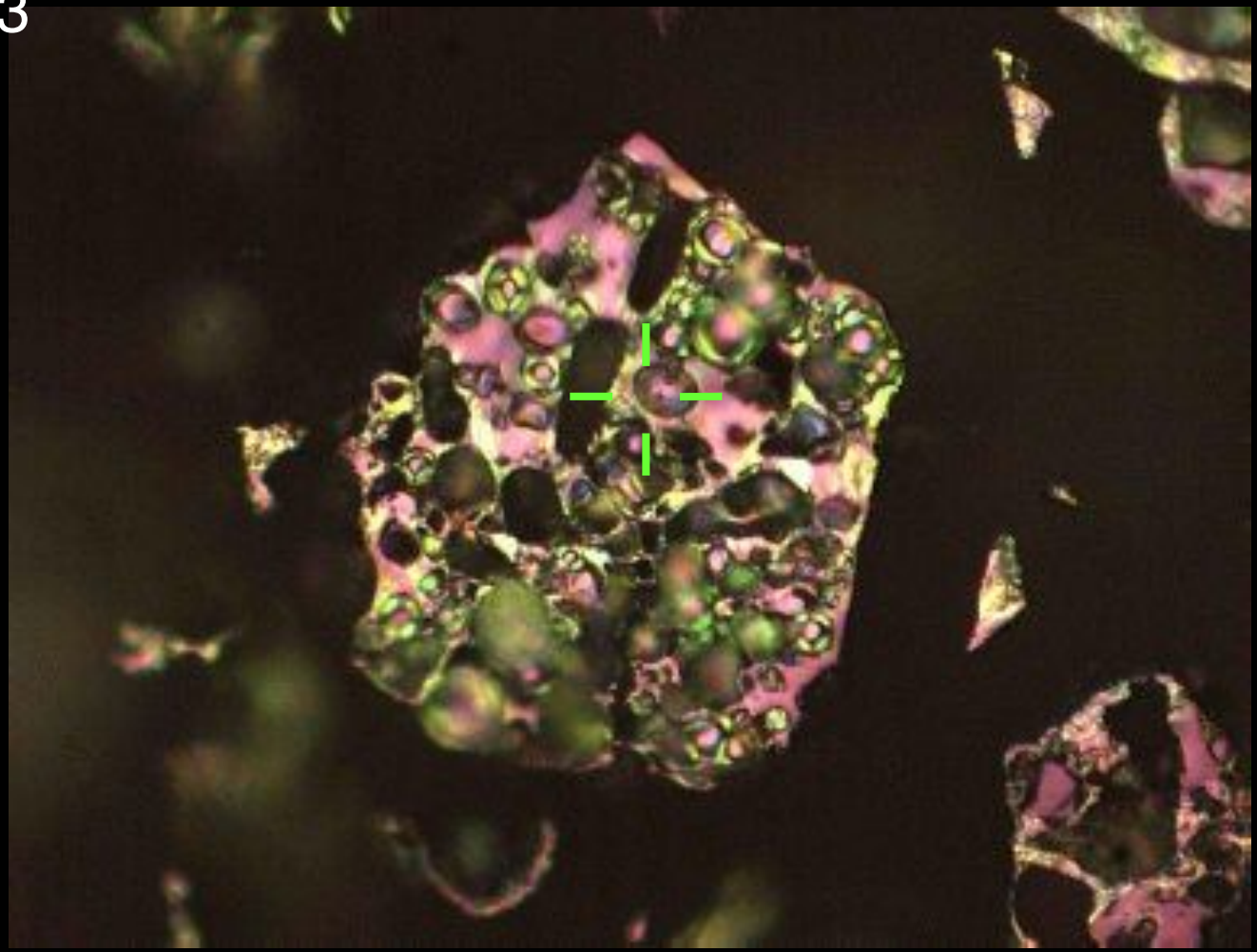


50 μm

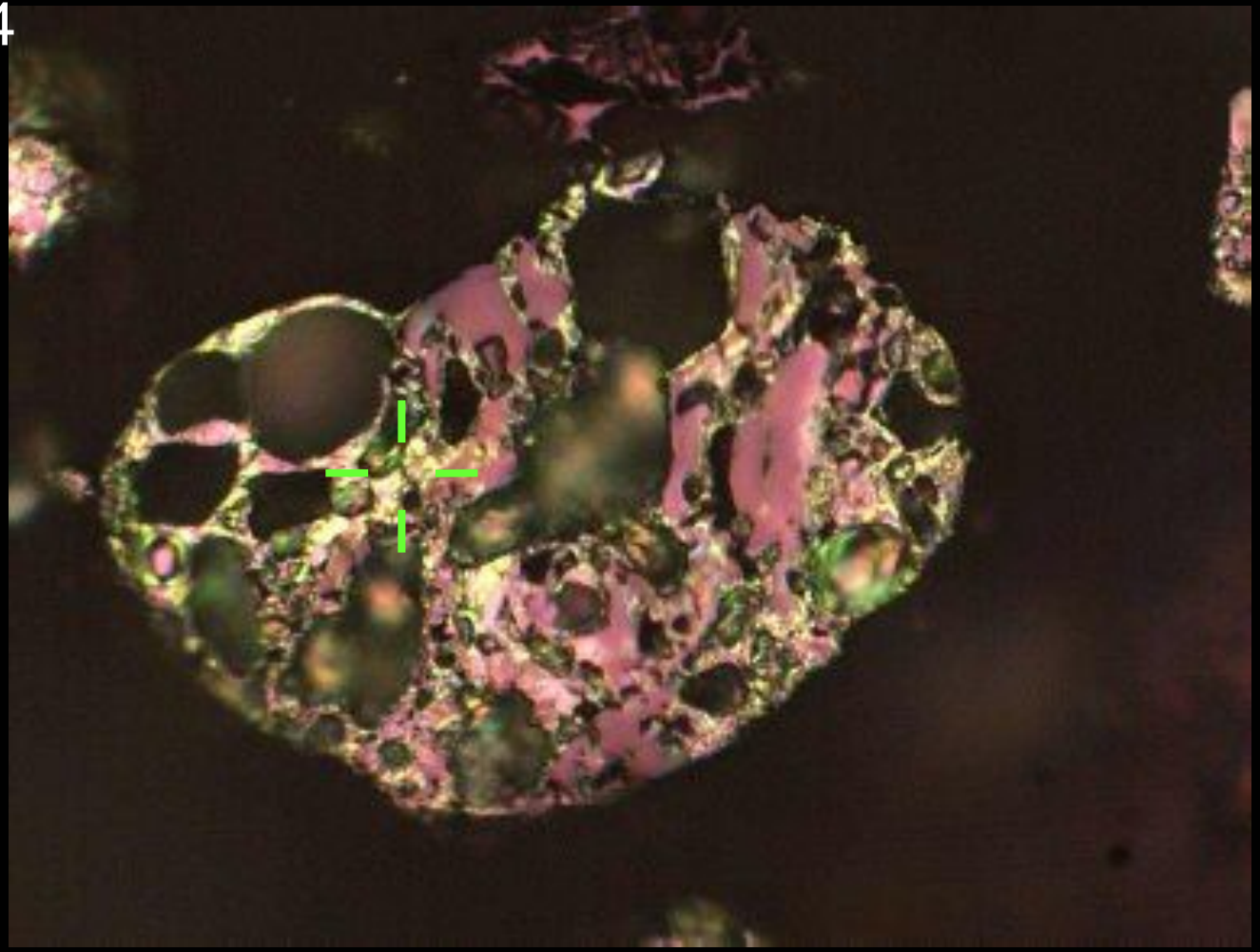
P2



P3

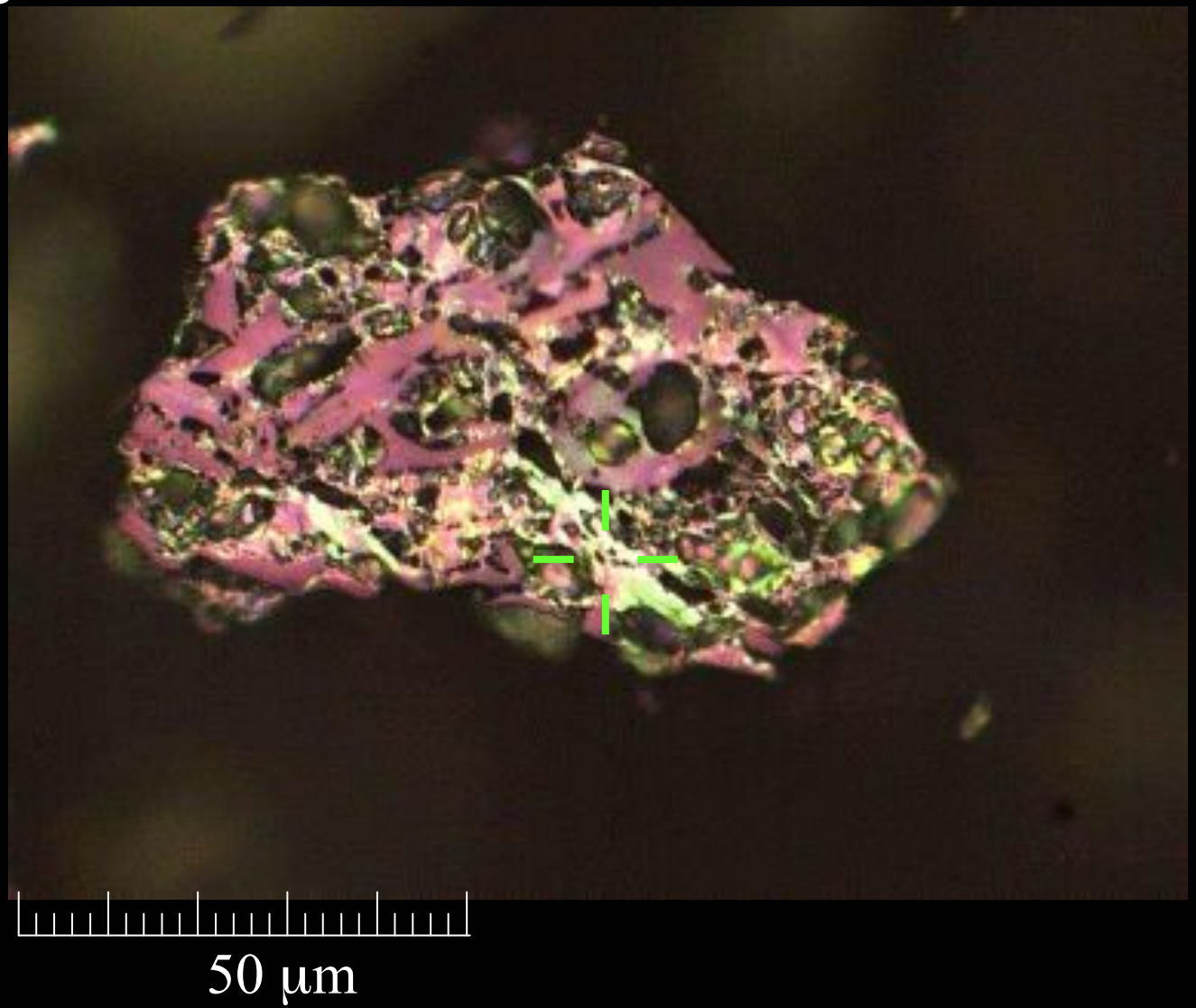


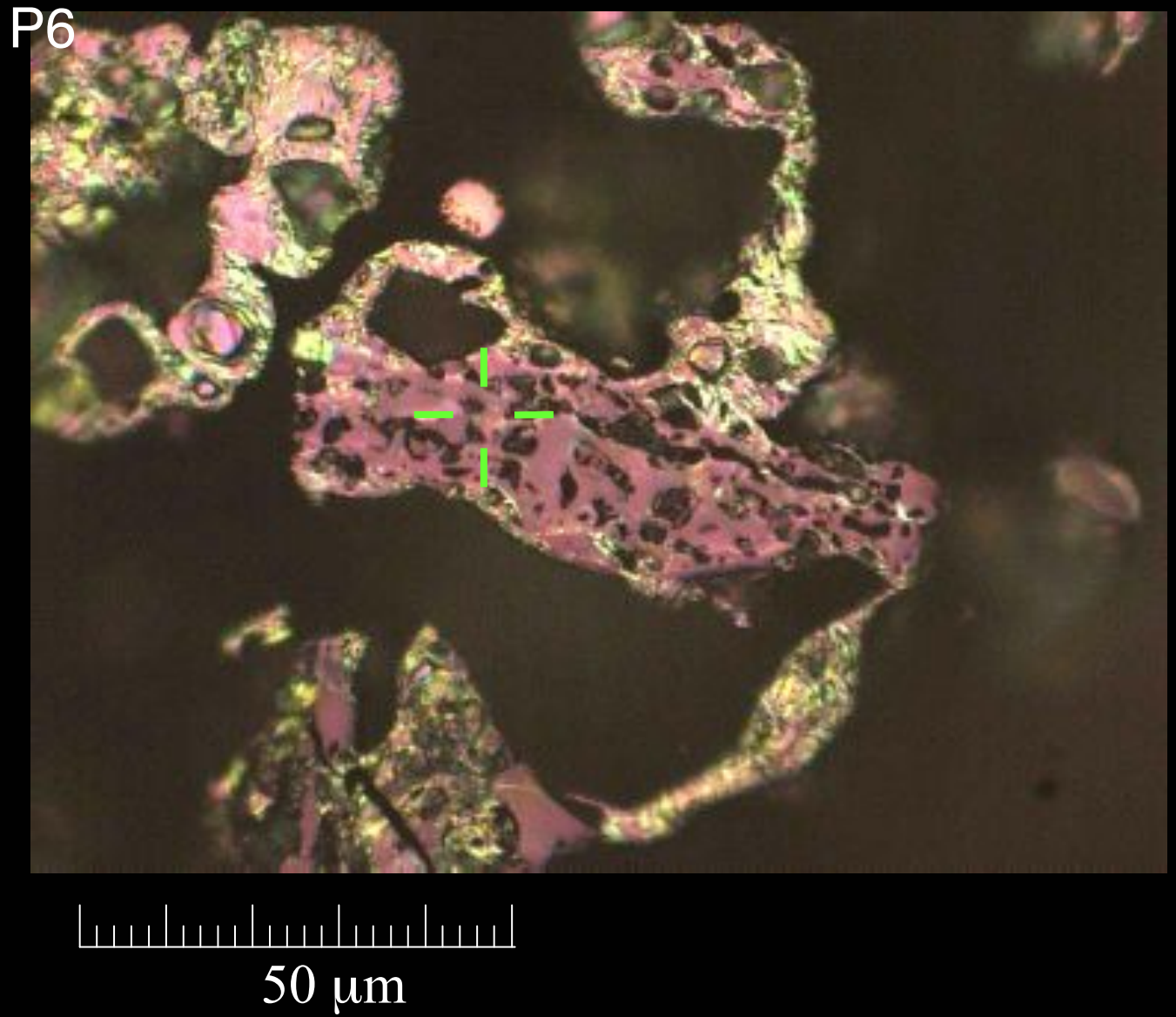
P4



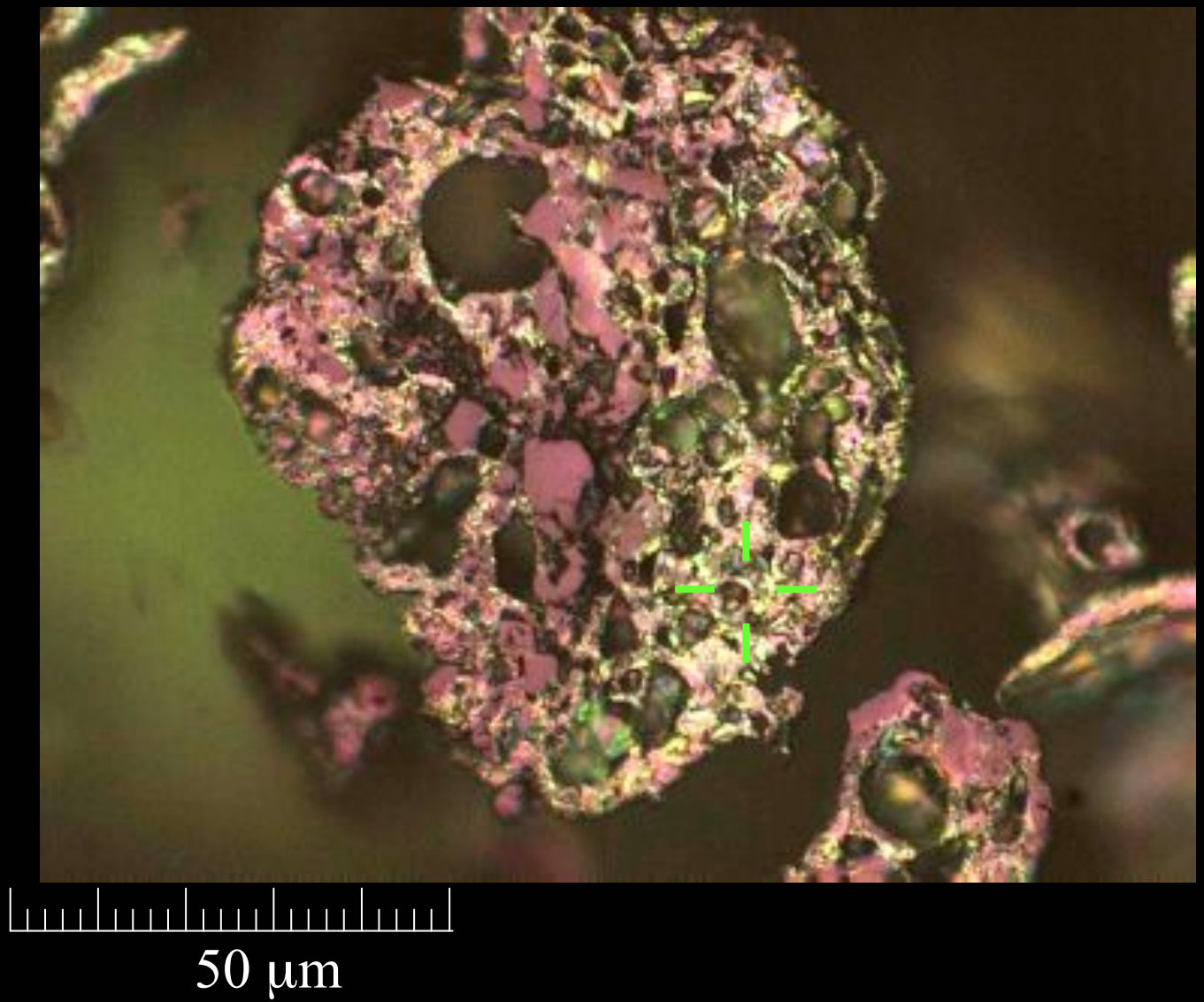
50 μm

P5

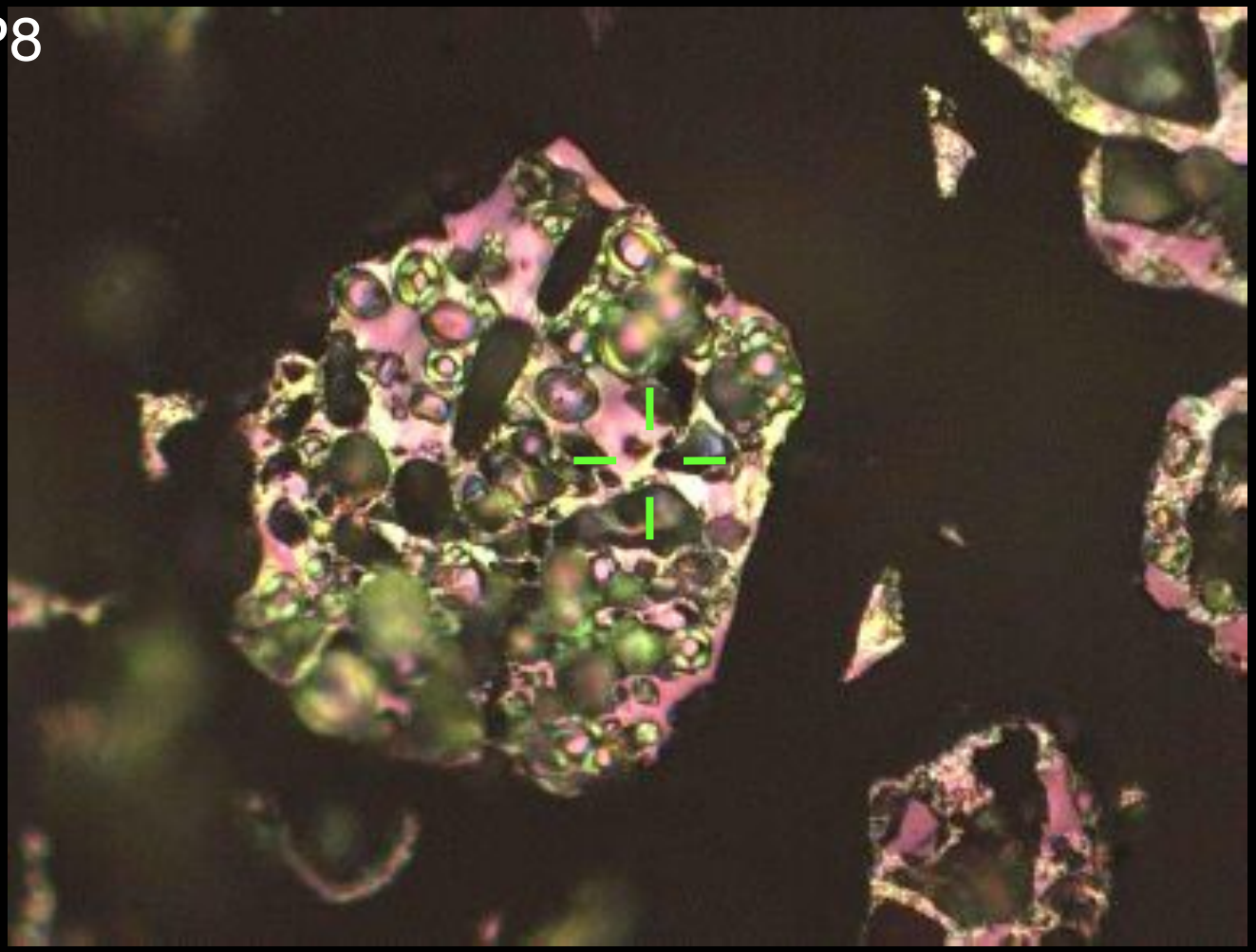




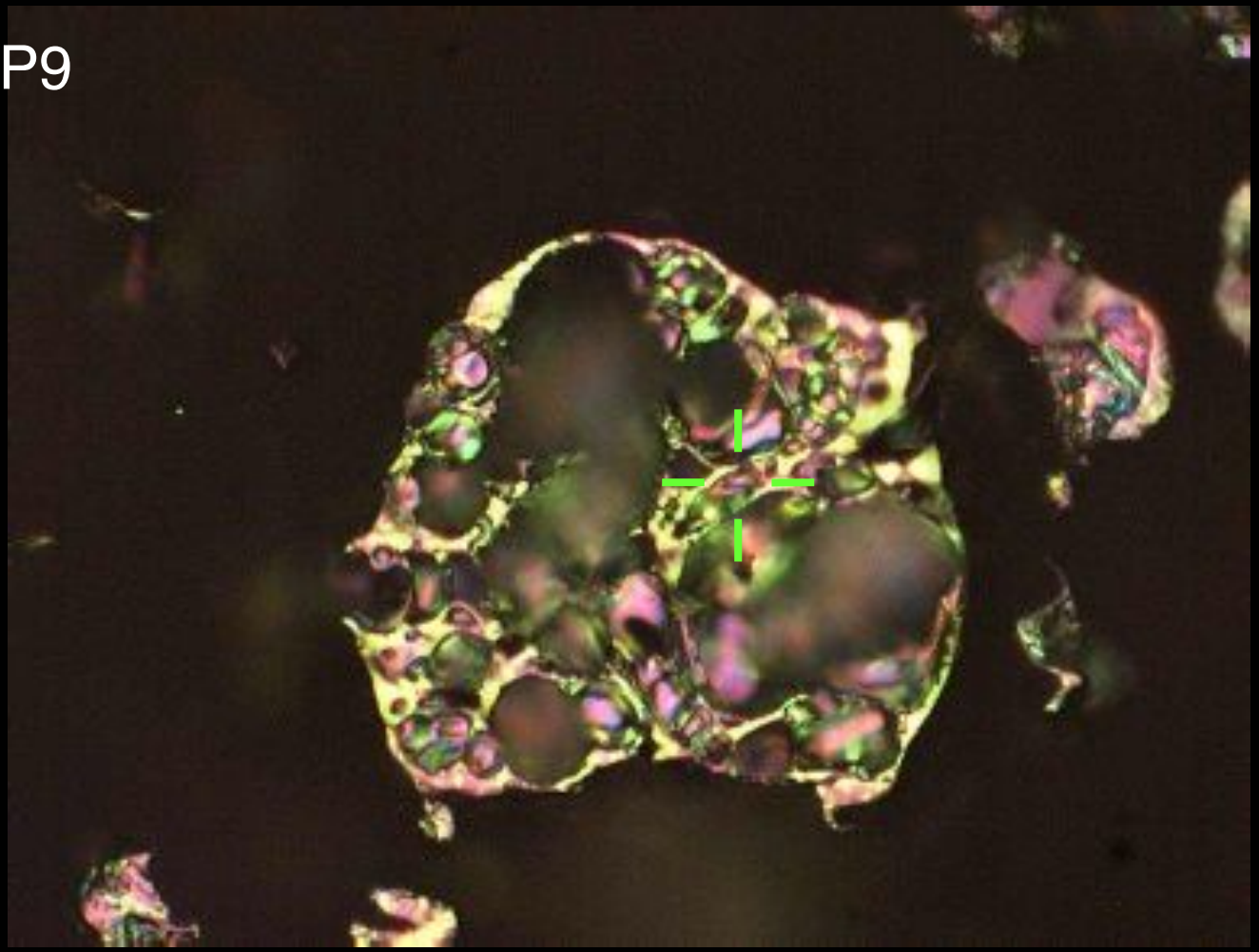
P7



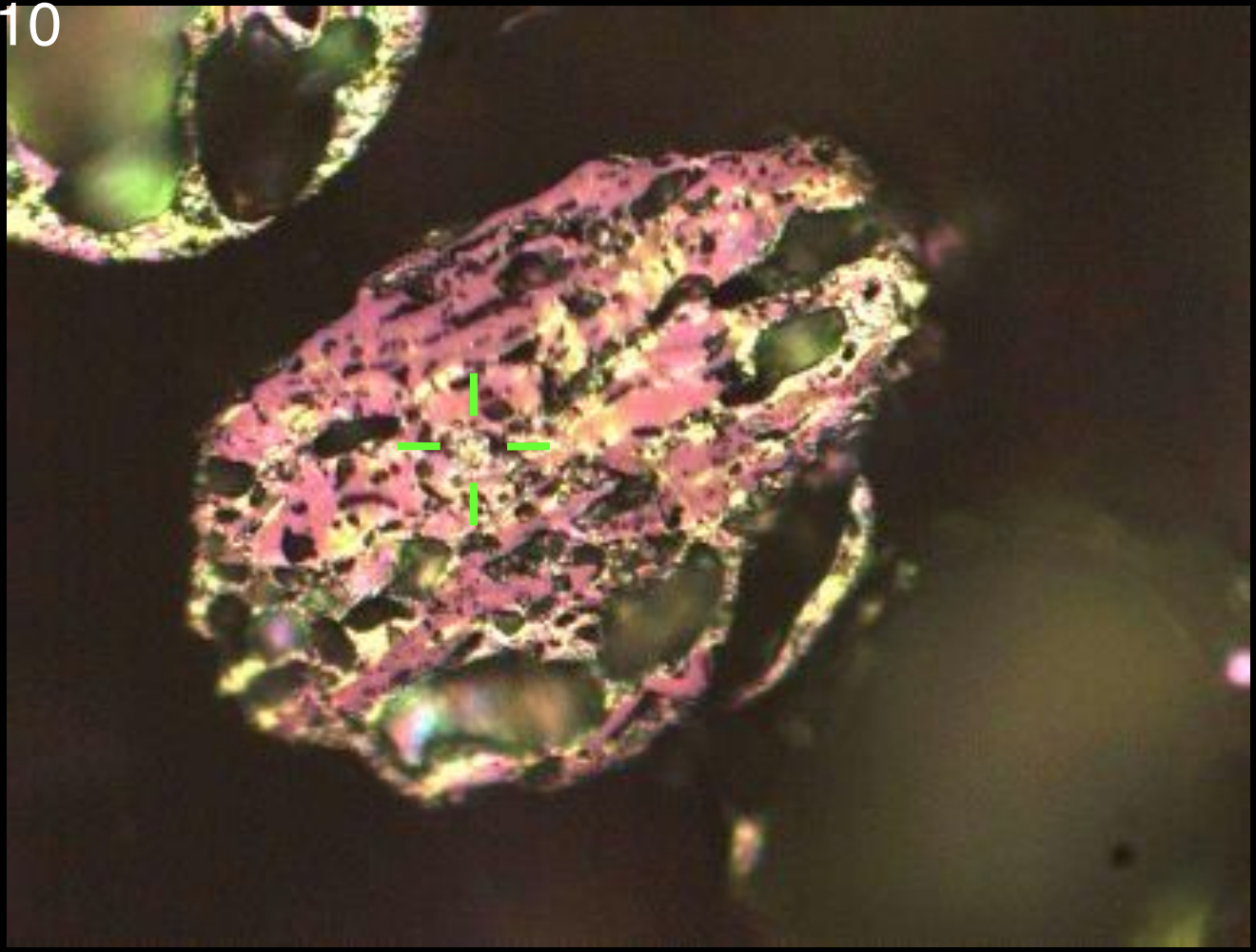
P8



50 μm

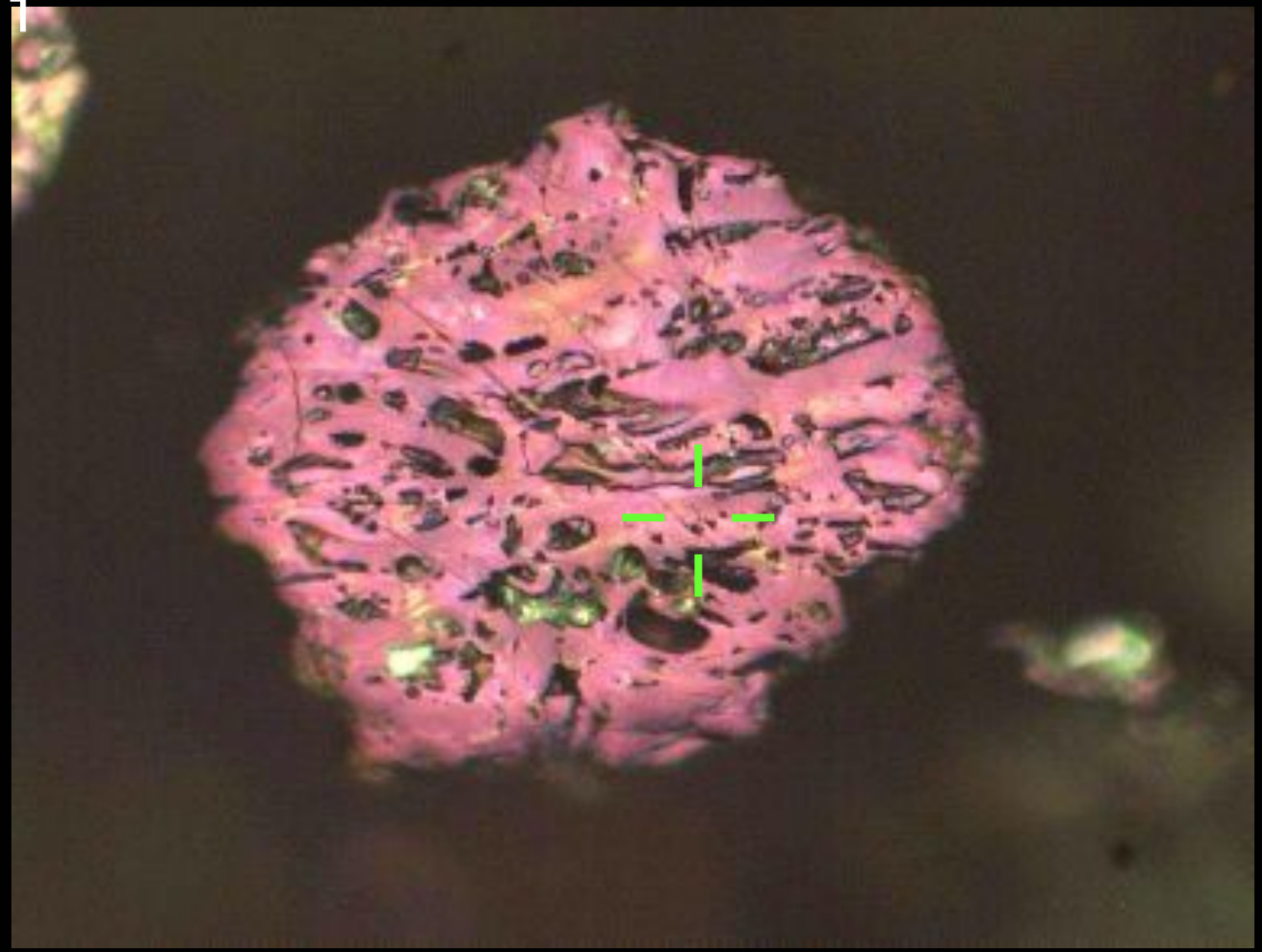


P10

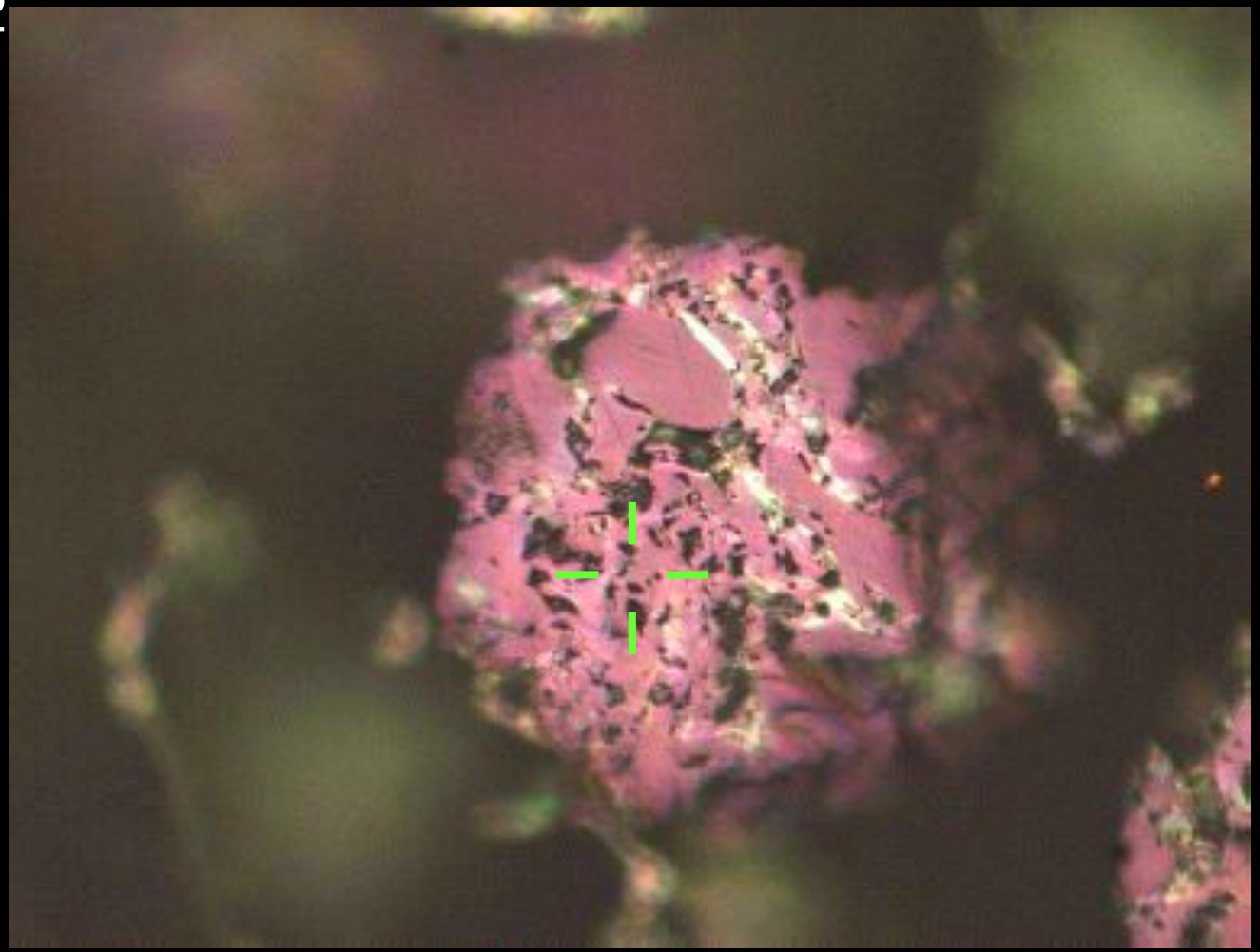


50 μm

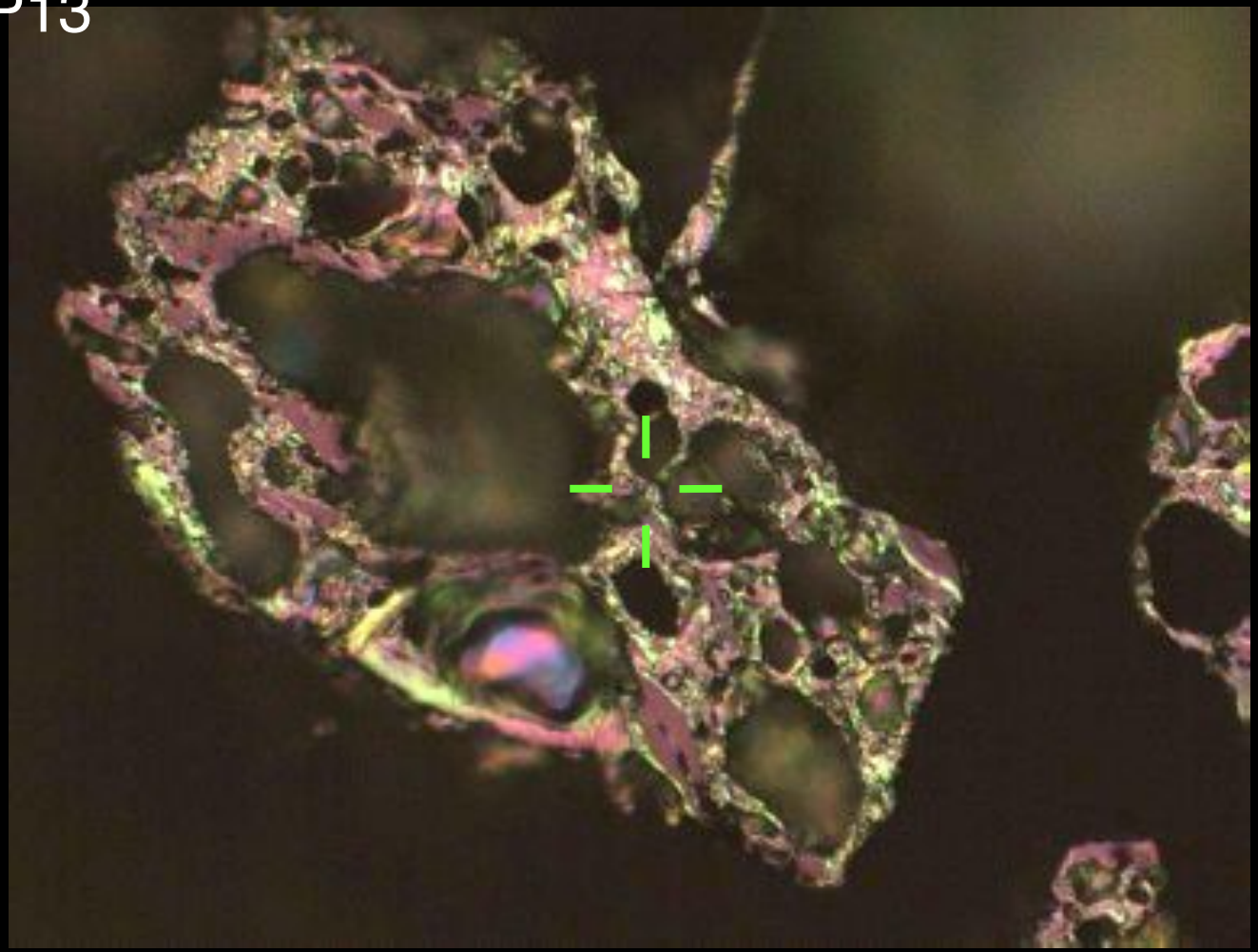
