

A. SIMS H<sub>2</sub>O concentration calibration curve

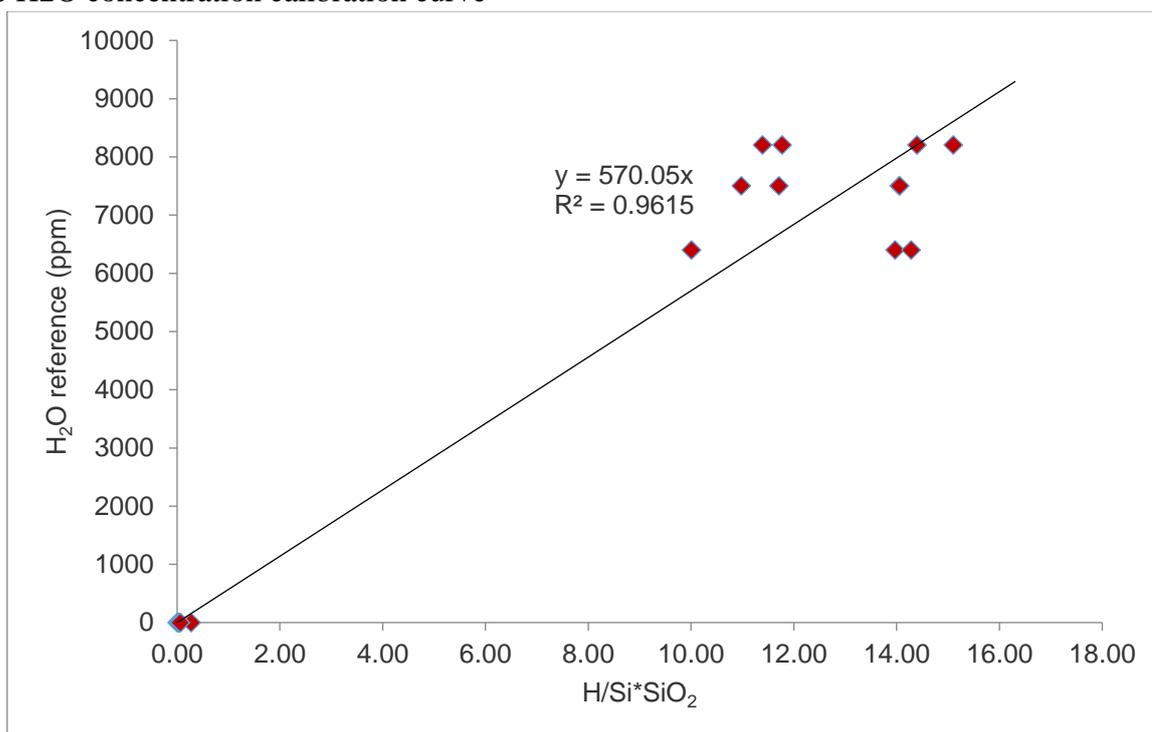


Figure S1: H<sub>2</sub>O calibration curve from silicate glass standards. H<sub>2</sub>O reference refers to published concentrations, see methods section for standards used and references. H/Si\*SiO<sub>2</sub> – H(cps)/ Si(cps) normalised to SiO<sub>2</sub> determined by EPMA.

## B. PEC correction for olivine and plagioclase-hosted melt inclusions

To check the validity of PEC corrections, we plotted measured and corrected Mg# ( $\frac{Mg}{(Mg+Fe)} \times 100$ ) vs Fo mol.% and Ca# ( $\frac{Ca}{(Ca+Na+K)} \times 100$ ) vs An mol.% for olivine- and plagioclase-hosted inclusions respectively (Figure SA). Nominal equilibrium values of  $Kd_{Fe-Mg}^{ol-liq} = 0.3 \pm 0.05$  (Roeder and Emslie, 1970) and  $Kd_{Ab-An}^{plag-liq} = 0.1 \pm 0.05$  ( $T \leq 1050^\circ\text{C}$ ) and  $Kd_{Ab-An}^{plag-liq} = 0.27 \pm 0.11$  ( $T \geq 1050^\circ\text{C}$ ) (Putirka, 2008a) are also plotted on these figures. Corrected compositions for all olivine-hosted inclusions fall within the expected equilibrium ranges, and our PEC-corrected compositions for olivine-hosted melt inclusions from Miðfell are very similar to those reported by Miller et al. (2019). Plagioclase-hosted melt inclusions from Snæfellsjökull require very little PEC correction and fall within the equilibrium Kd range for  $T < 1050^\circ\text{C}$  (Figure S3).

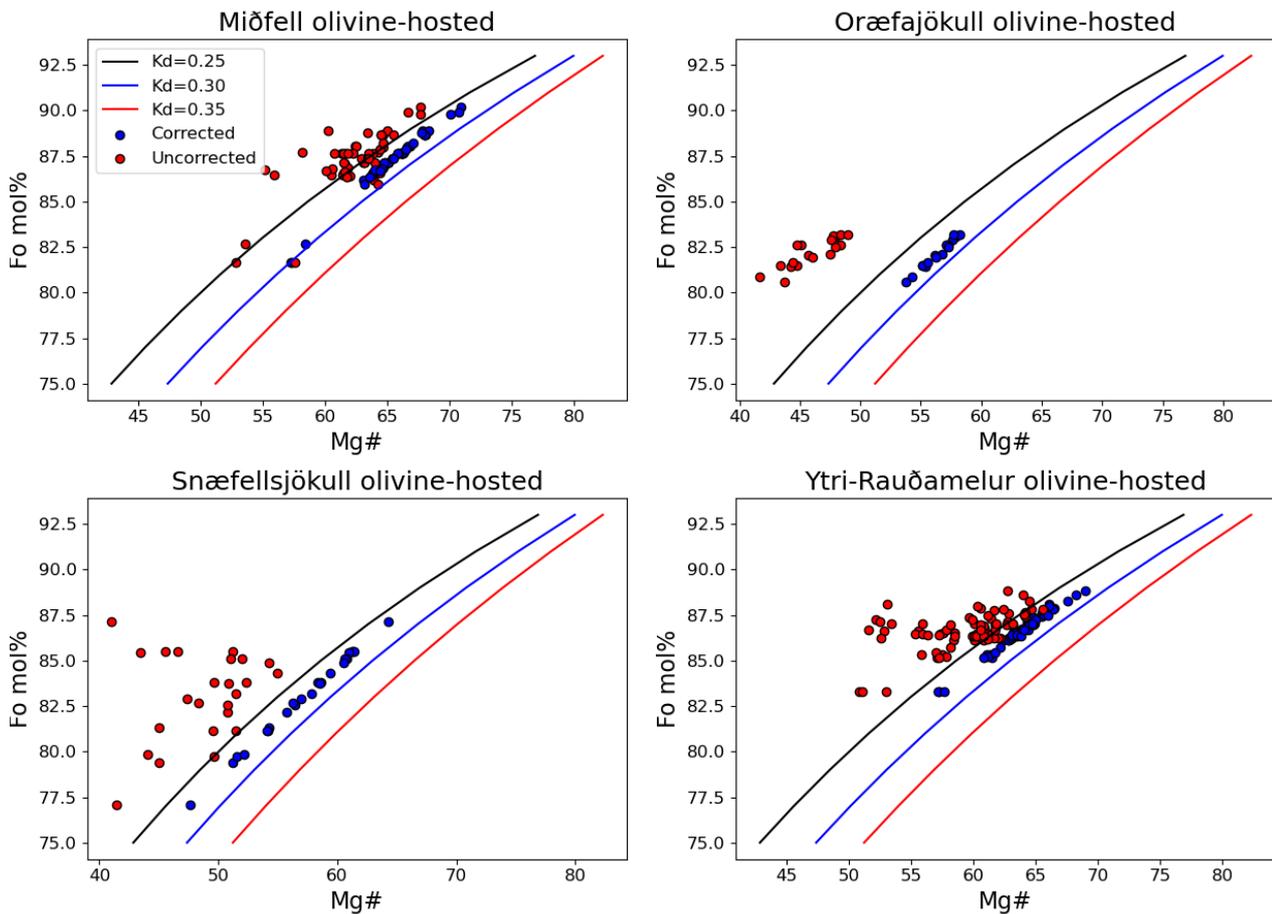


Figure S2 Olivine-melt Kd of uncorrected and corrected melt inclusion compositions. Equilibrium Kd values from Roeder and Emslie (1970).

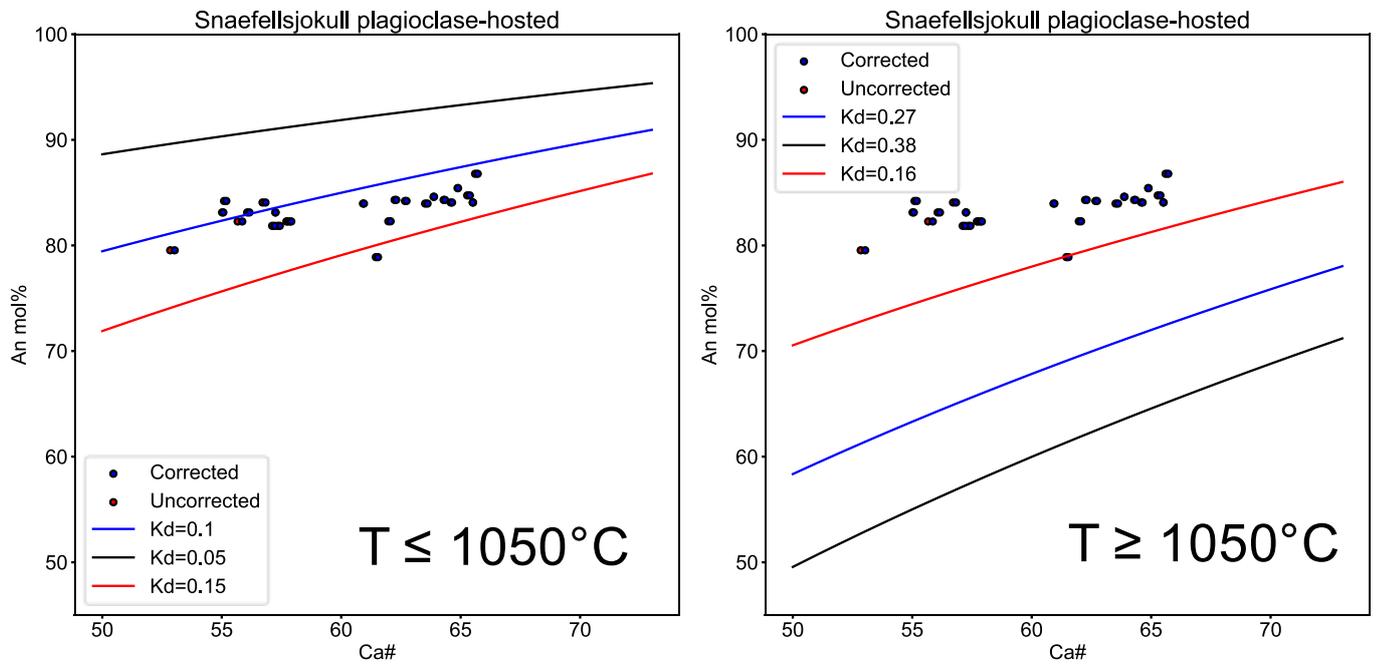


Figure S3: Plagioclase-melt  $K_d$  of uncorrected and corrected melt inclusions. Equilibrium  $K_d$  values from Putirka (2008a).

### C. Average trace element compositions used in models

The following section presents the literature and measured data used to determine an average trace element composition used in modelling.

#### Flank Zones

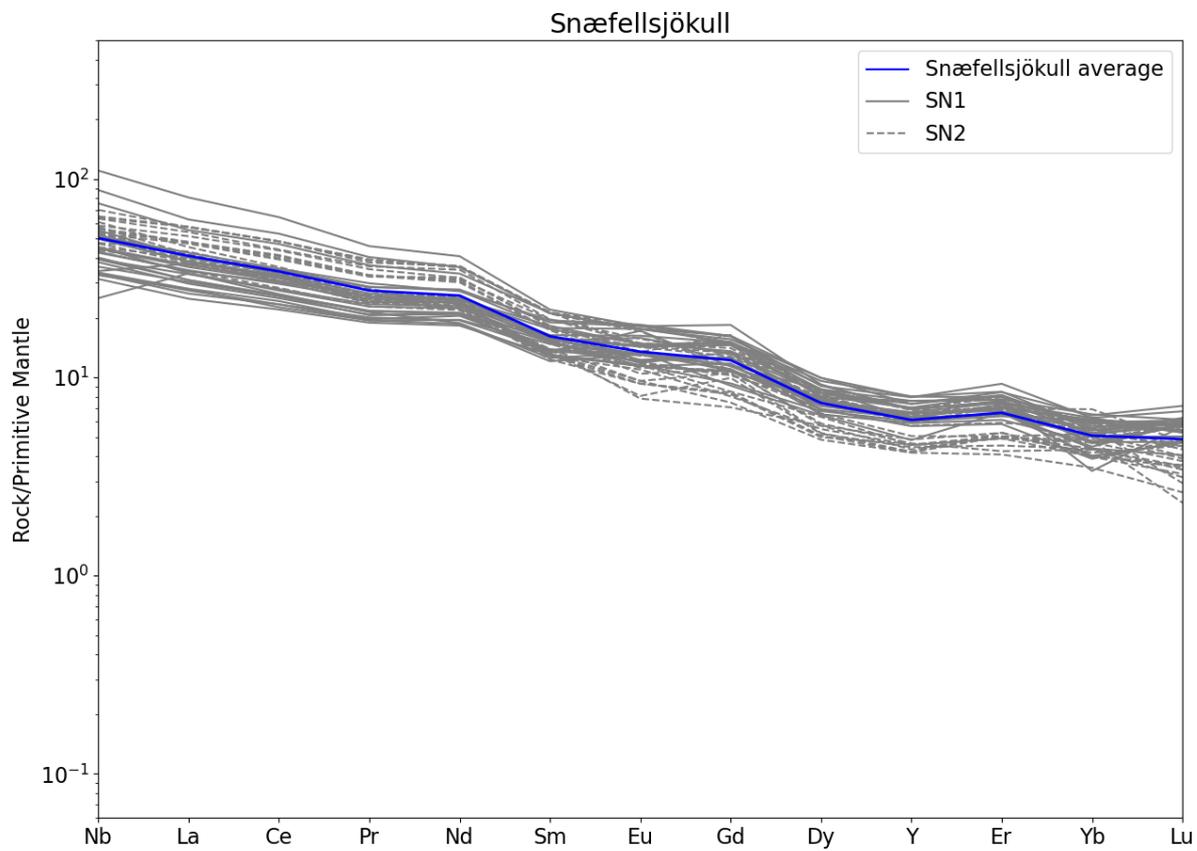


Figure S4: Snæfellsjökull (SN1 and SN2) melt inclusions measured in this study and the average melt composition determined for use in modelling.

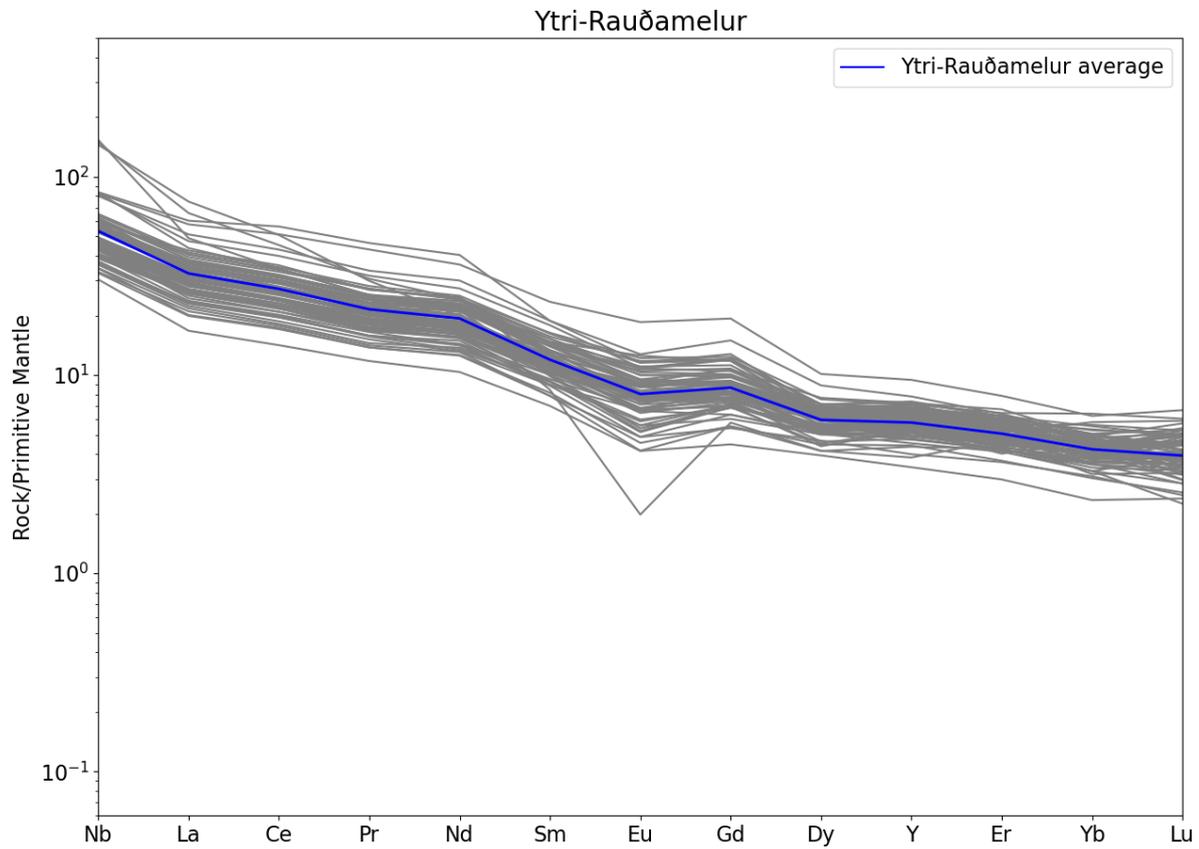


Figure S5: Ytri-Rauðamelur melt inclusions measured in this study and the average melt composition determined for use in modelling.

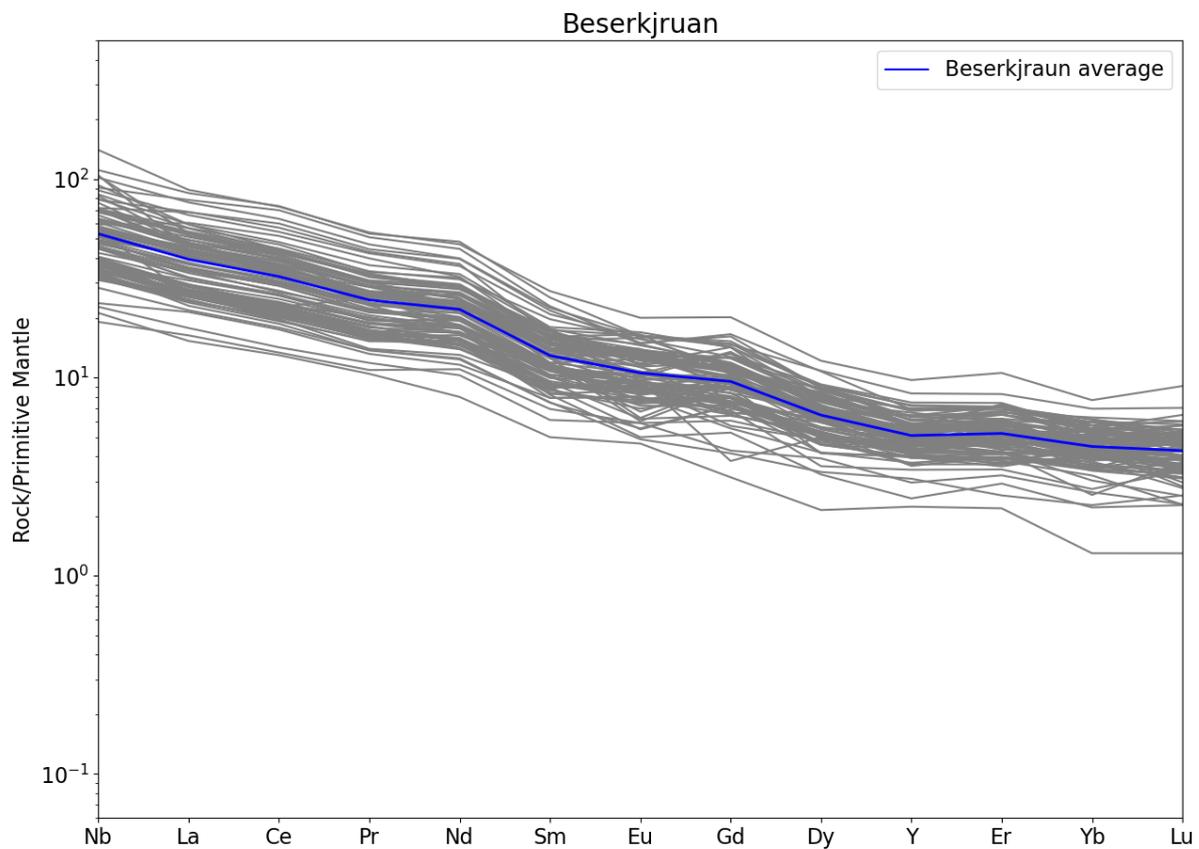


Figure S6: Bersekjruan melt inclusion compositions from Matthews et al. (2021) and the average melt composition determined for use in modelling.