P11



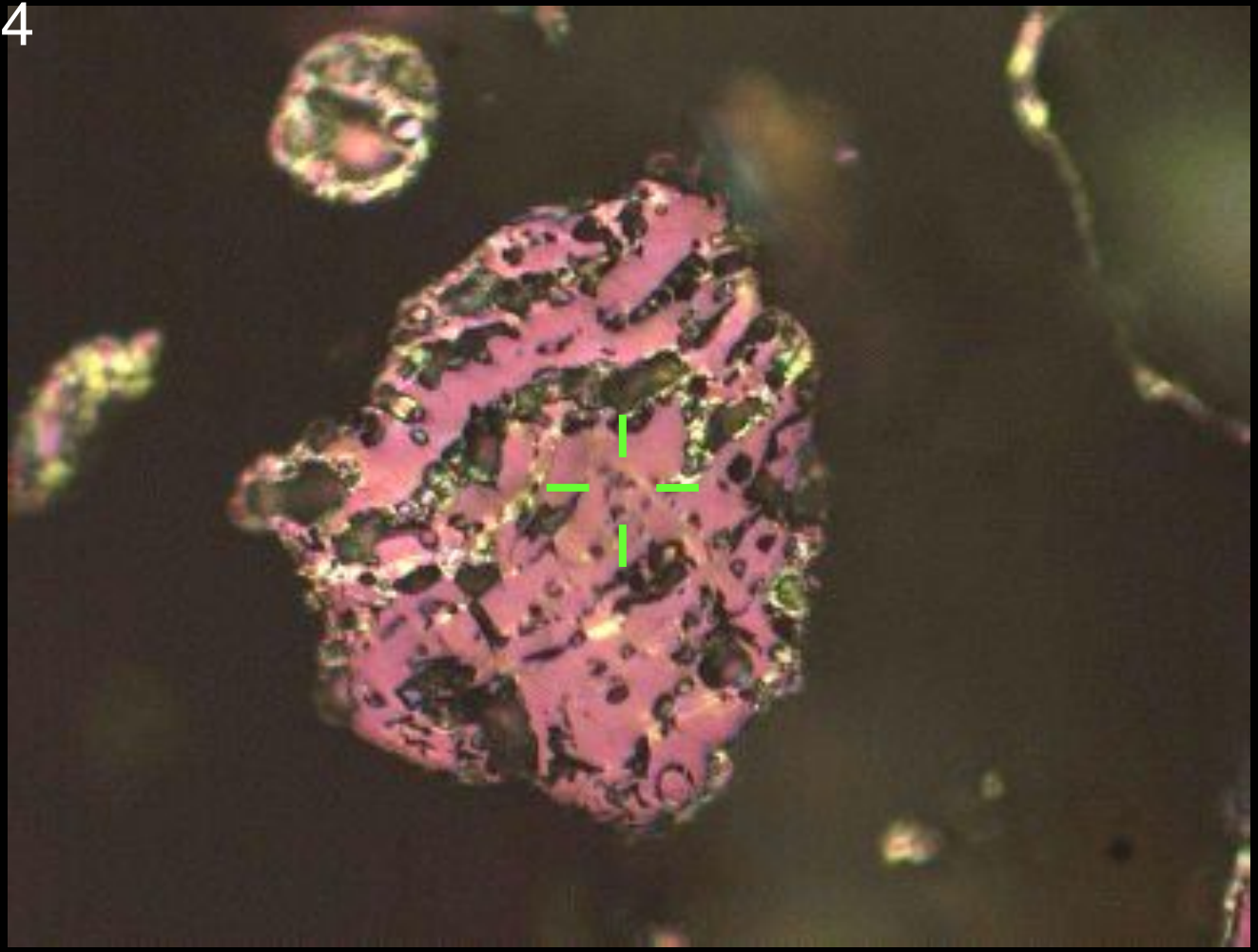
P12



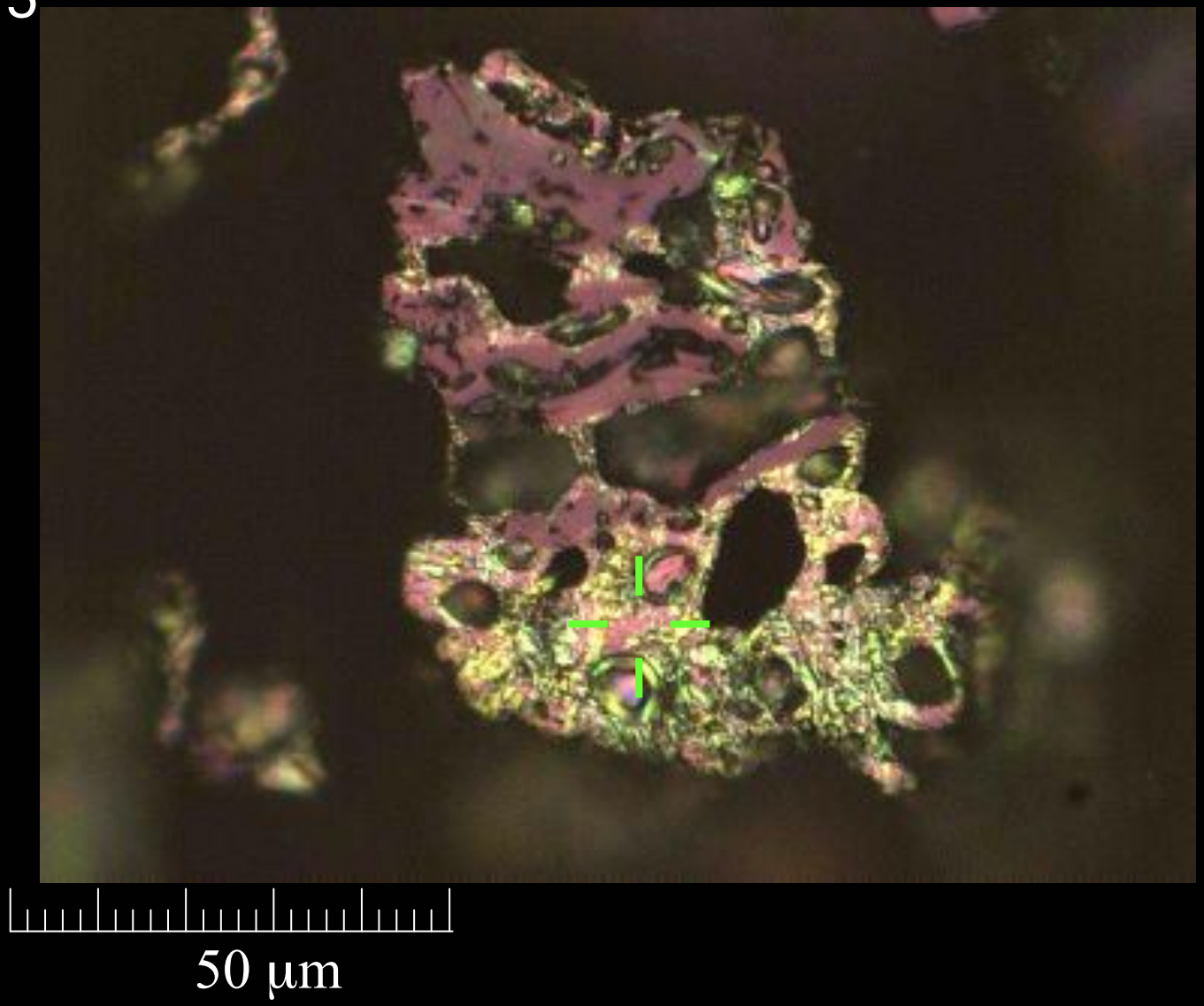
P13



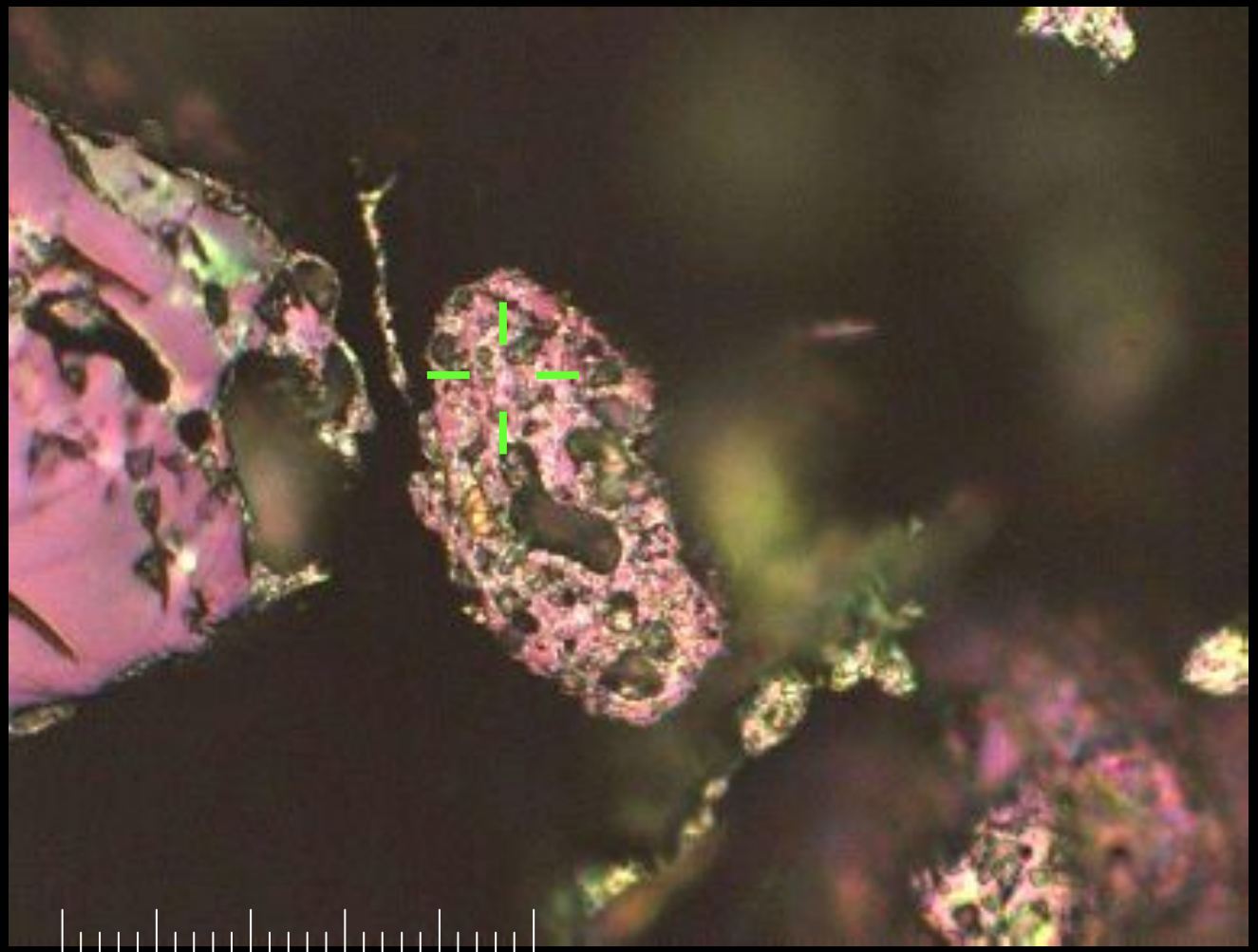
P14



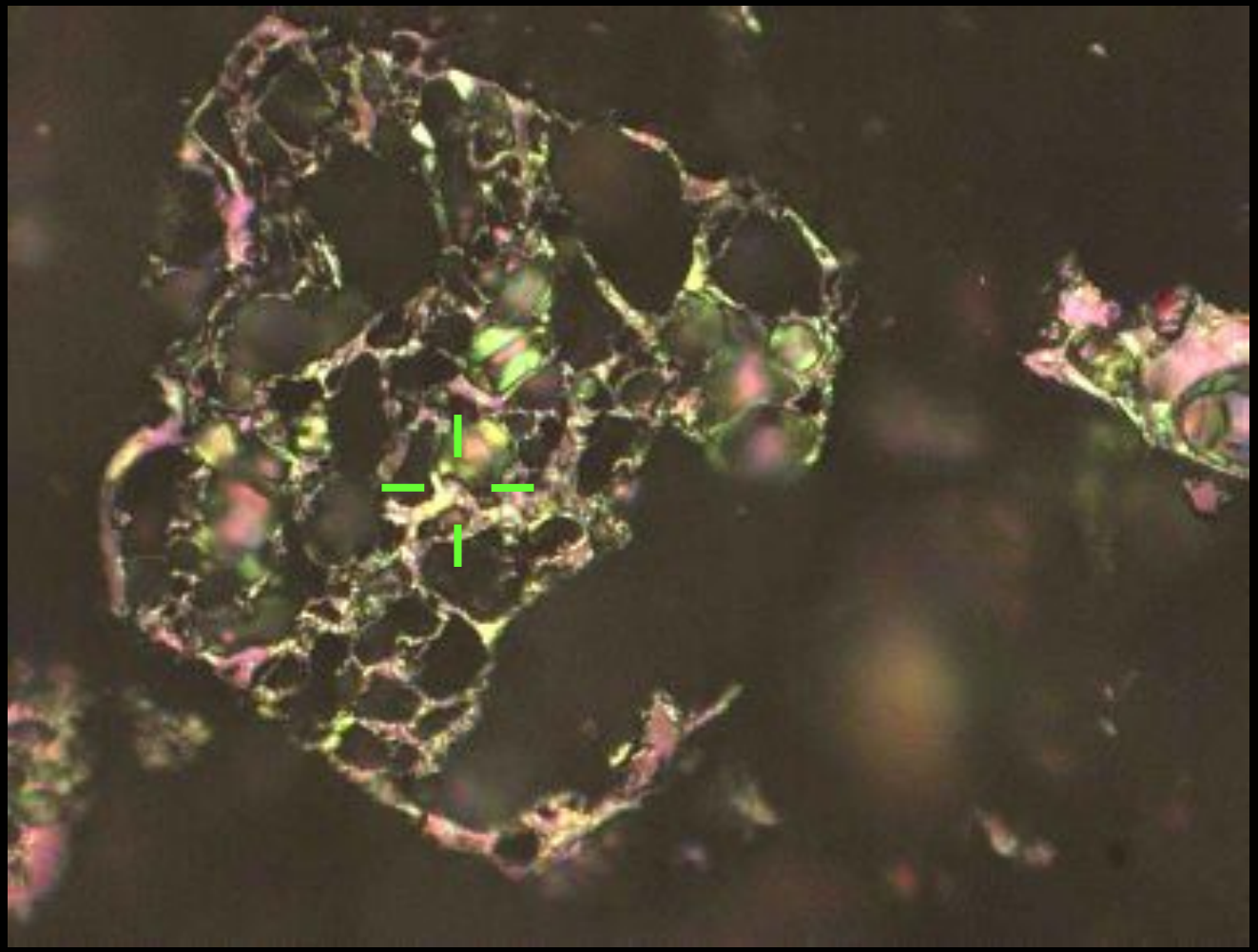
P15



P16

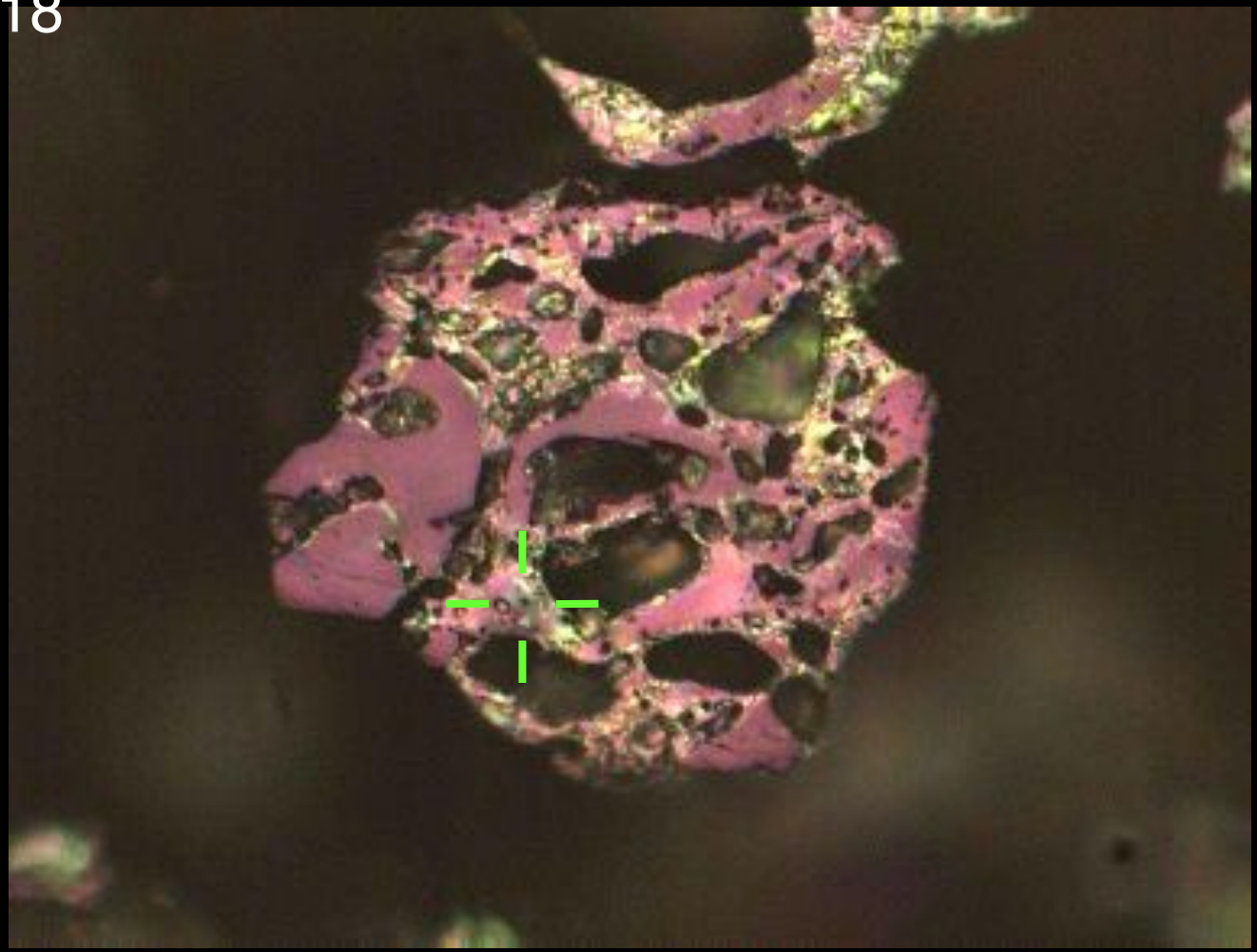


P17

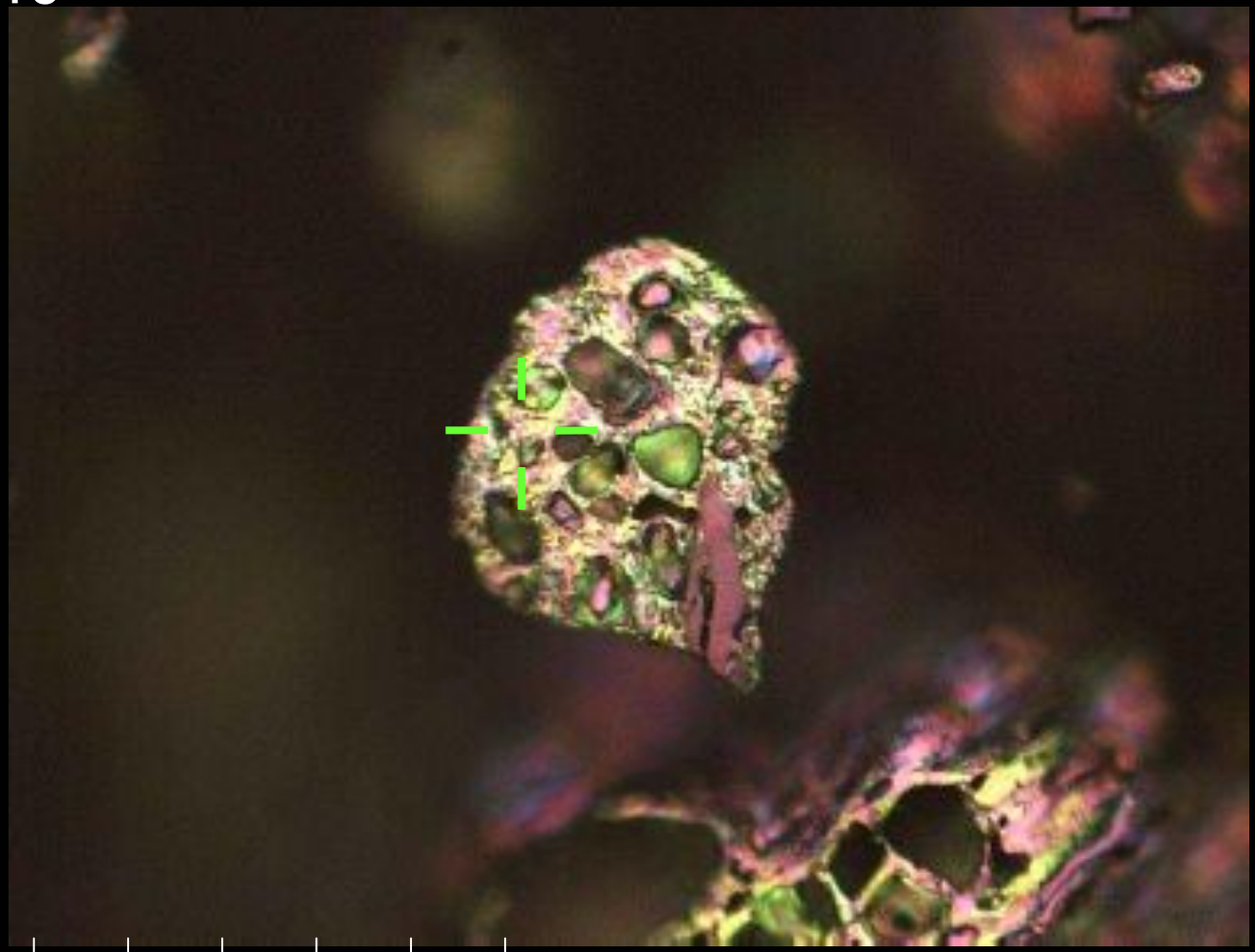


50 μm

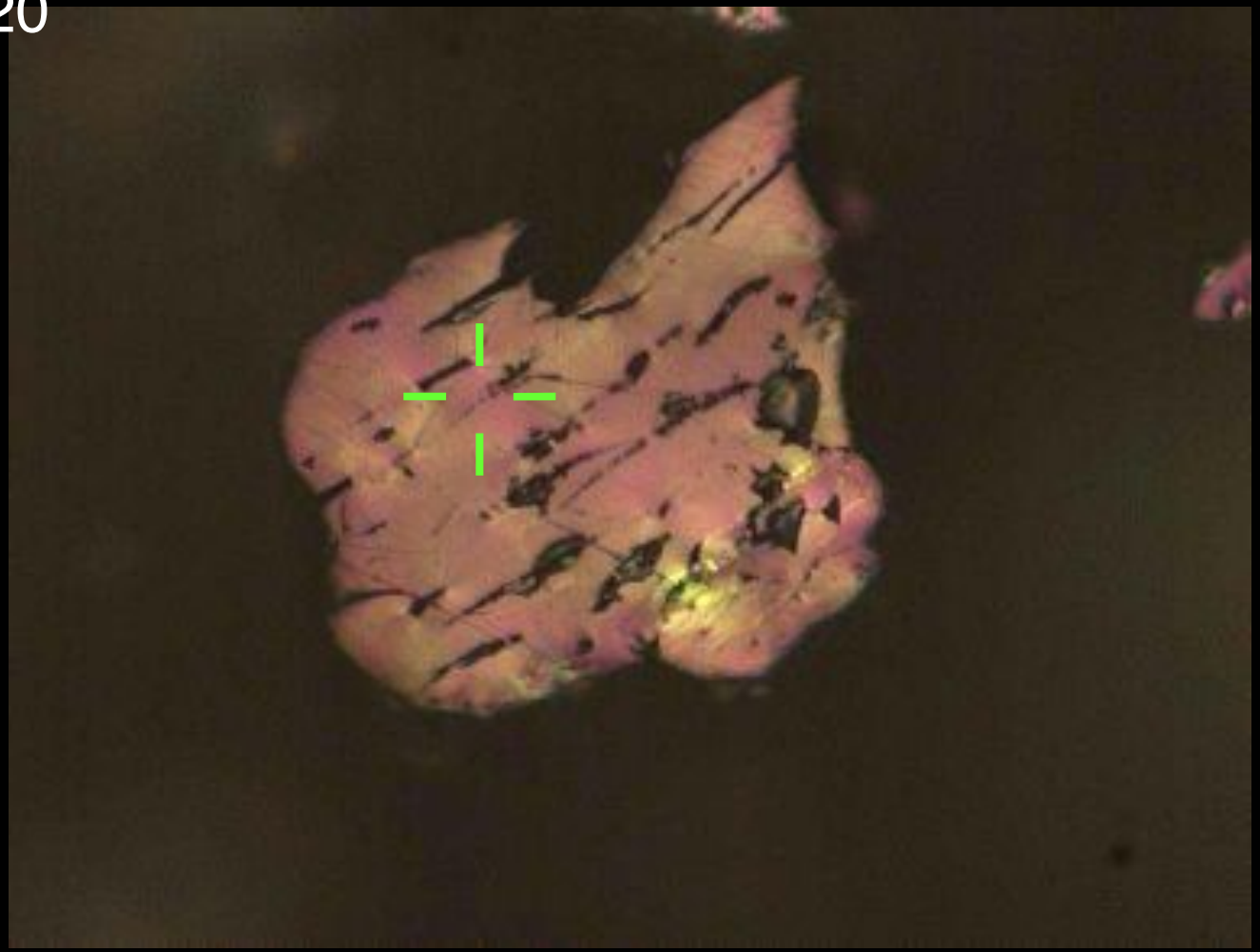
P18



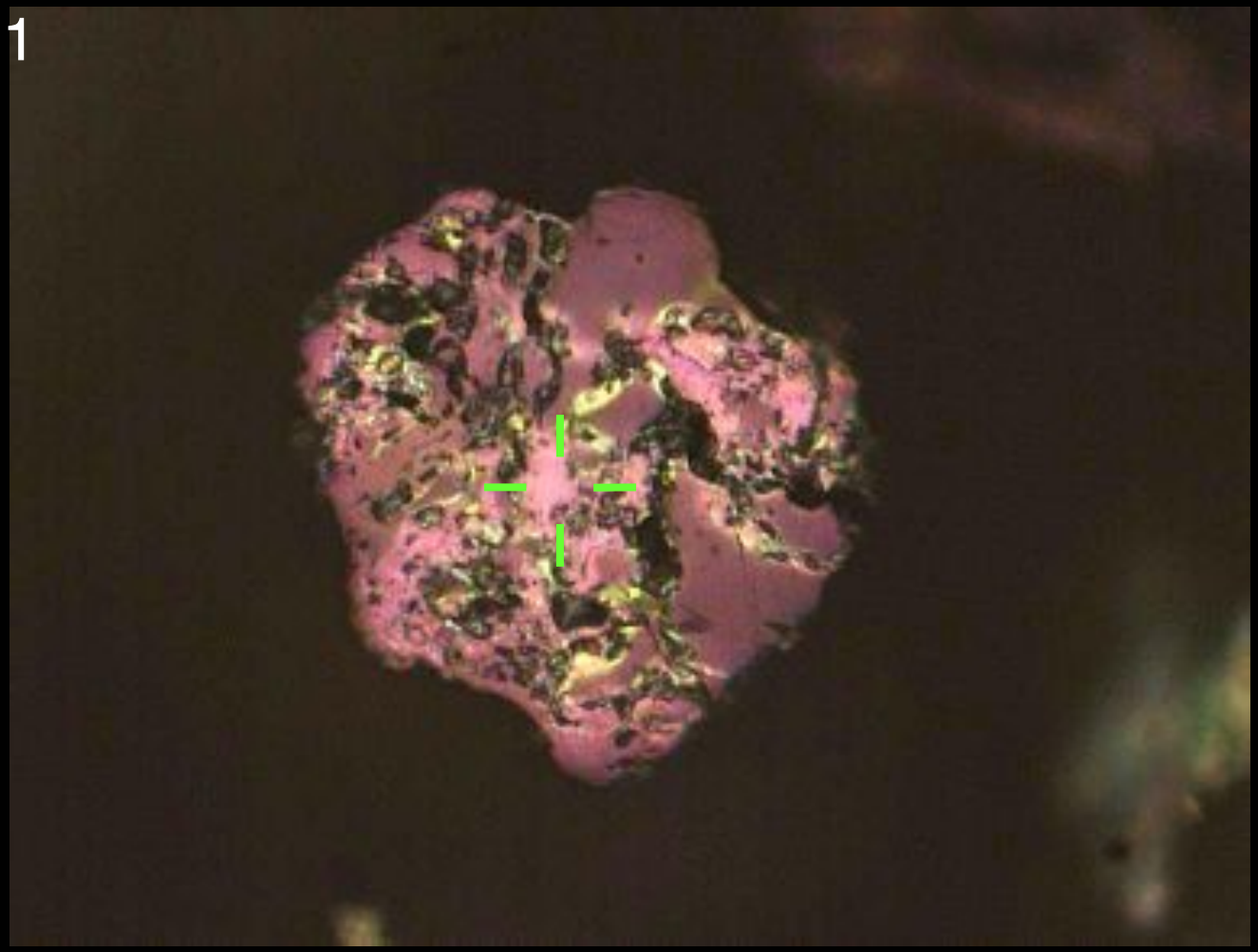
P19



P20

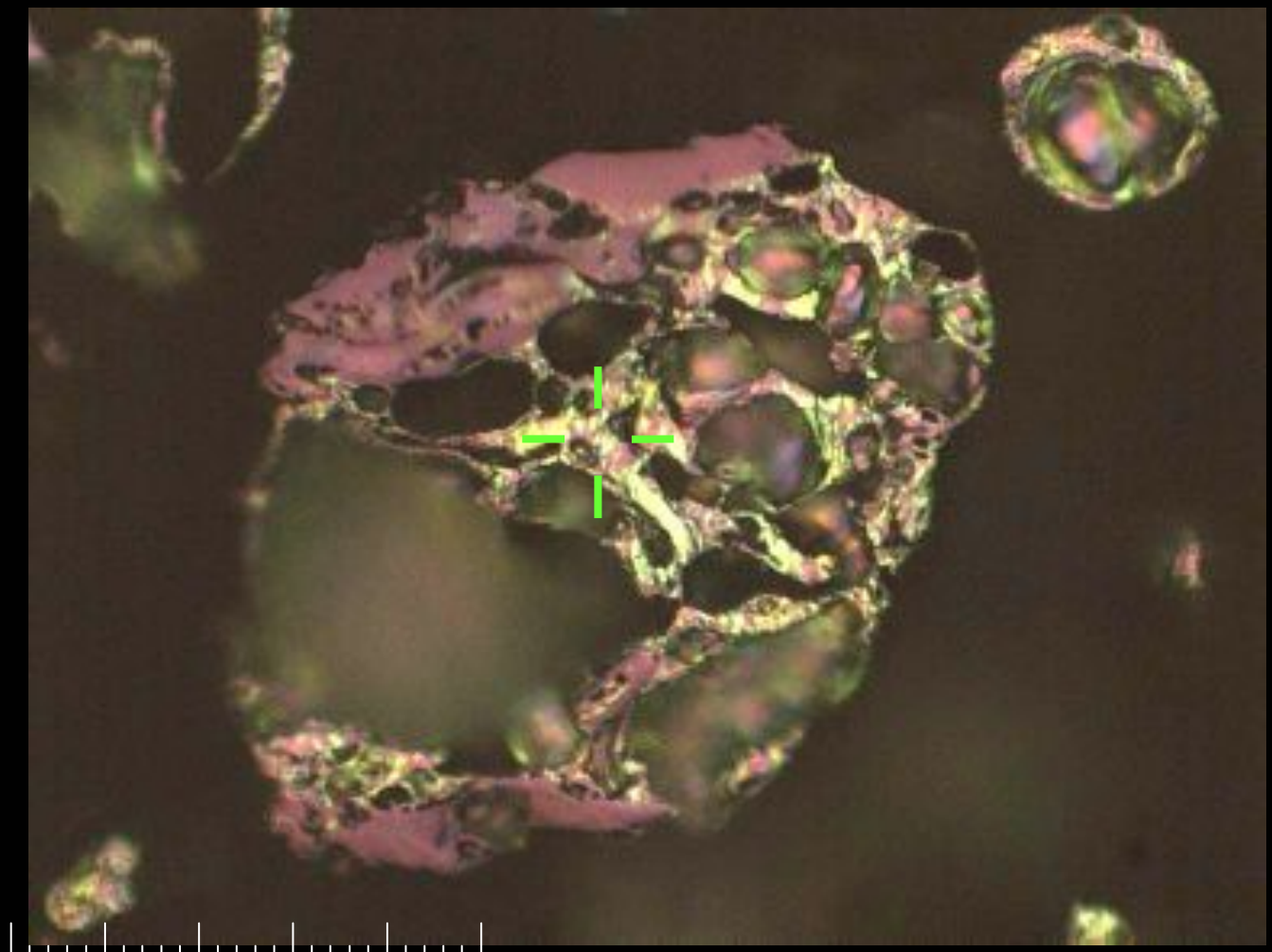


P21

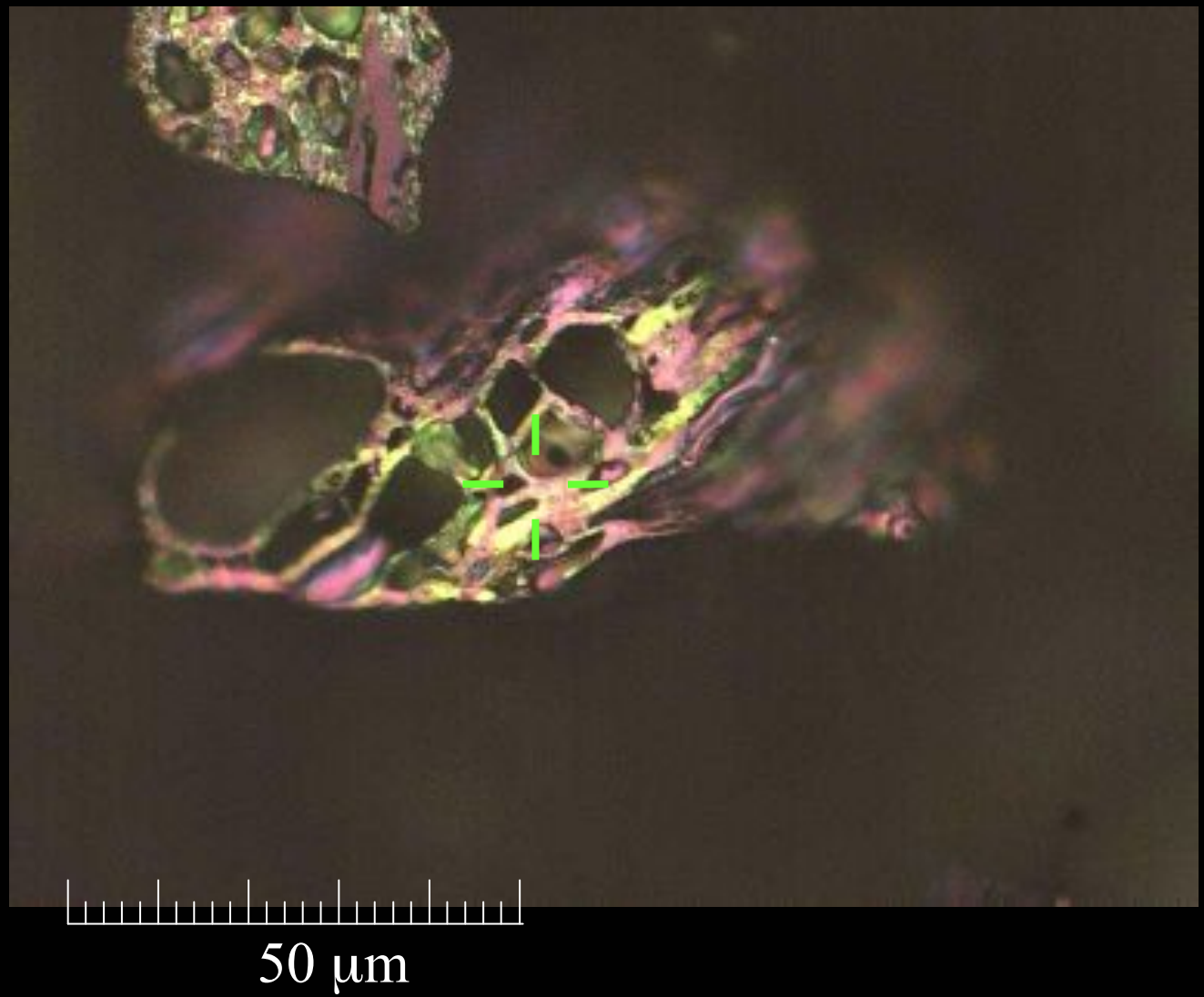


50 μm

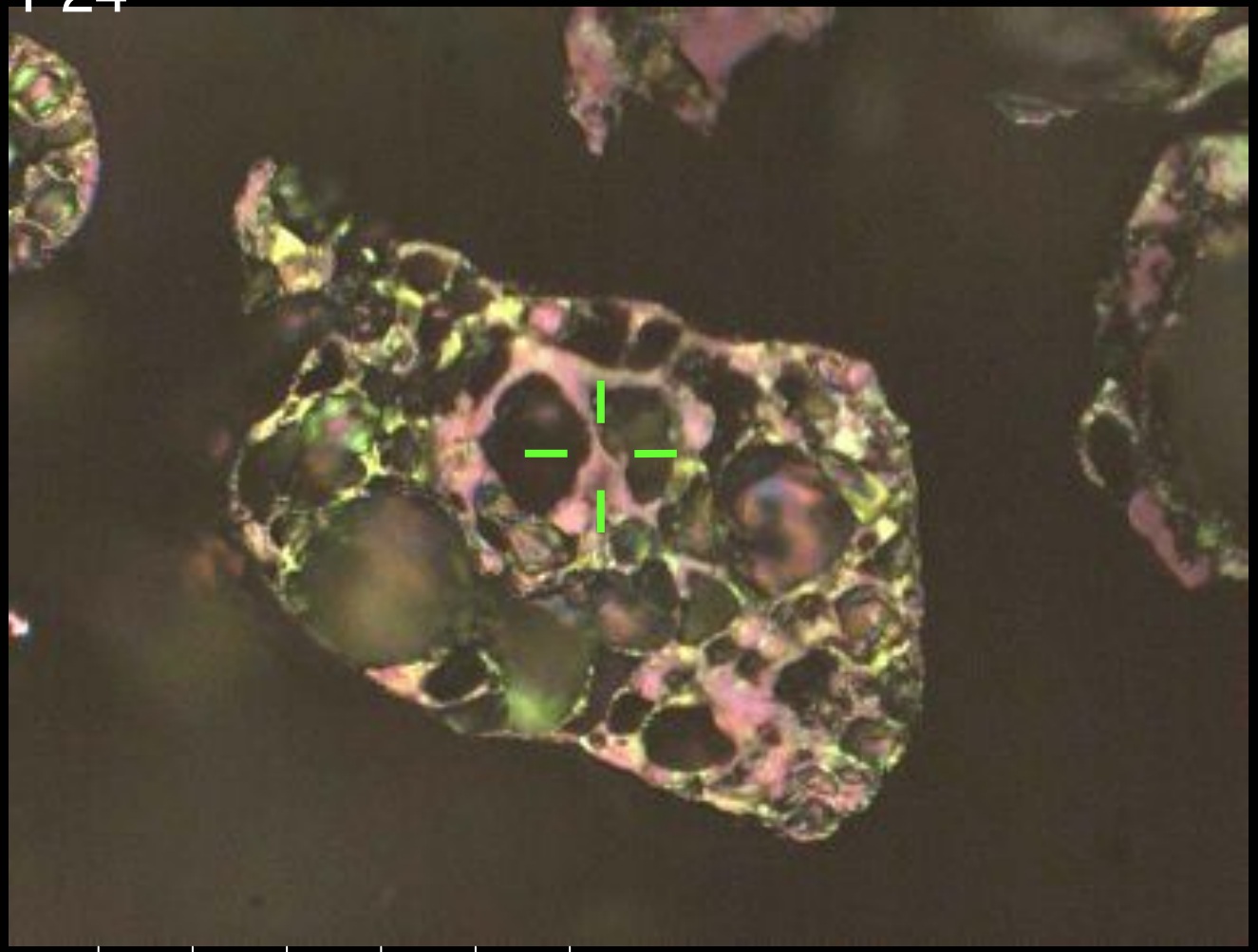