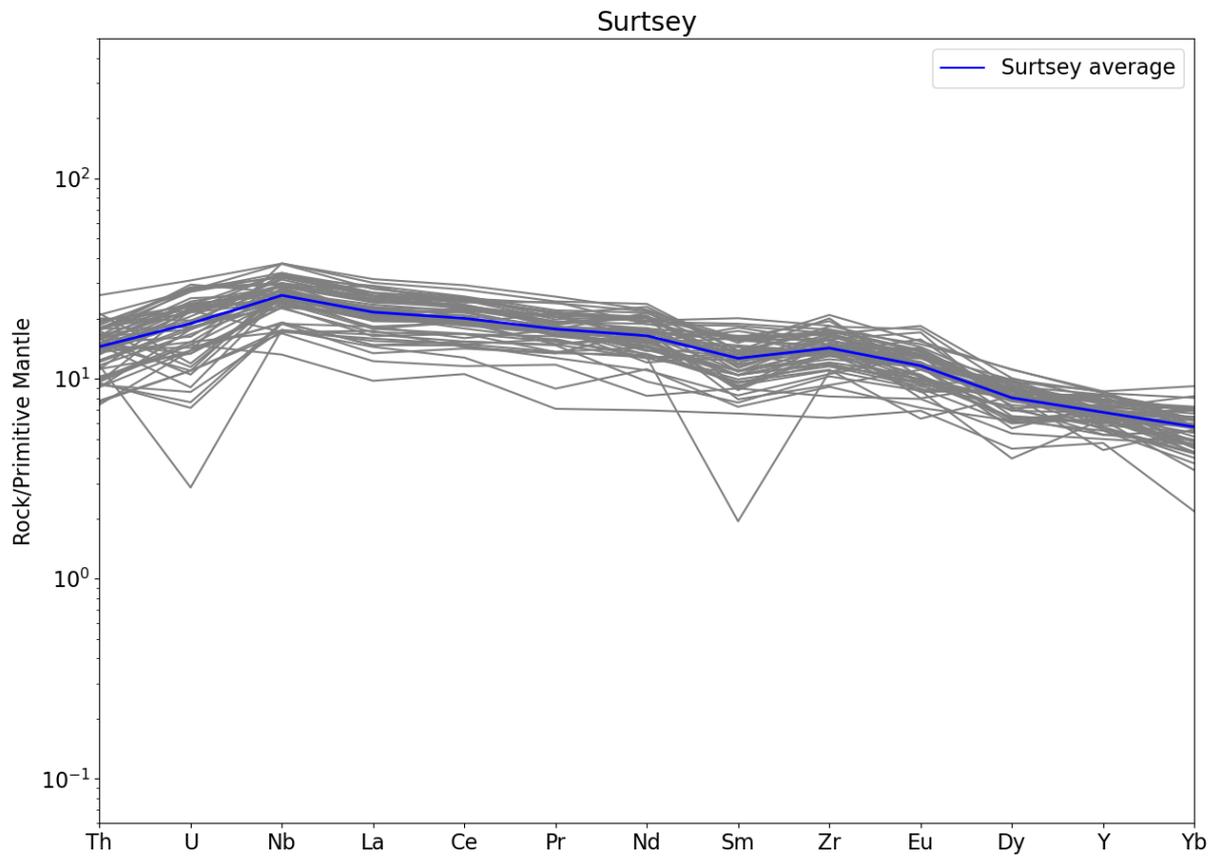


Figure S7: Surtsey melt inclusion compositions from Schipper et al. (2016) and the average melt composition determined for use in modelling. Melt inclusions defined as “type 1” by Schipper et al. (2016) were used.

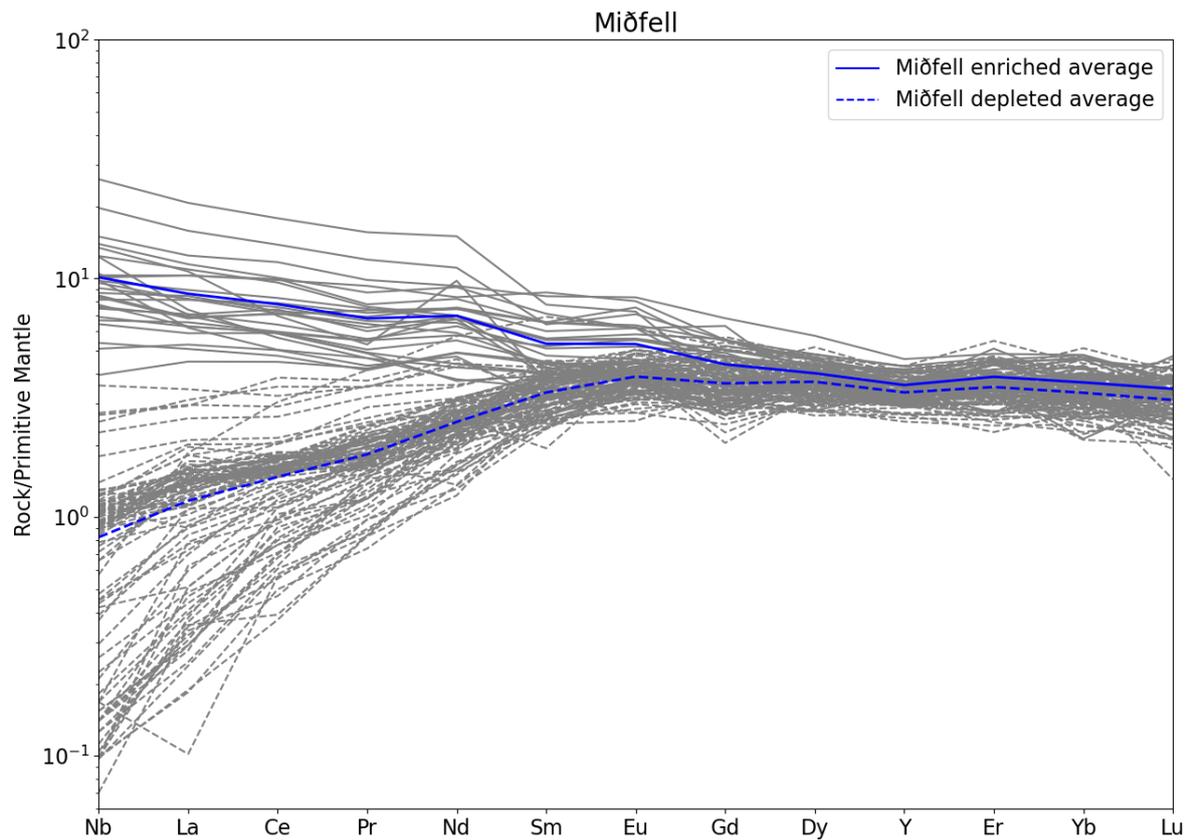


Figure S8: Miðfell melt inclusion compositions measured in this study and from Miller et al. (2019) and the average melt composition determined for use in modelling. Enriched compositions are shown by solid lines, depleted compositions by dashed lines. Enriched compositions are classified as those with primitive mantle normalised  $La \geq 4$ . Depleted compositions are classified as those with primitive mantle normalised  $La < 4$  and primitive mantle normalised  $Nb \geq 0.8$ . Compositions that do match either criterion are classified as Ultra-depleted and can not be matched by this study.

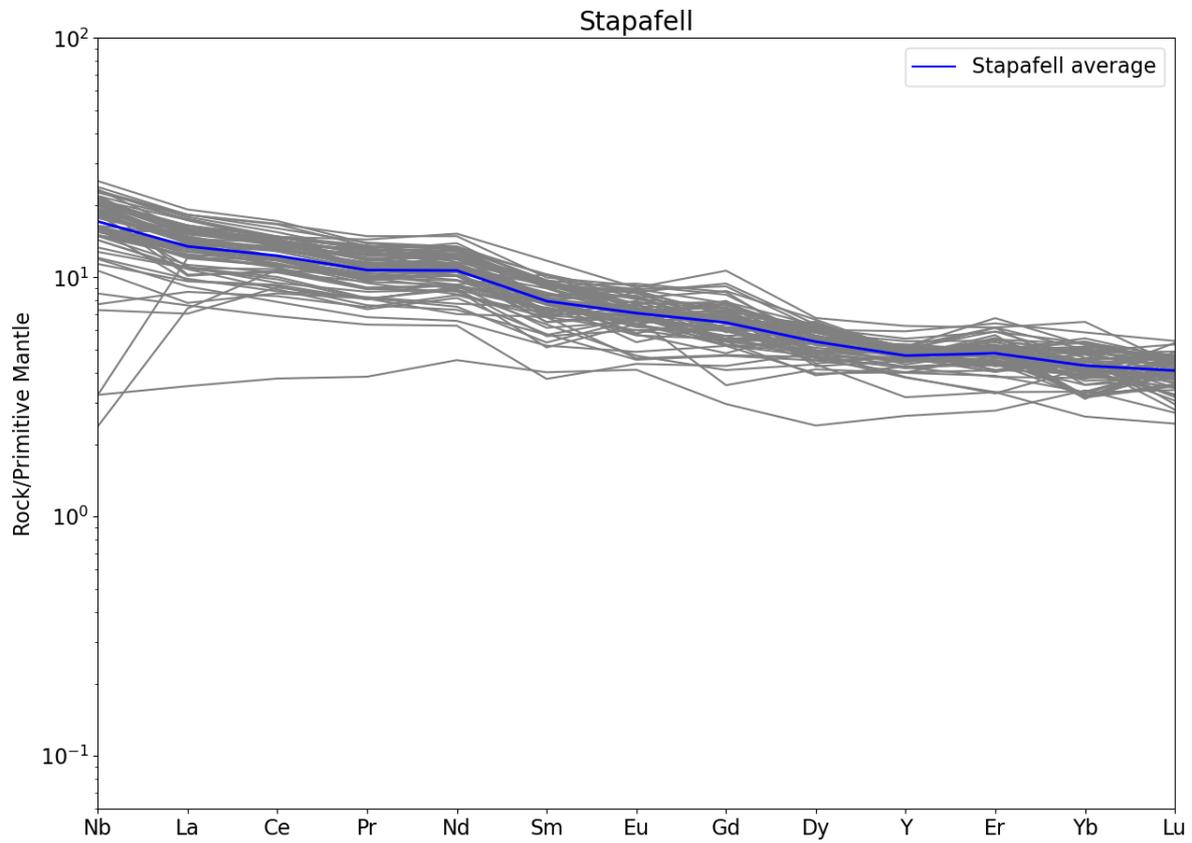


Figure S9: Staphafell melt inclusion compositions from Matthews et al. (2021) and the average melt composition determined for use in modelling.

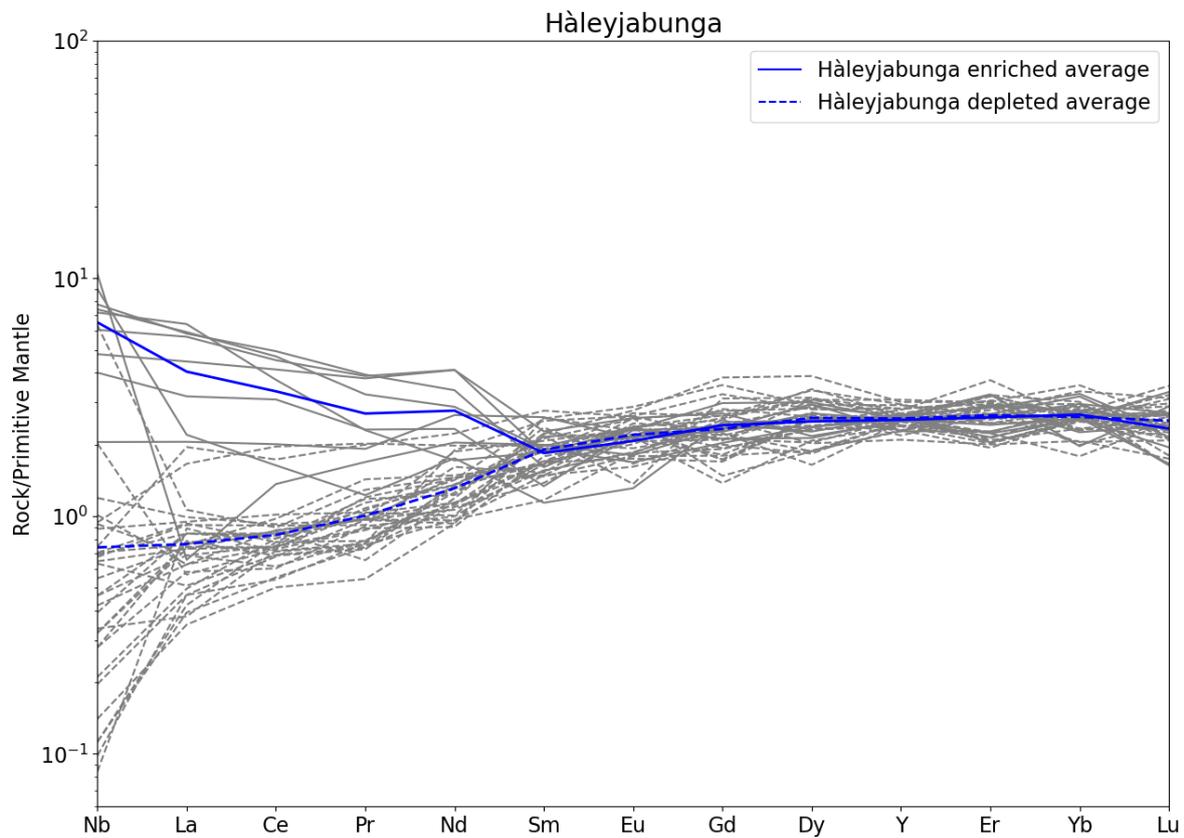


Figure S10: Håleyjabunga melt inclusion compositions from Matthews et al. (2021) and the average melt composition determined for use in modelling. Enriched compositions are shown by solid lines, depleted compositions by dashed lines. Enriched compositions are classified as those where primitive mantle normalised Nb and Ce > 1. All other compositions are classified as depleted.

Eastern Volcanic Zone (EVZ)

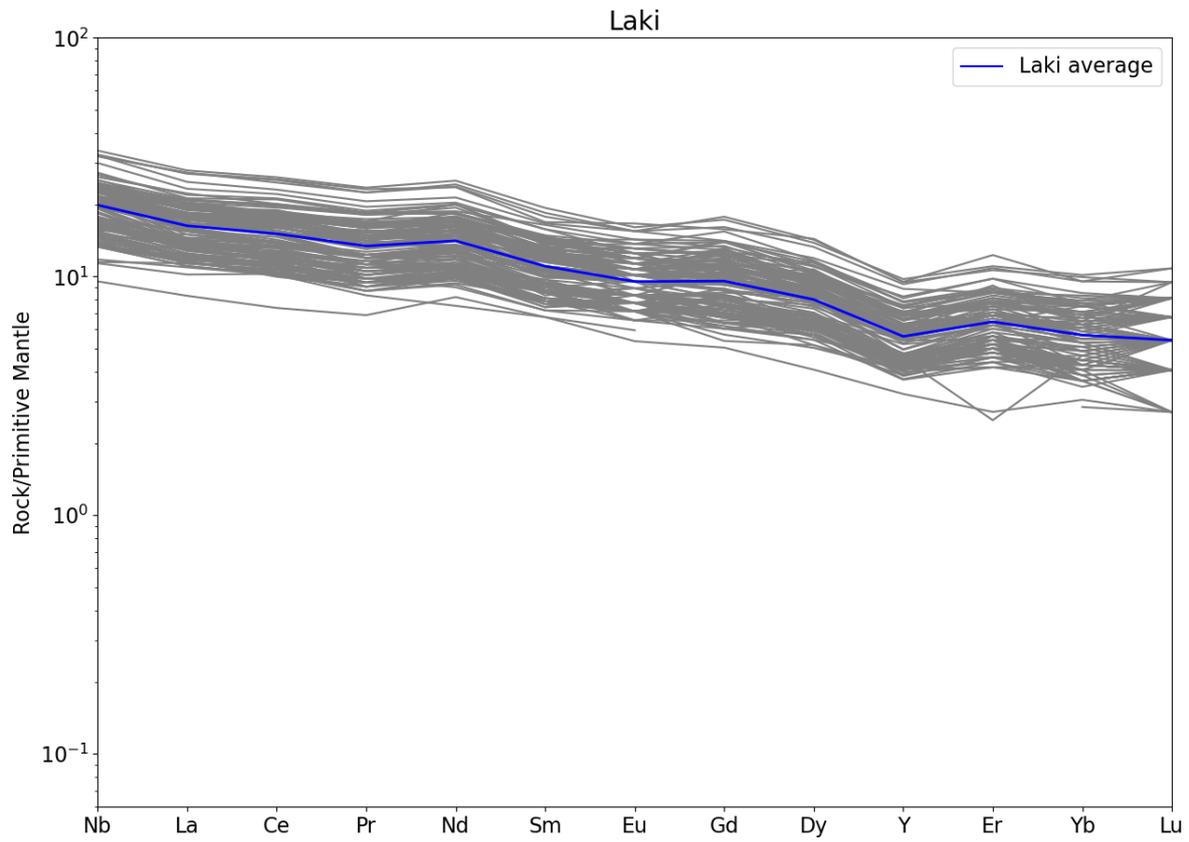


Figure S11: Laki melt inclusion compositions from Neave et al. (2013) and the average melt composition determined for use in modelling.

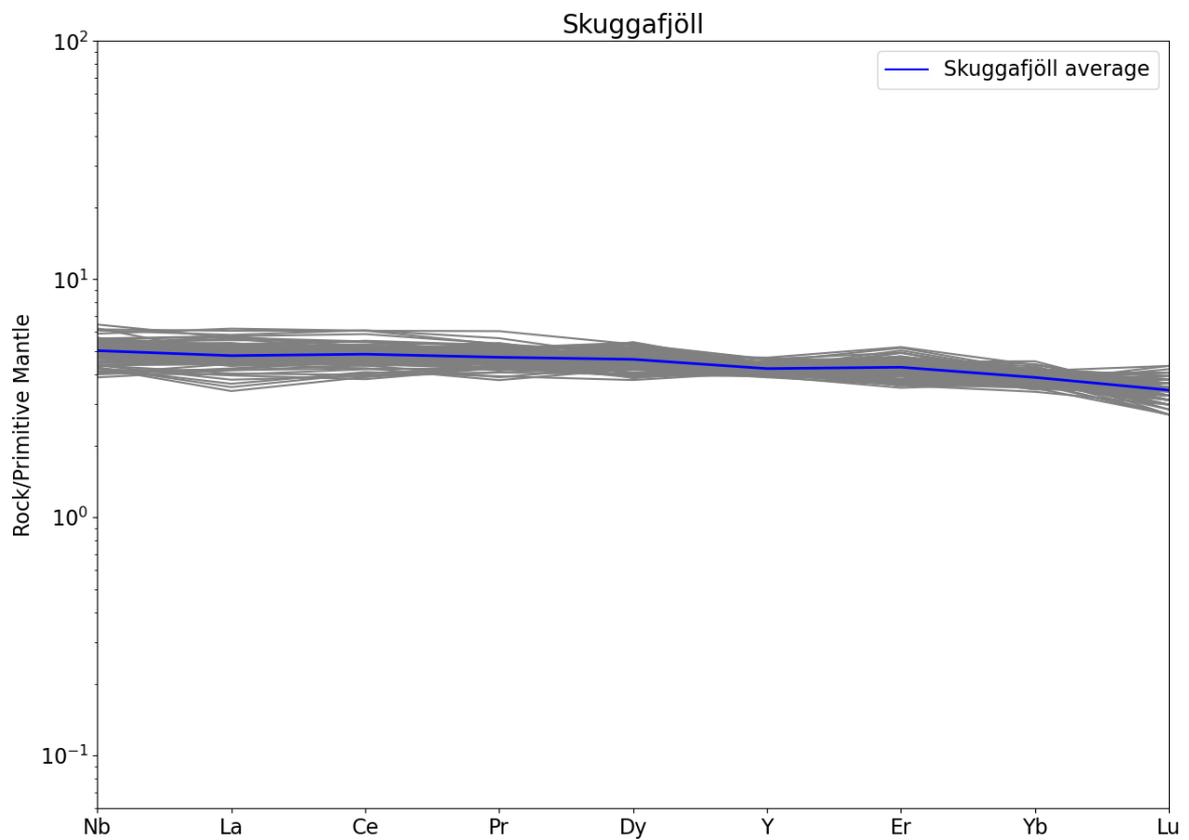


Figure S12: Skuggafjöll melt inclusion compositions from Neave et al. (2014) and the average melt composition determined for use in modelling. Only compositions classified by Neave et al. (2014) as primitive were used.

Northern Volcanic Zone (NVZ)

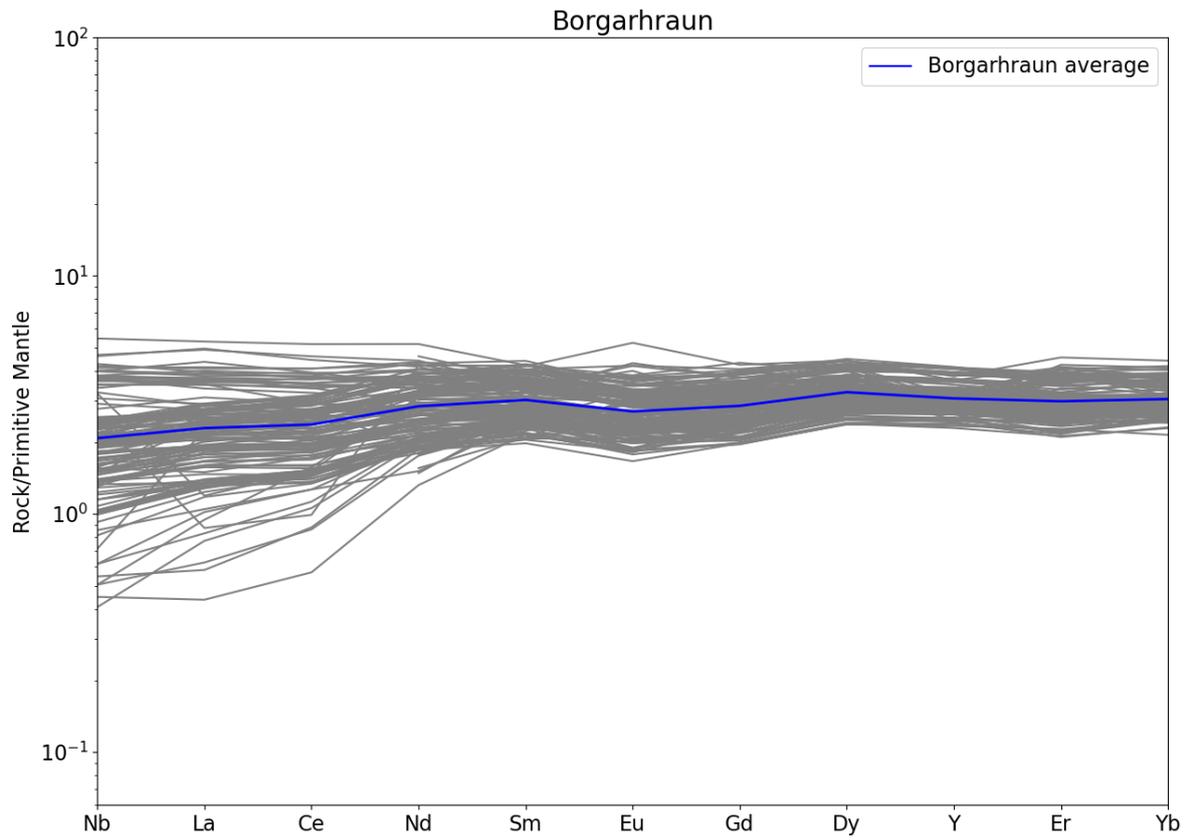


Figure S13: Borgarhraun melt inclusion compositions from Hauri et al. (2018) and the average melt composition determined for use in modelling.

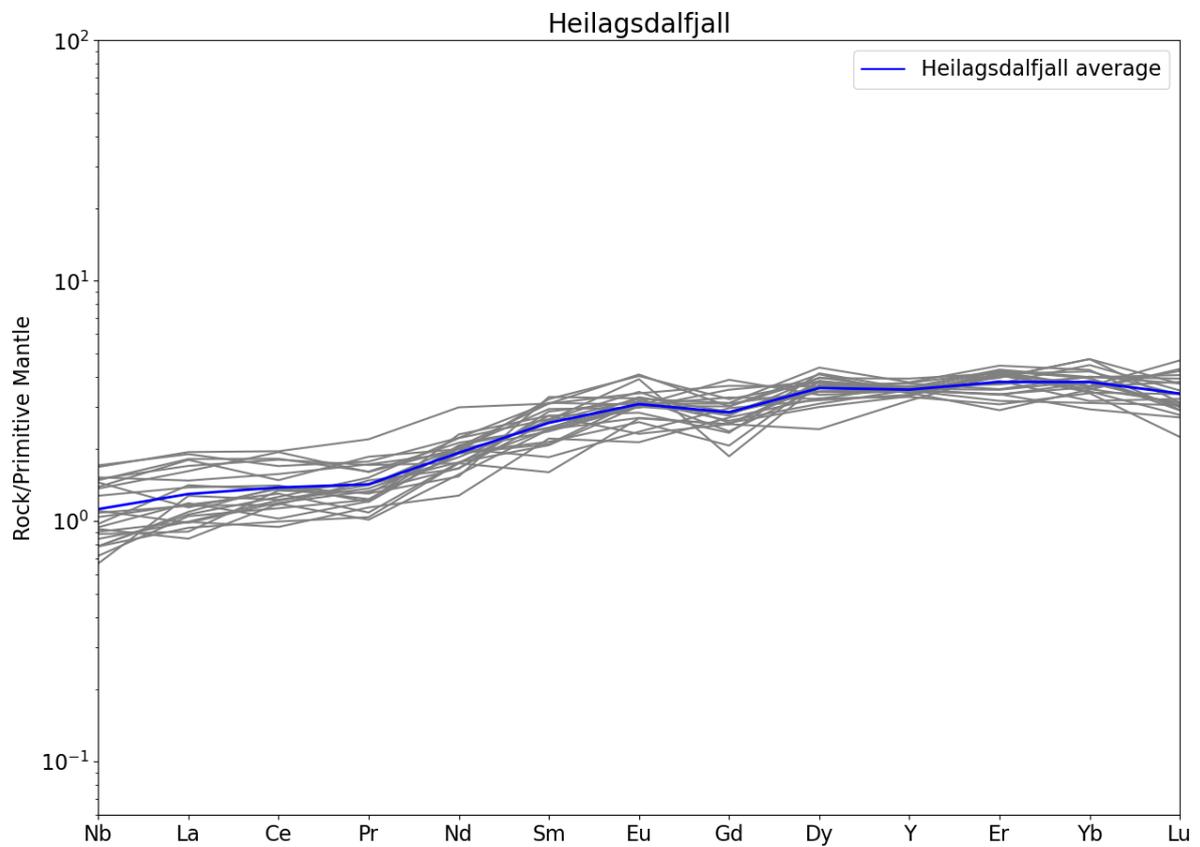


Figure S14: Heilagsdalfjall melt inclusion compositions from Matthews et al. (2021) and the average melt composition determined for use in modelling.

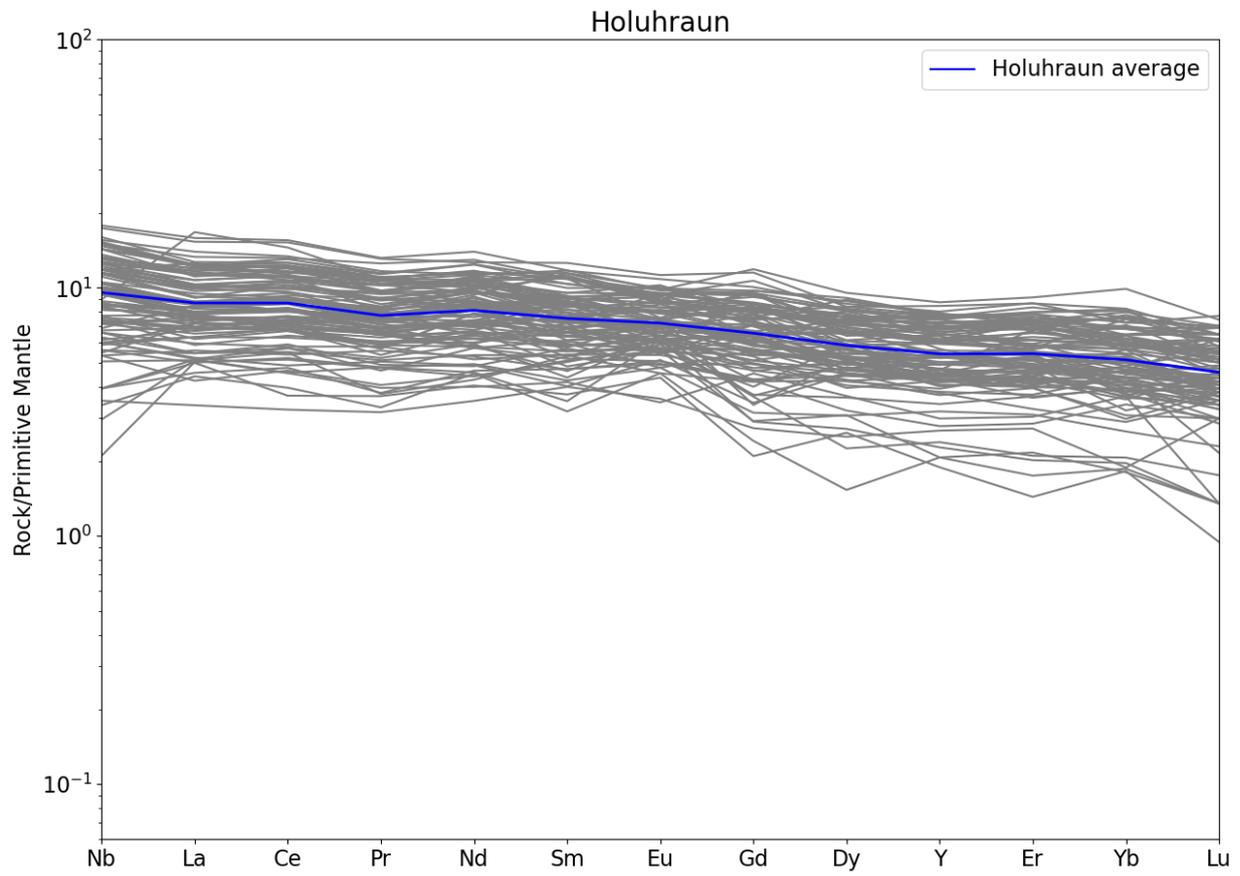
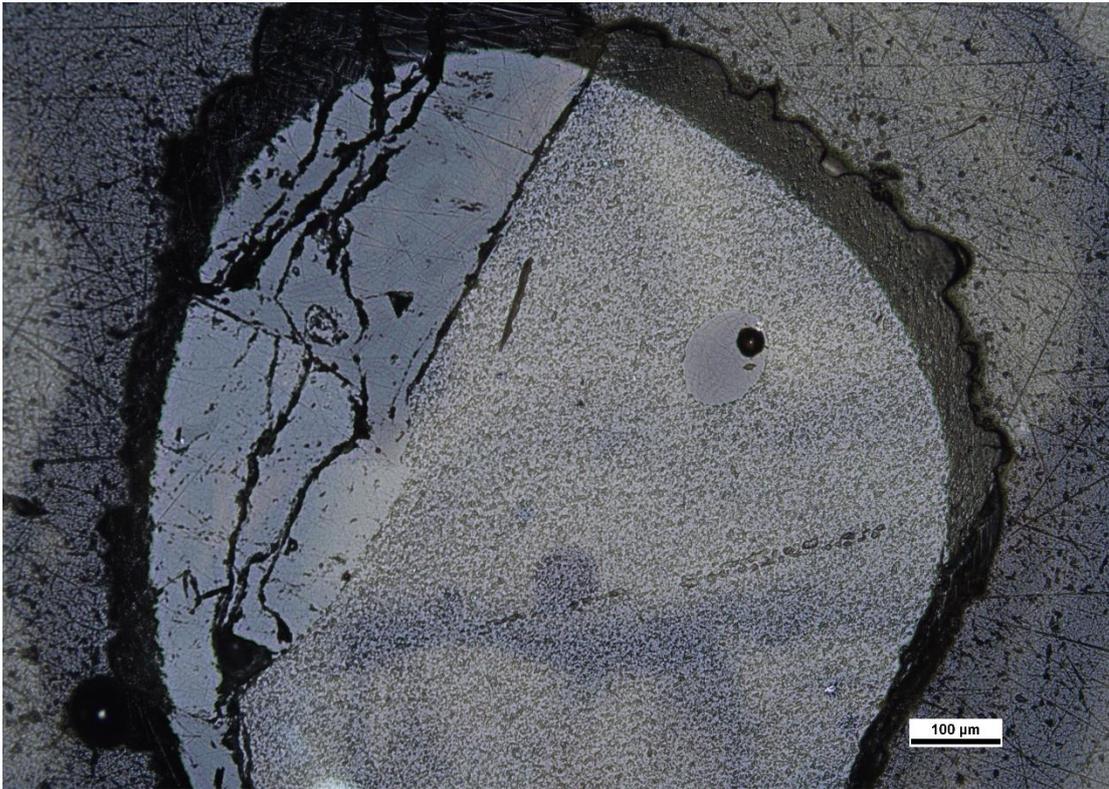


Figure S15: Holuhraun melt inclusion compositions from Hartley et al. (2018) and the average melt composition determined for use in modelling.

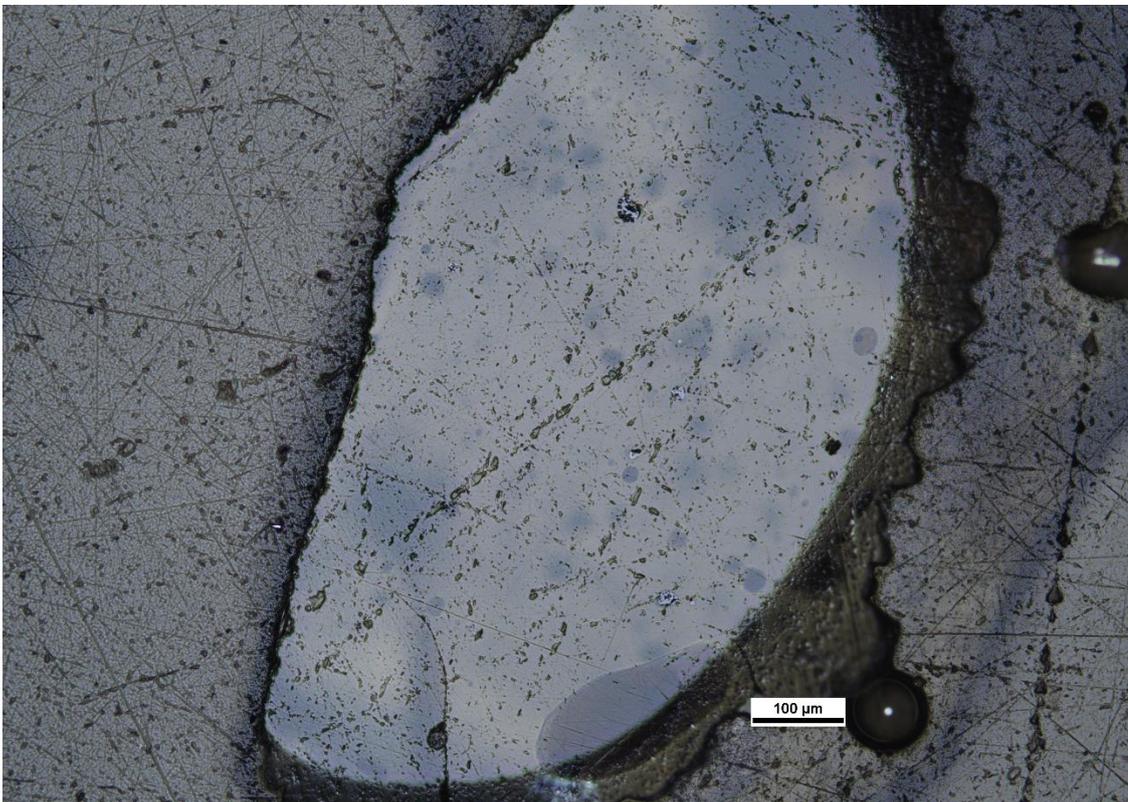
D. Melt inclusion reflected light images