P22

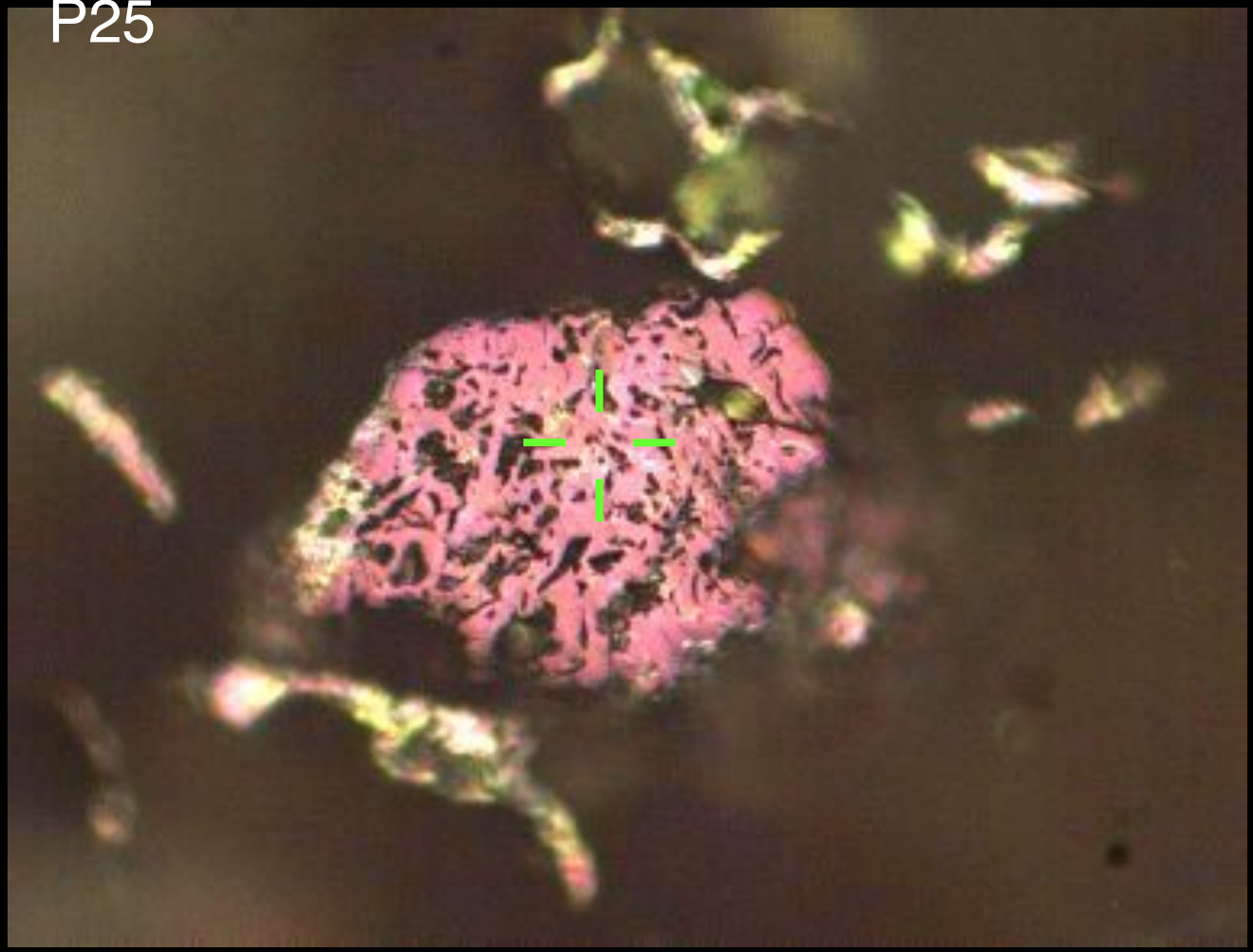


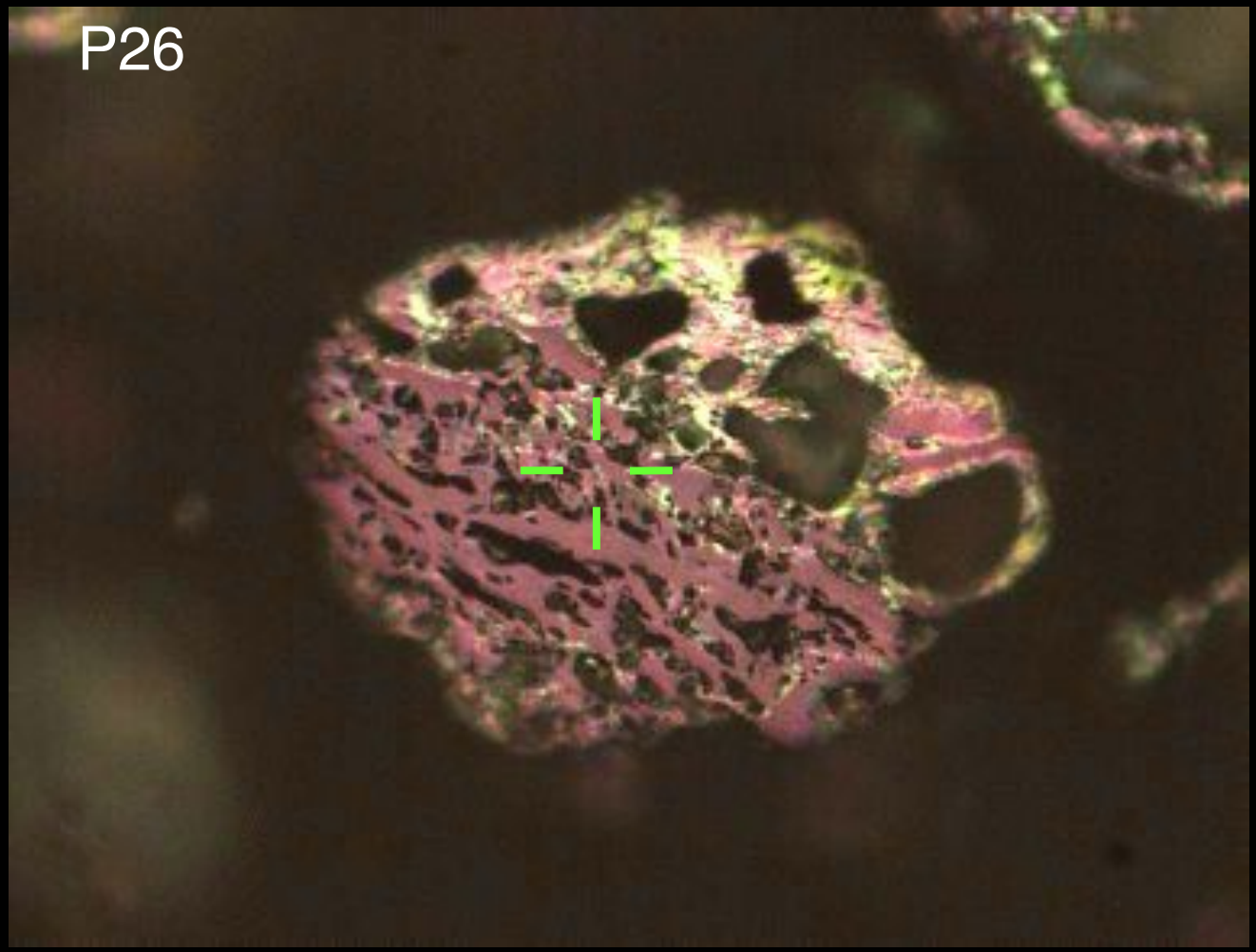
P23



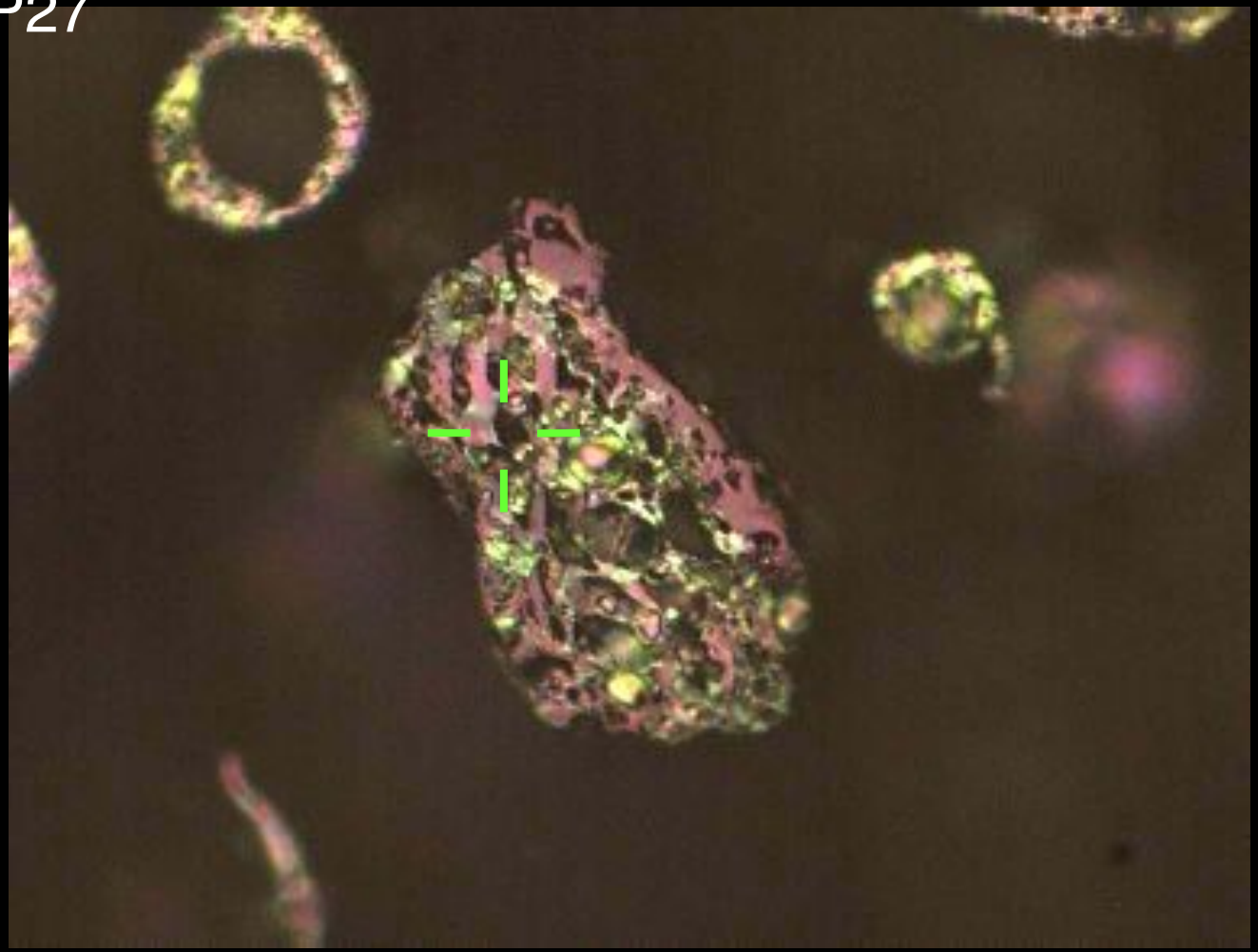
P24



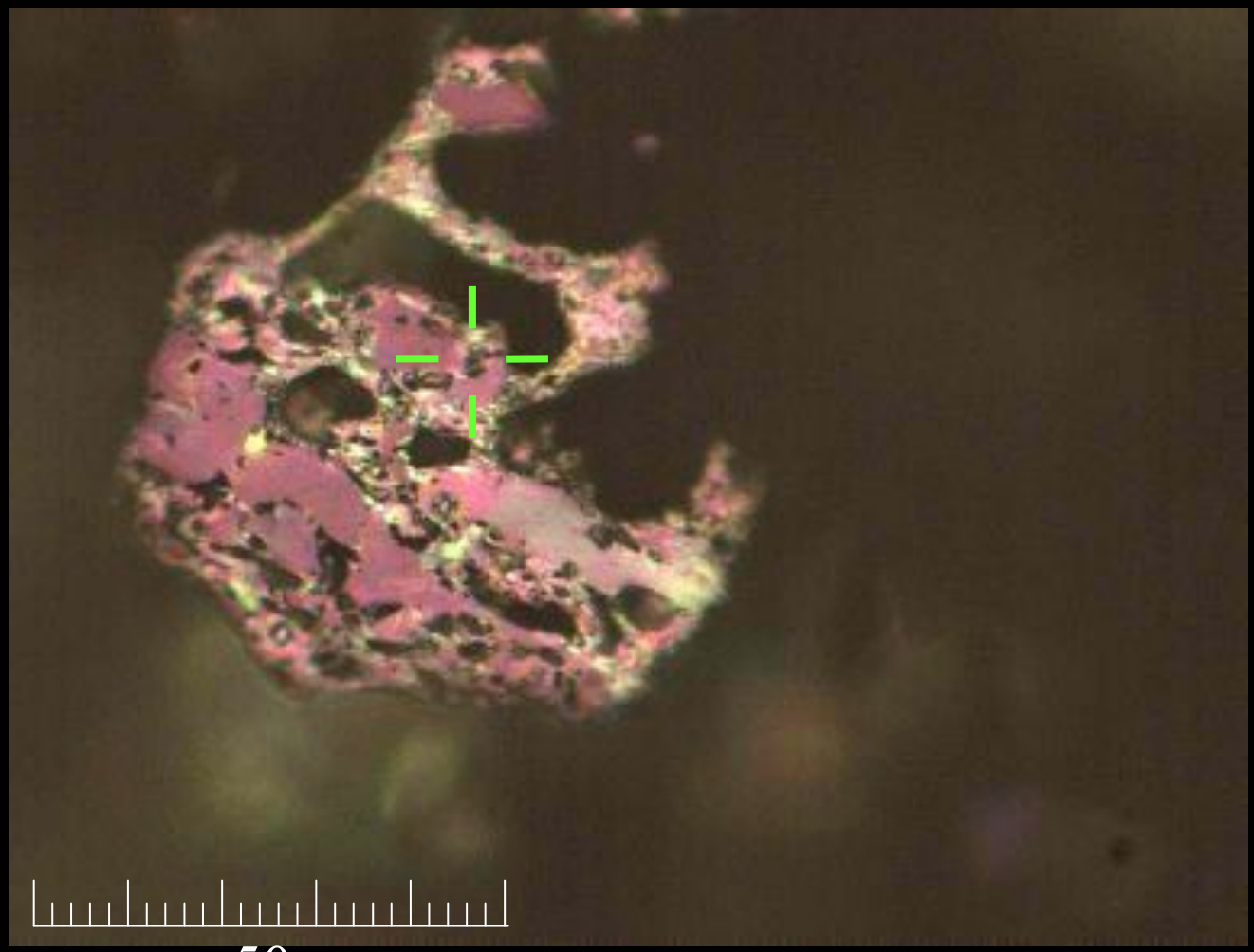




P27

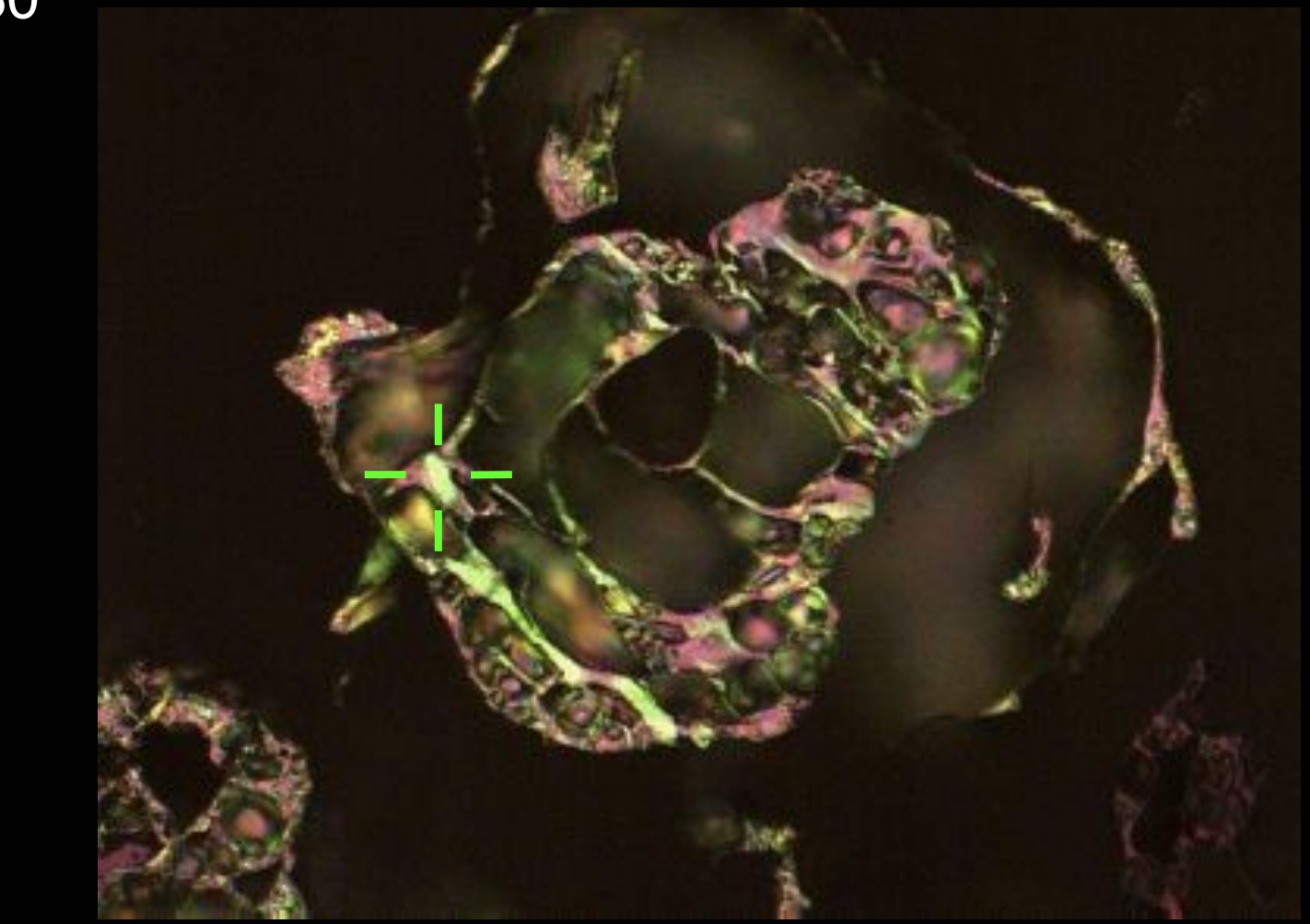


P28

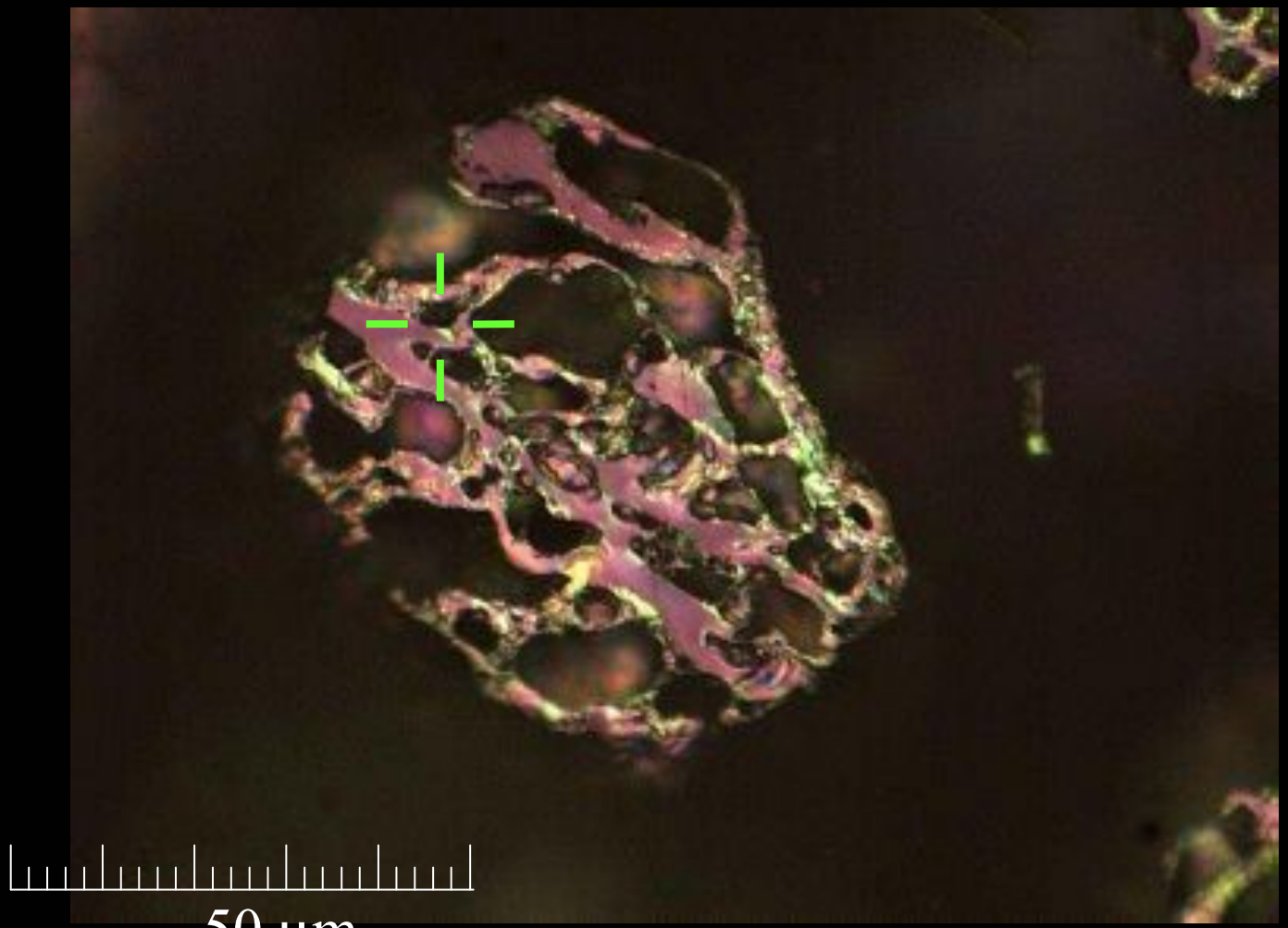


P29

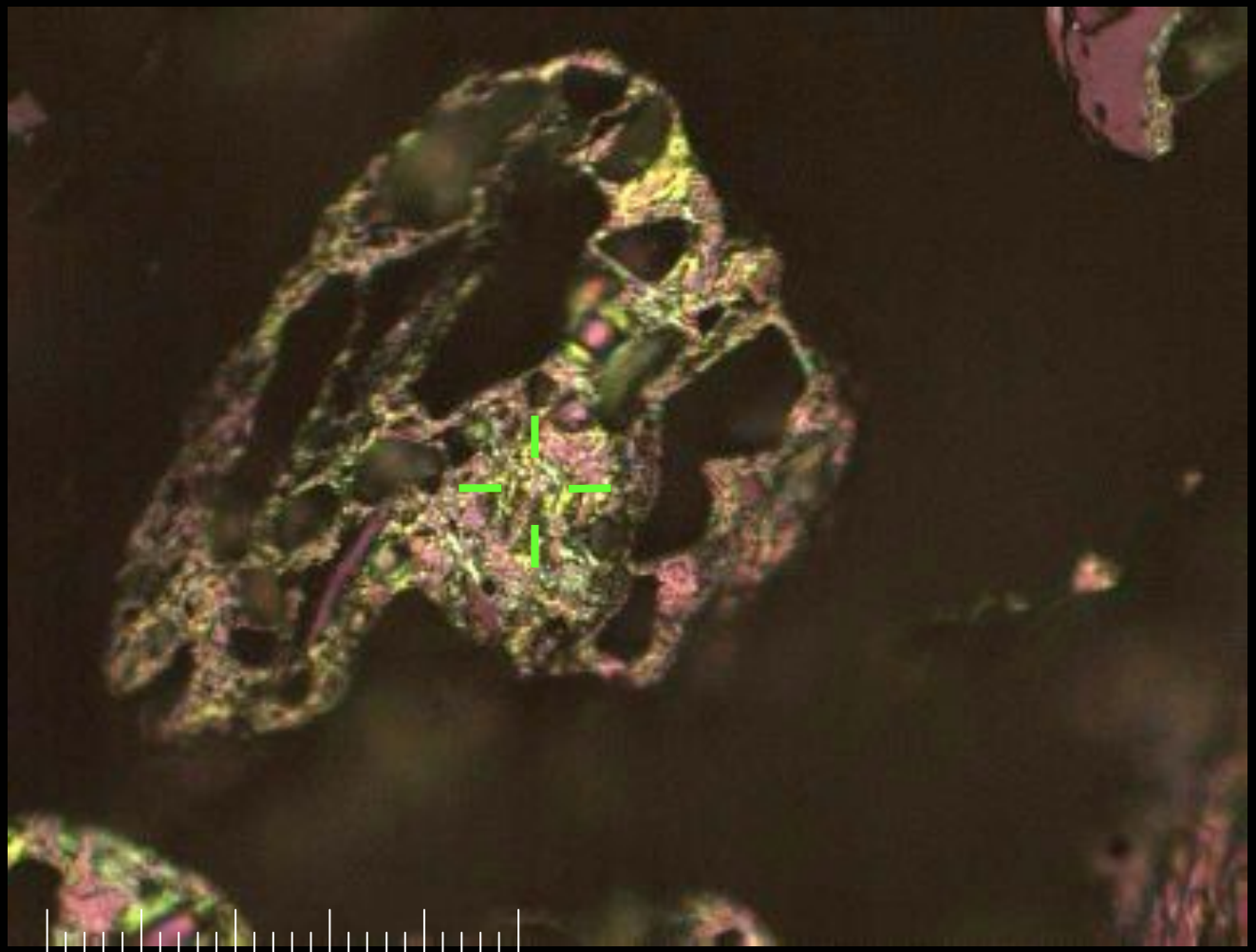
P30



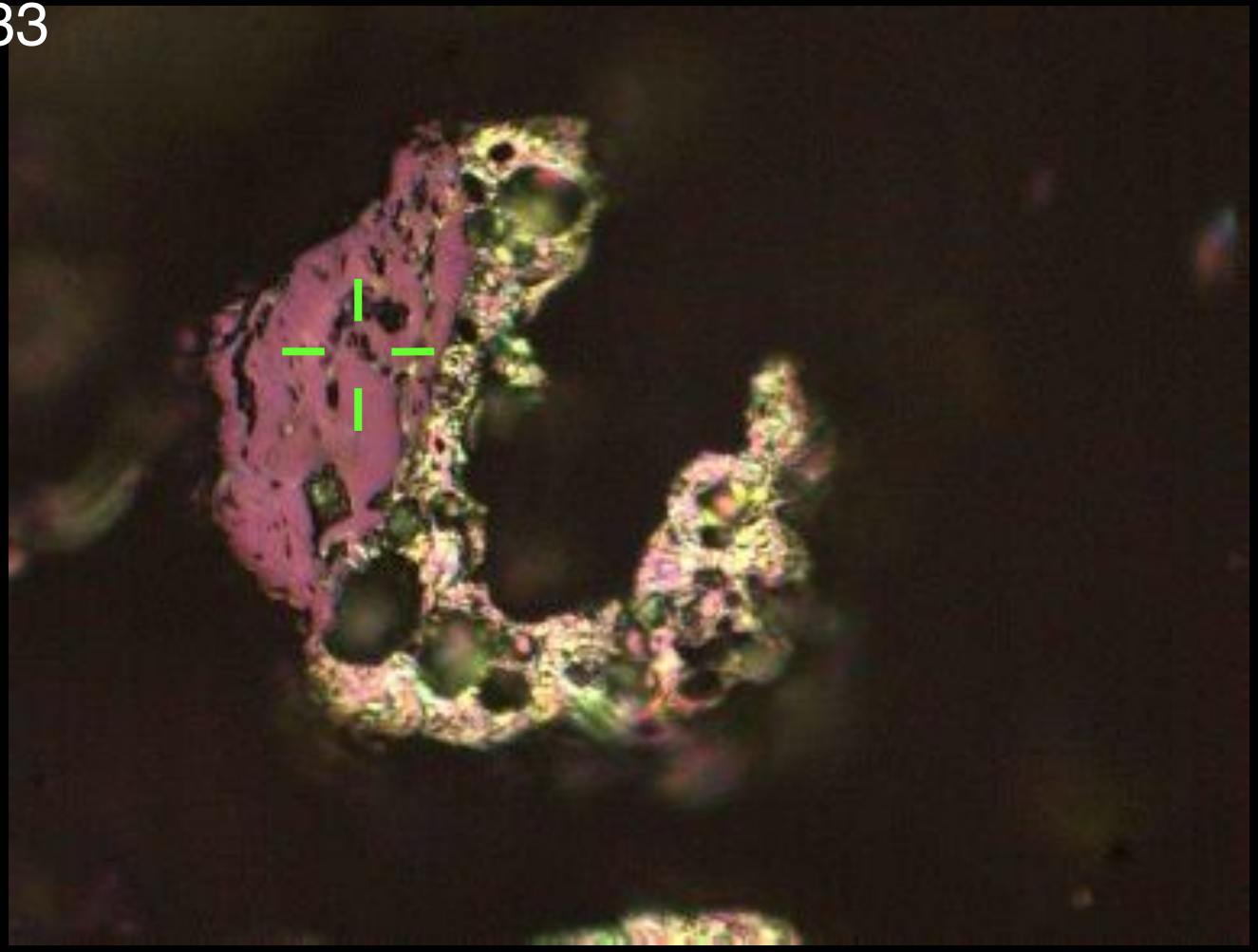
P31



P32

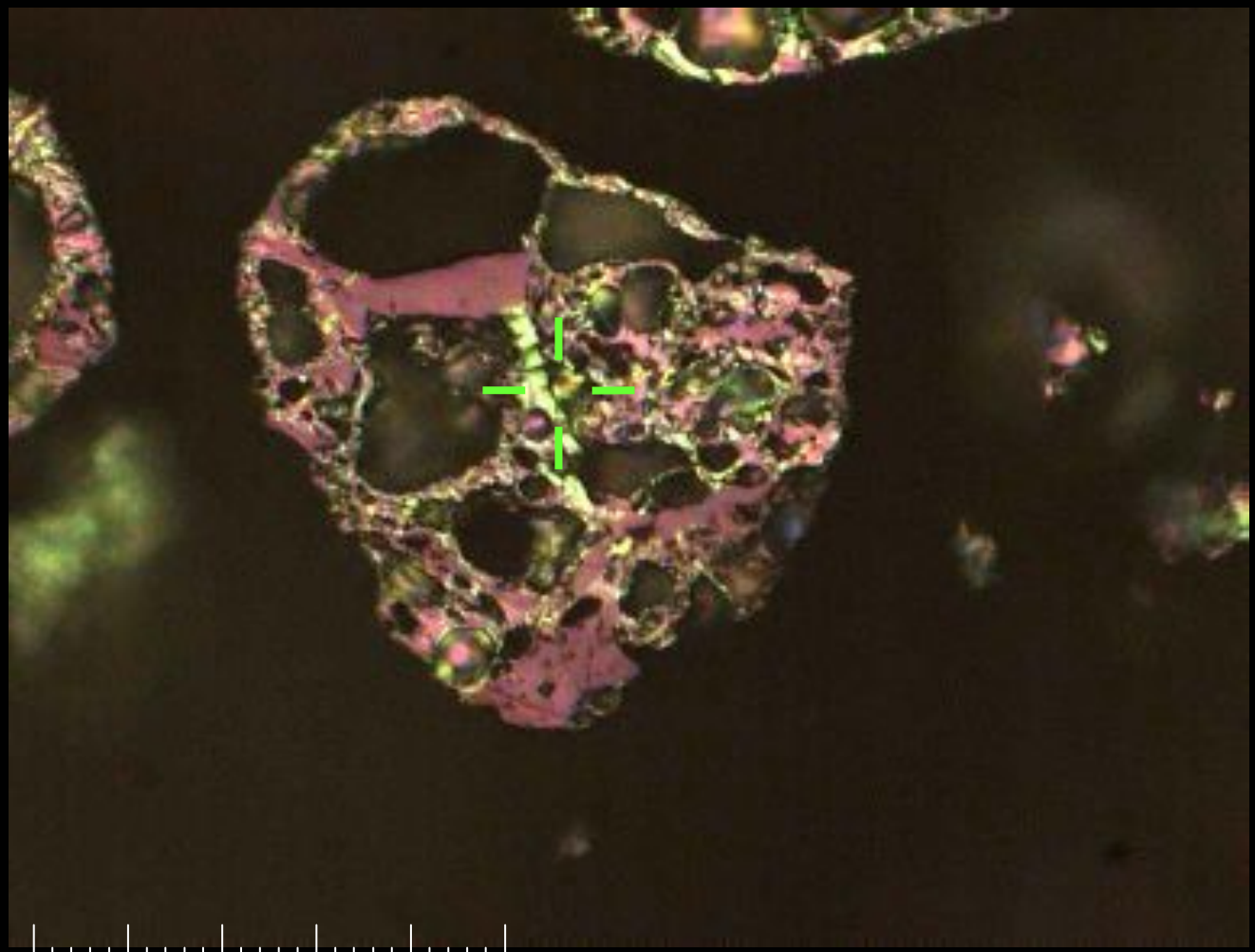


P33

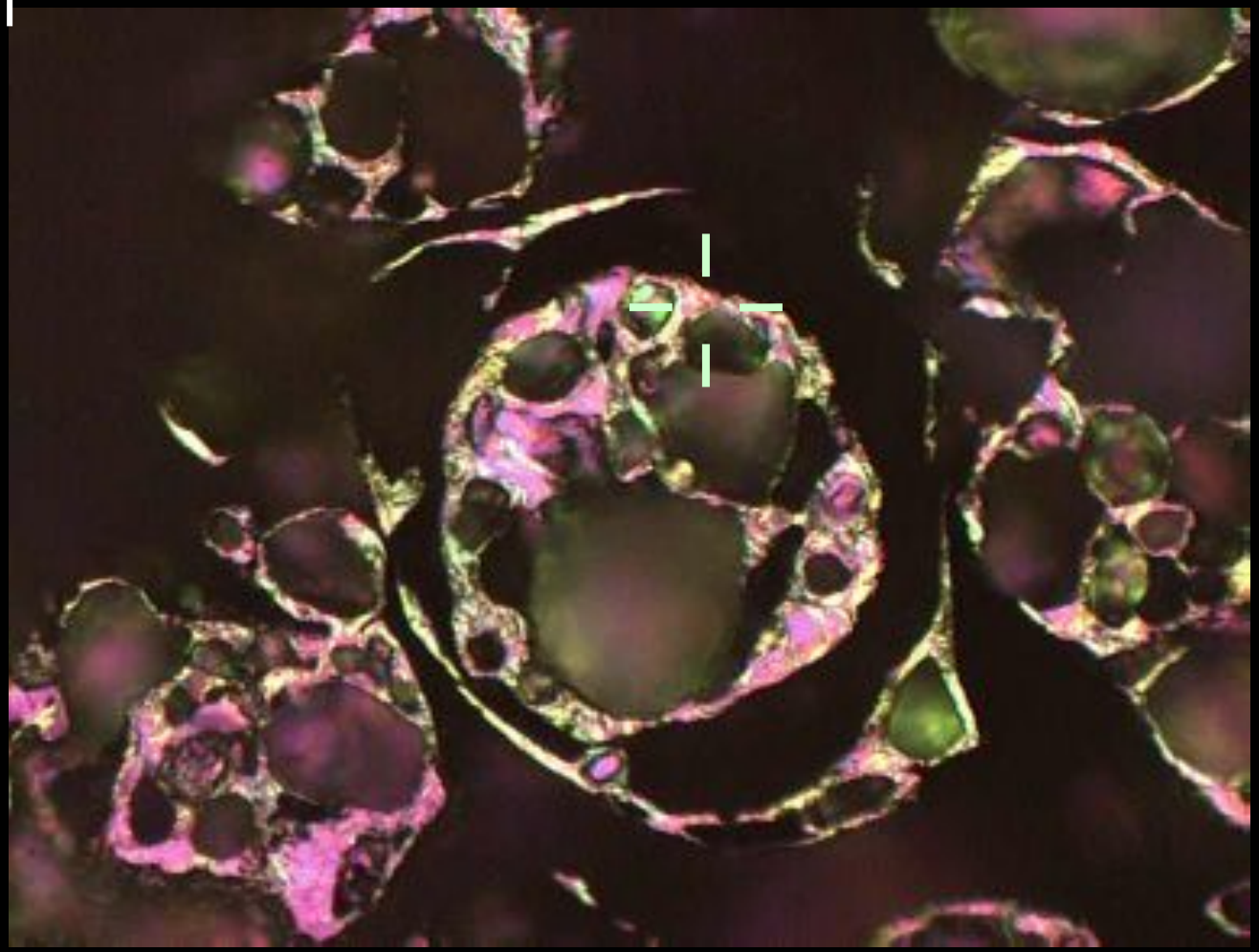


50 μm