Mount EW2.1 – Snæfellsjökull melt inclusions

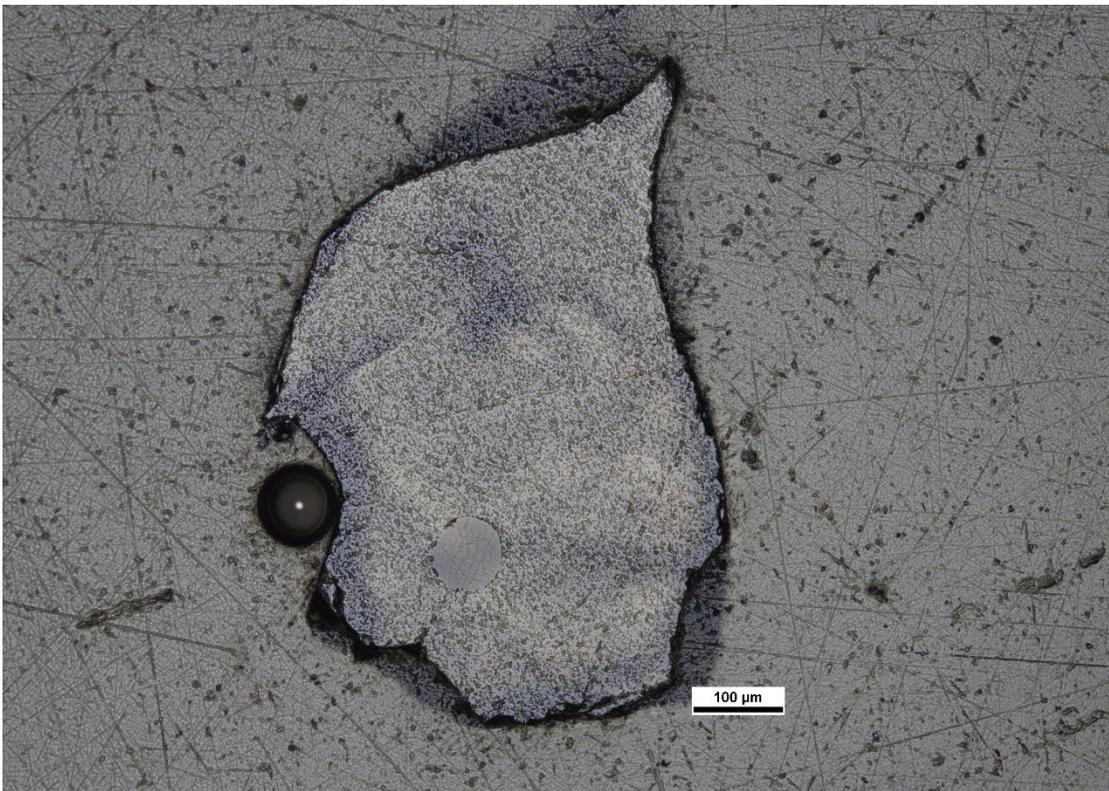
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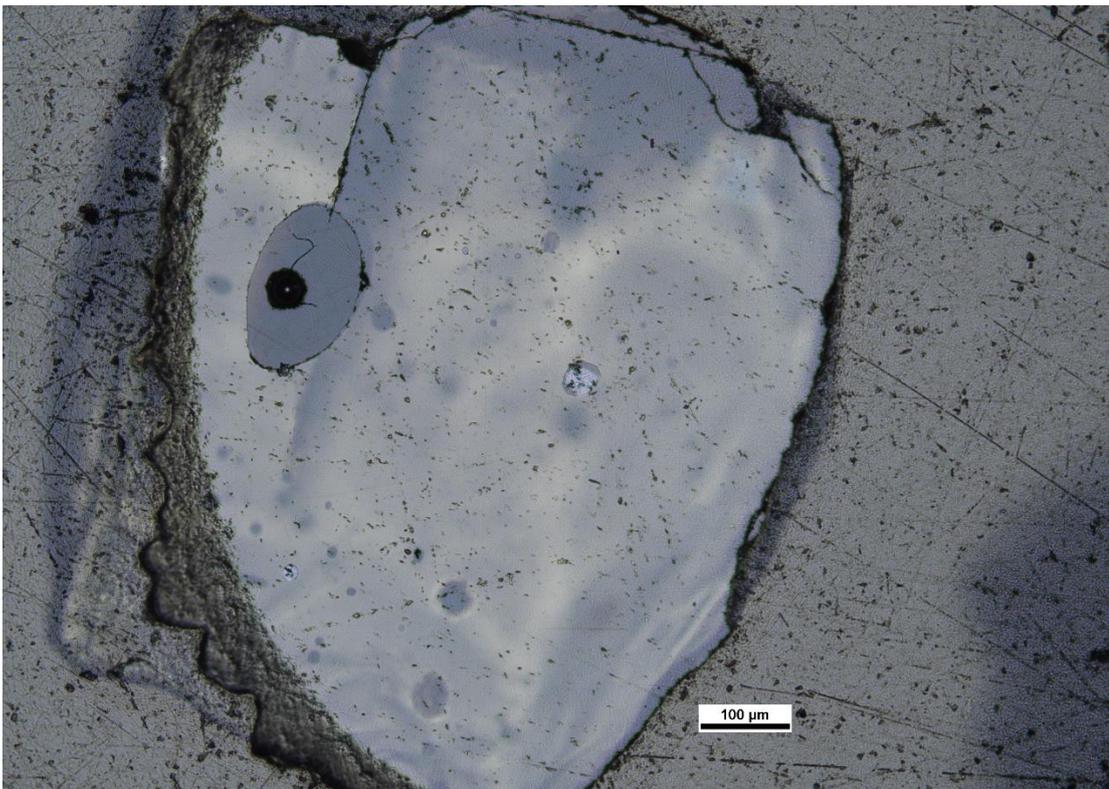
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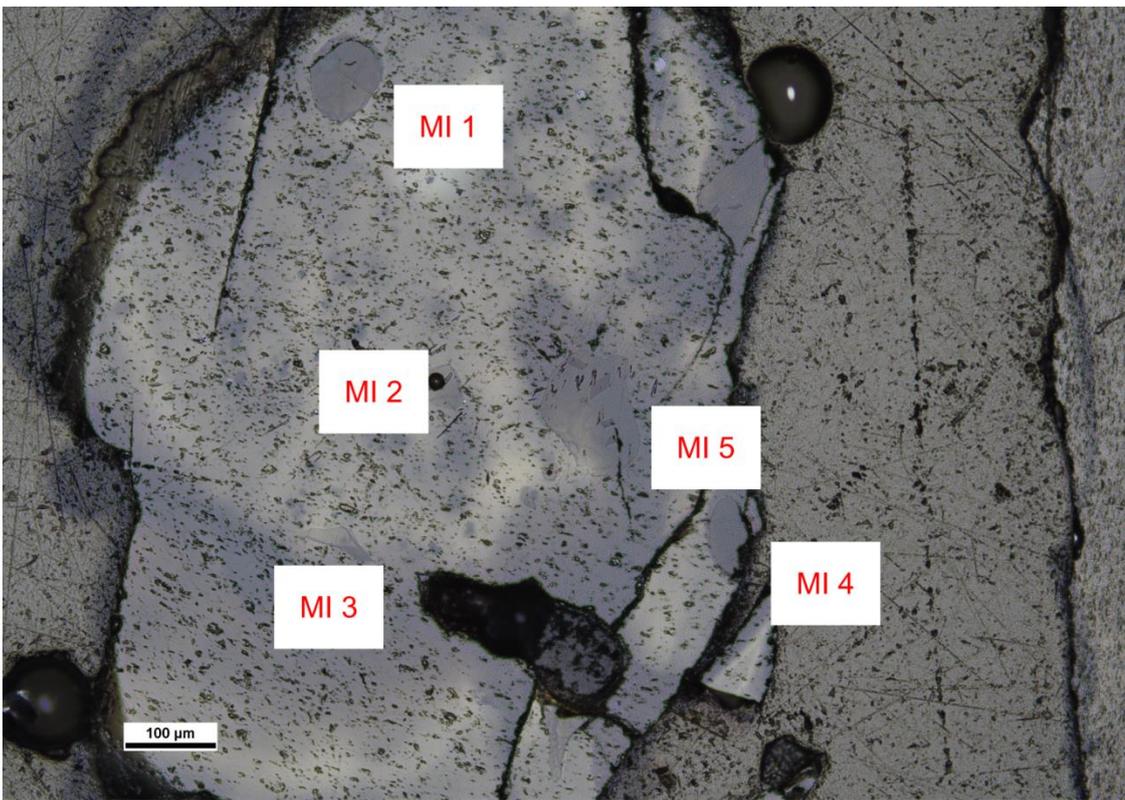
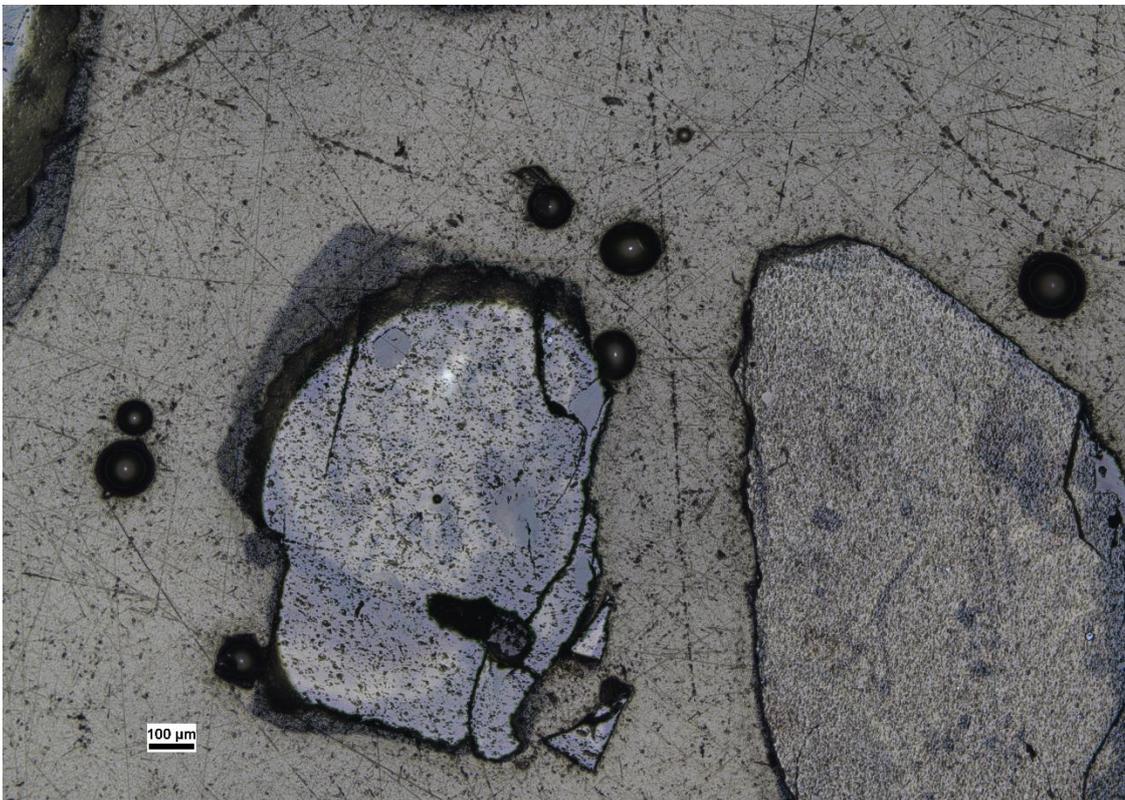
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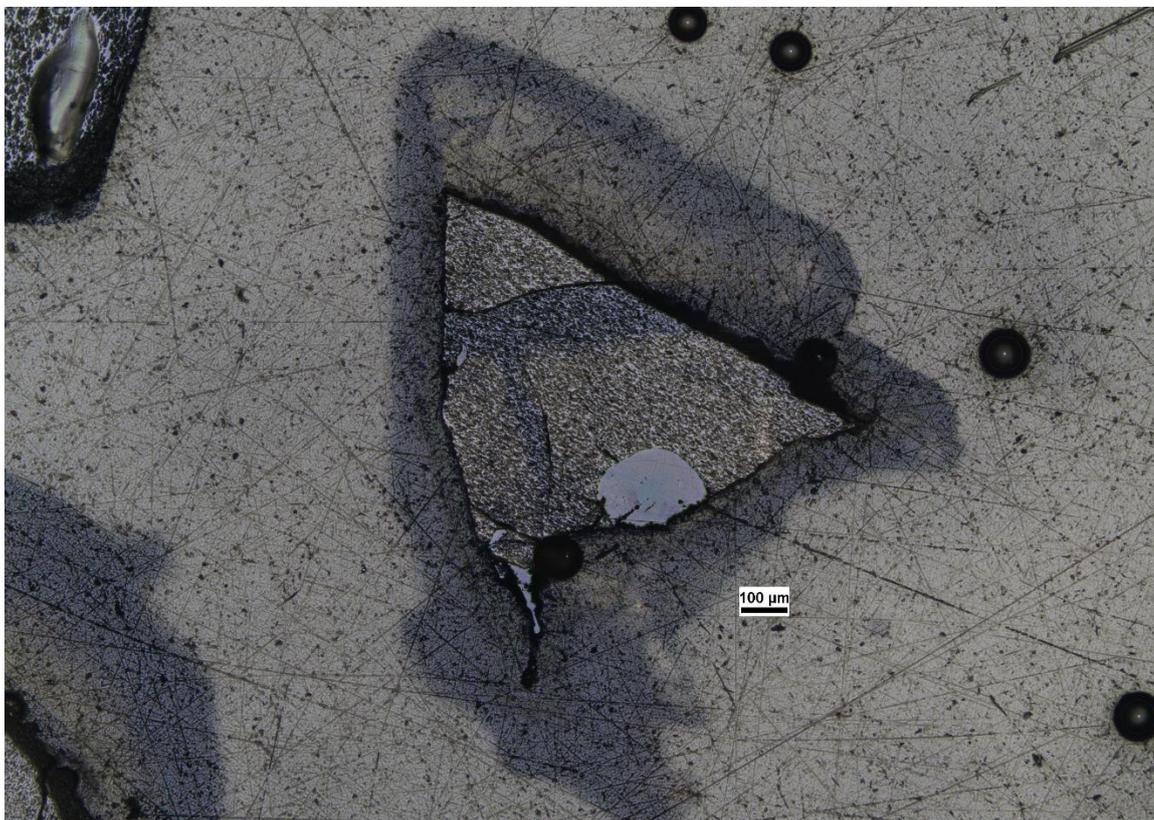
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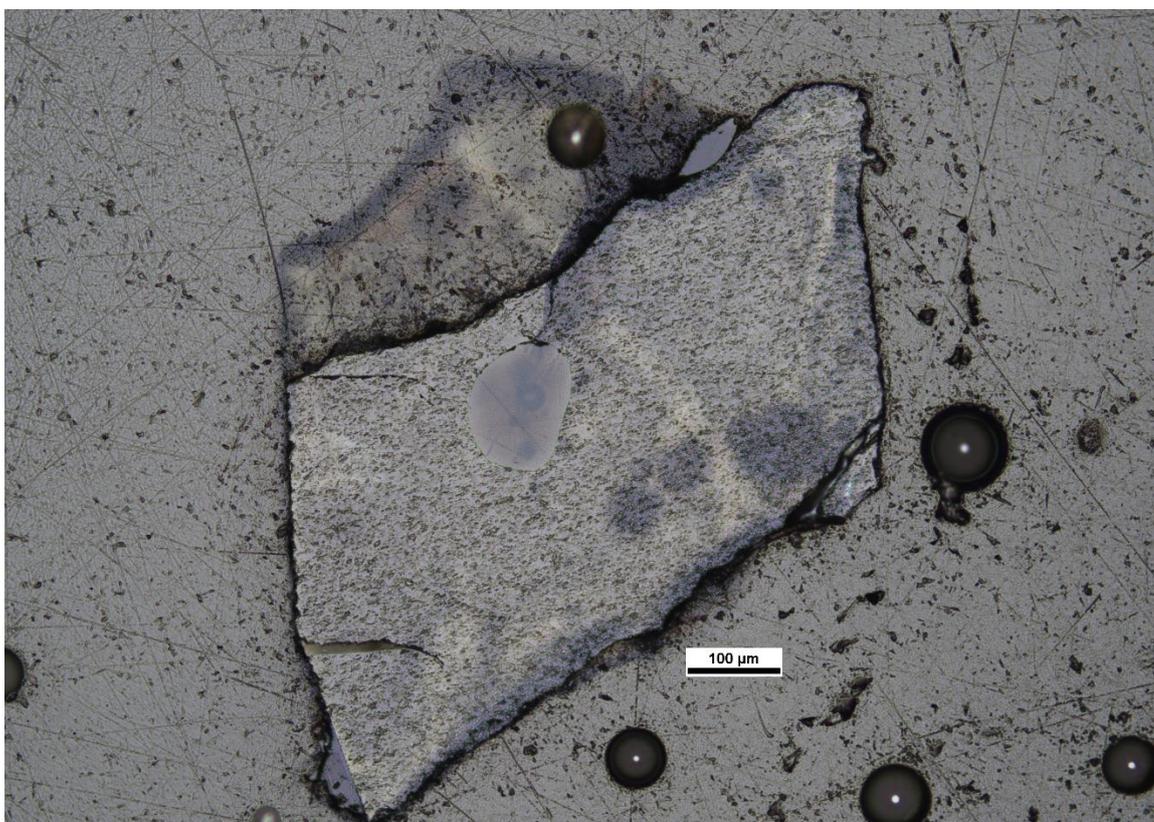
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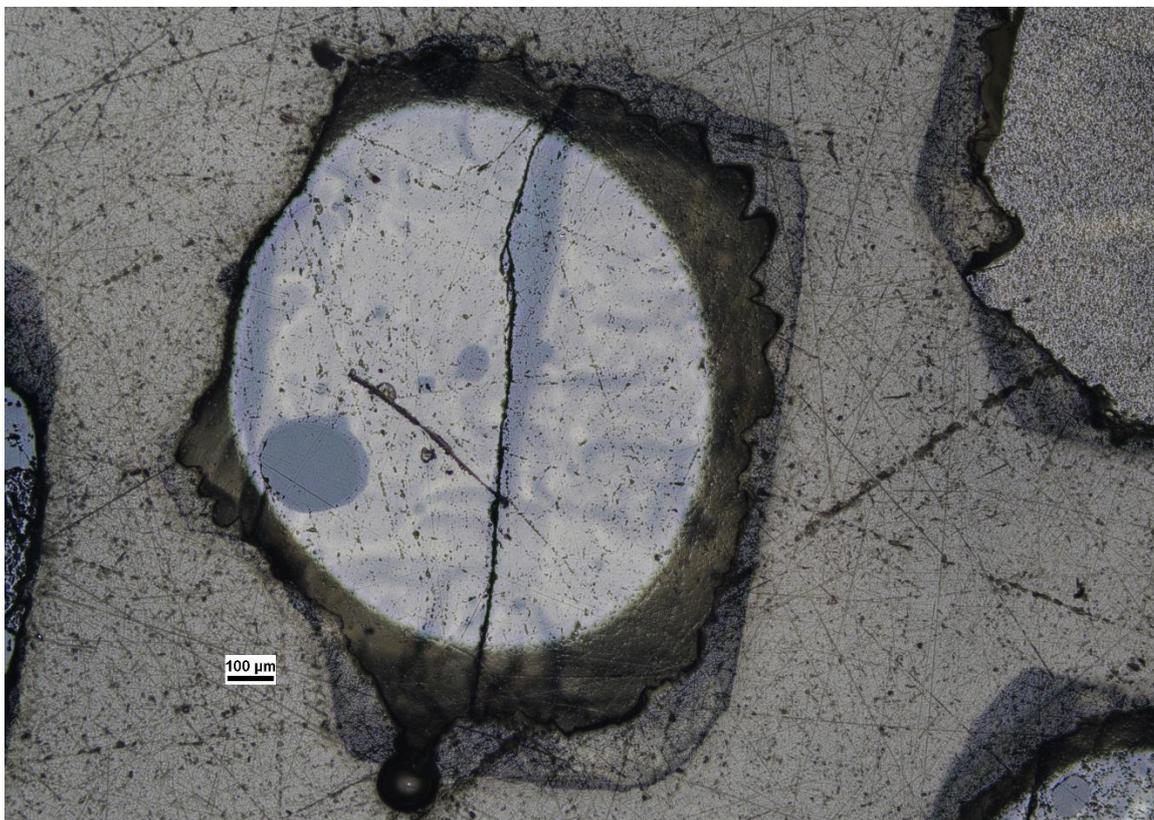
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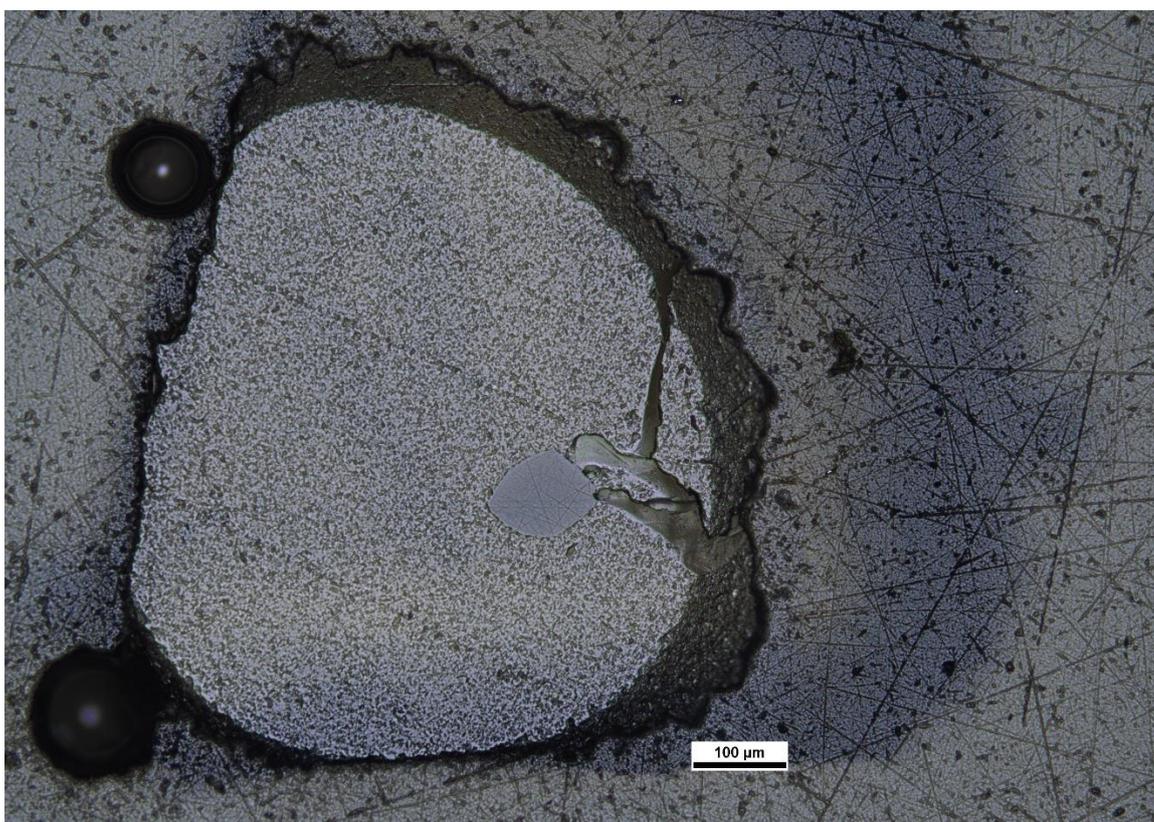
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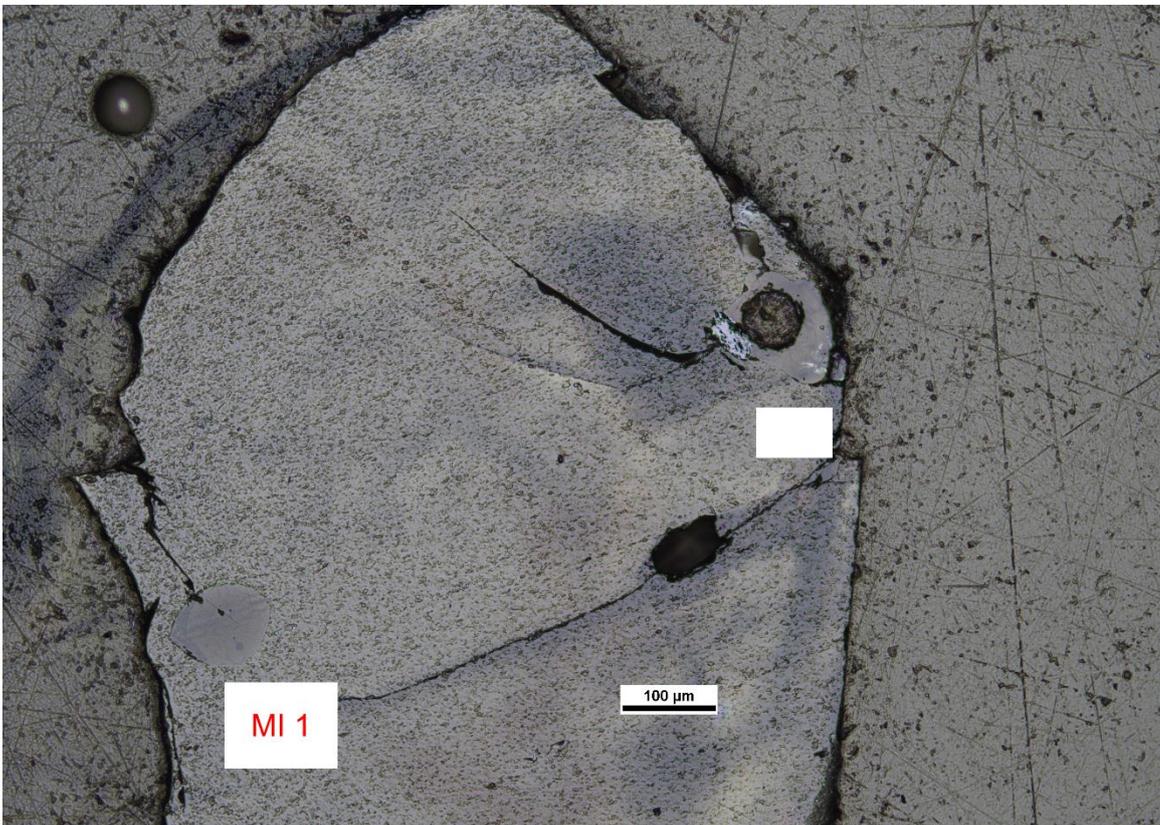
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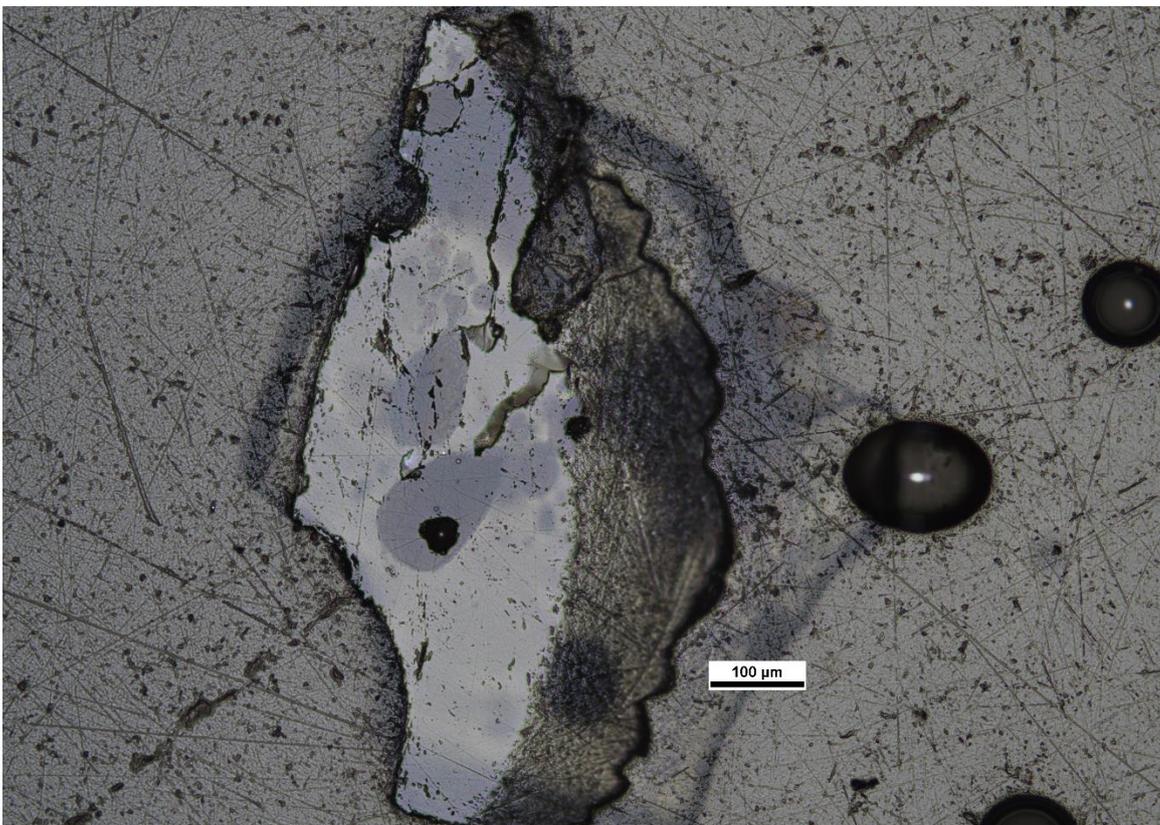
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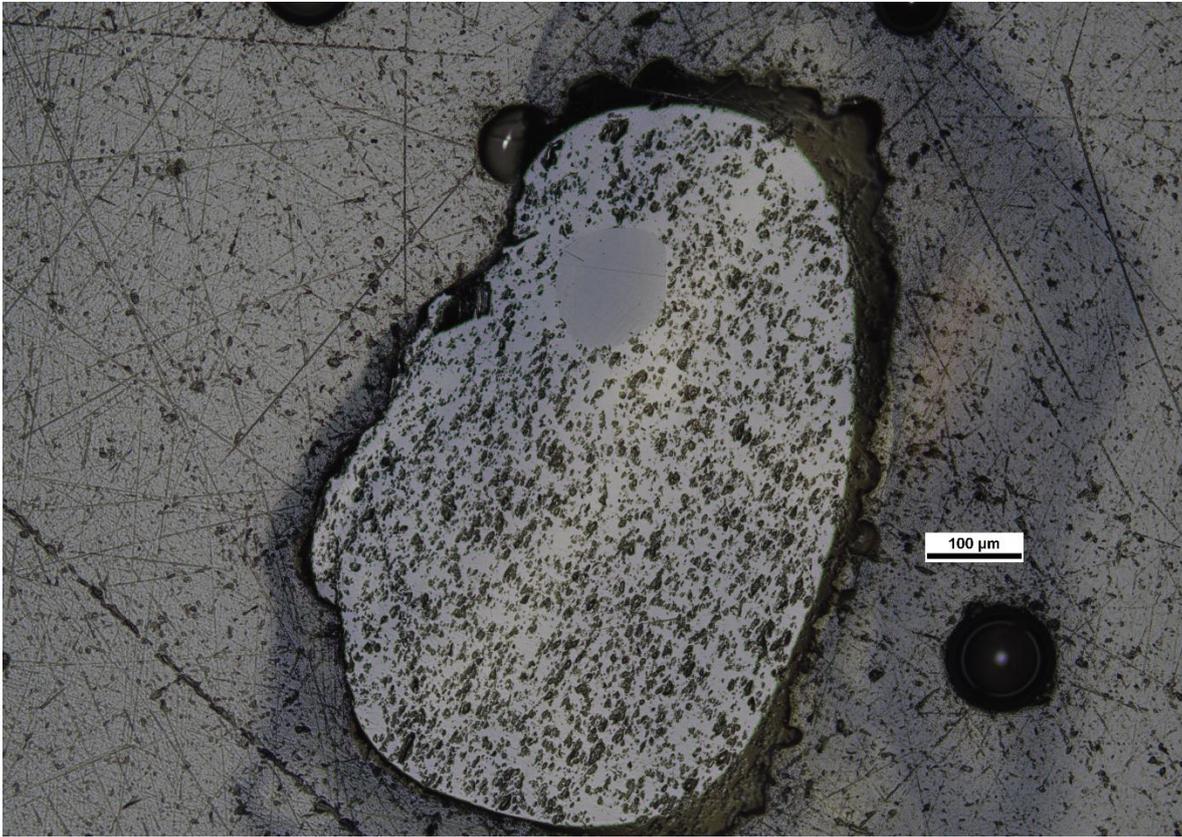
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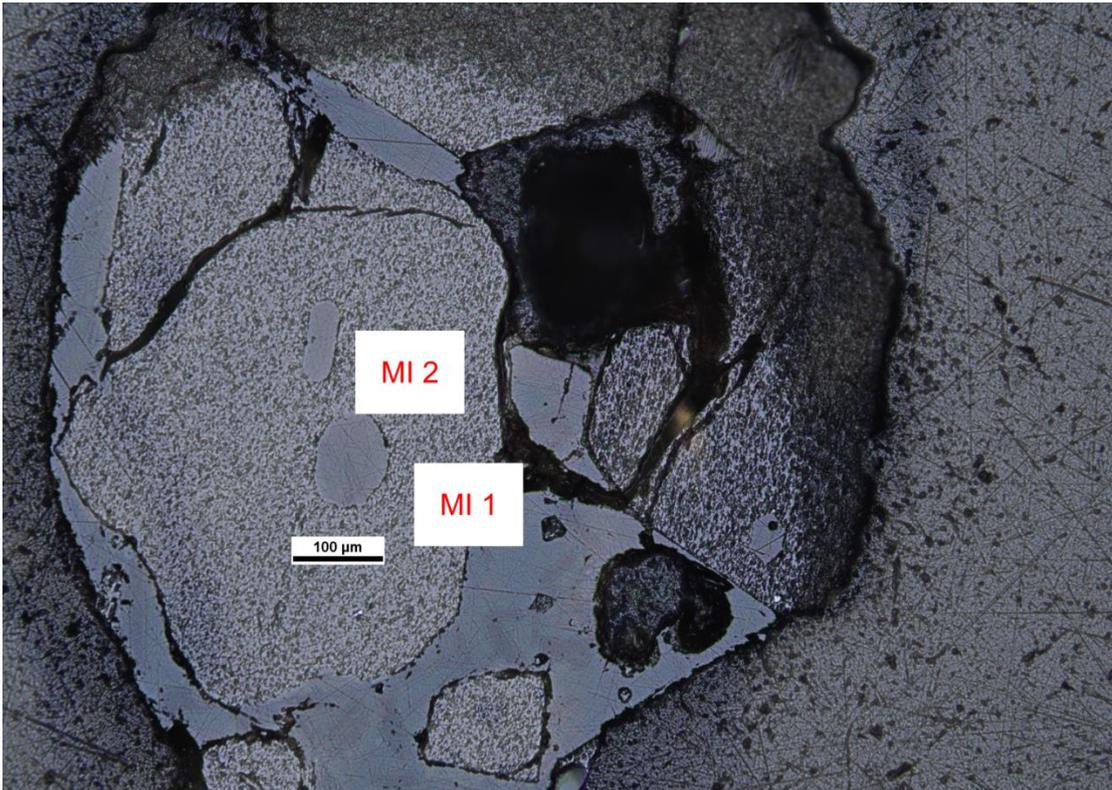
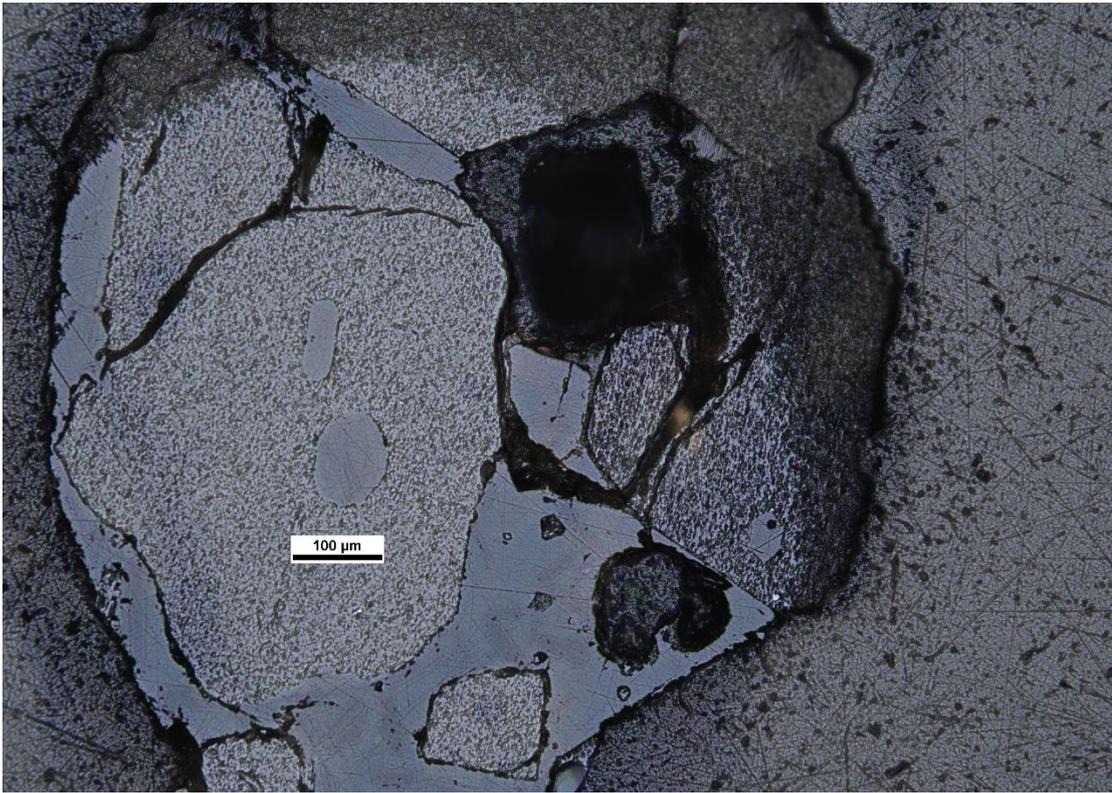
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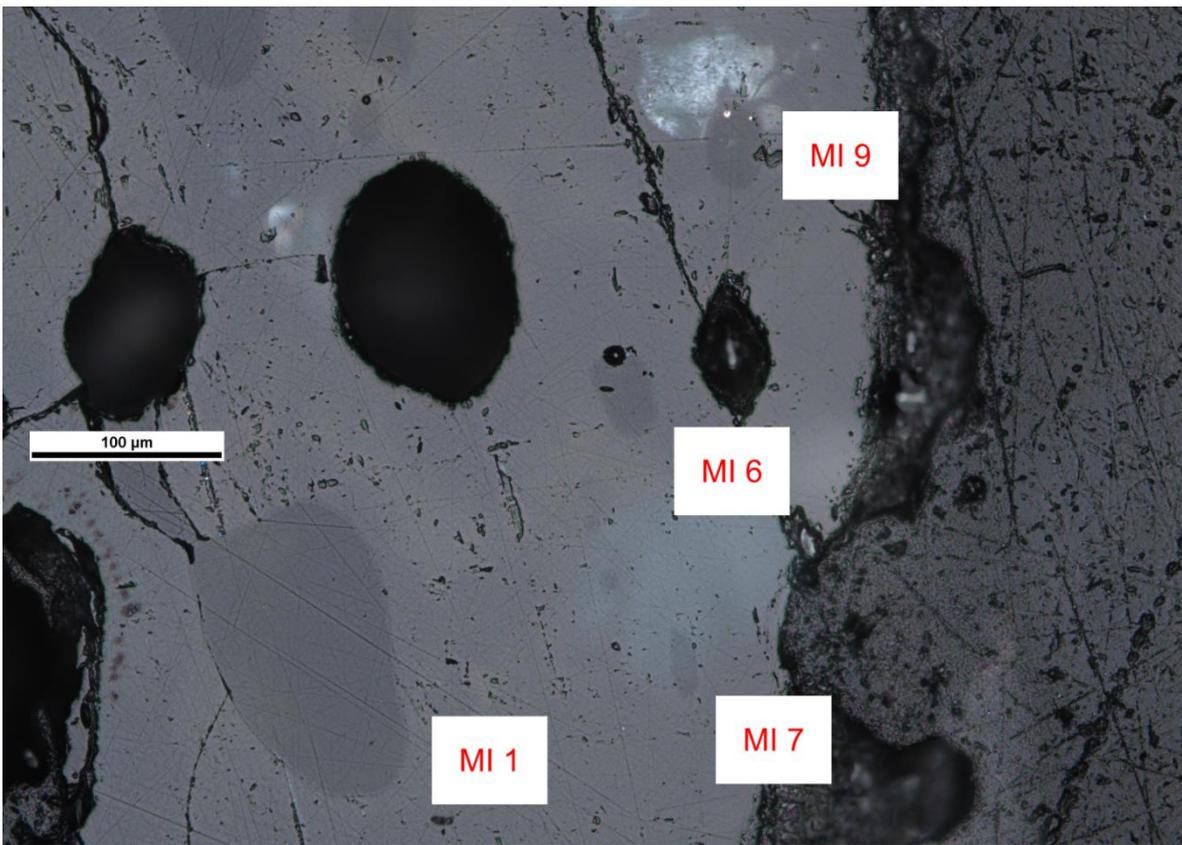
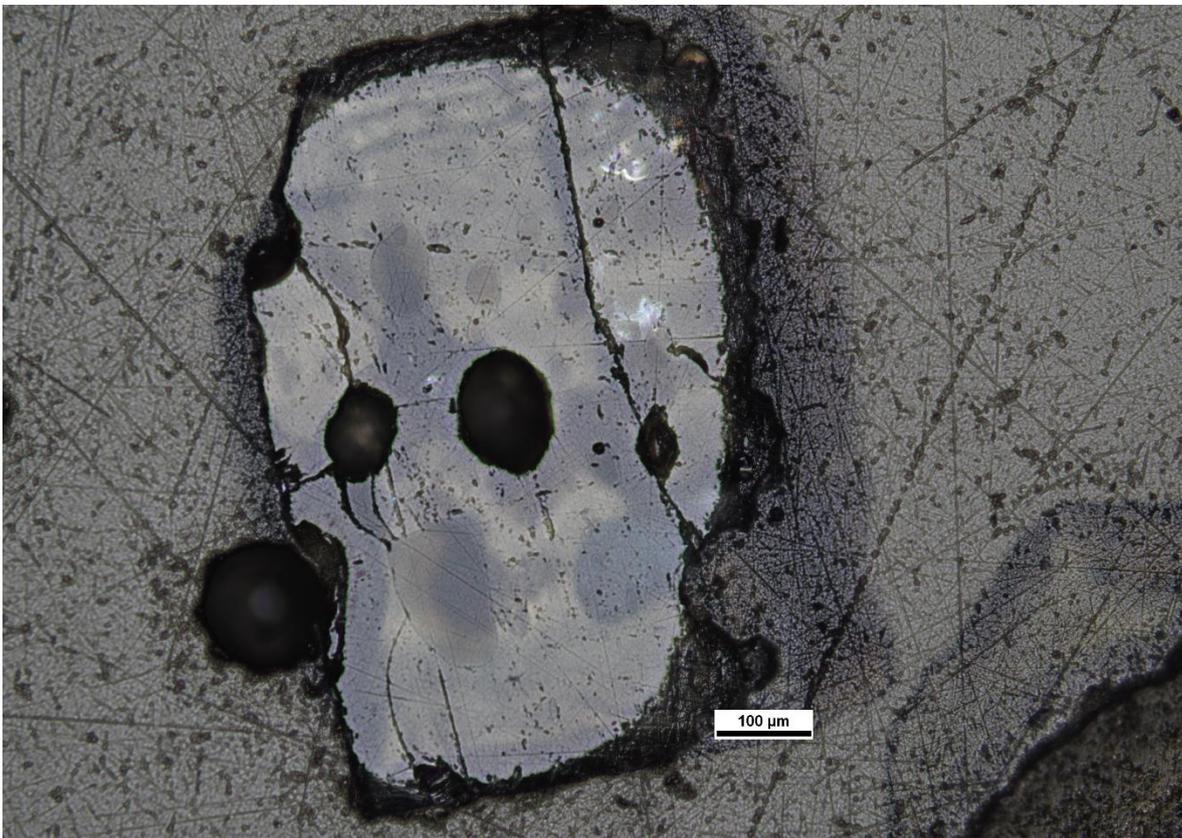
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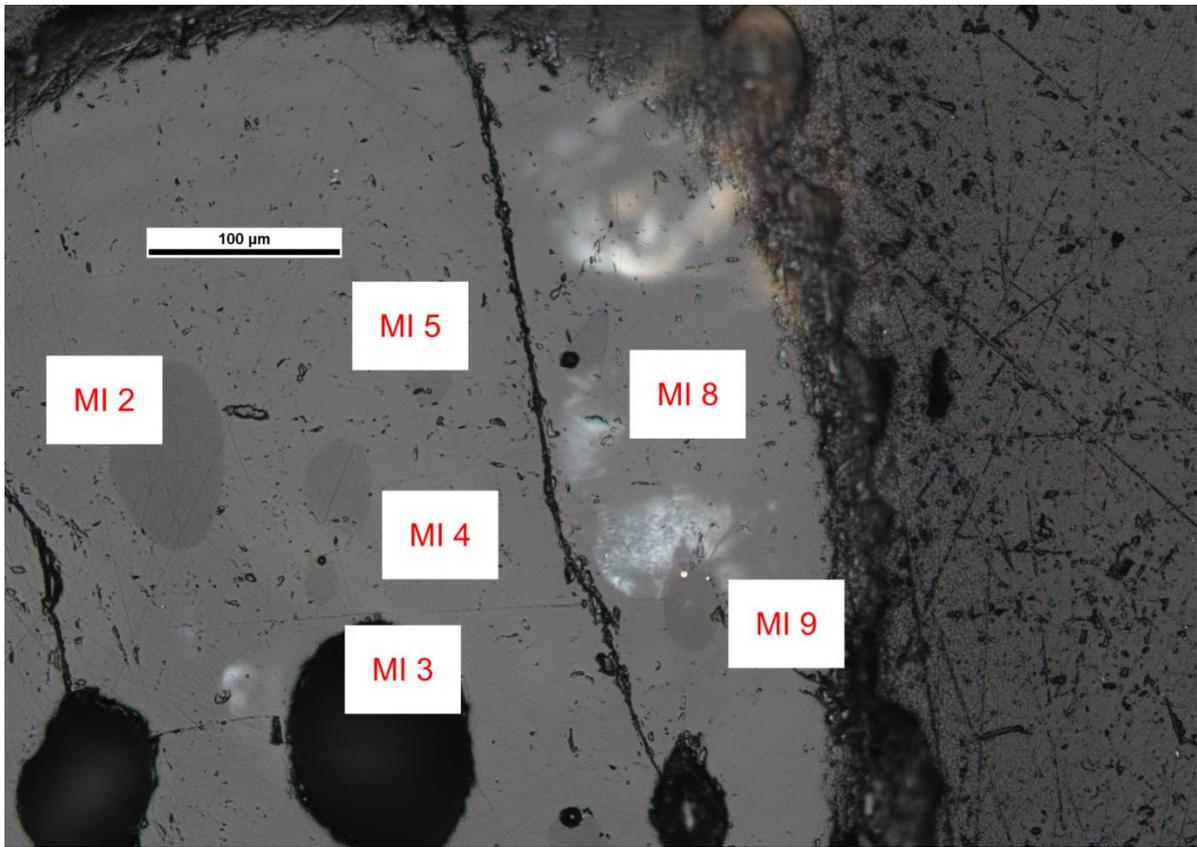