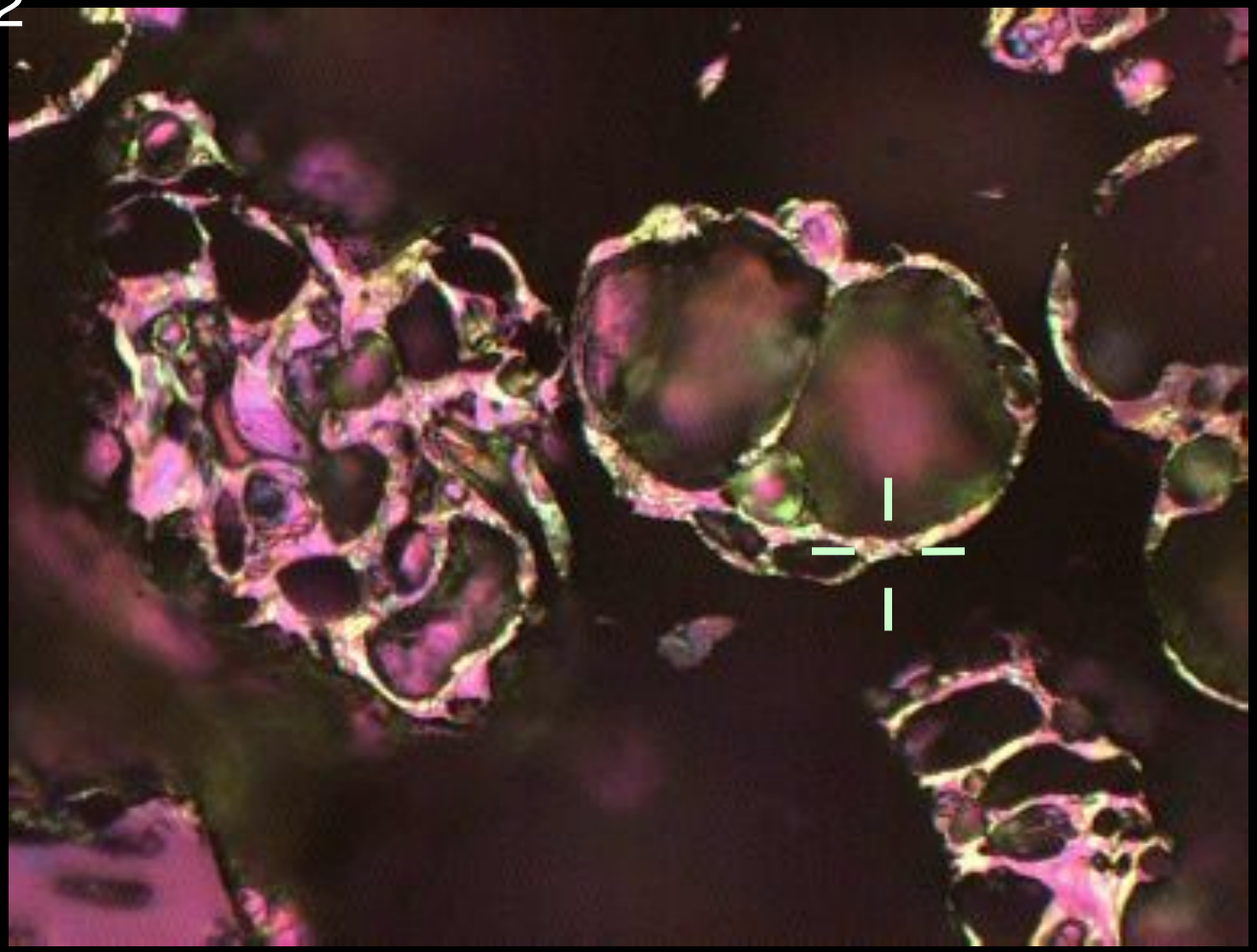
P34



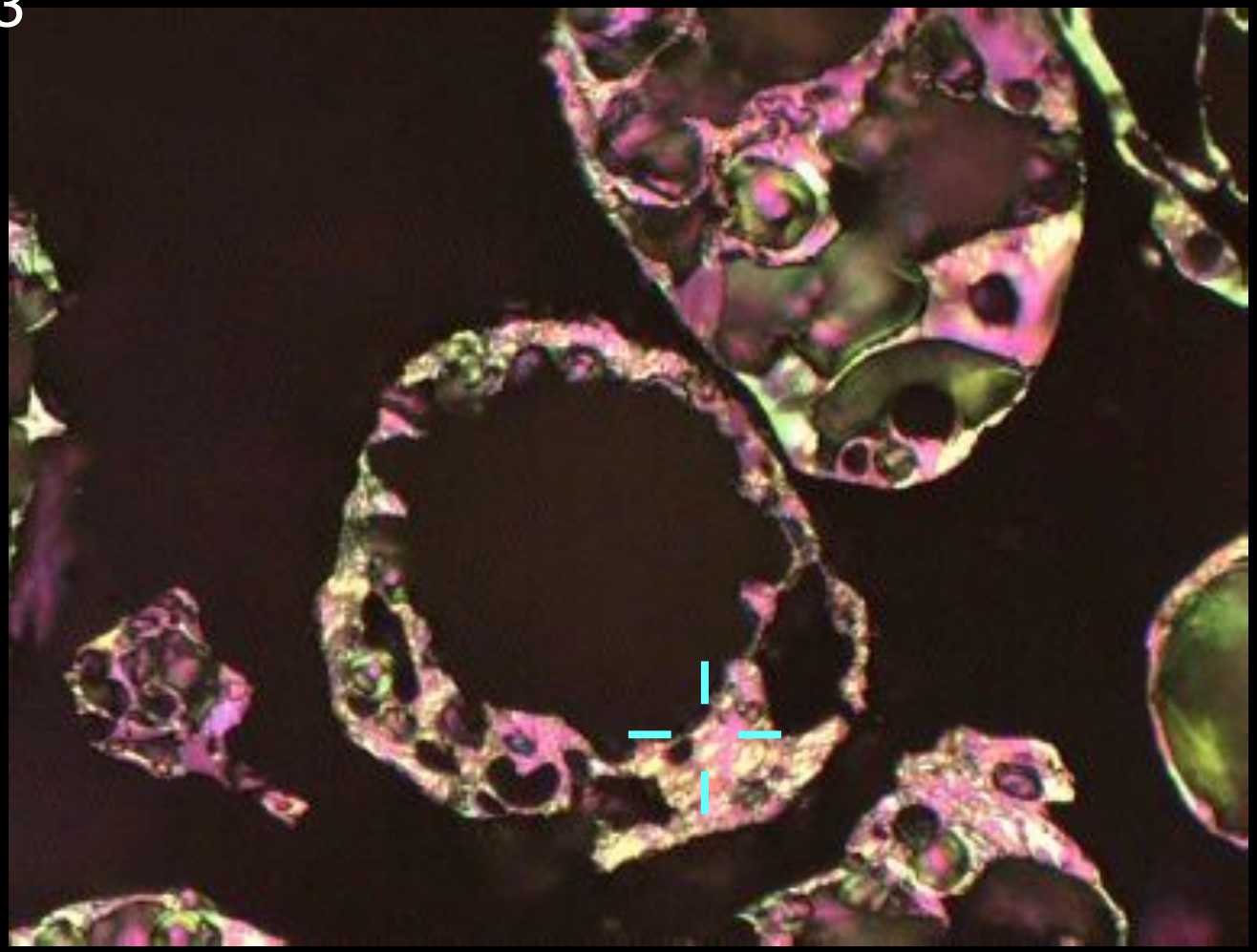
T1



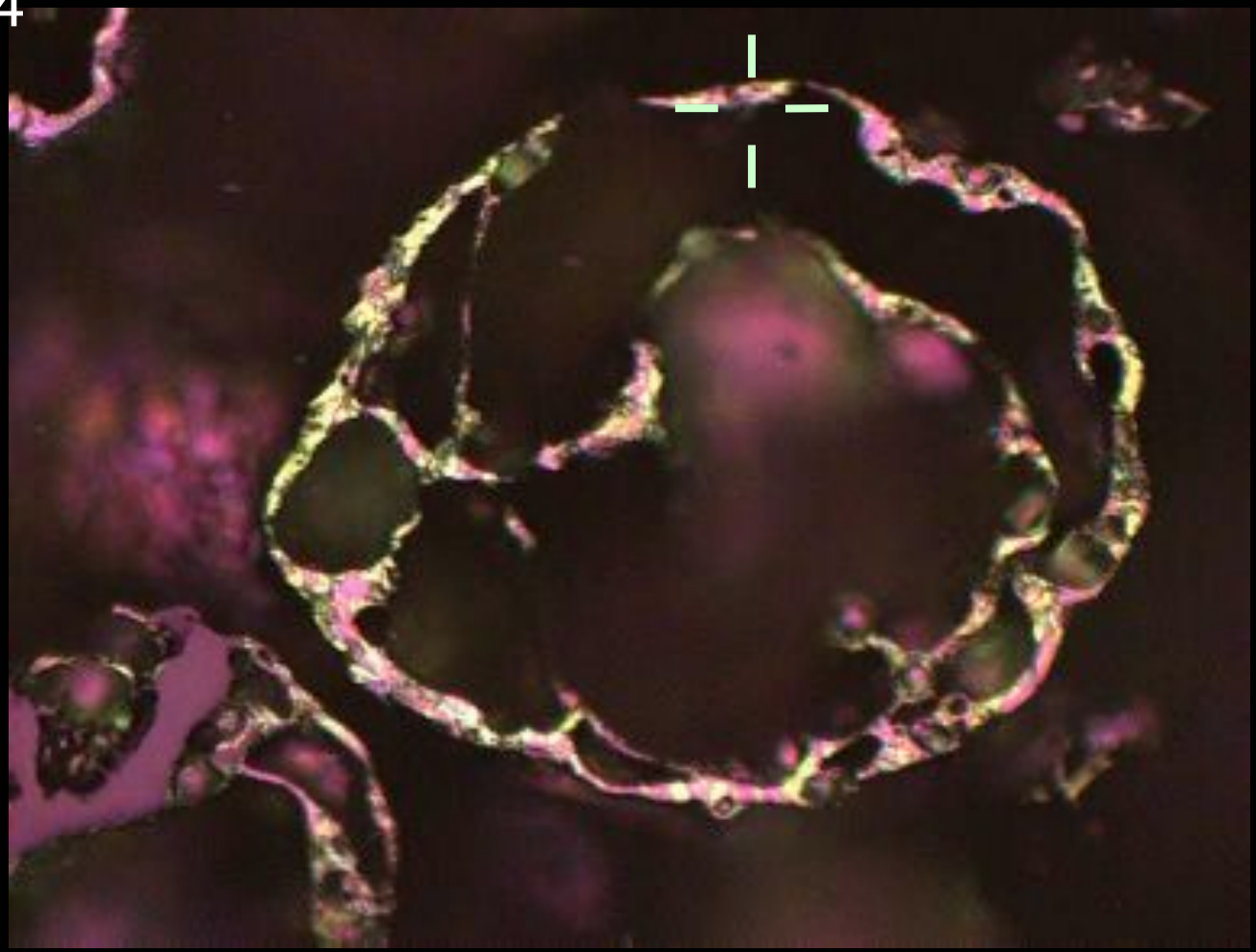
T2



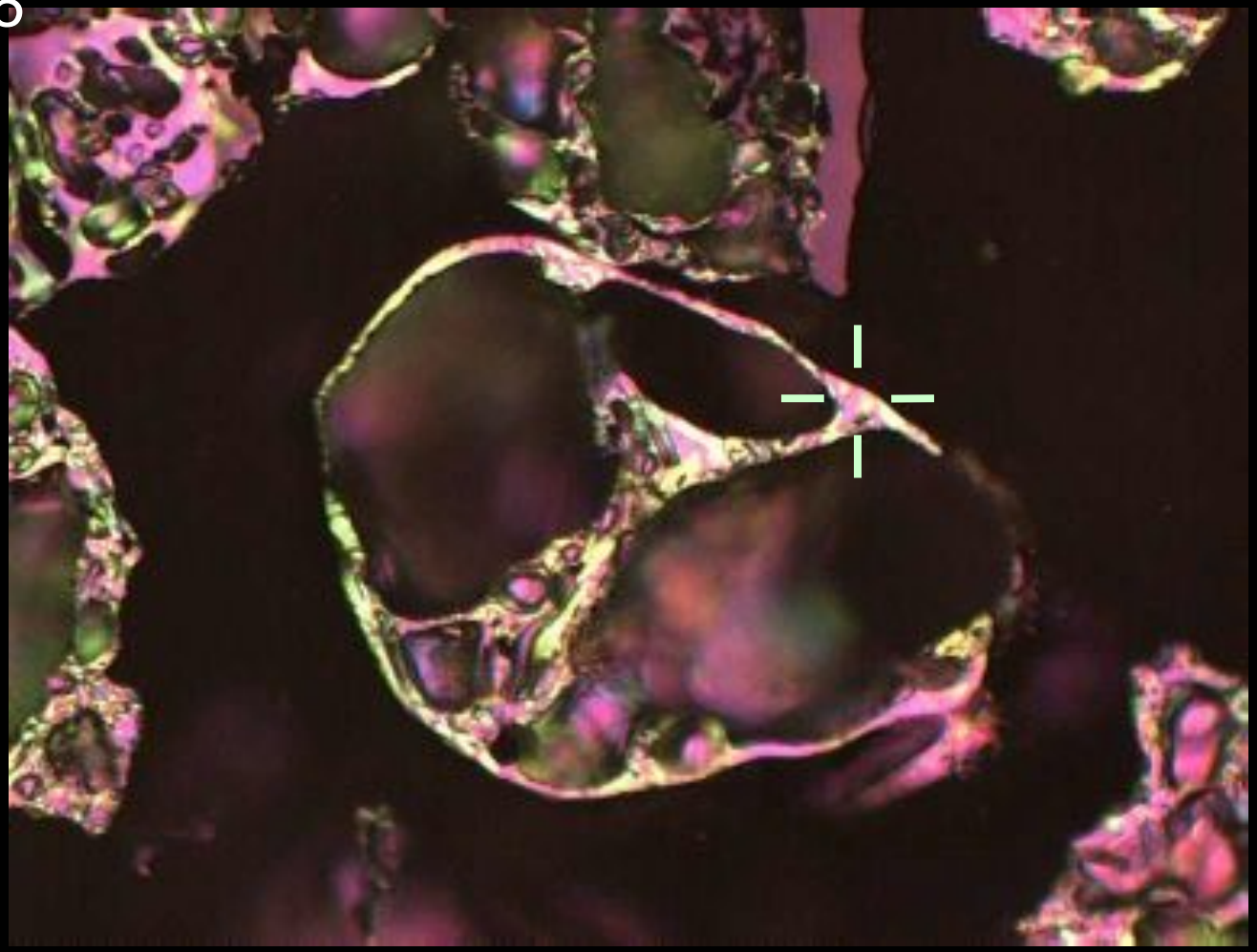
T3



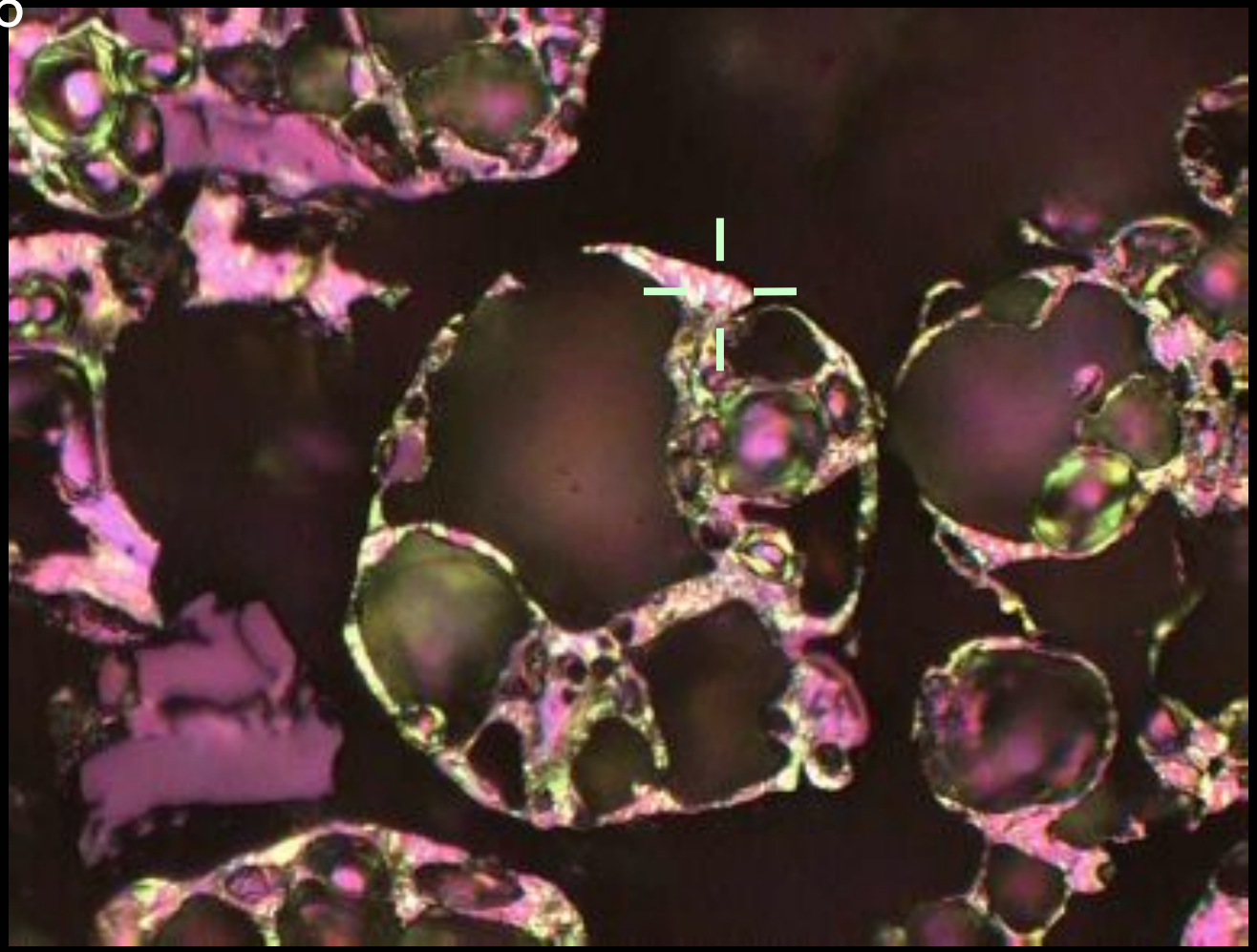
T4



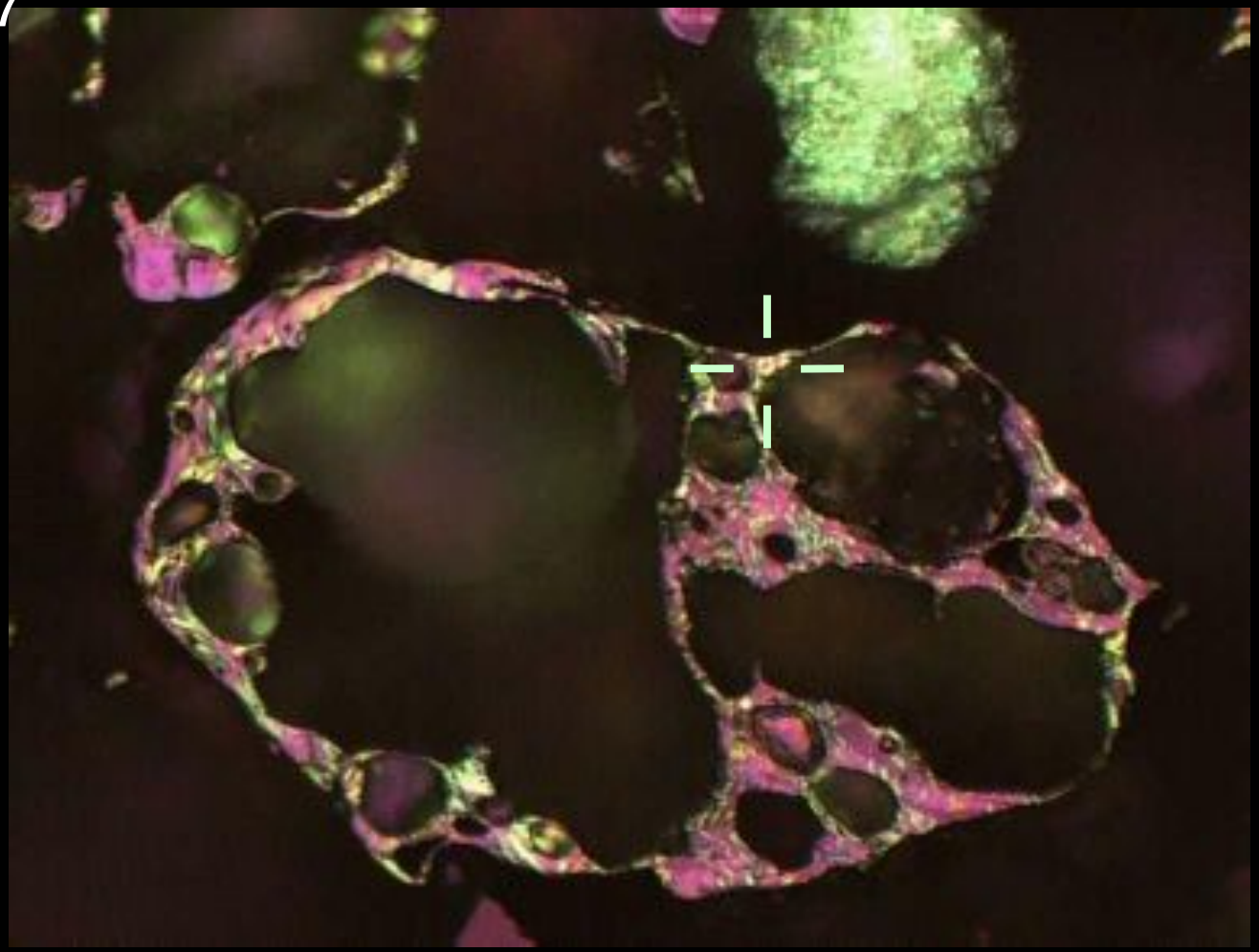
T5



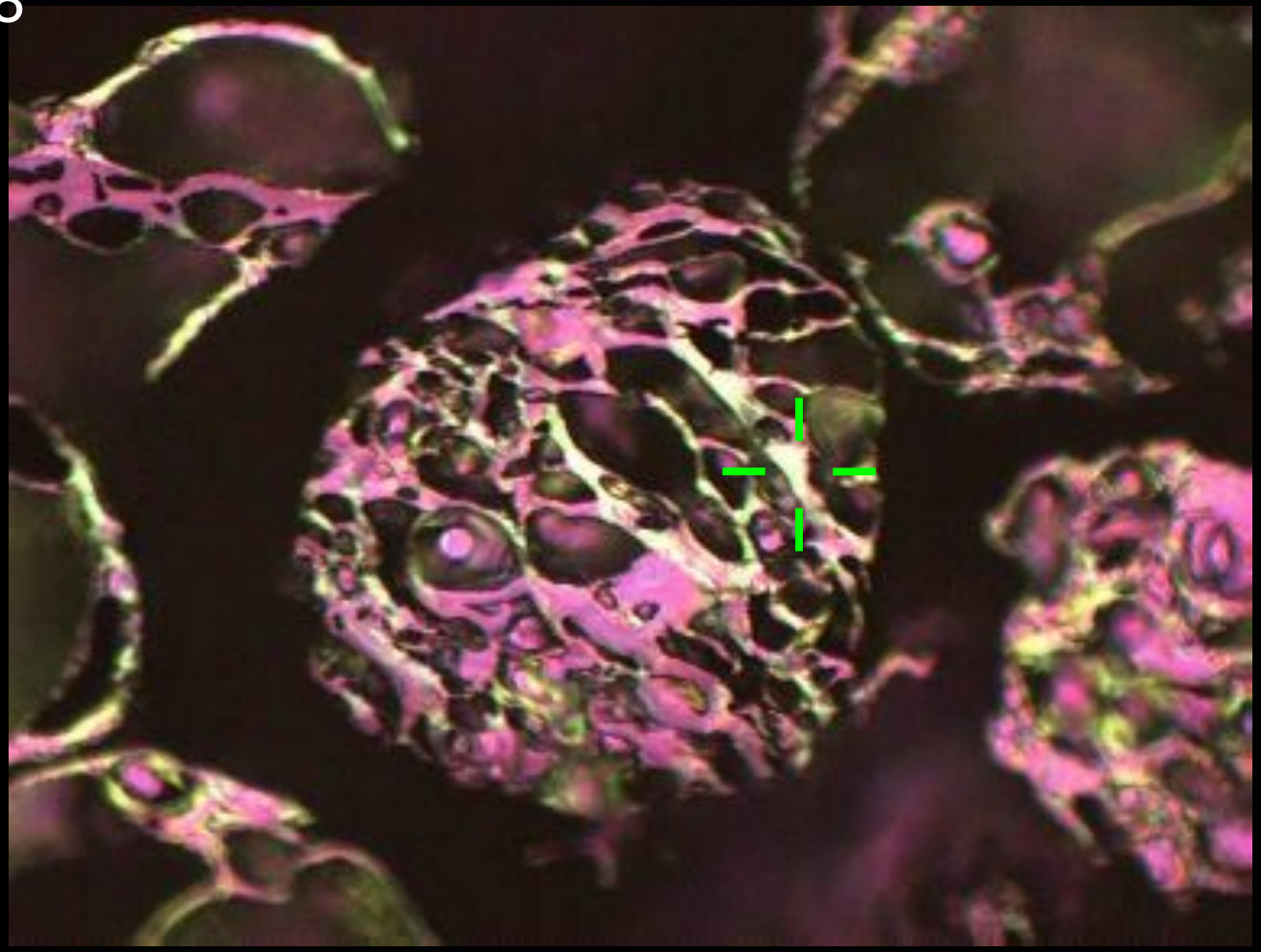
T6



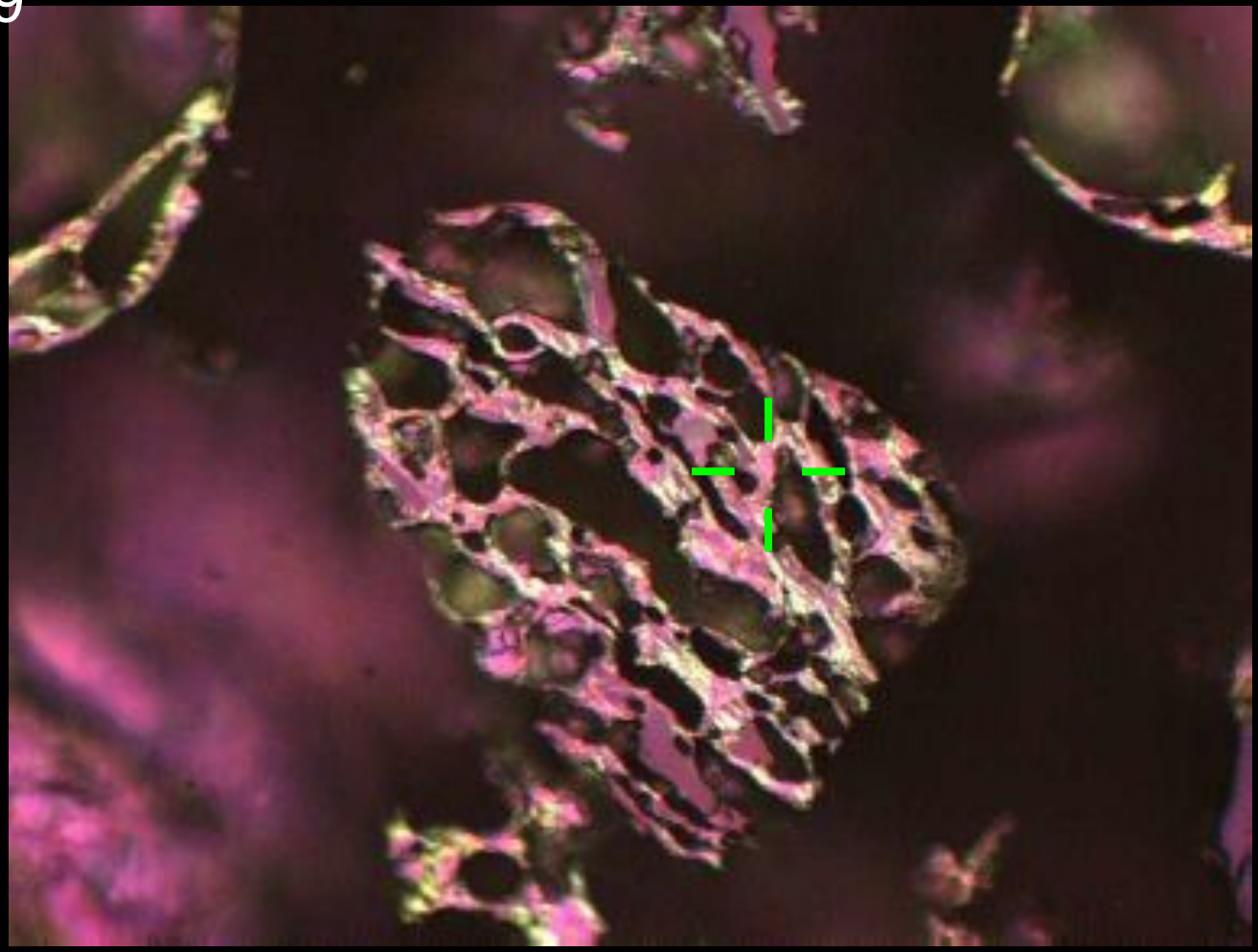
T7



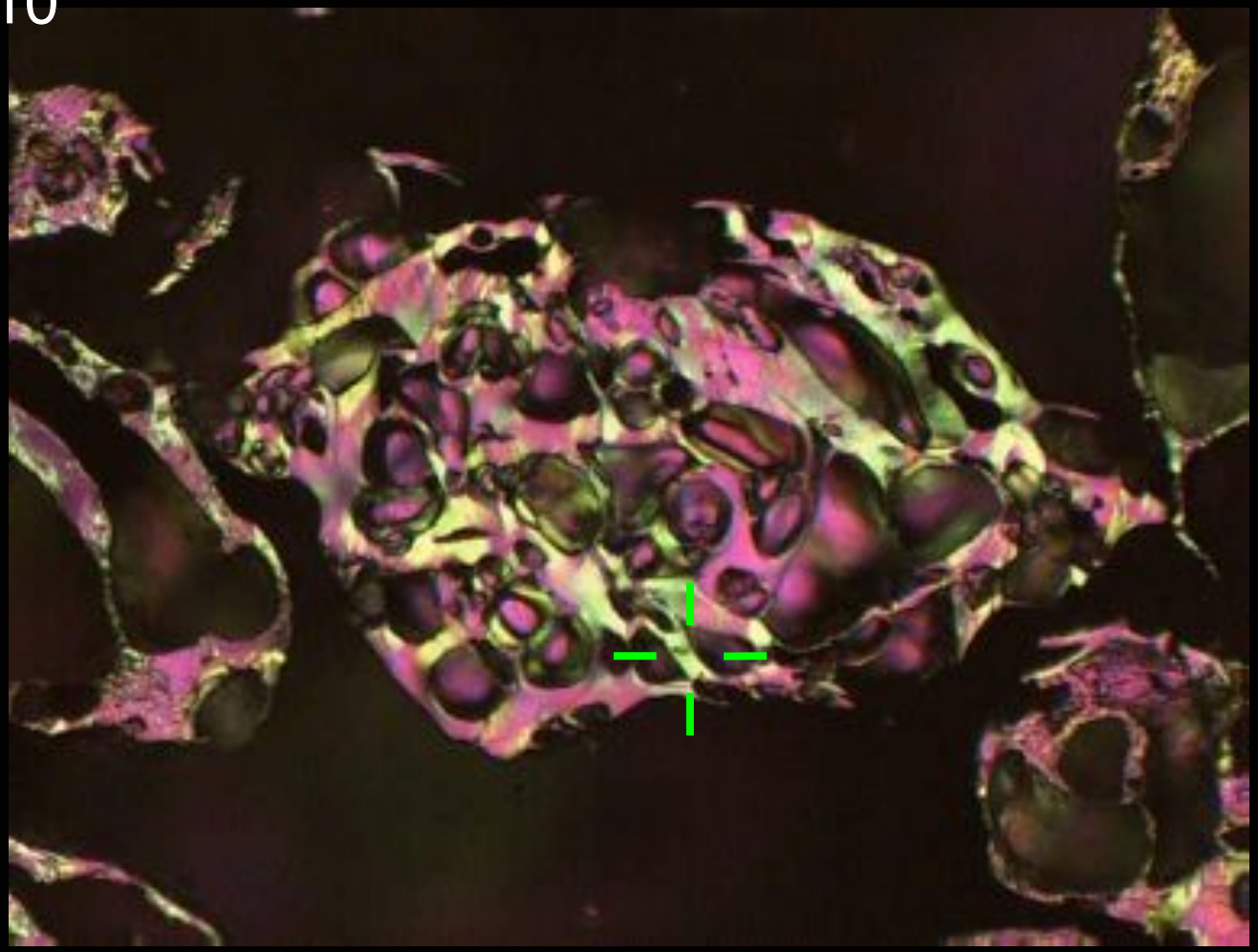
T8



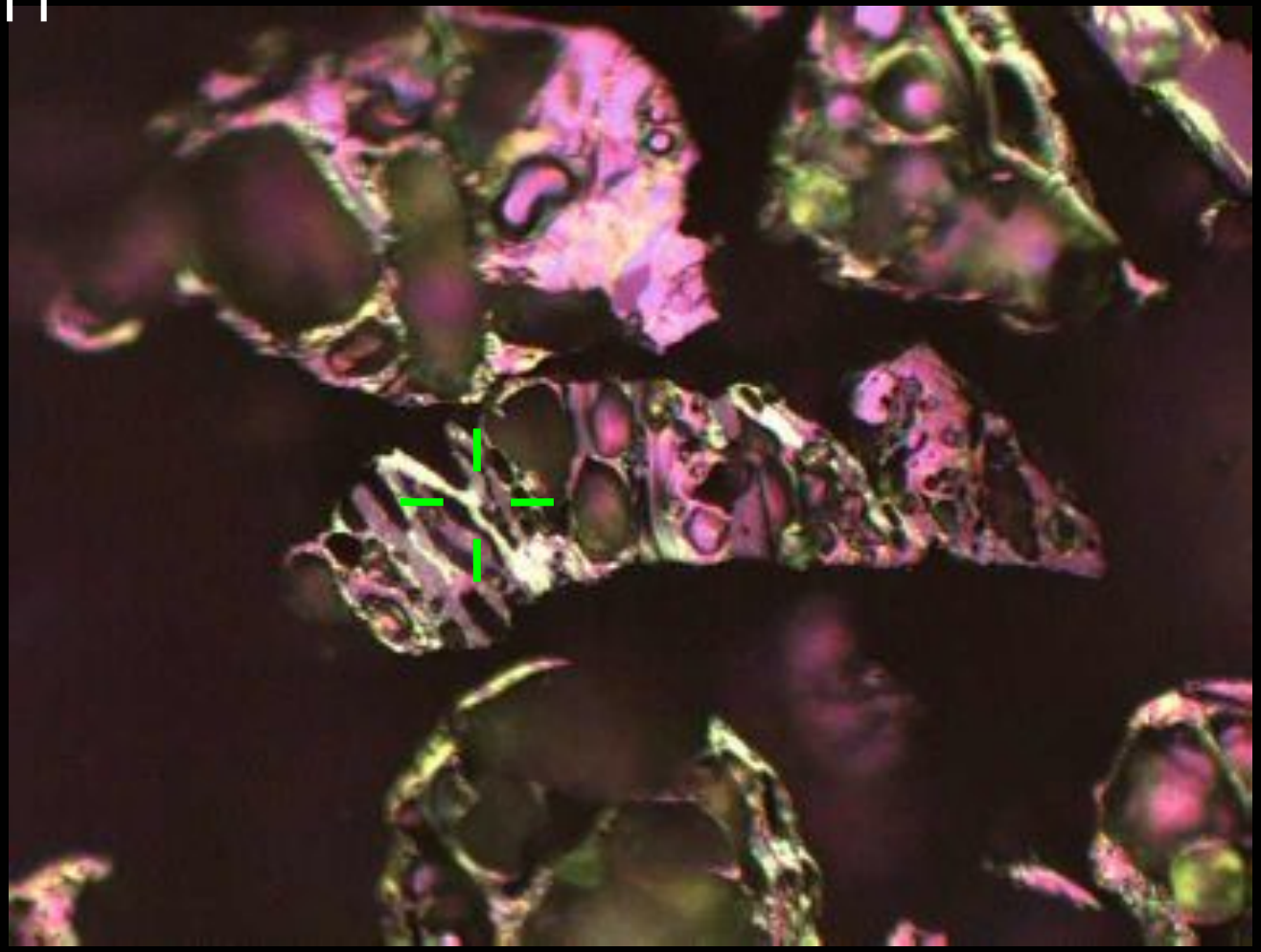
T9



T10

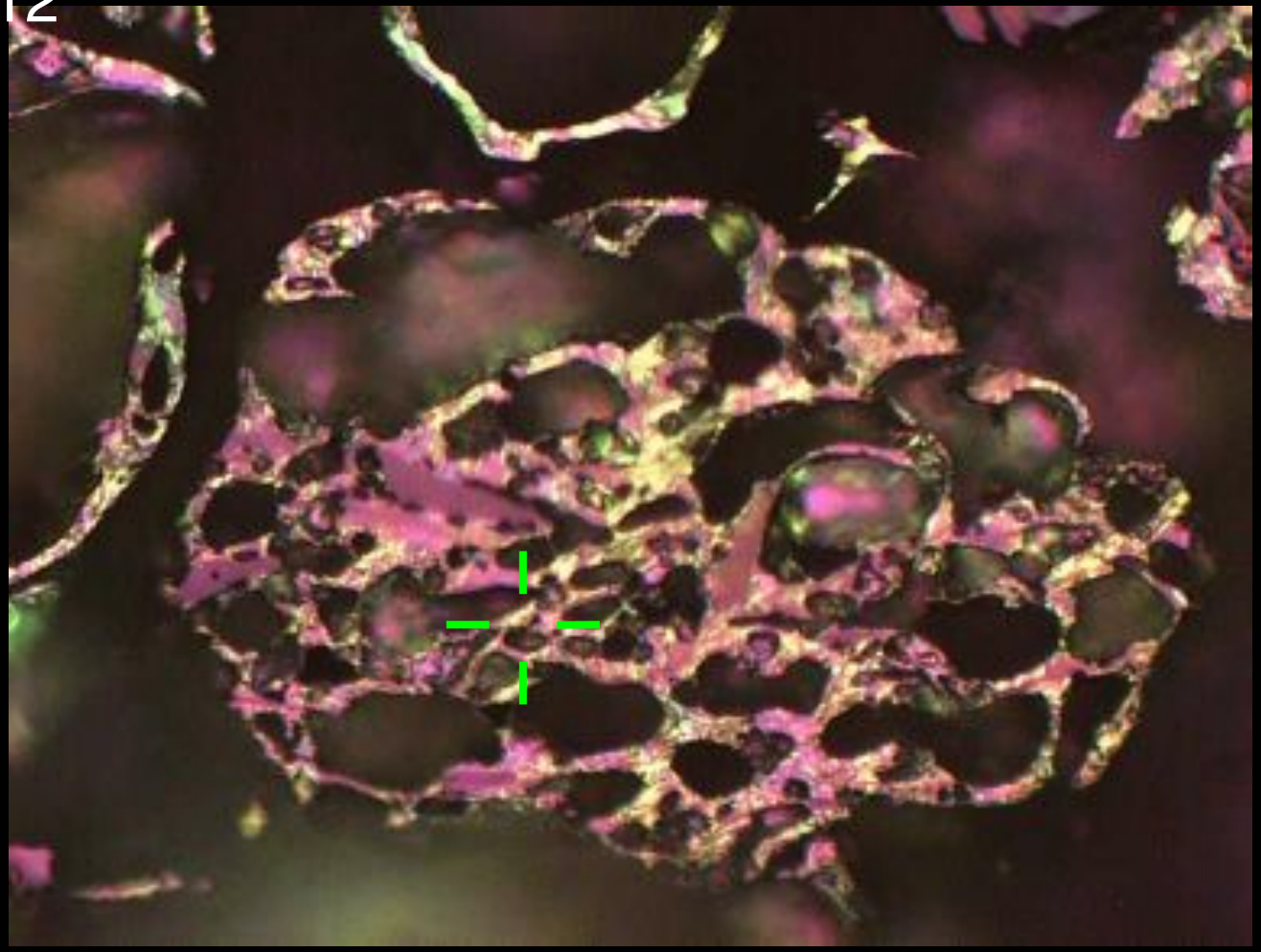


T11

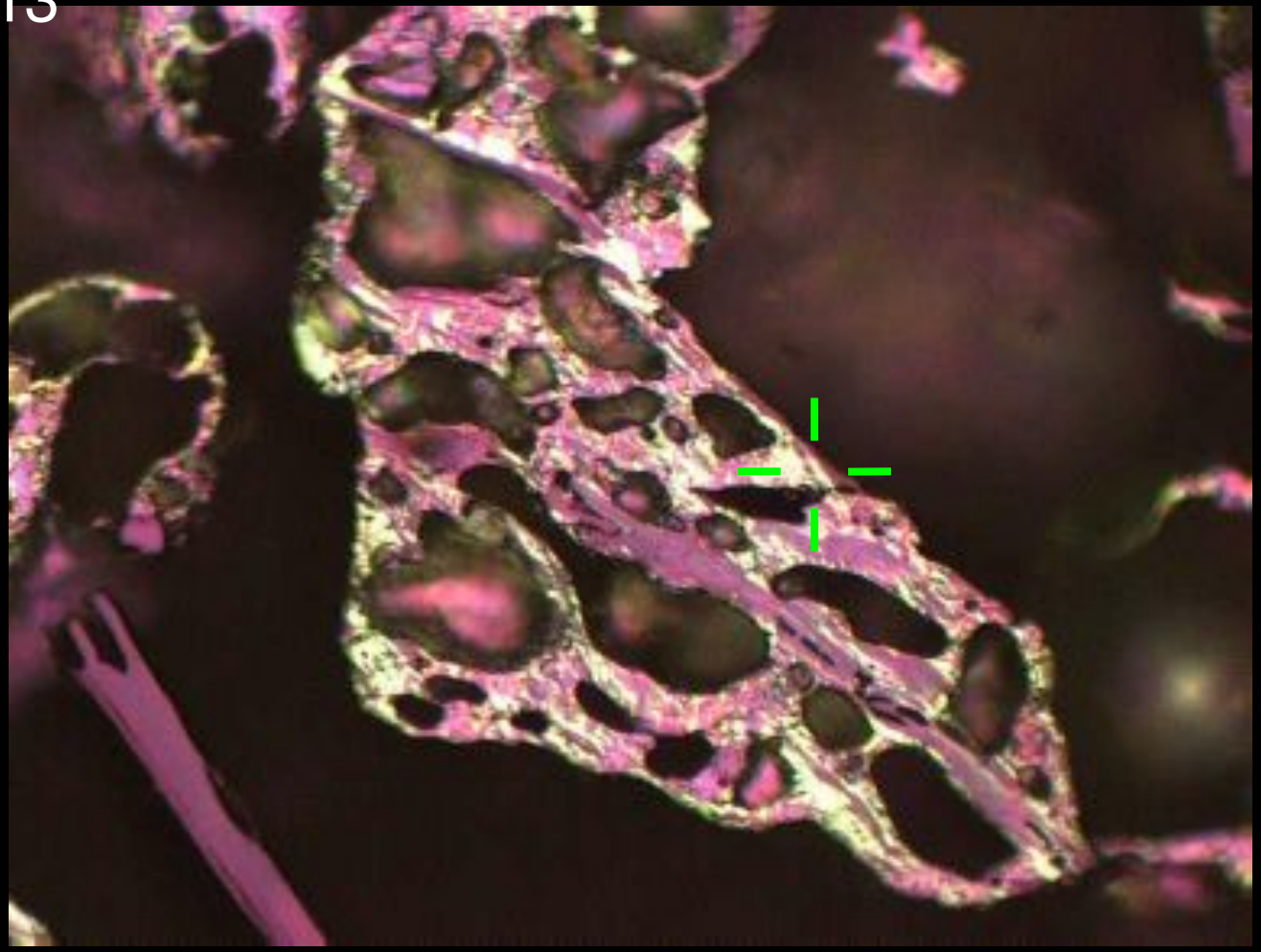


50 μm

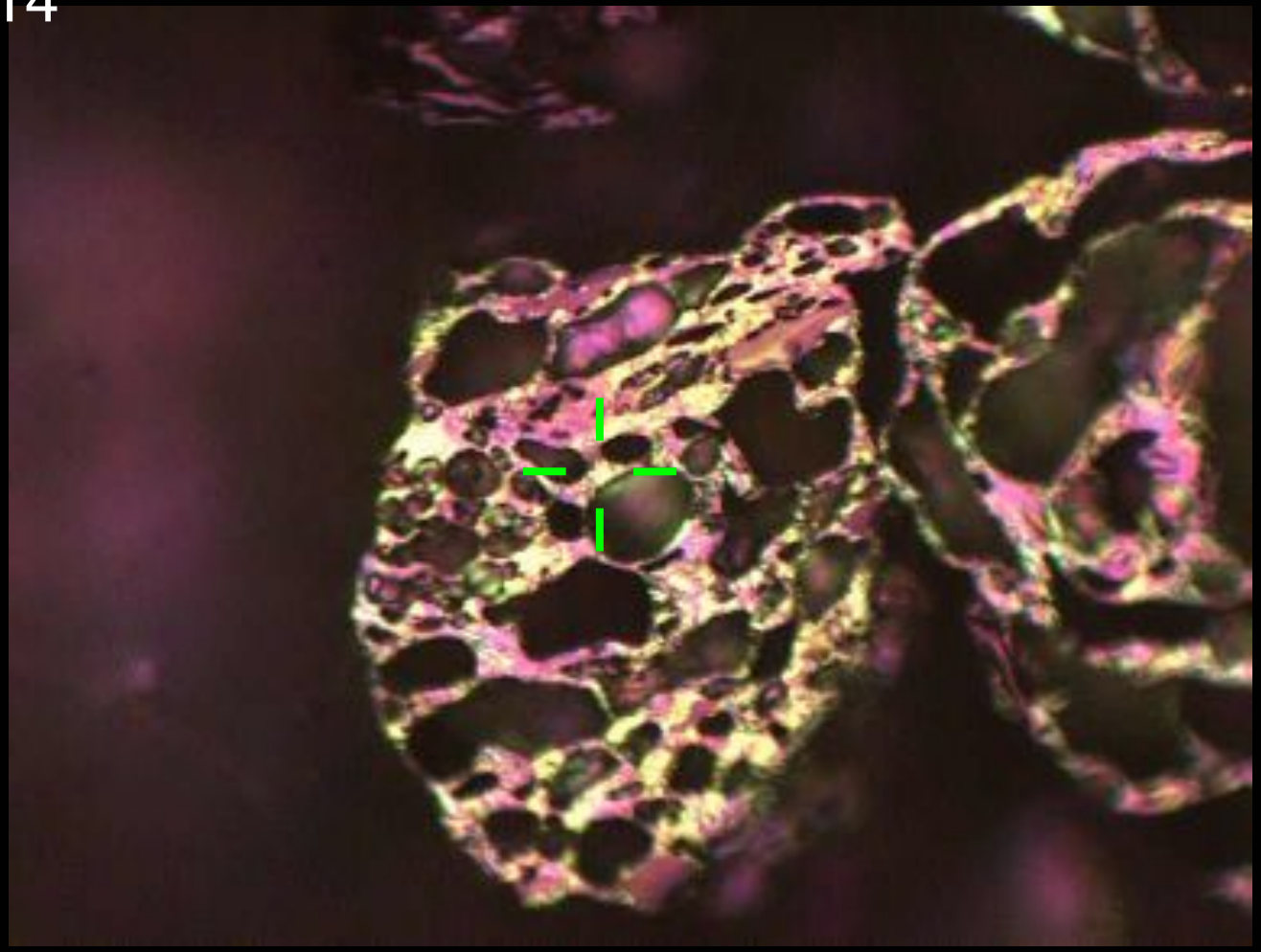
T12



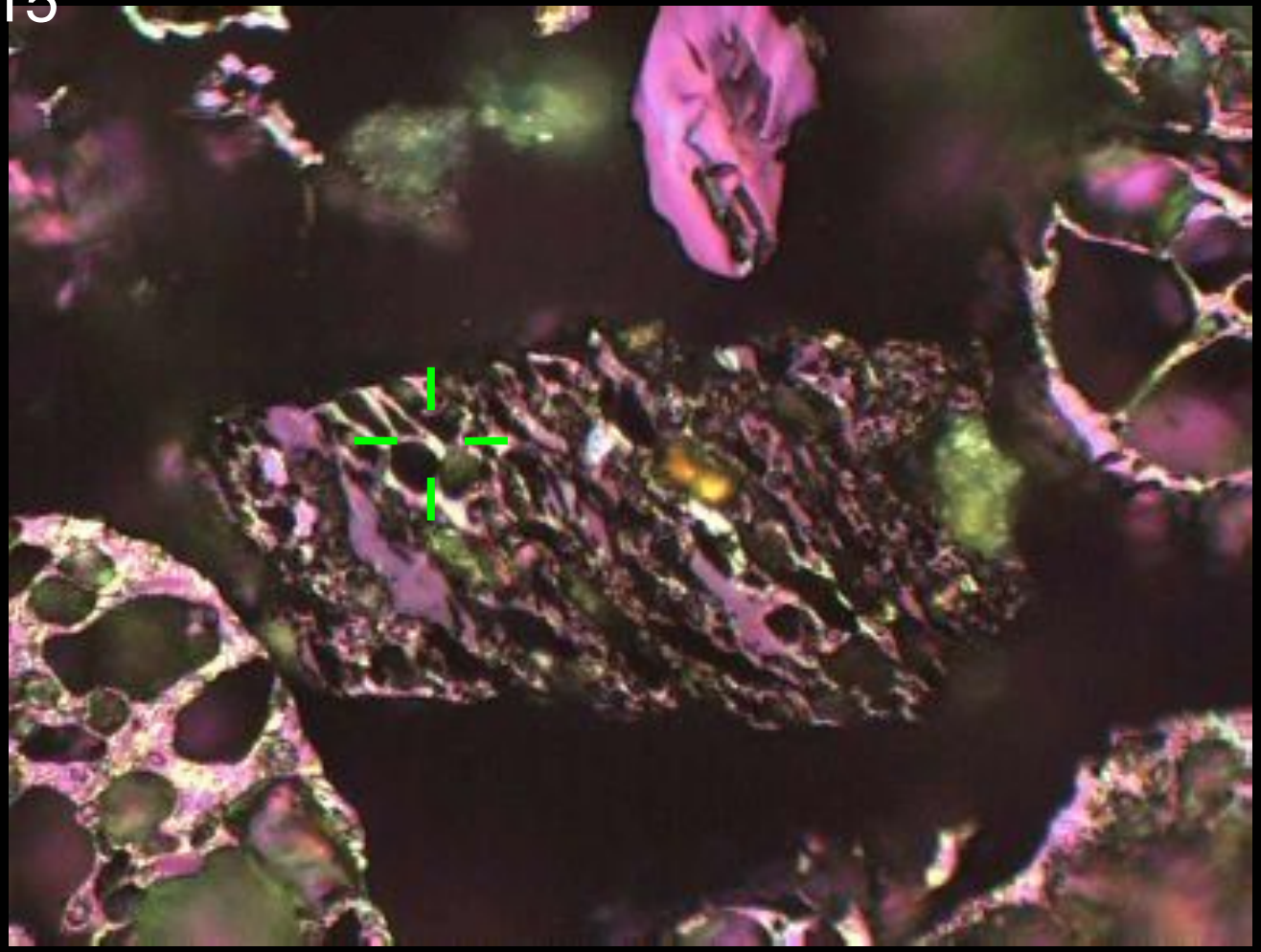
T13



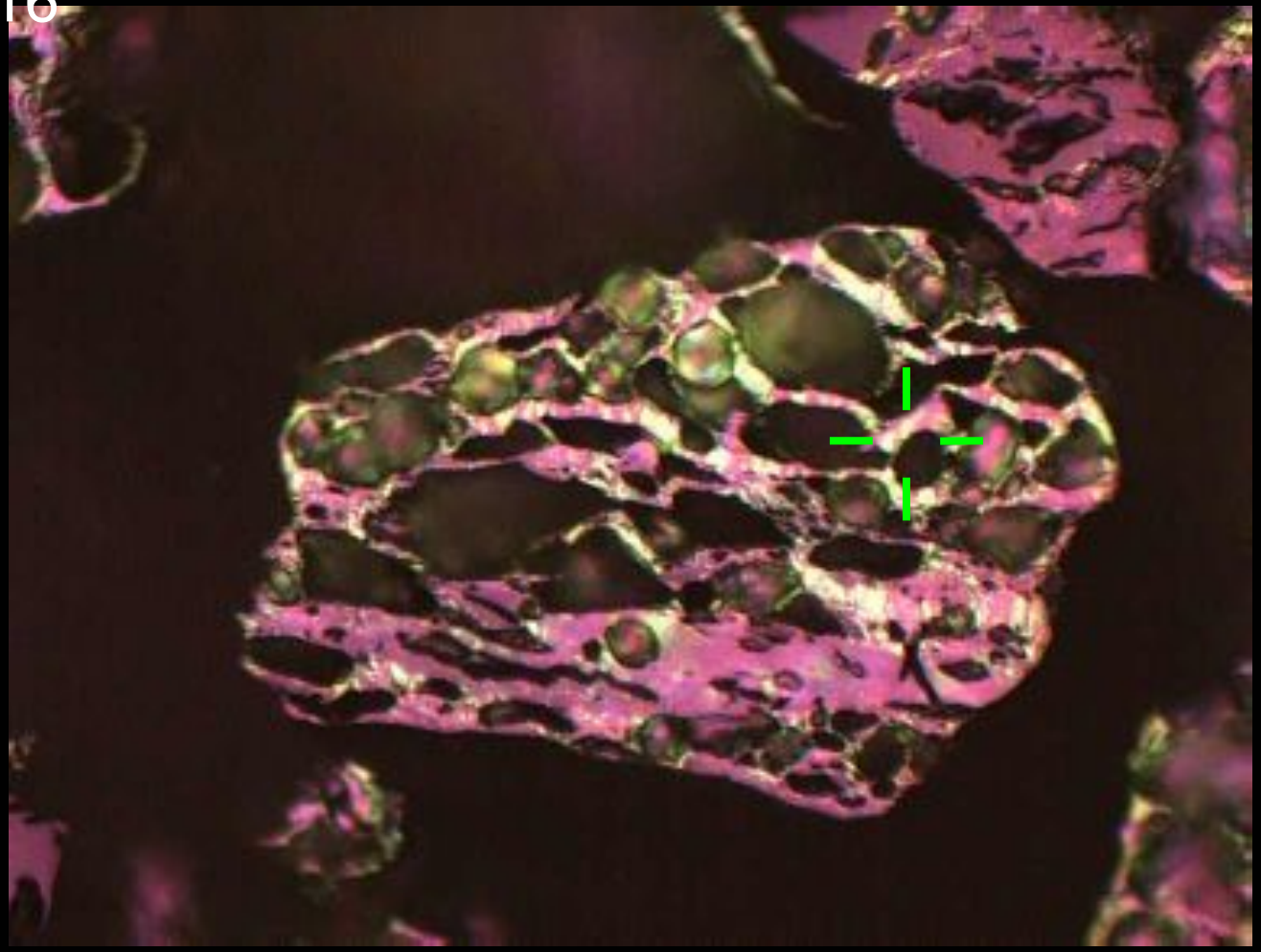
T14



T15



T16



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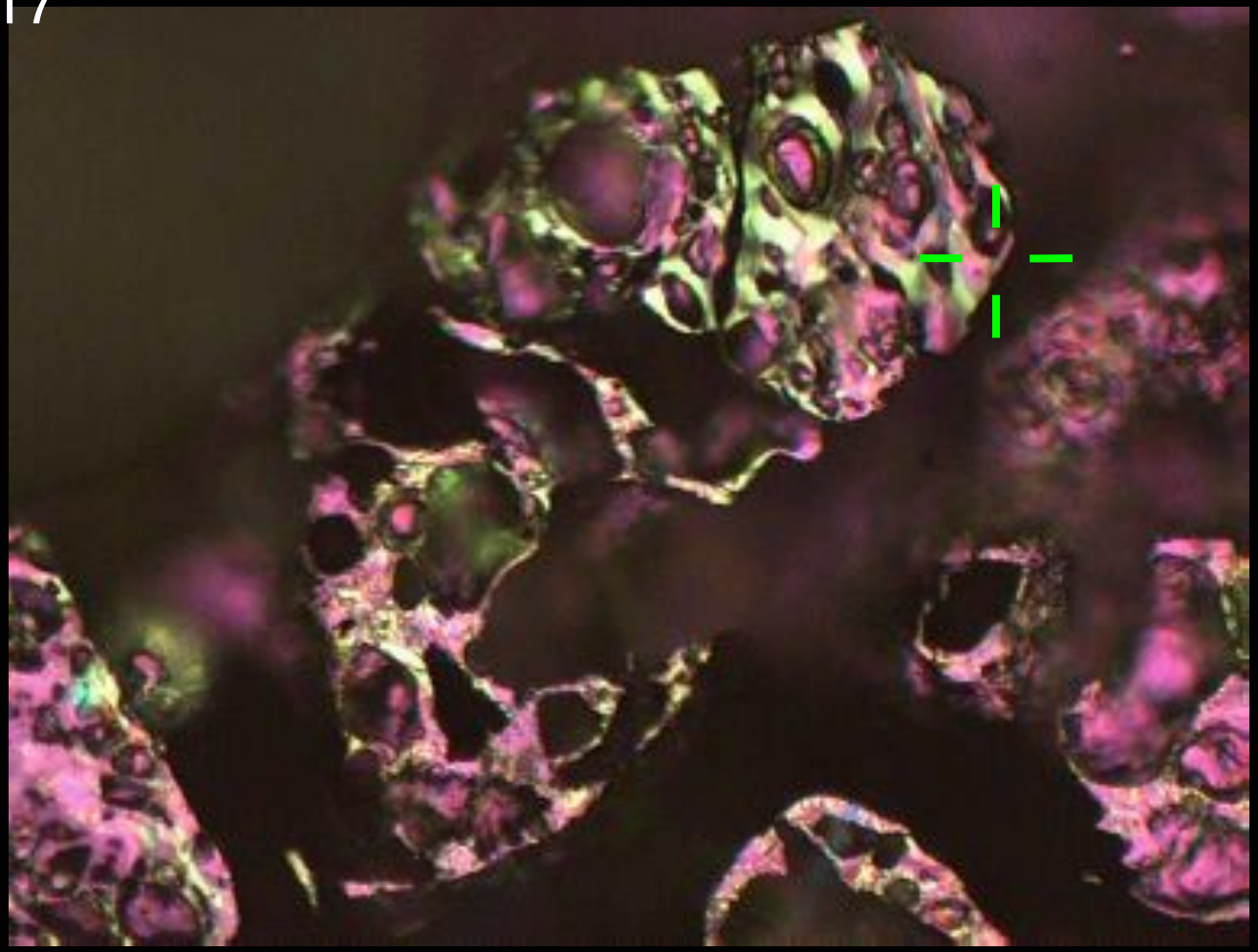

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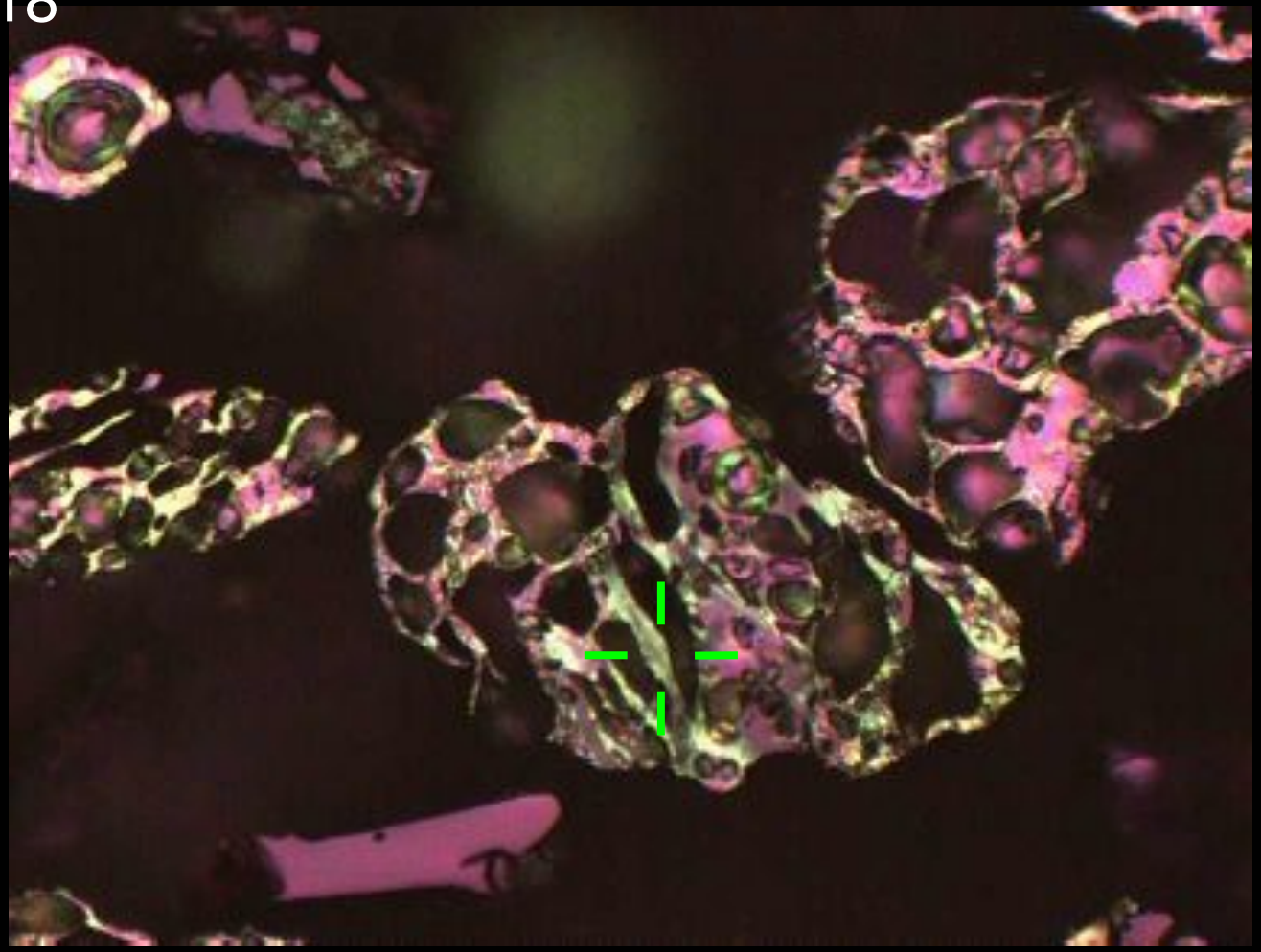

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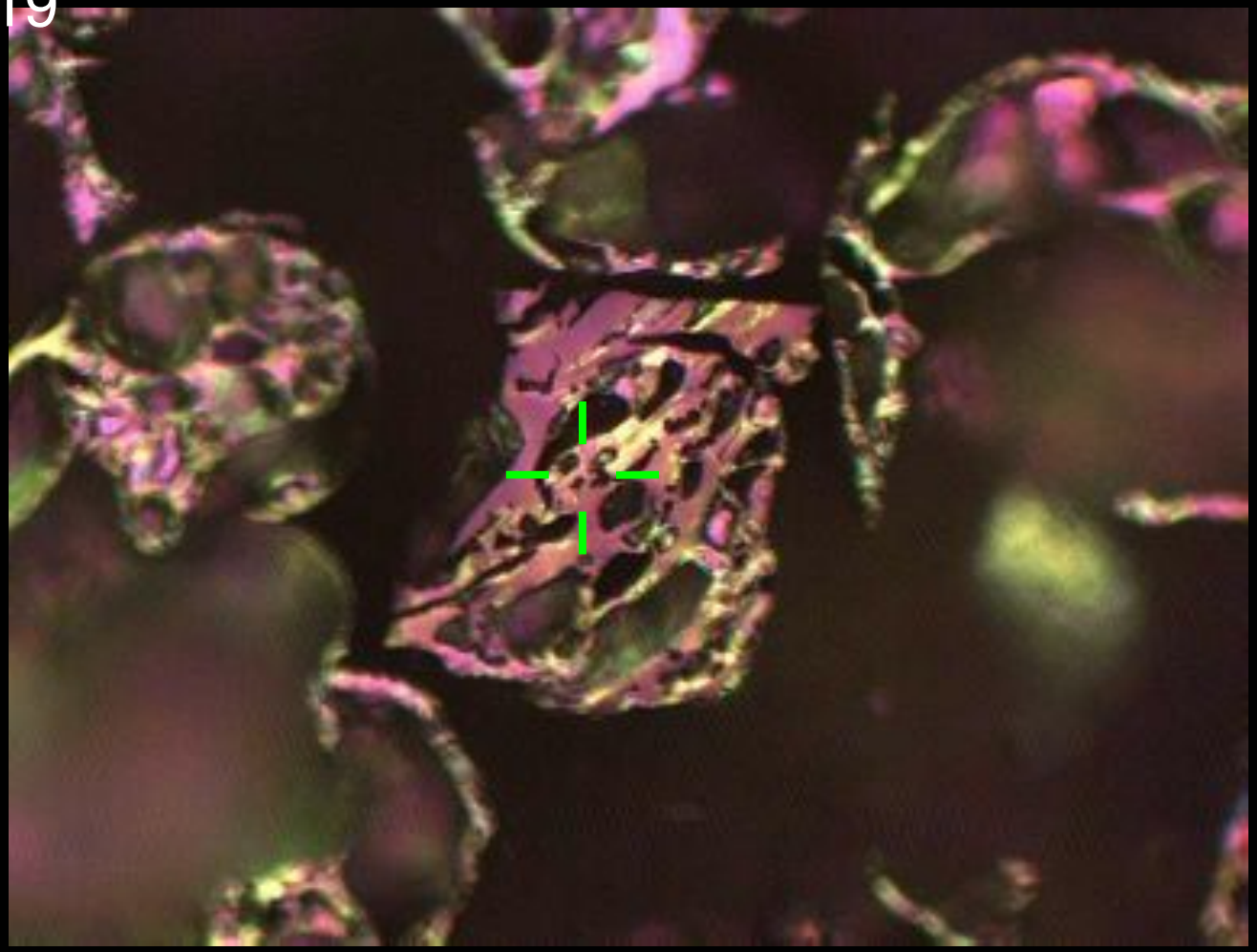

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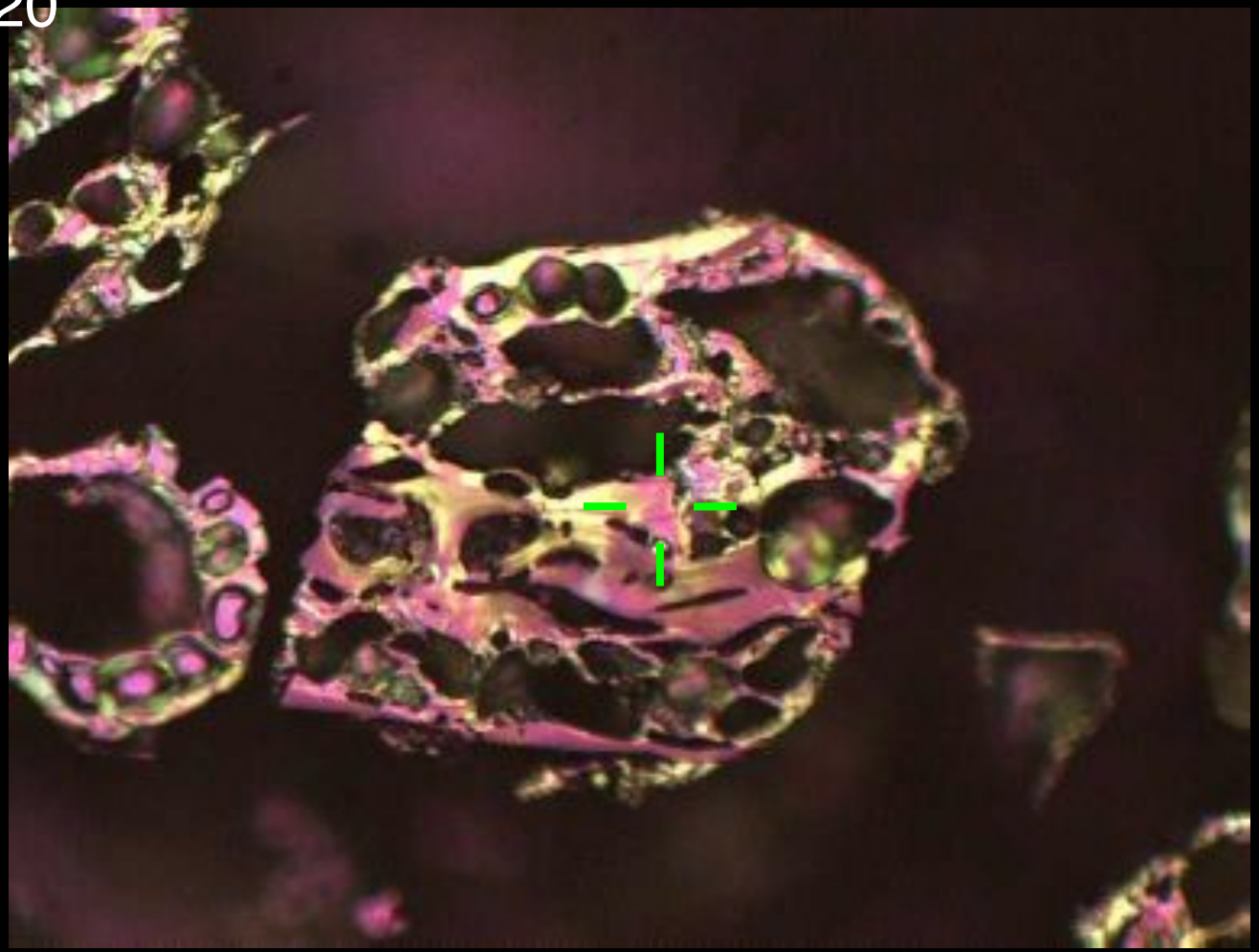