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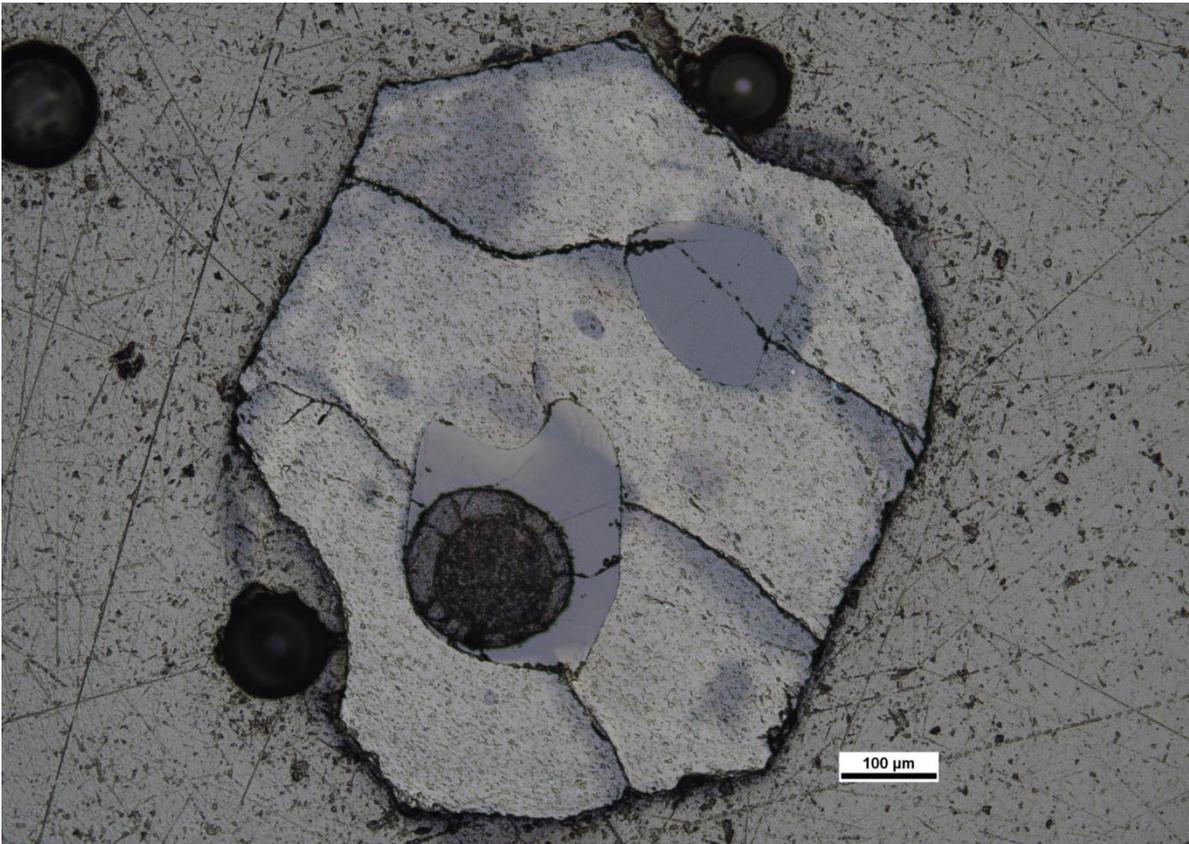


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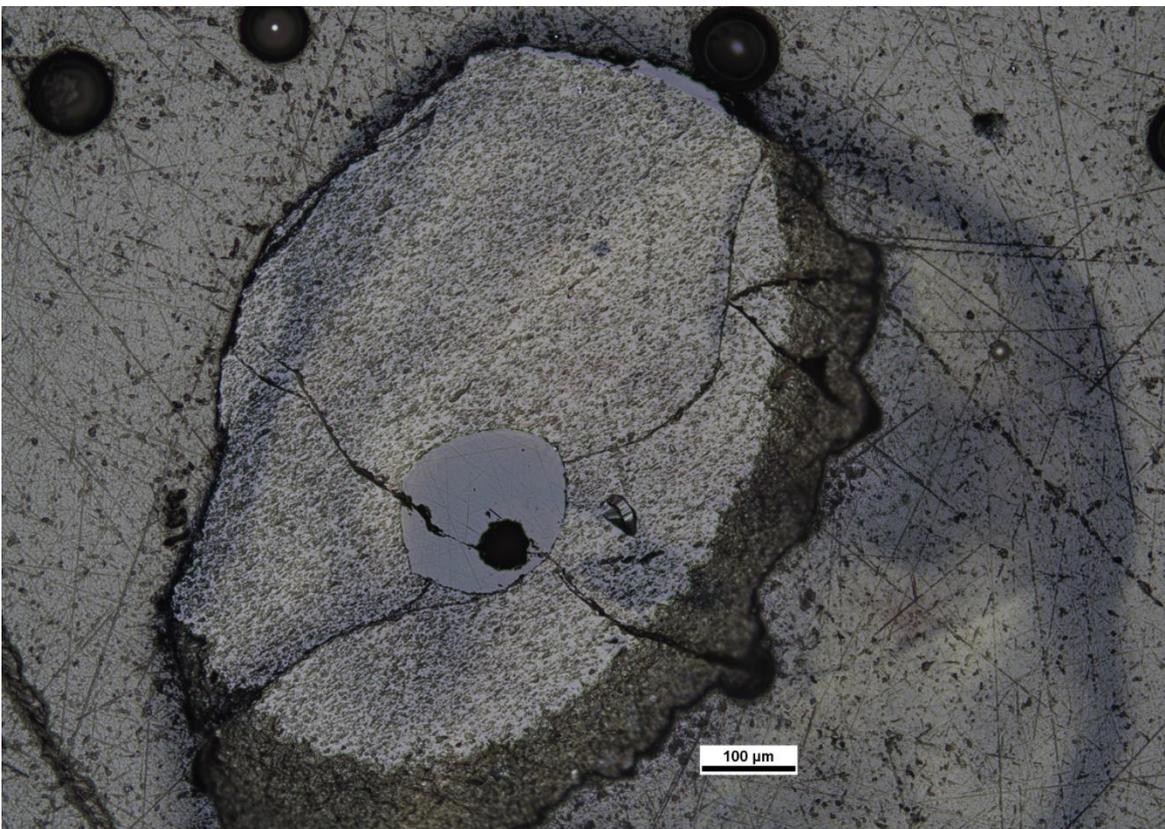




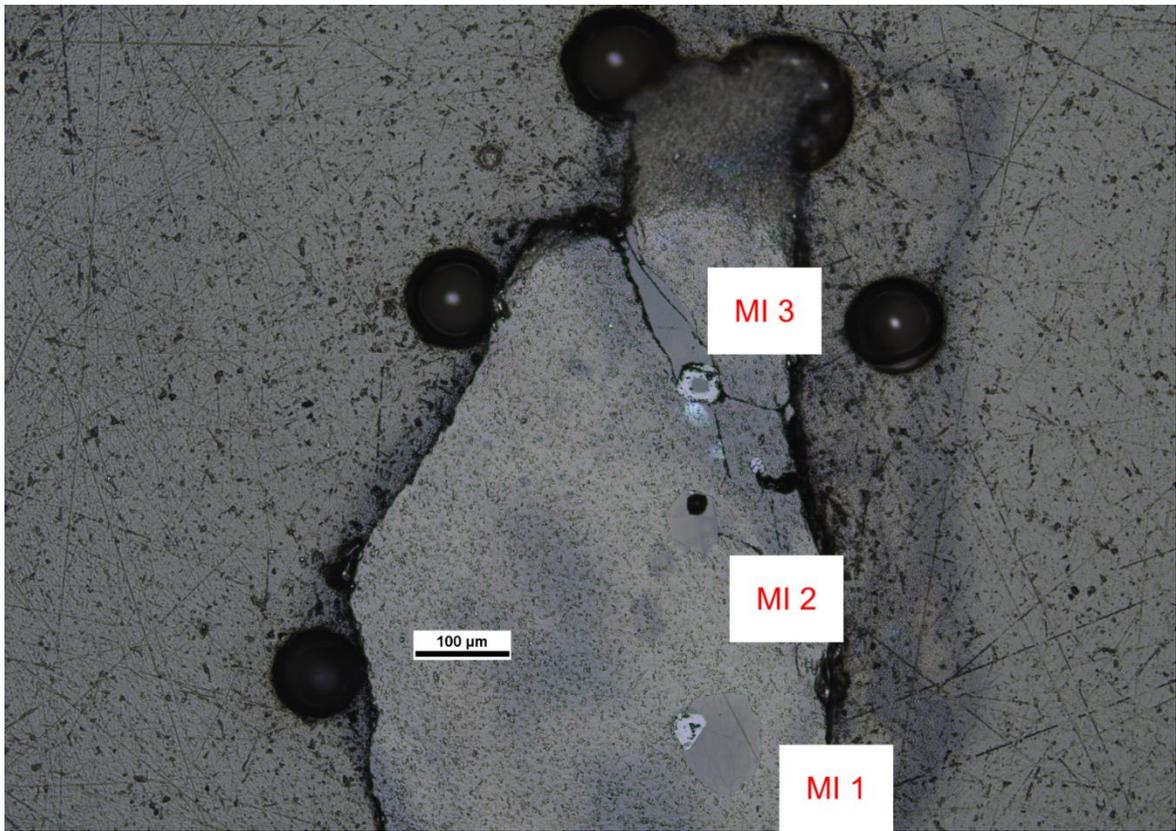
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Host Crystal 32

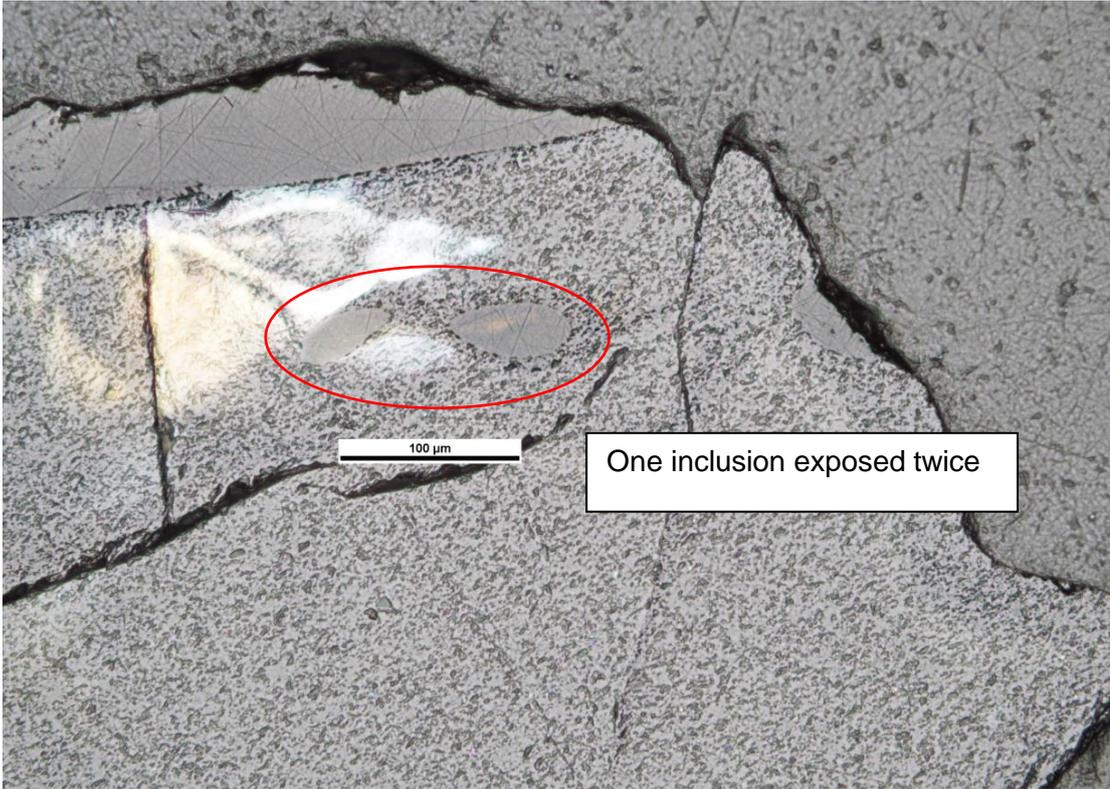


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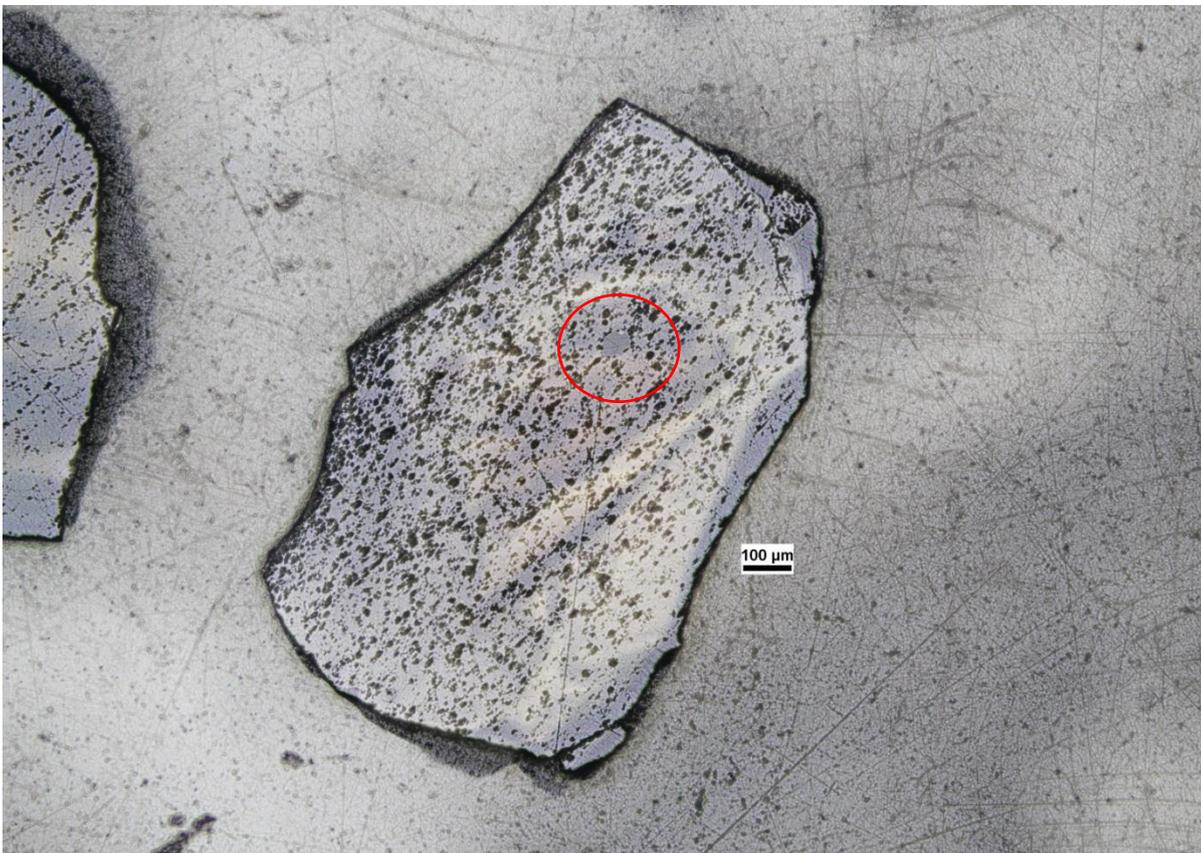