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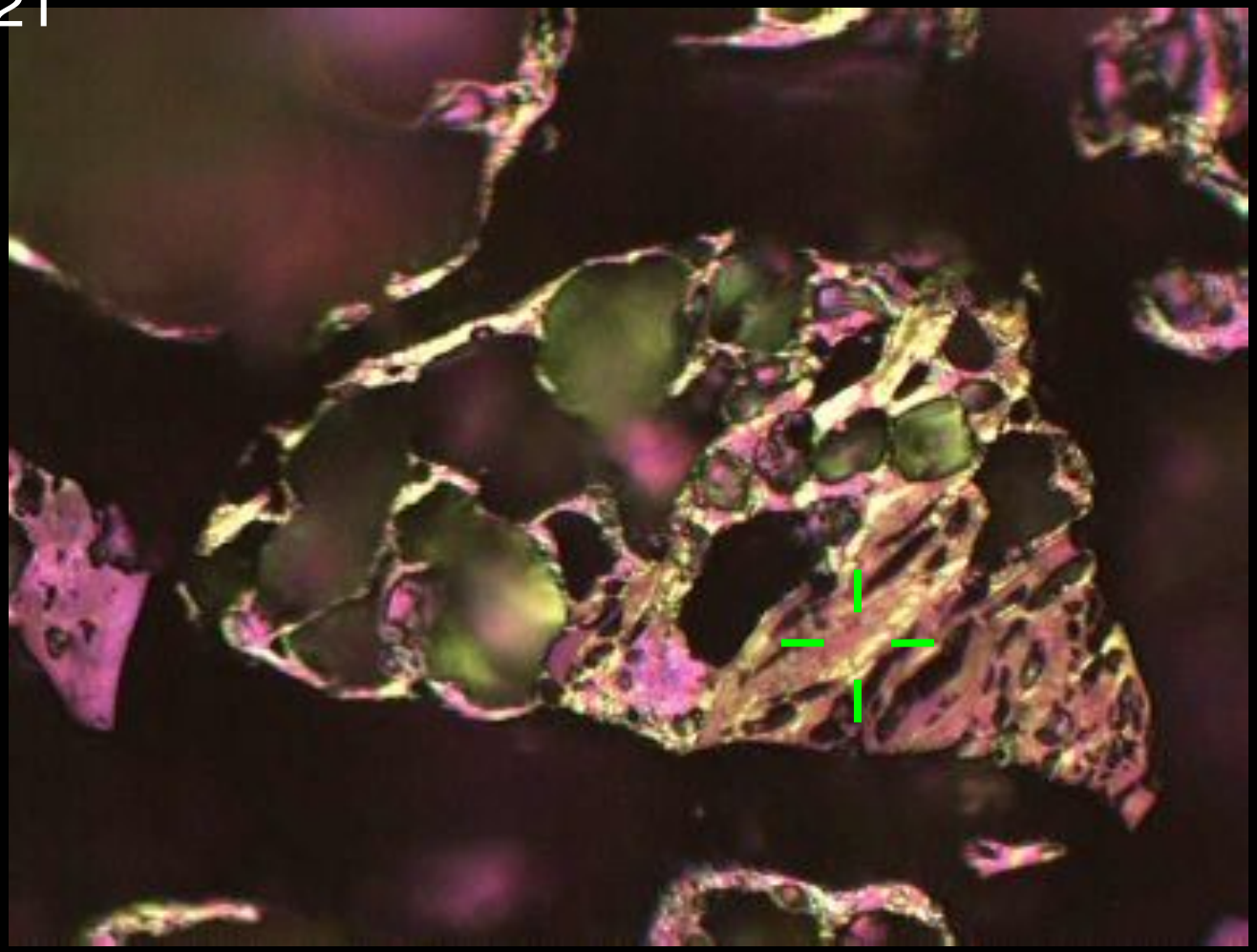
T21



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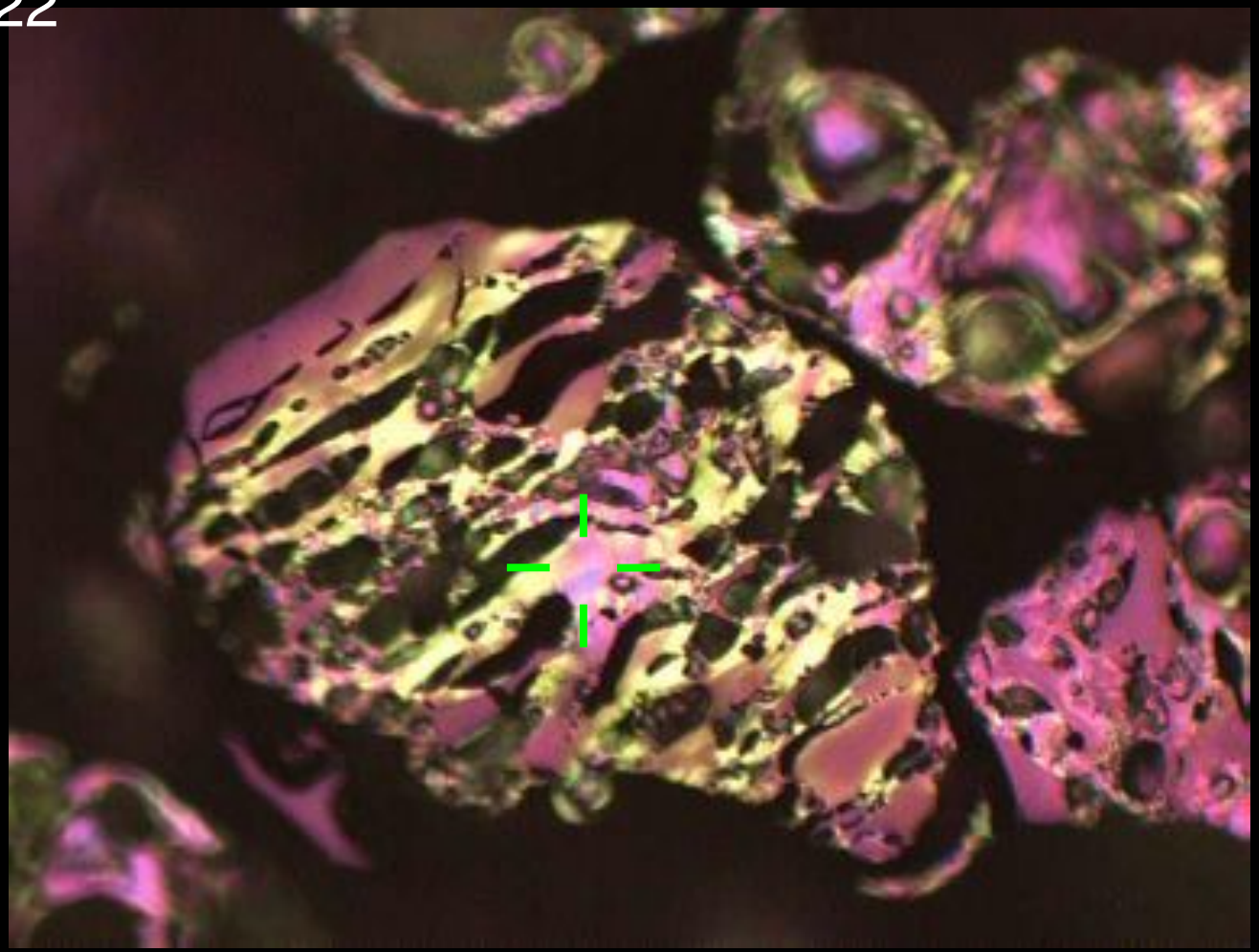

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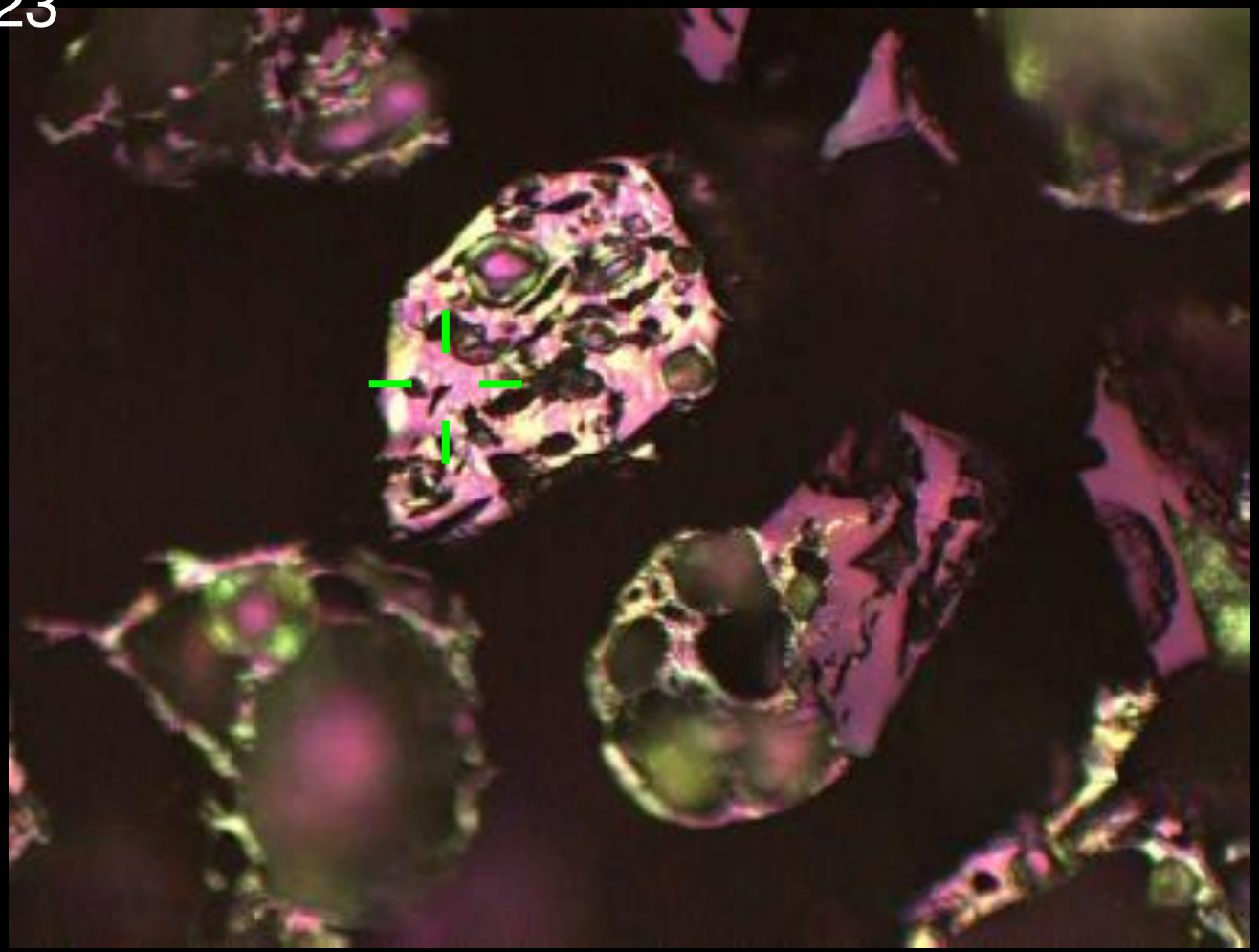

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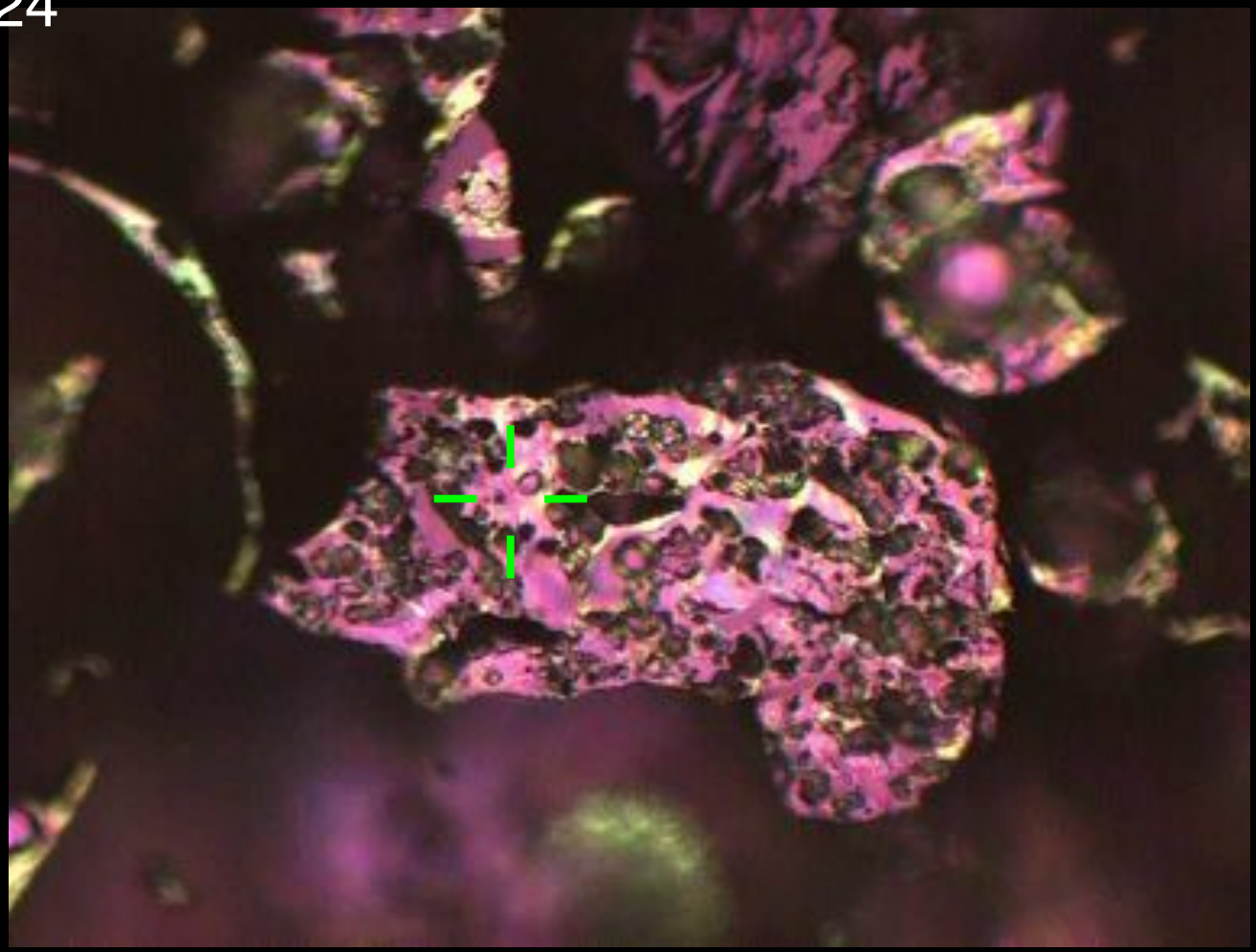

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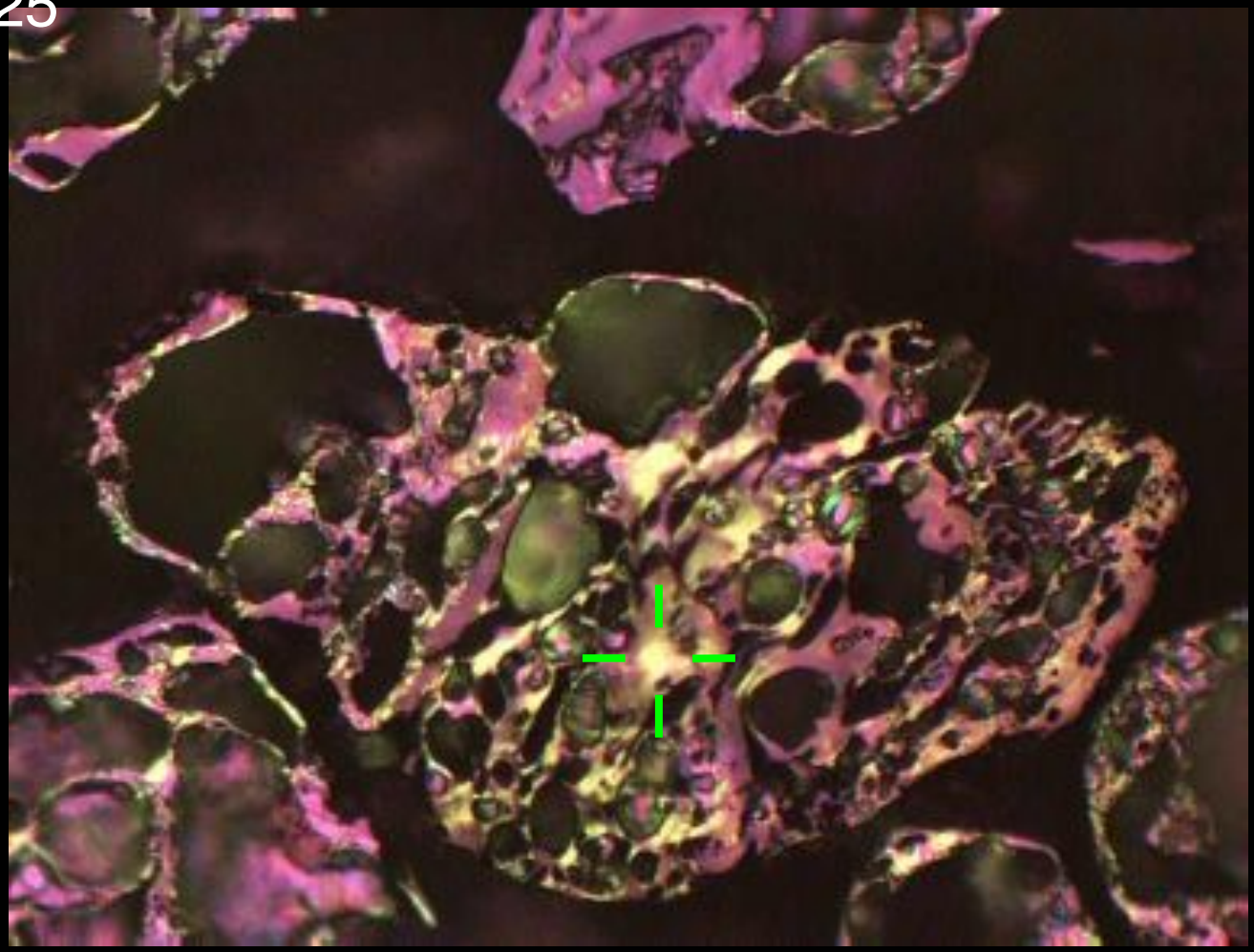
T25



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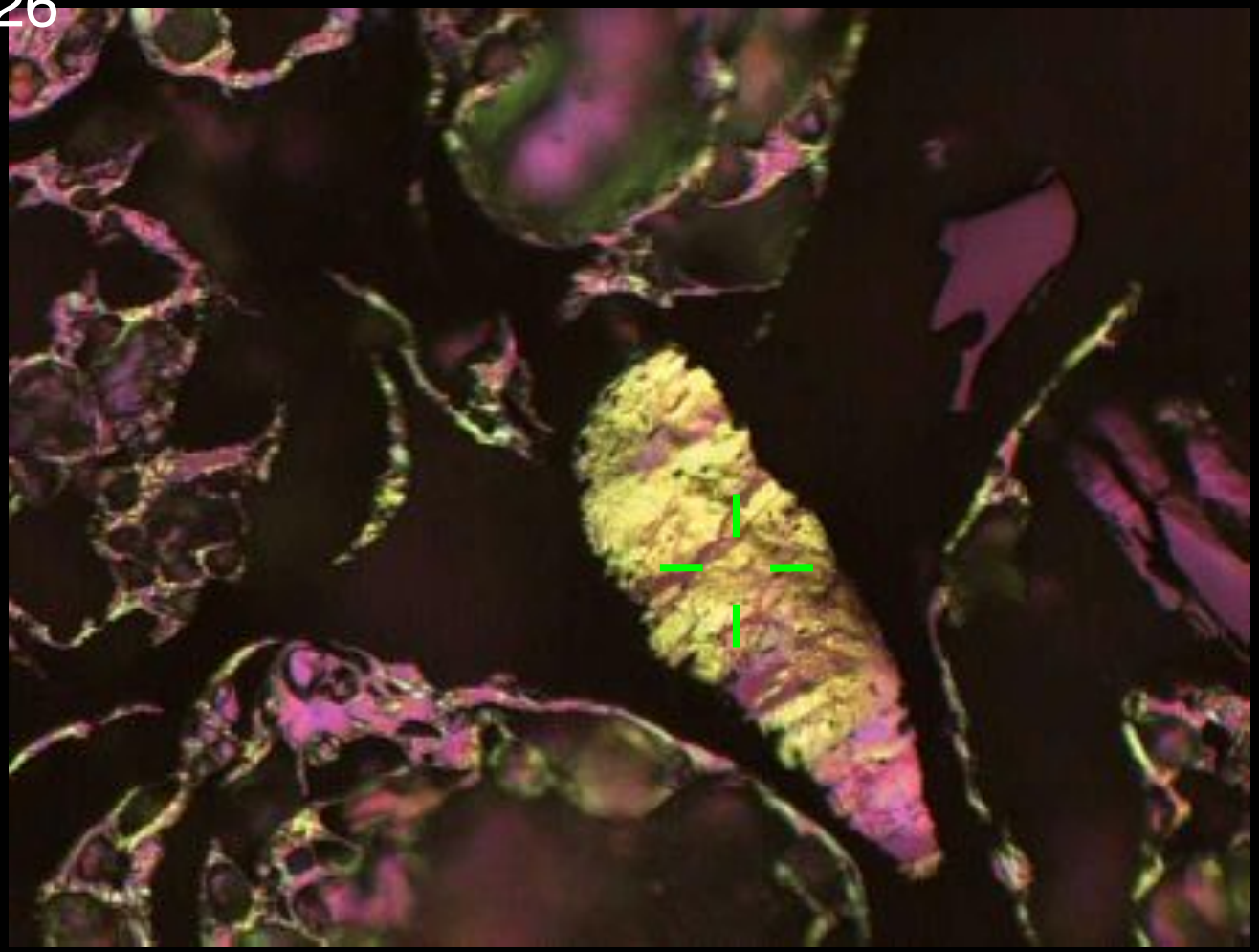
T26



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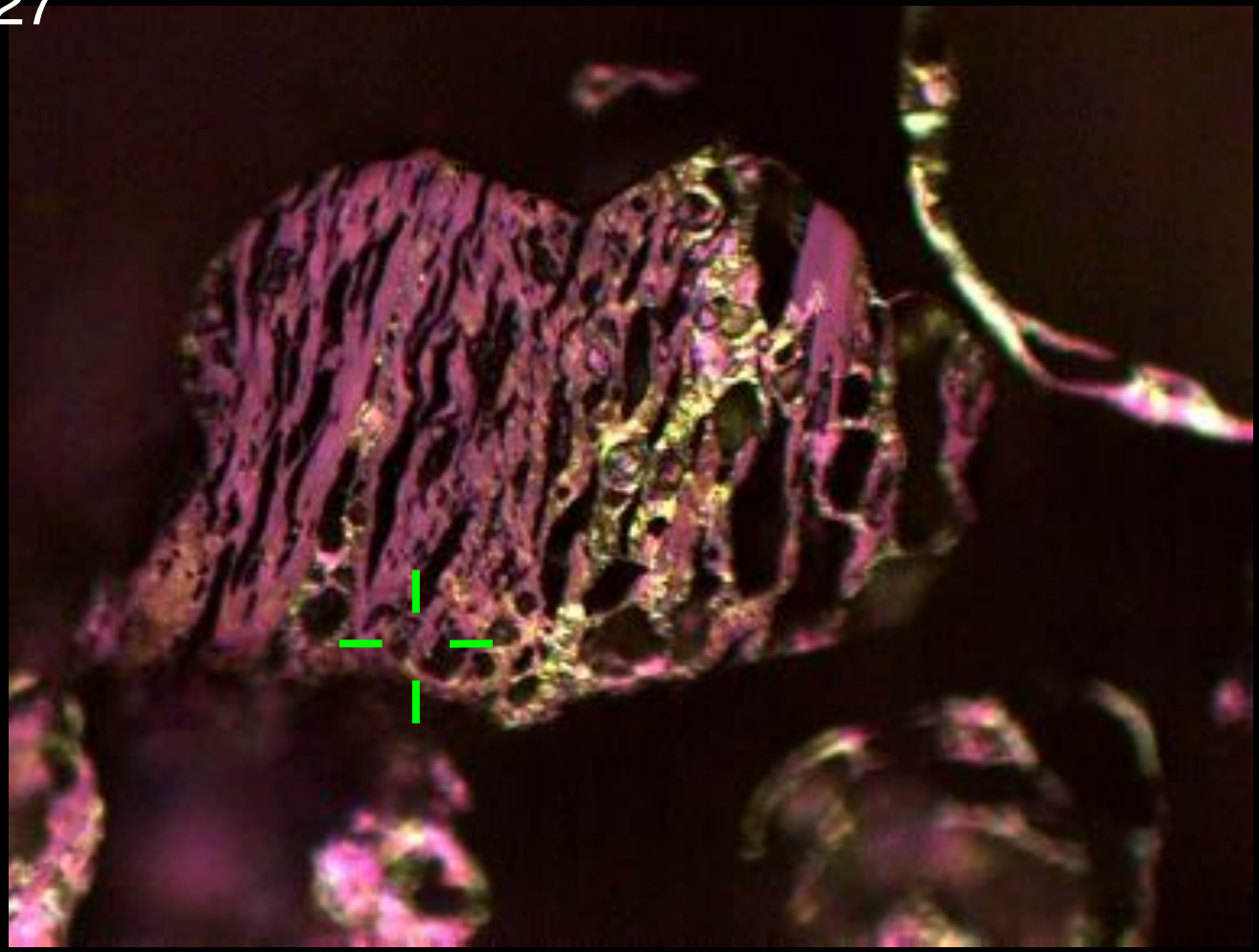
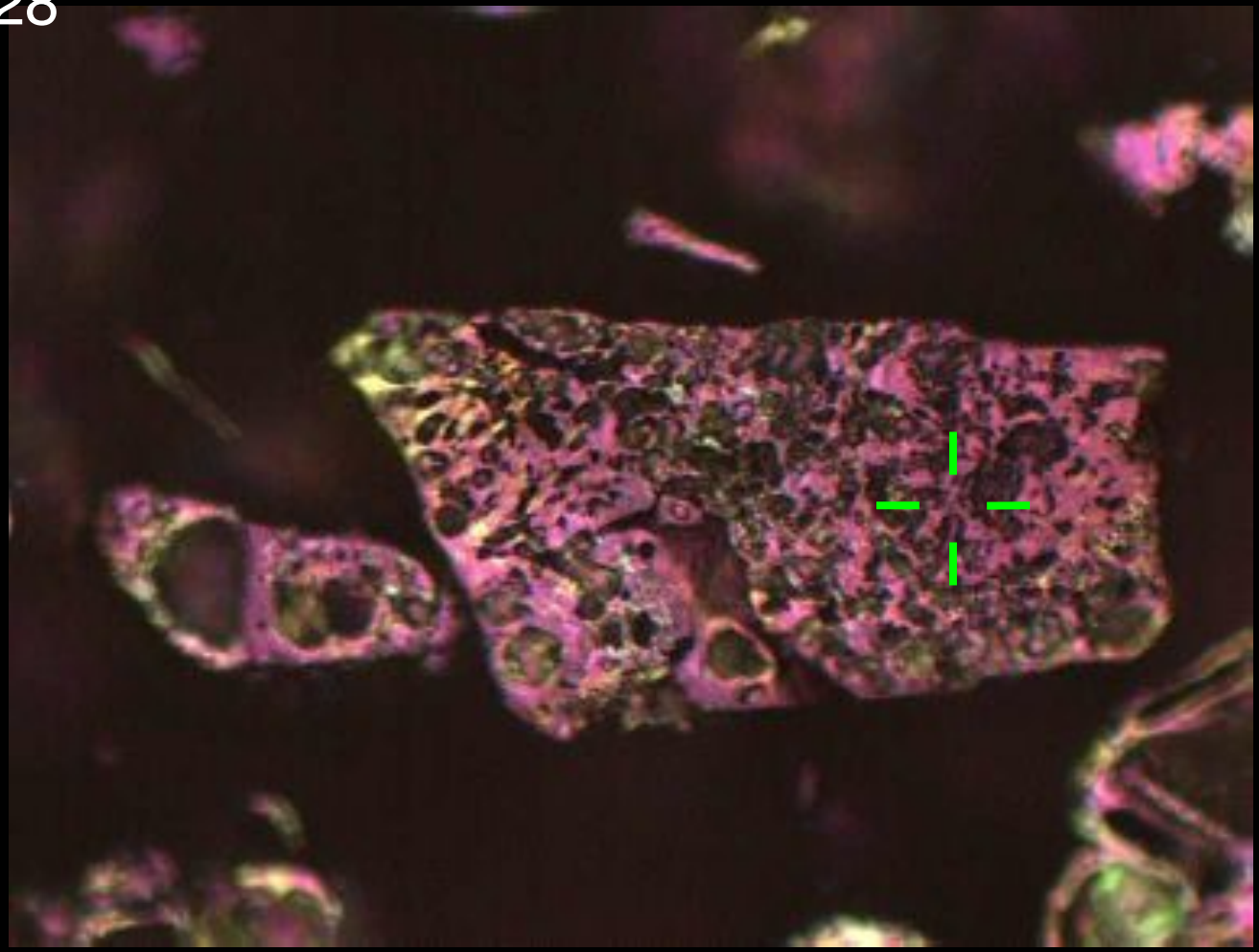
T27



T28



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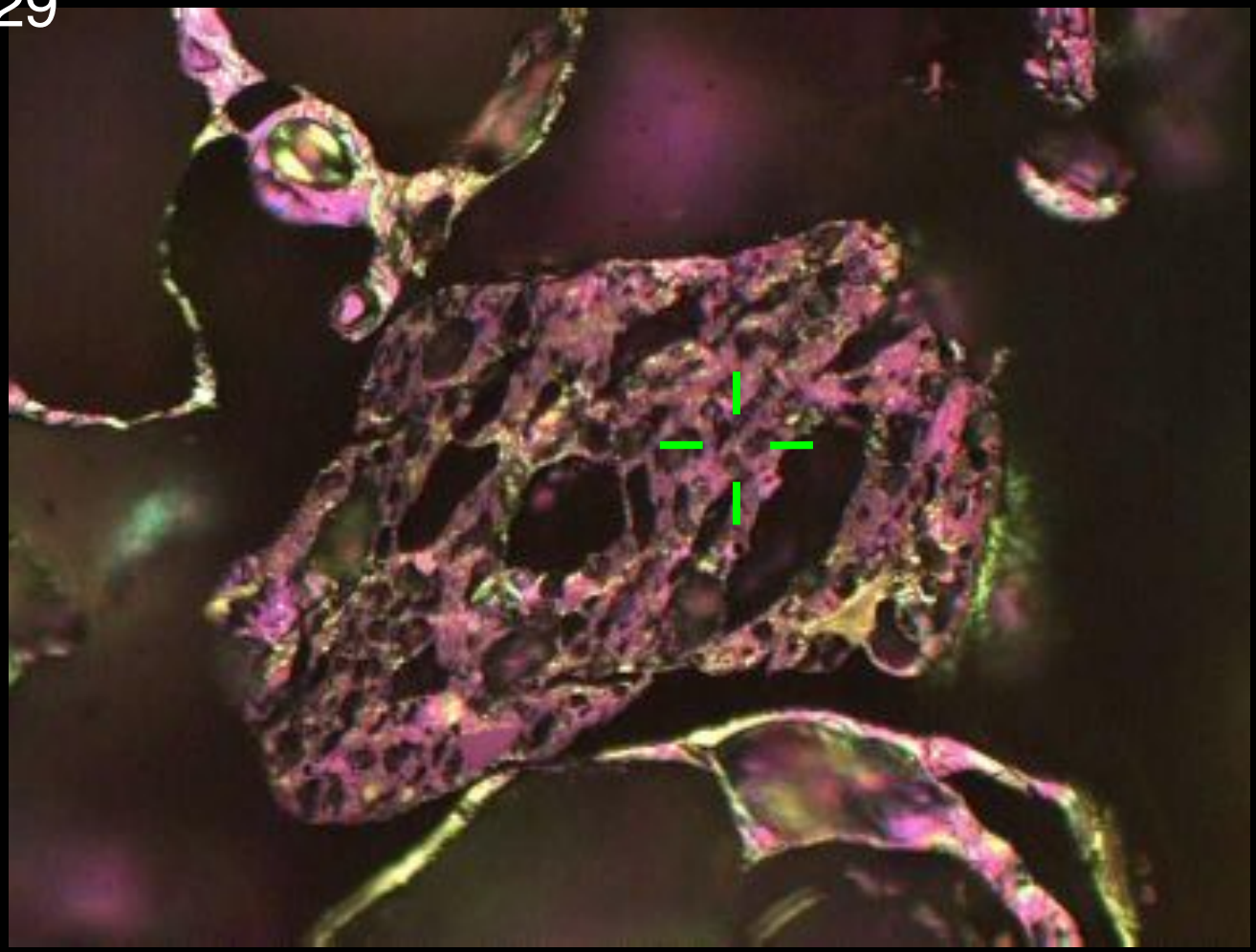
T29



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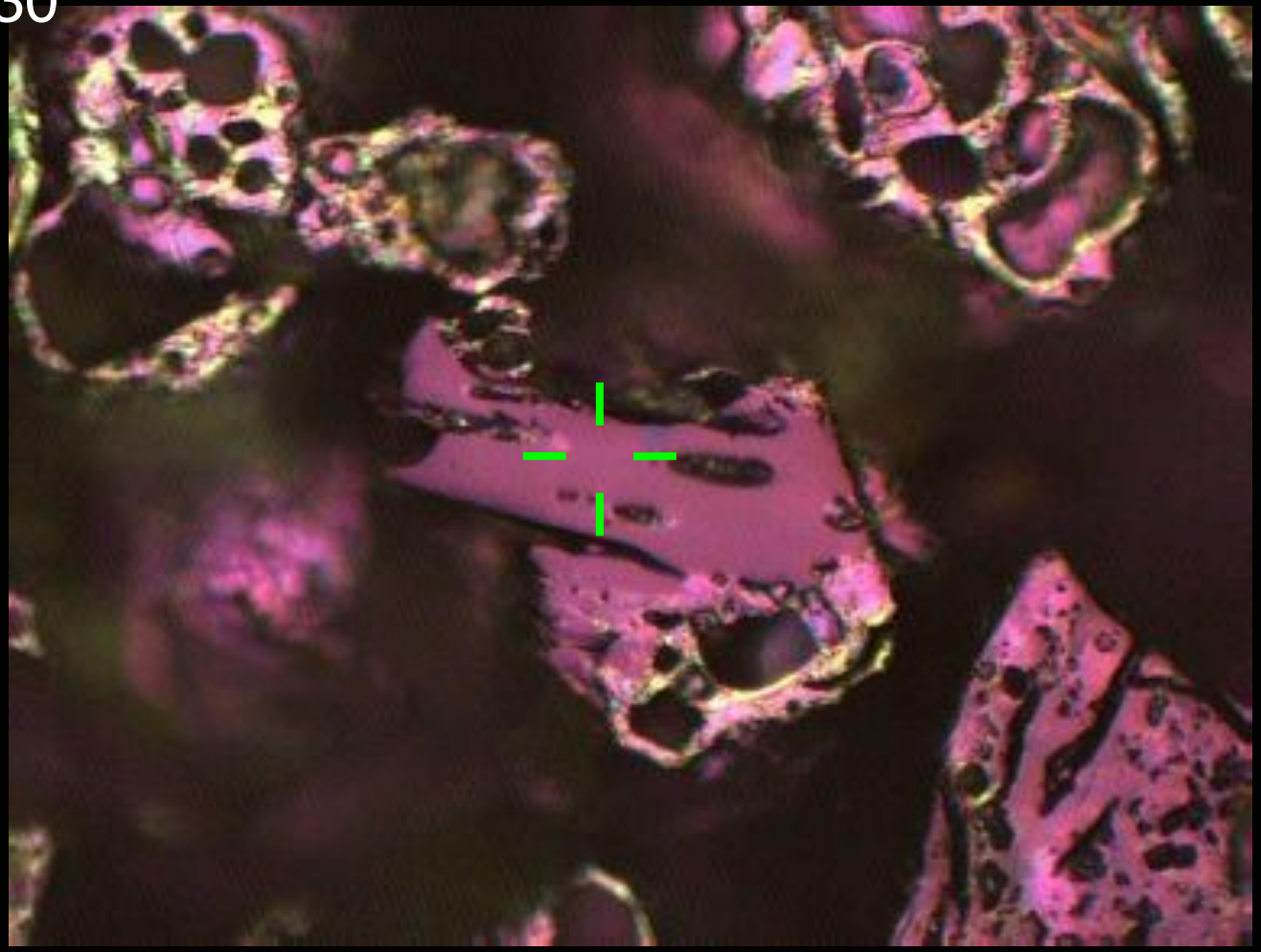
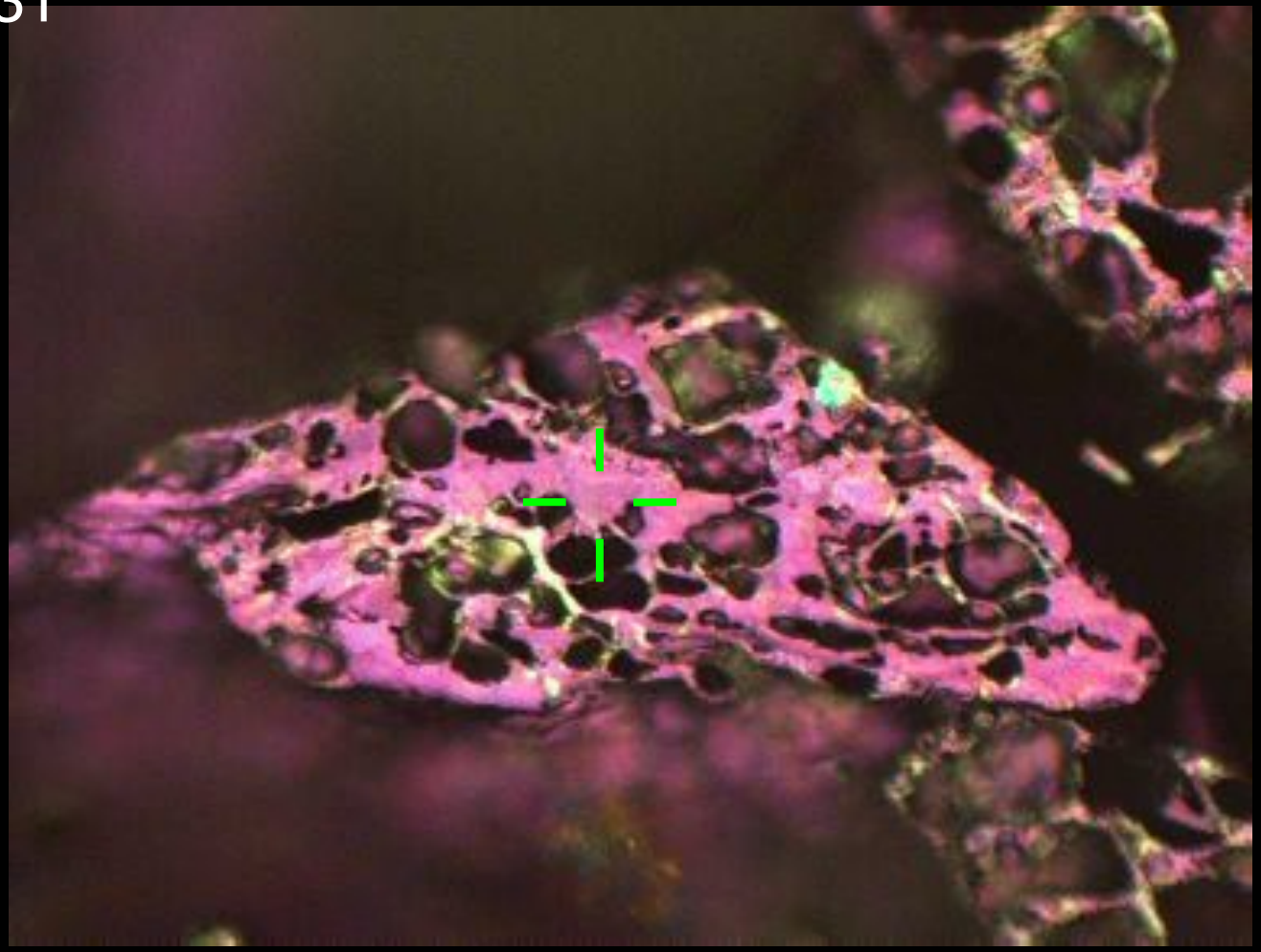
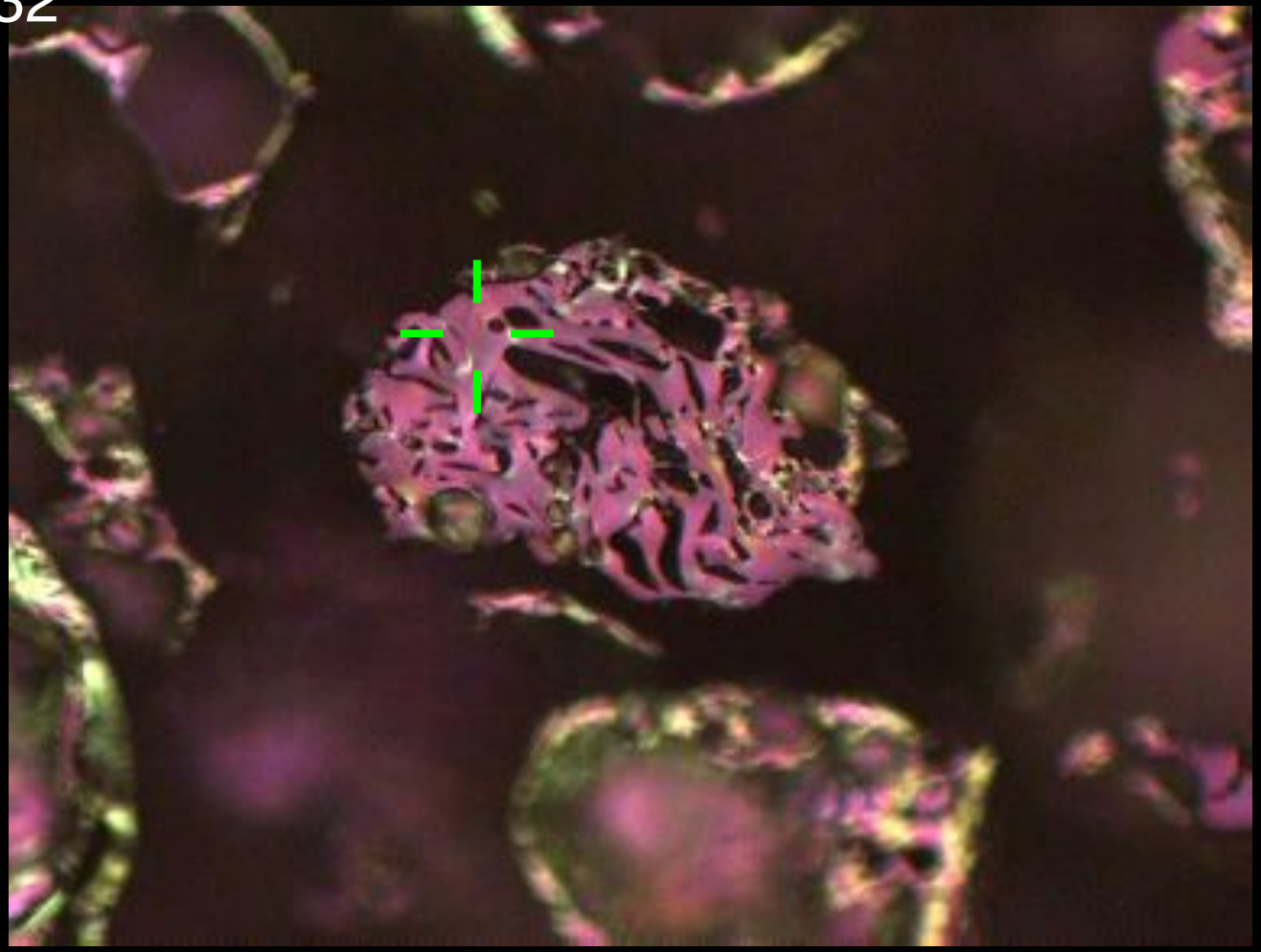
T30



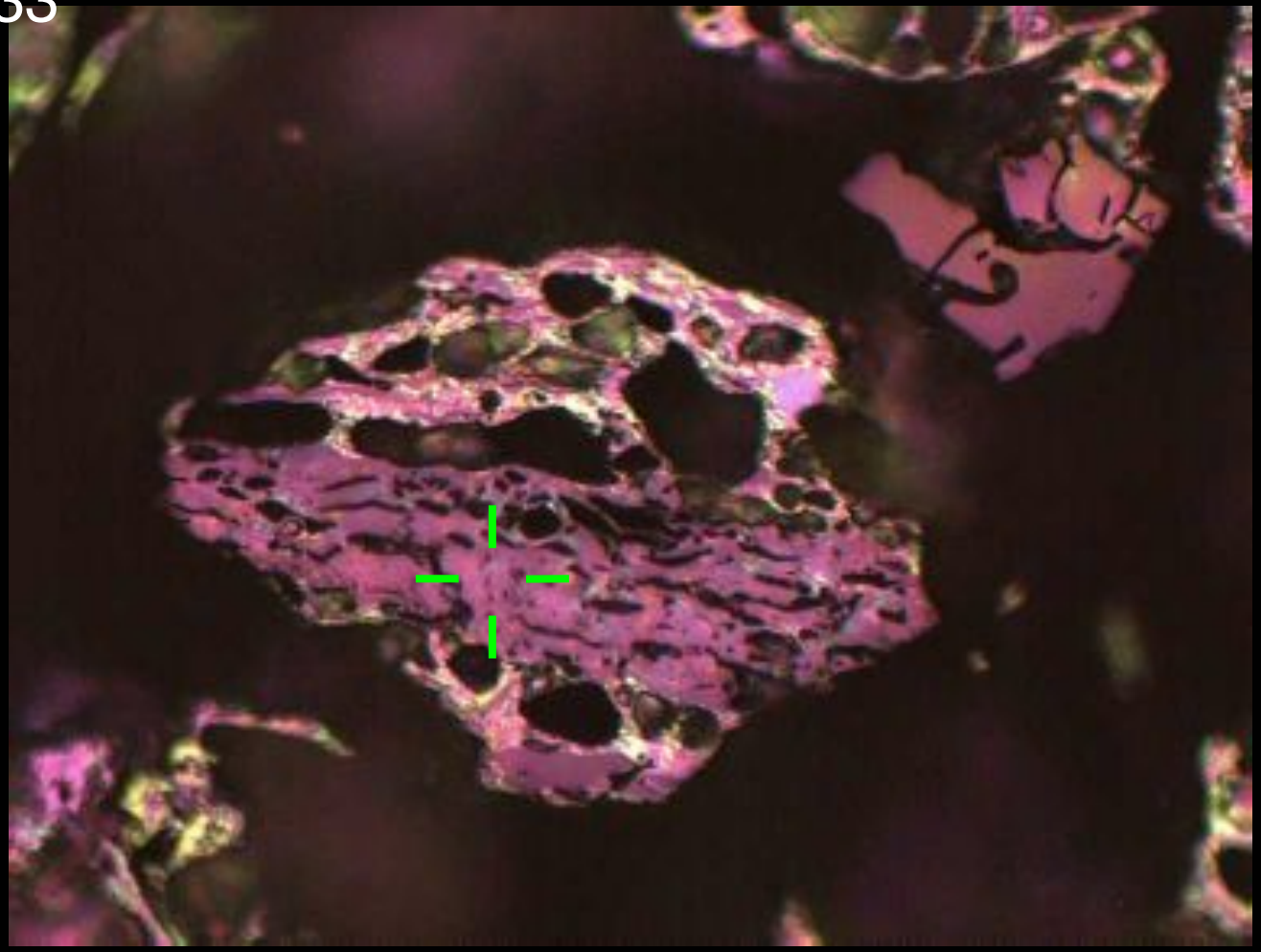
T31



T32



T33



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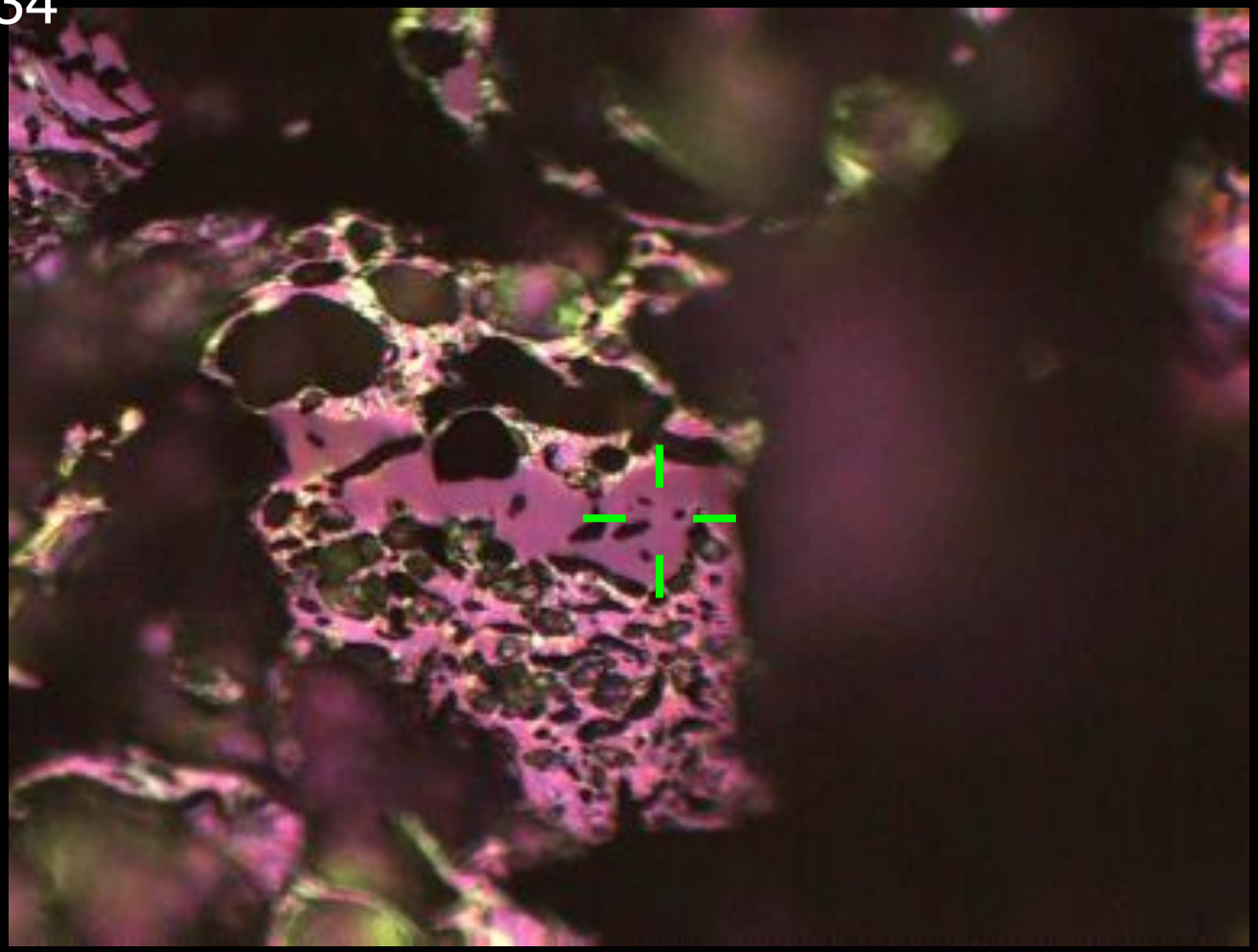