Mount EW1.2 – Snæfellsjökull melt inclusions

Host Crystal 3



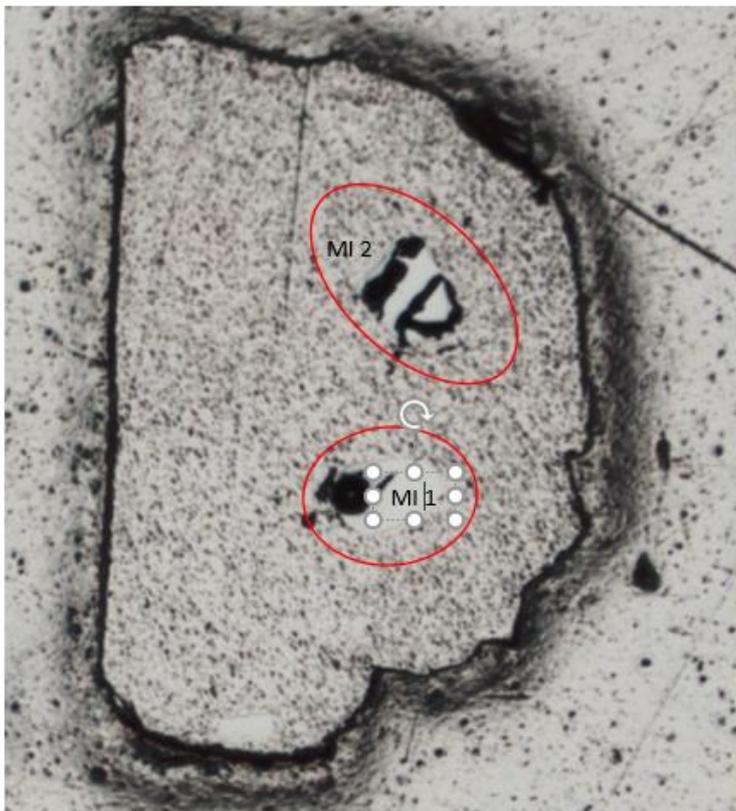
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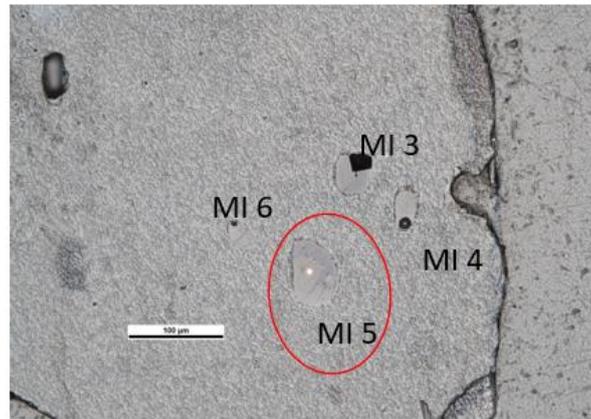
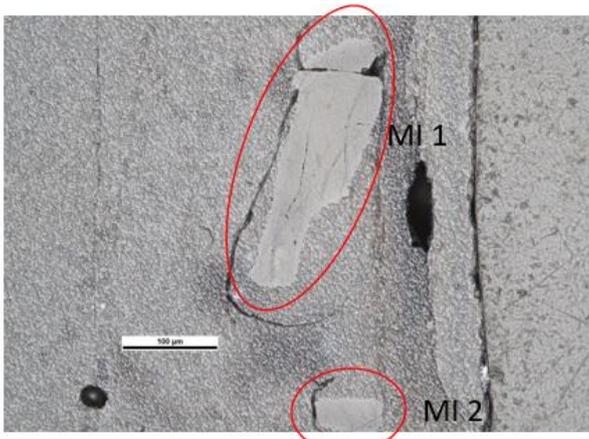
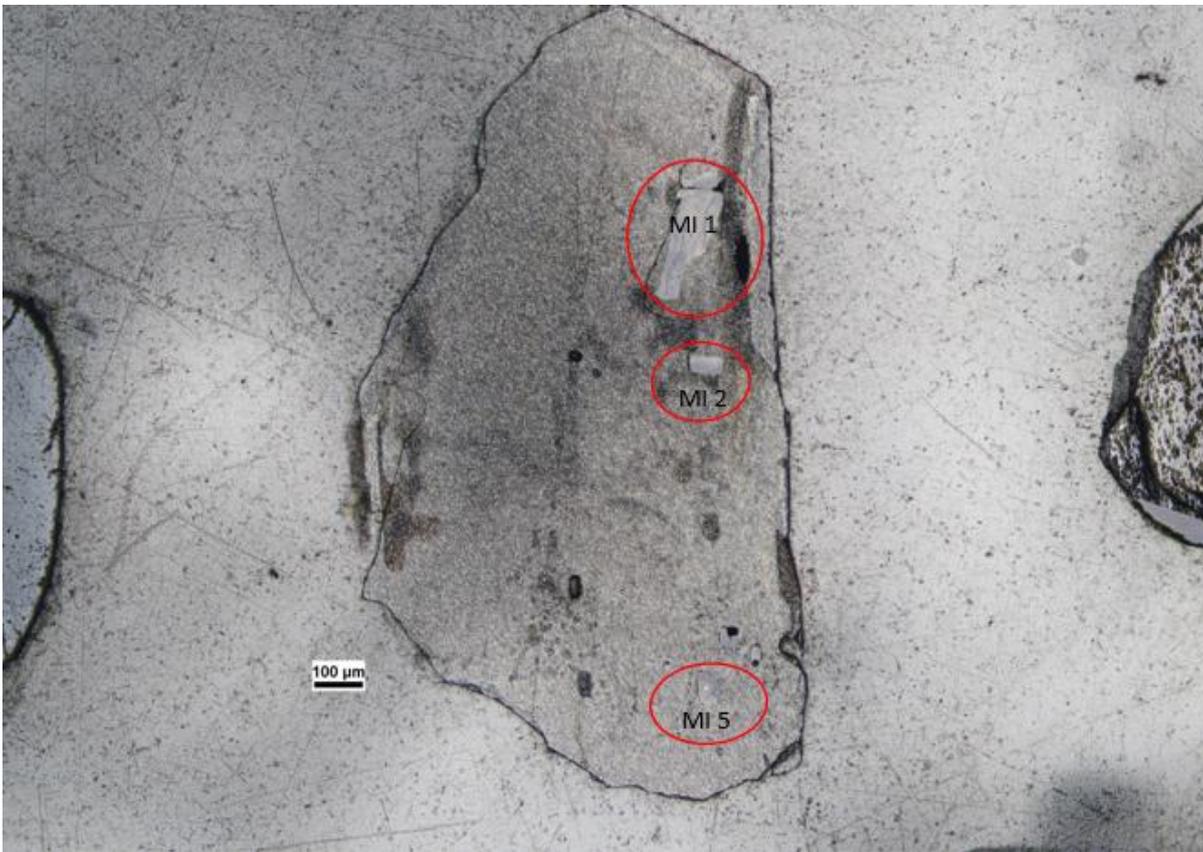
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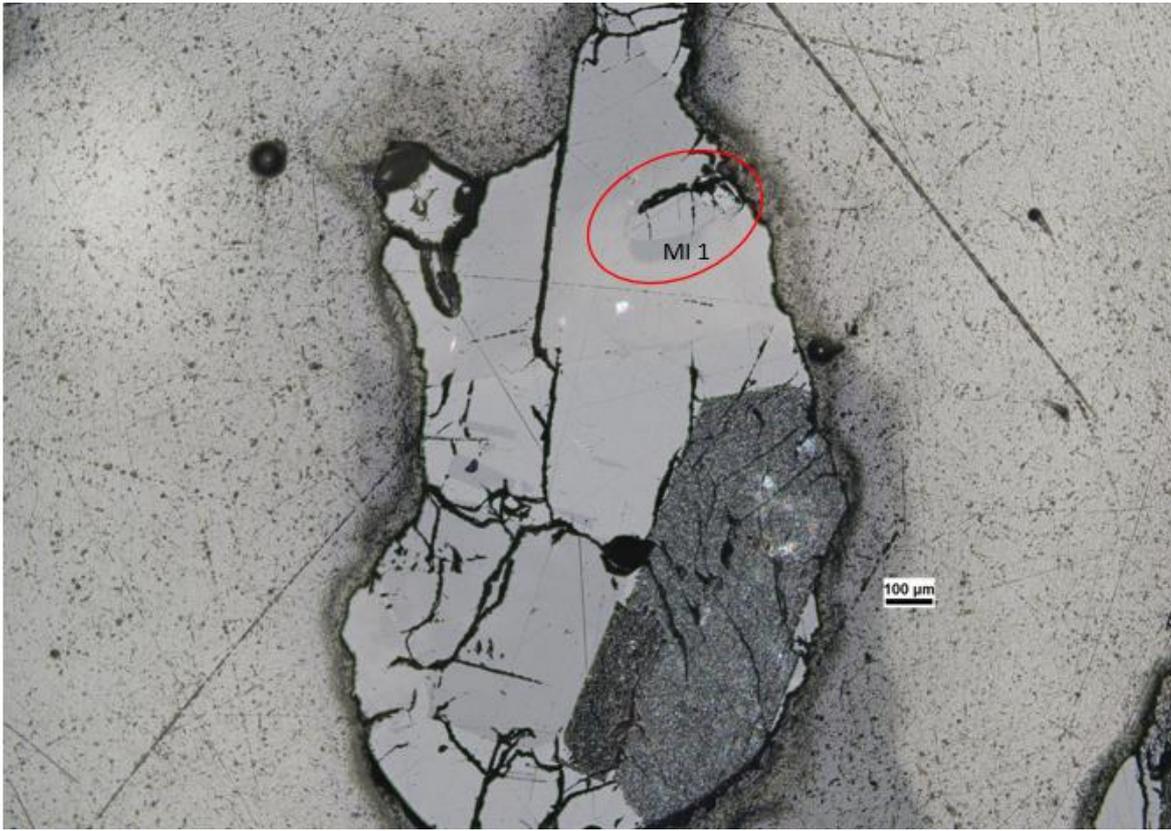
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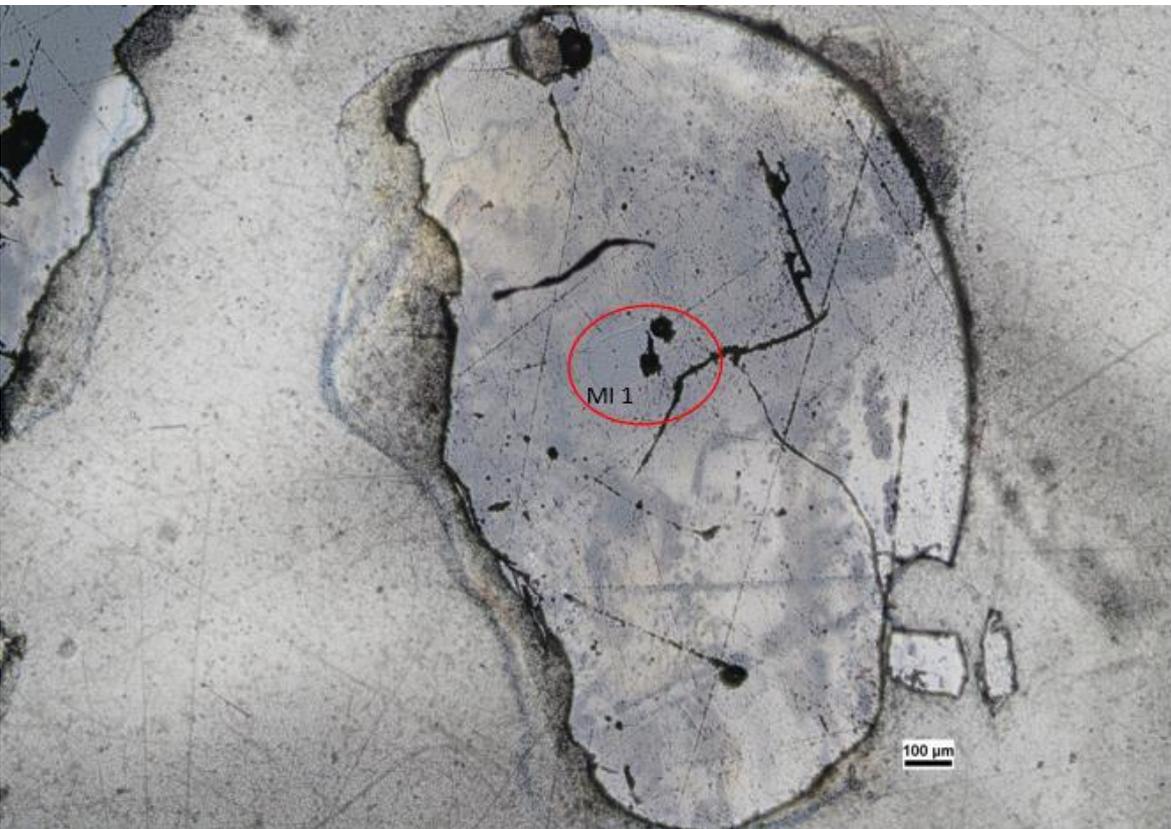
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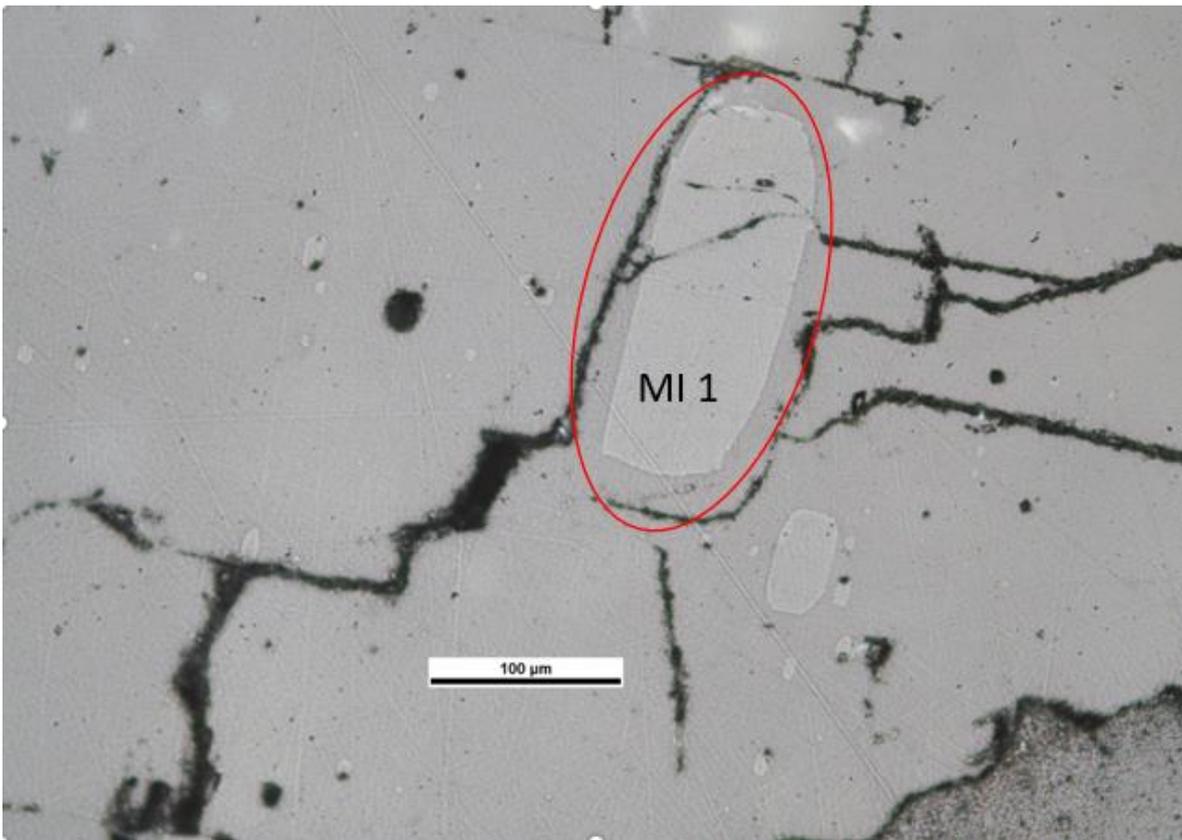
Host Crystal 21