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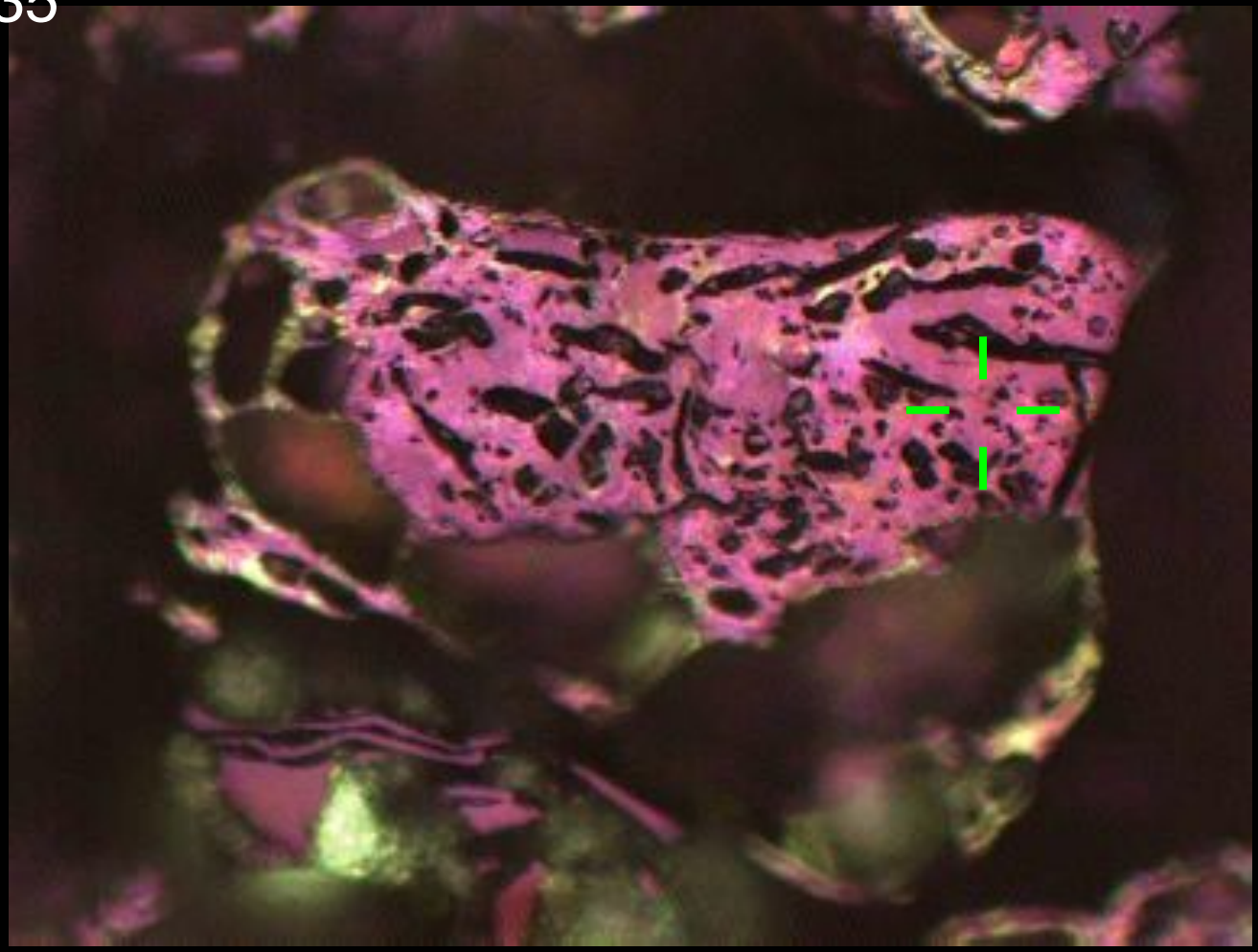

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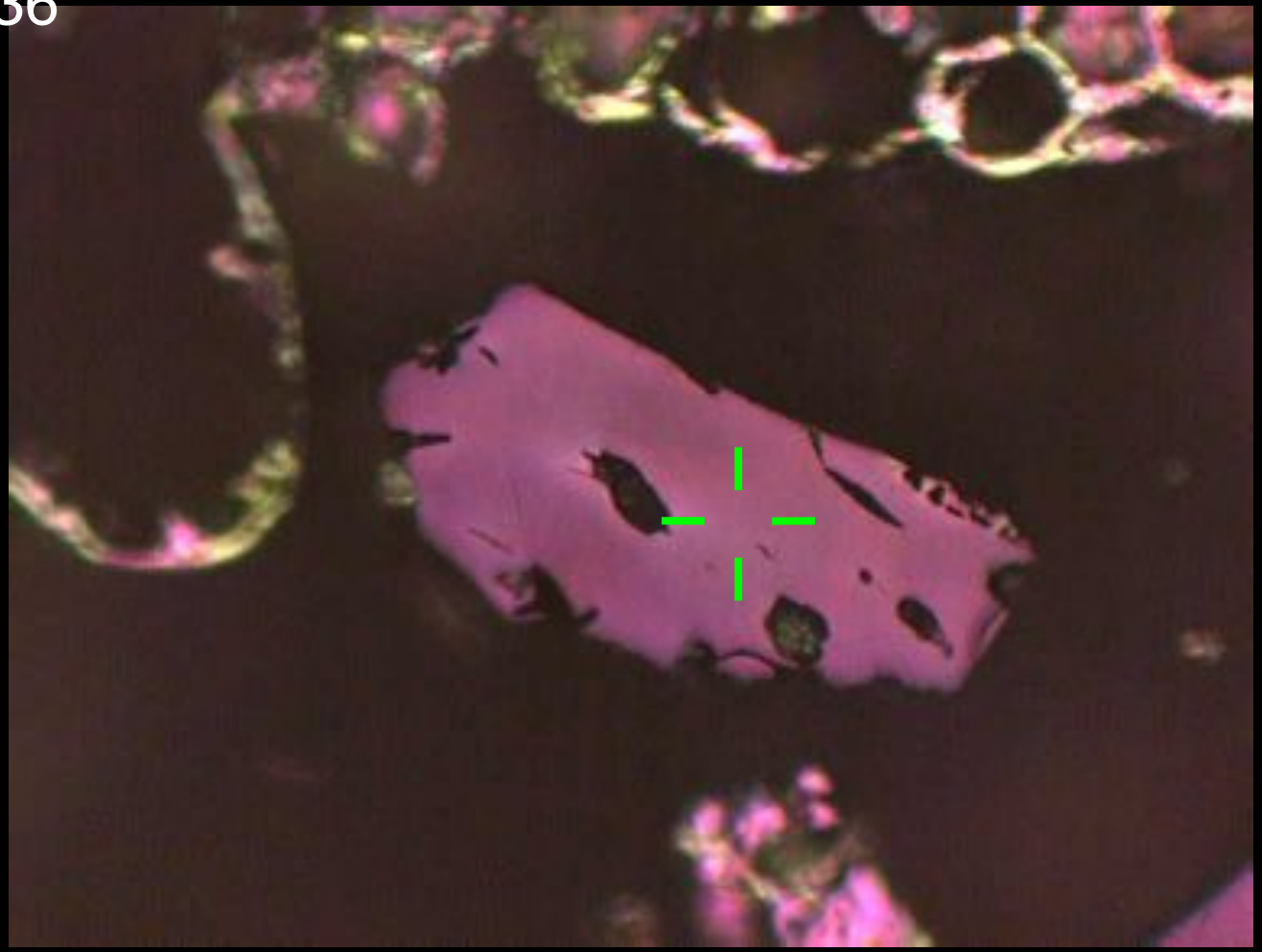

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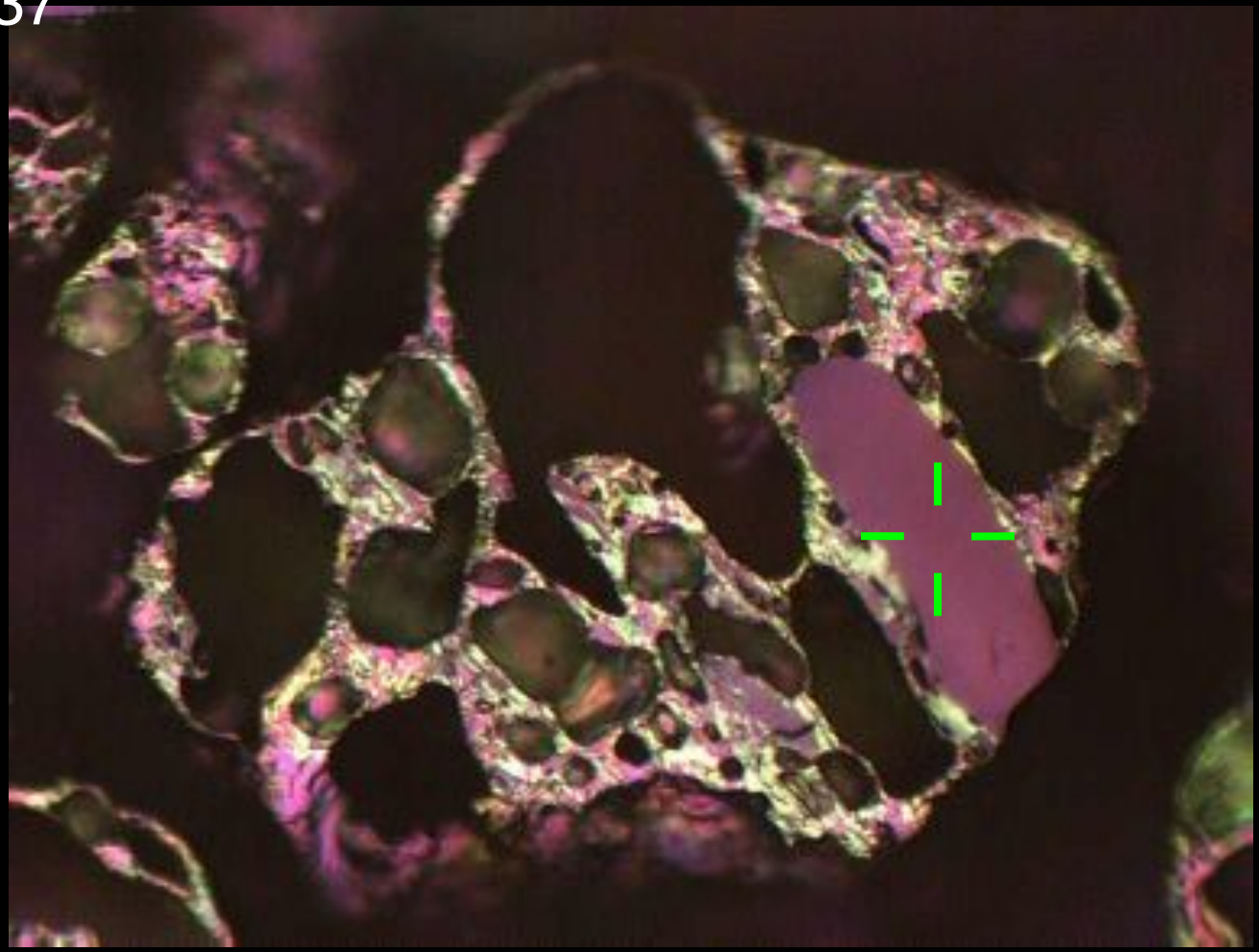
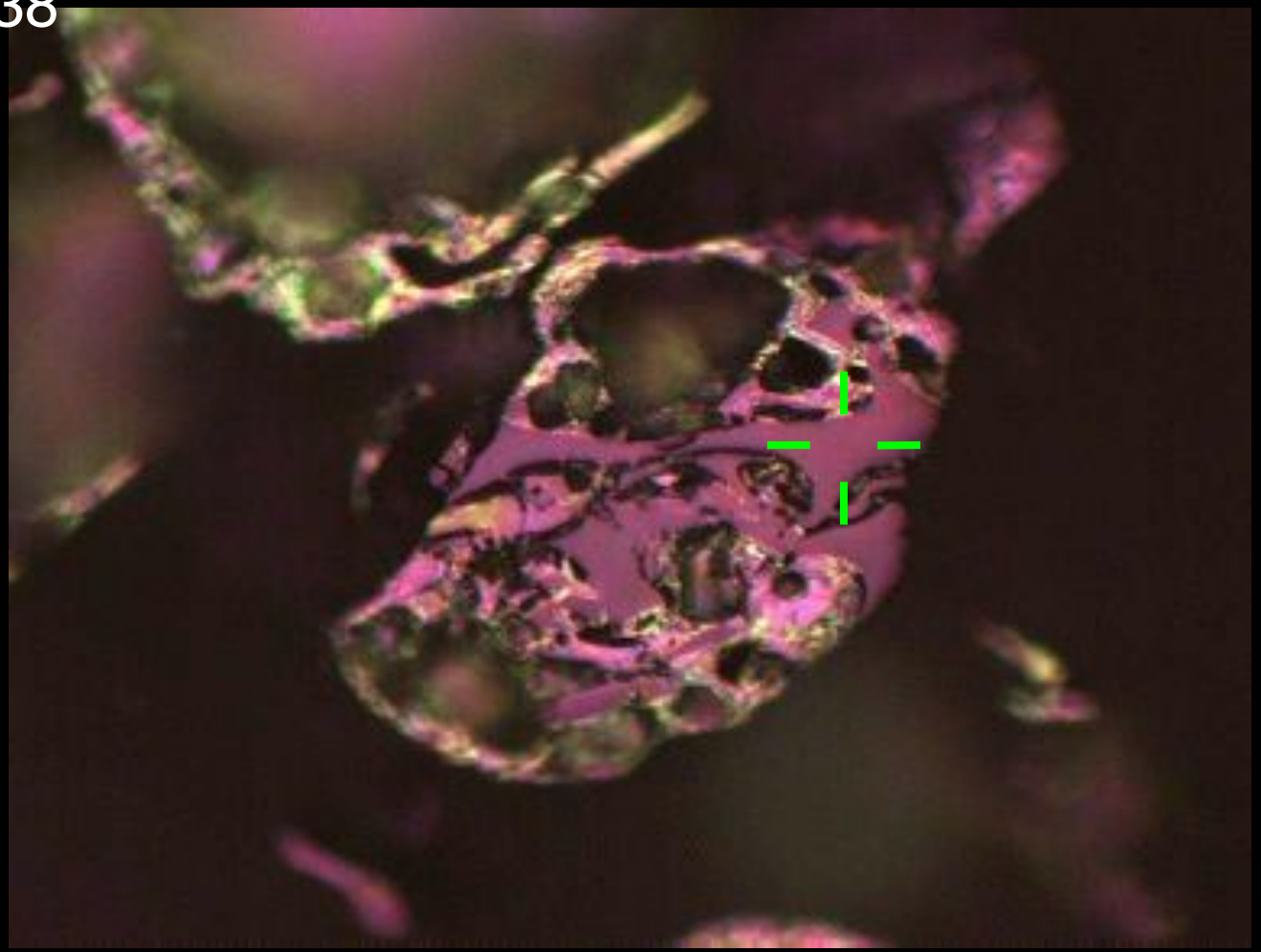
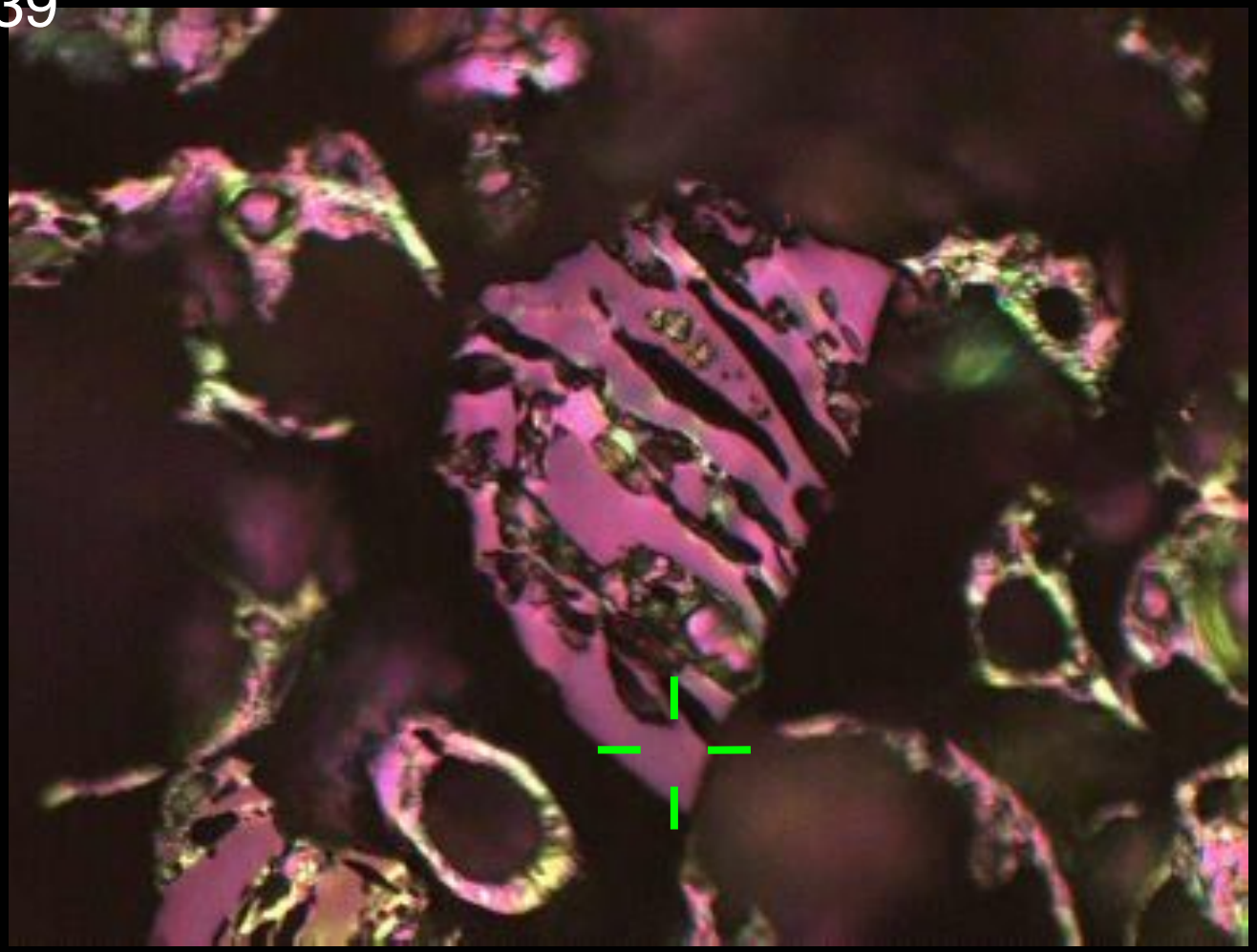


T38



50 μm

T39



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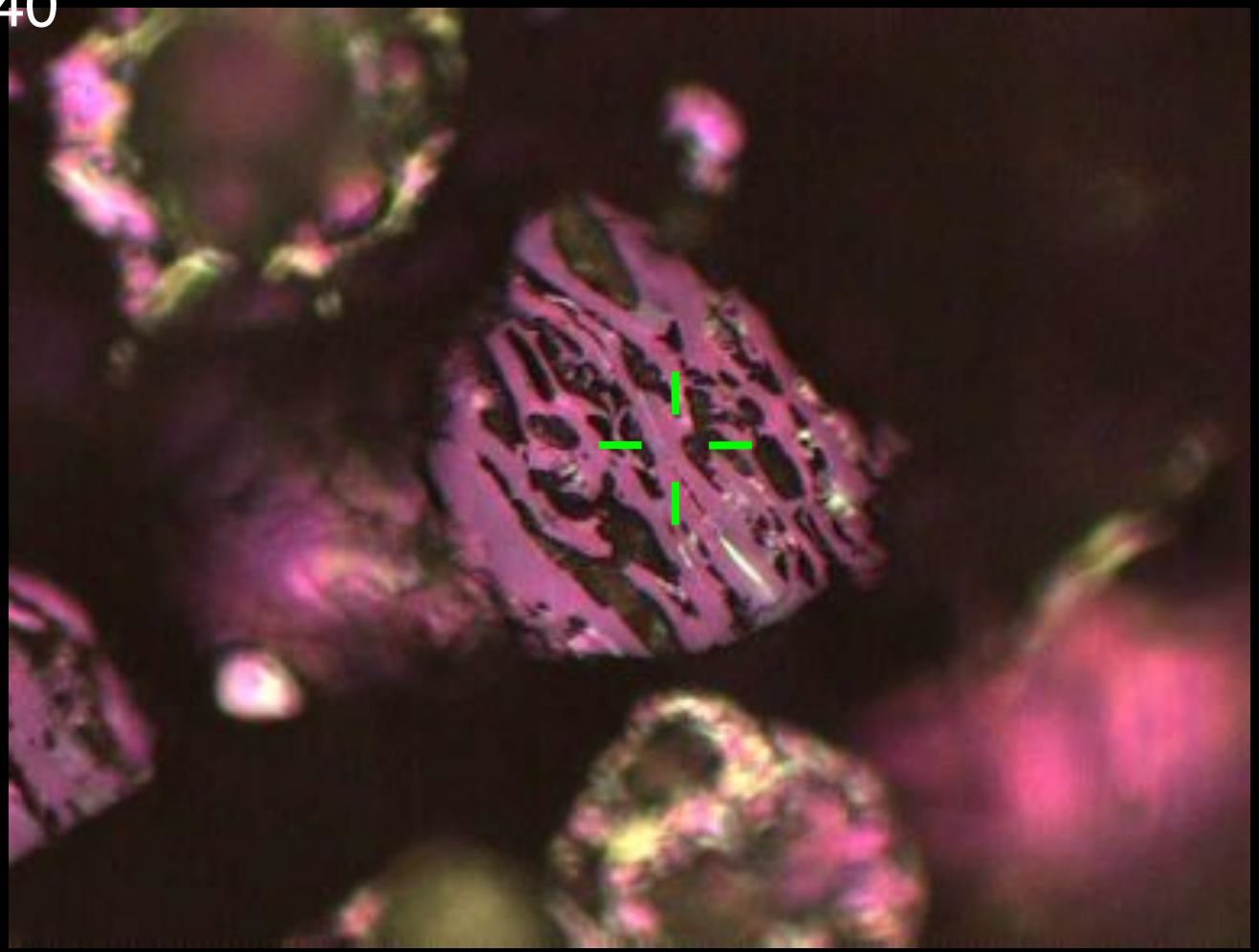
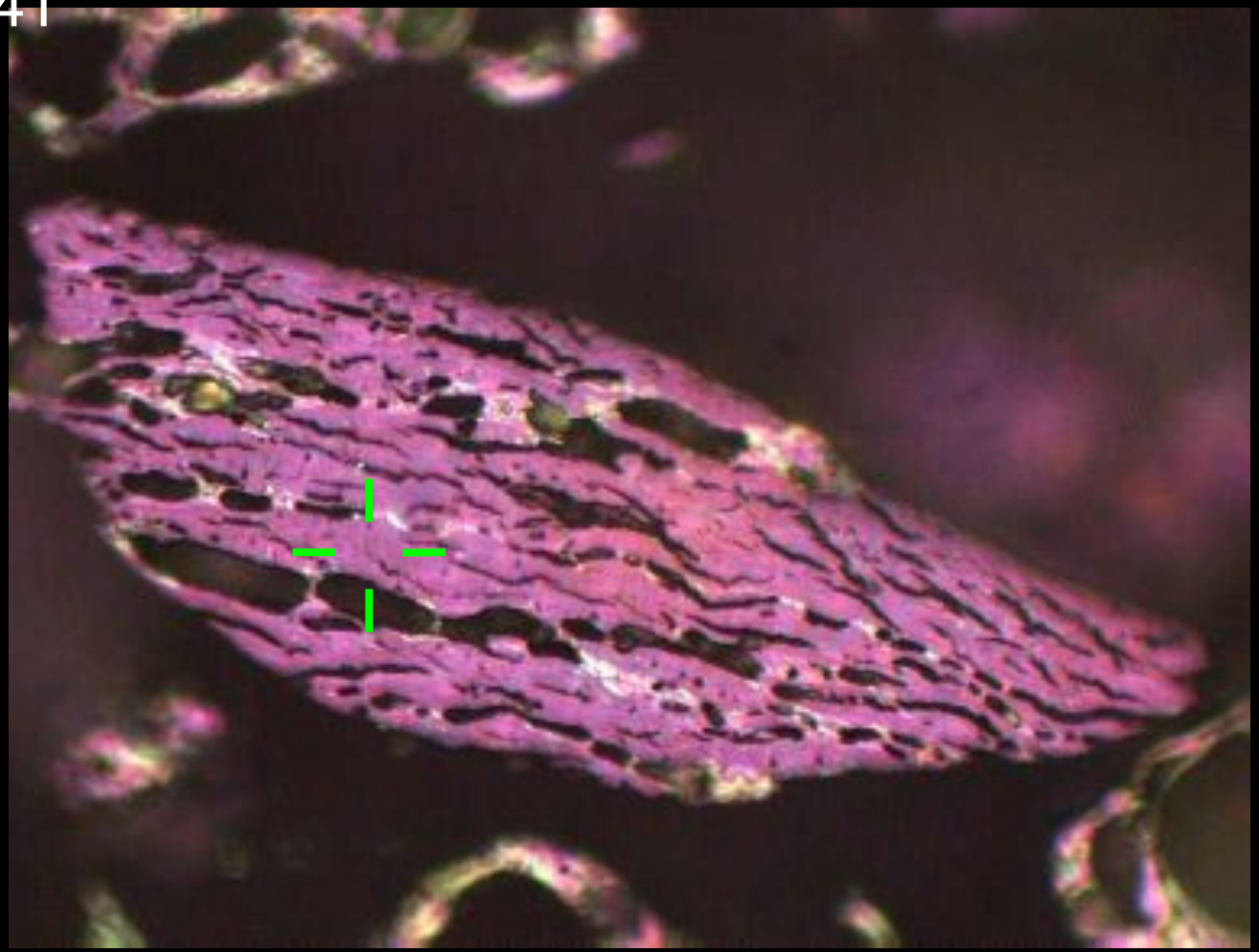


50 μm

T41



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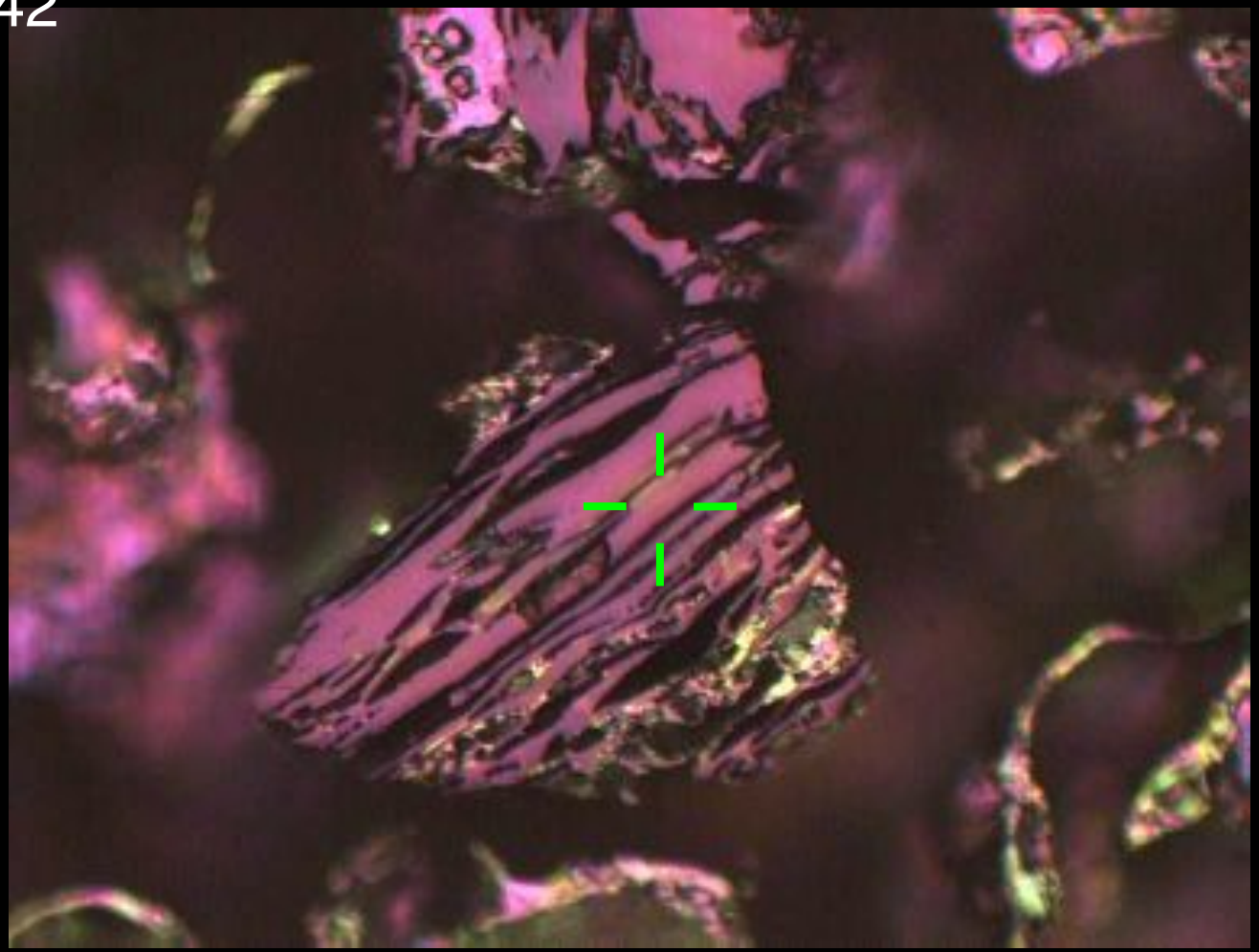
T42



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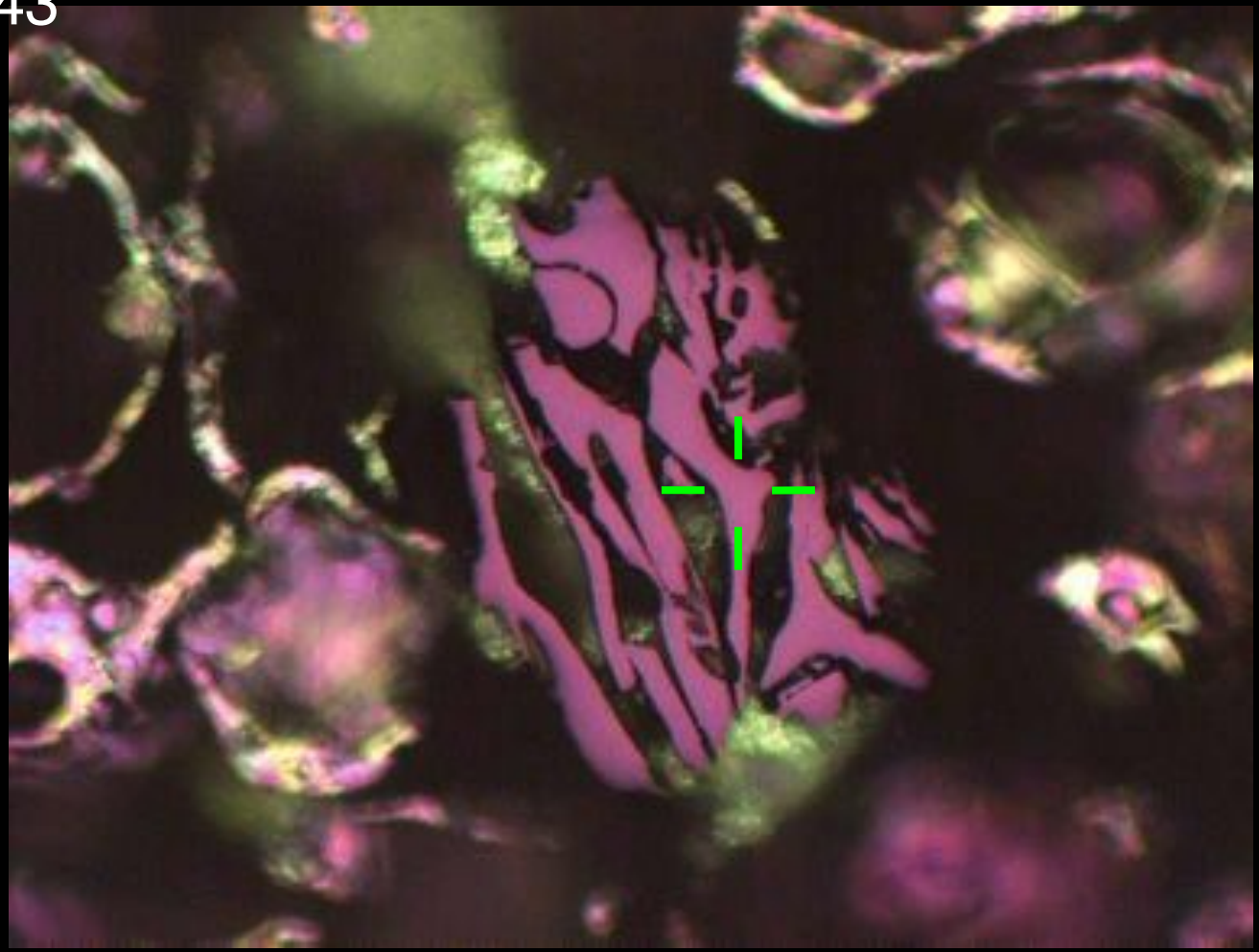

50 μm

T44