Host Crystal 24



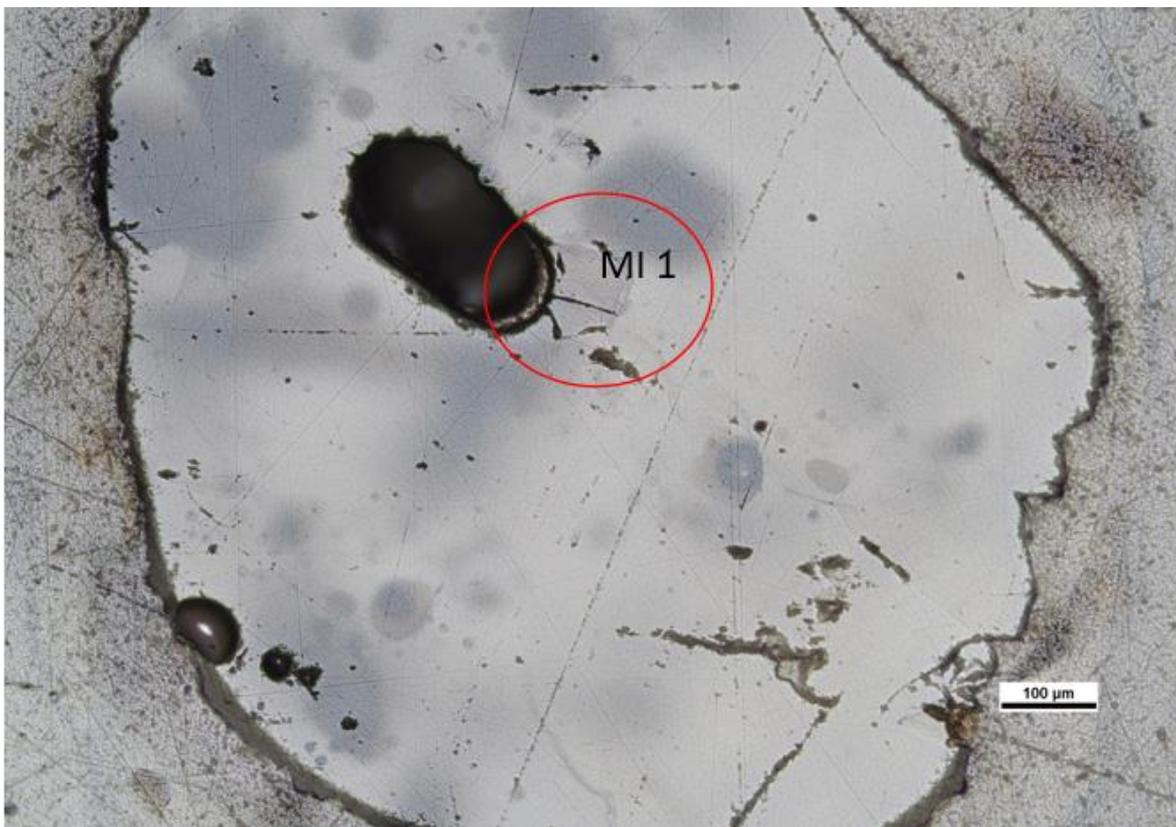
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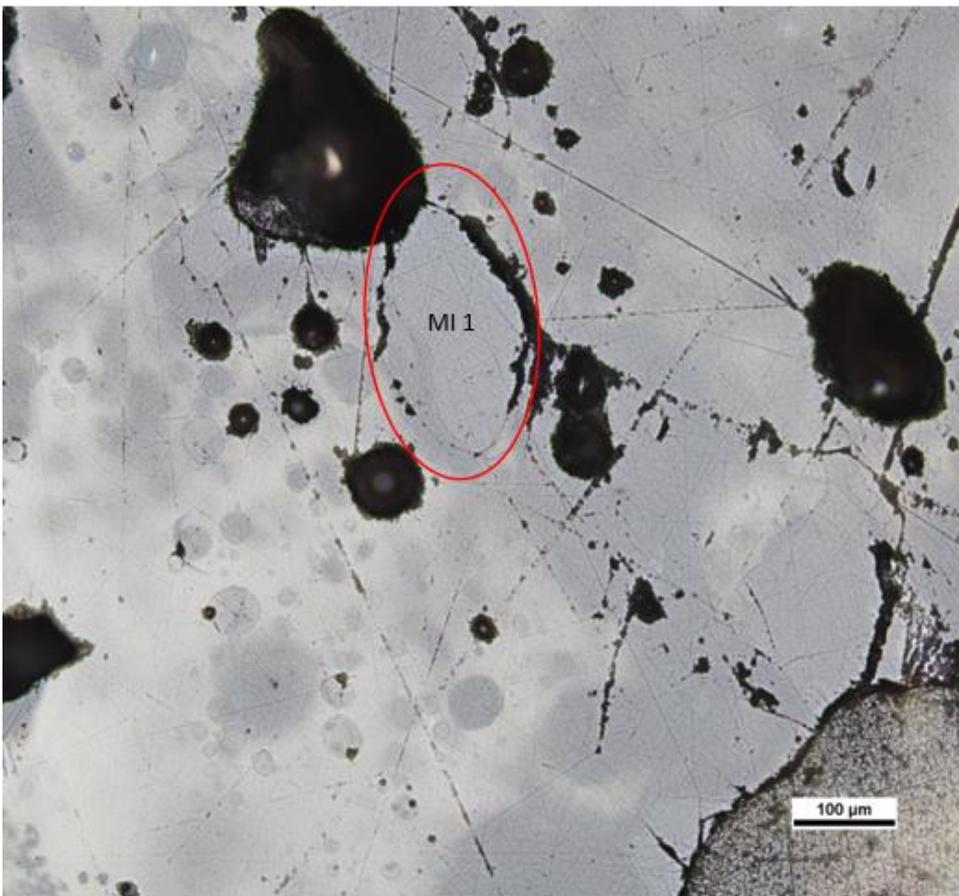
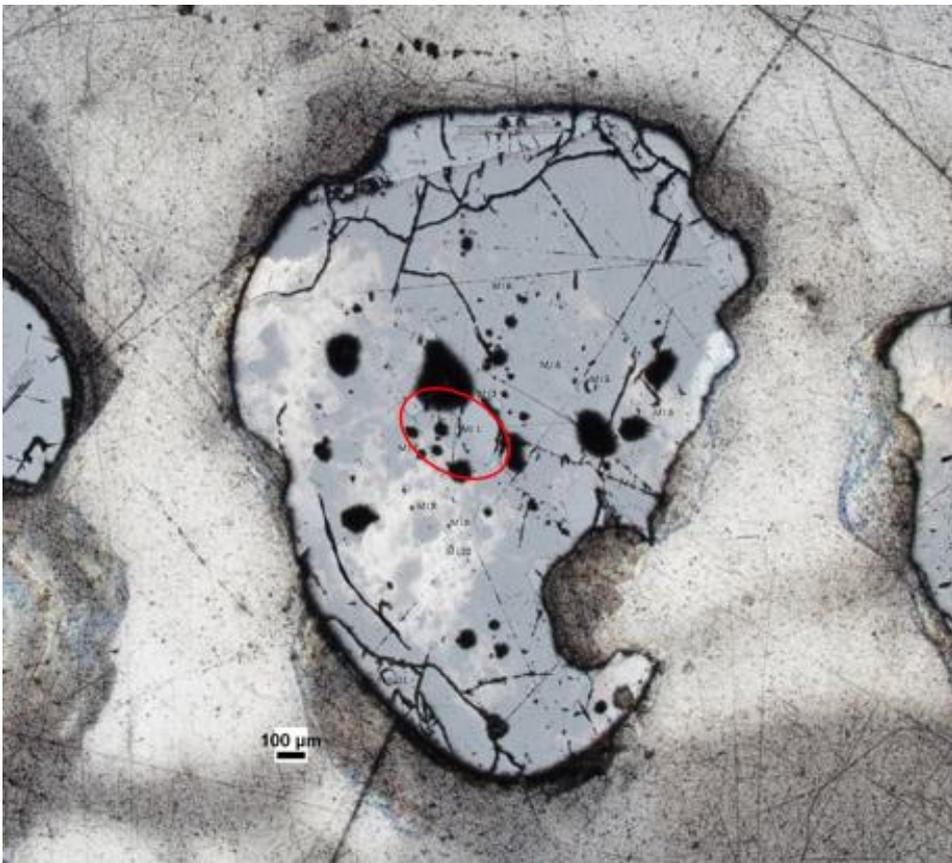
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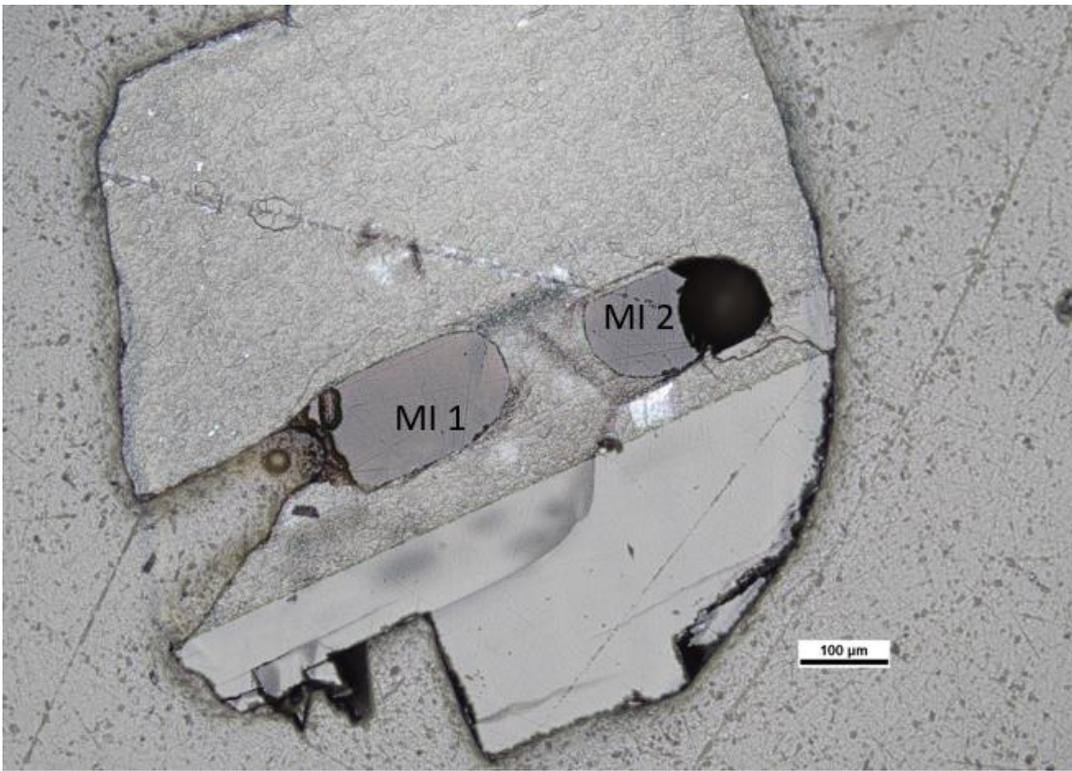
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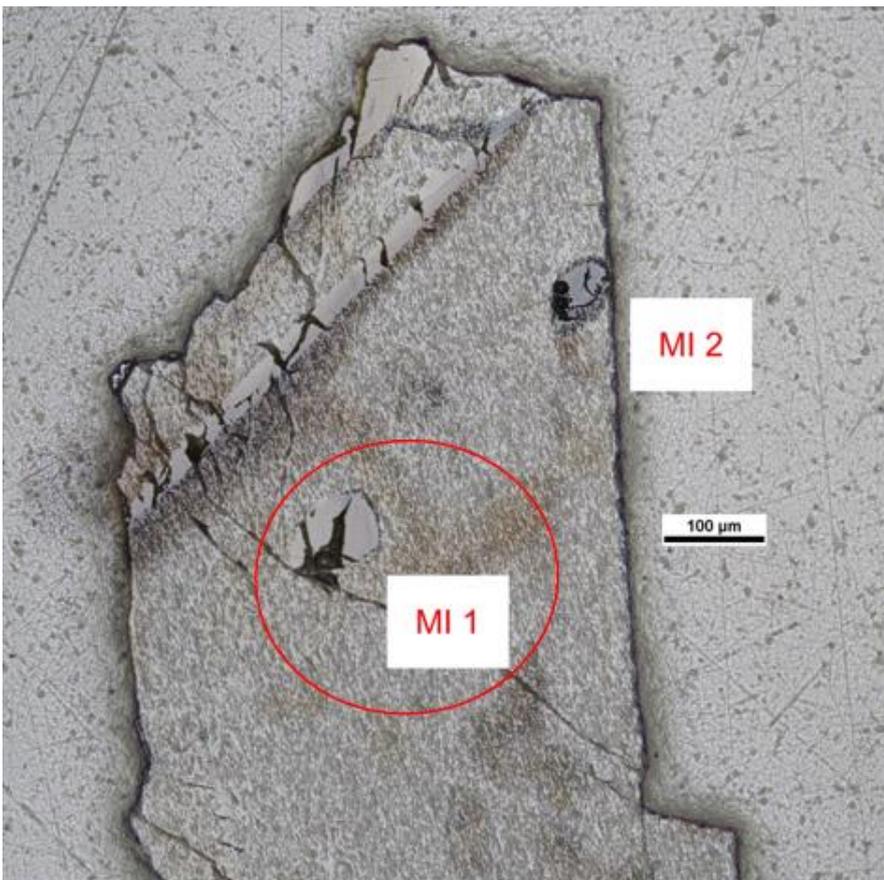
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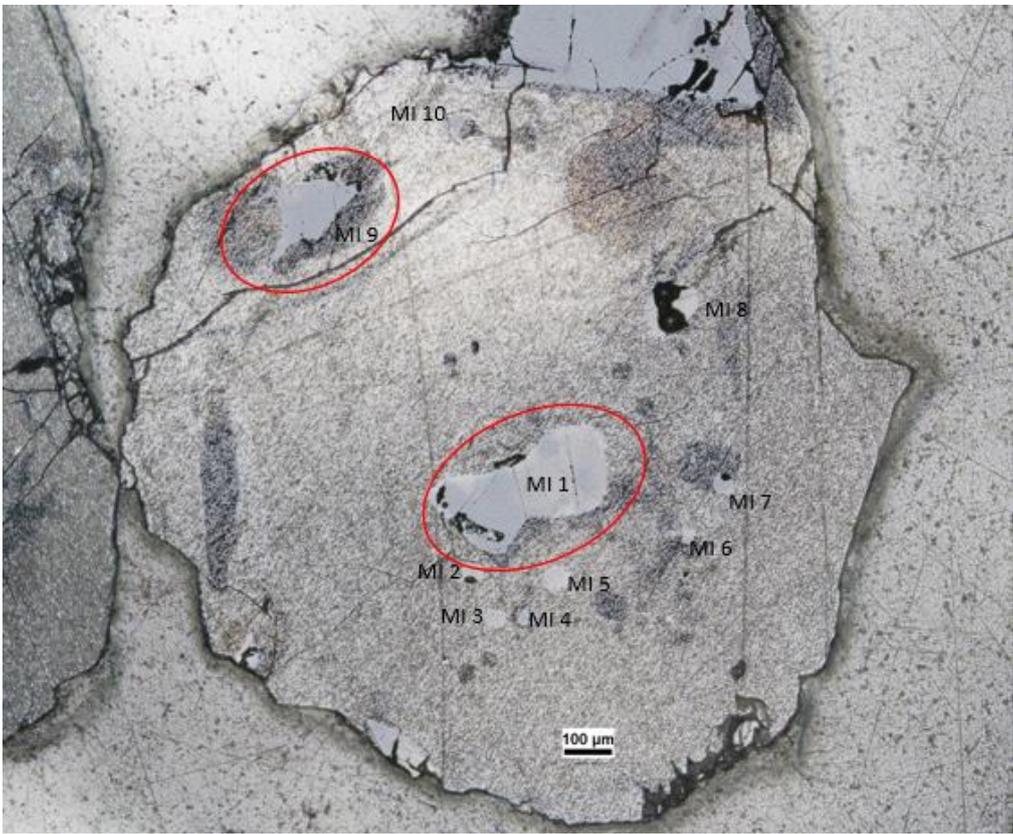
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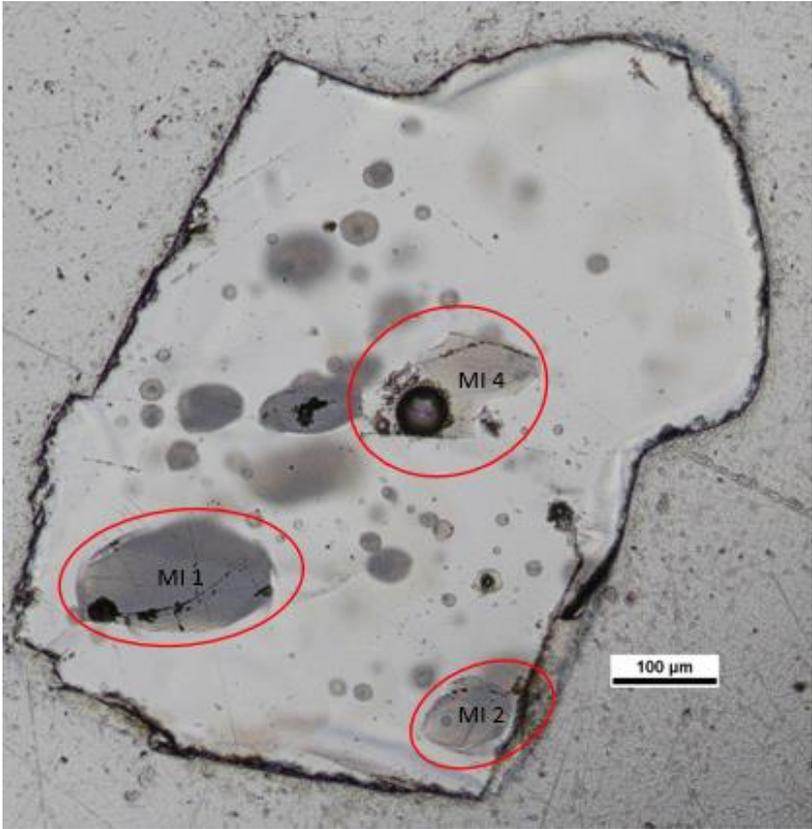
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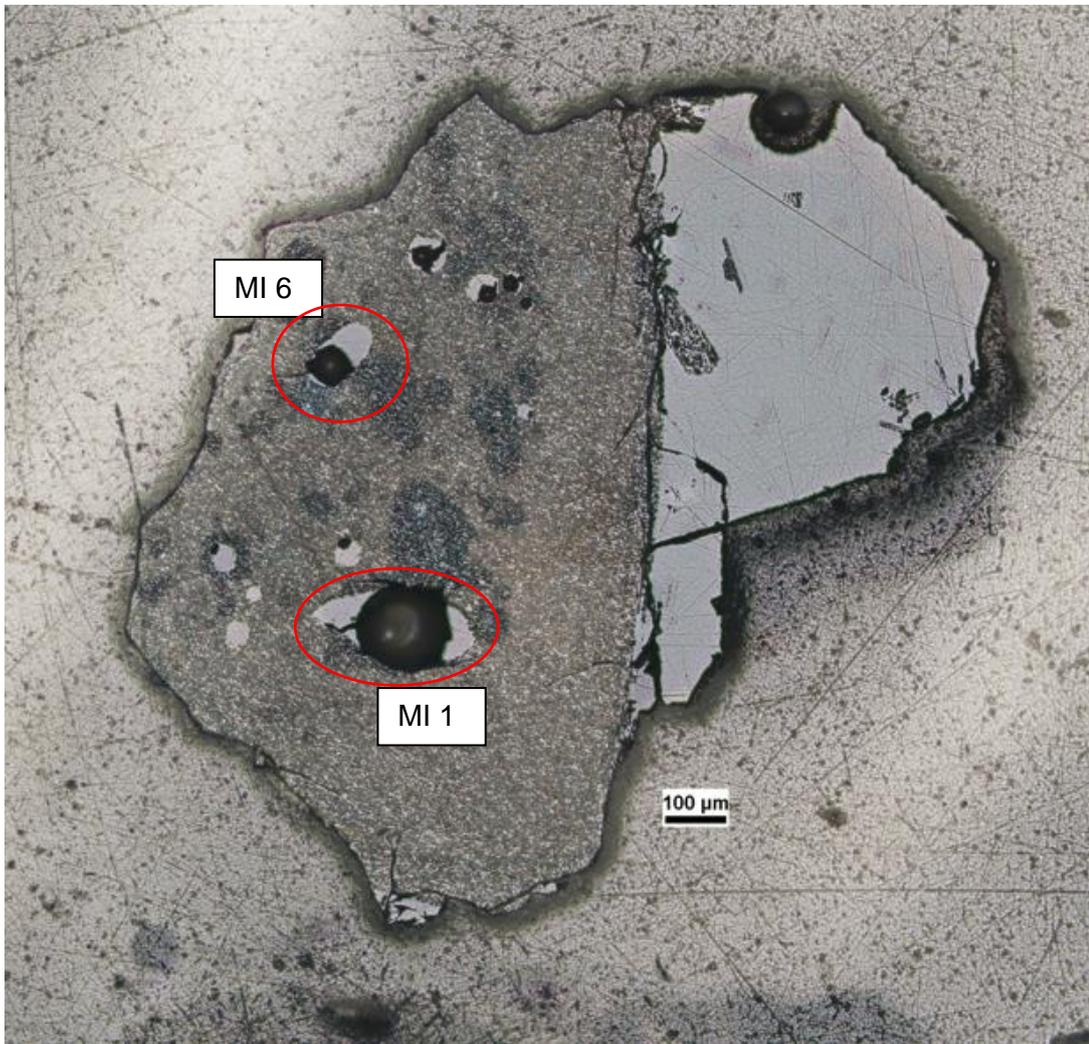
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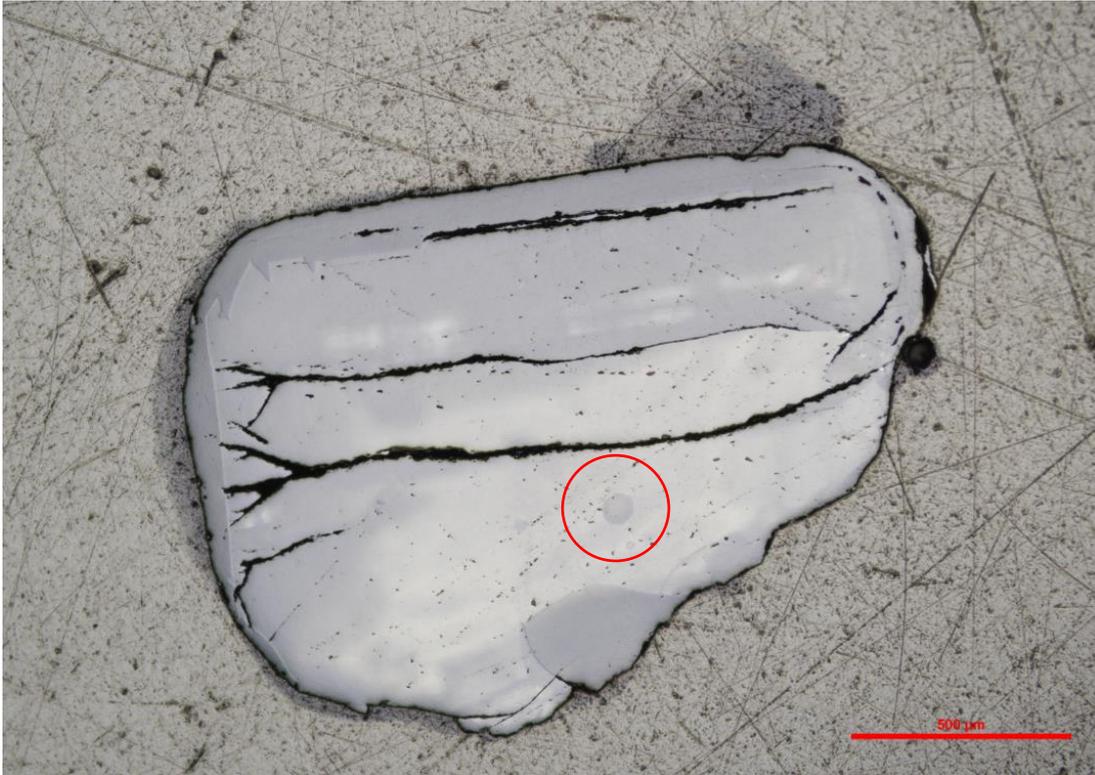


Host Crystal 46

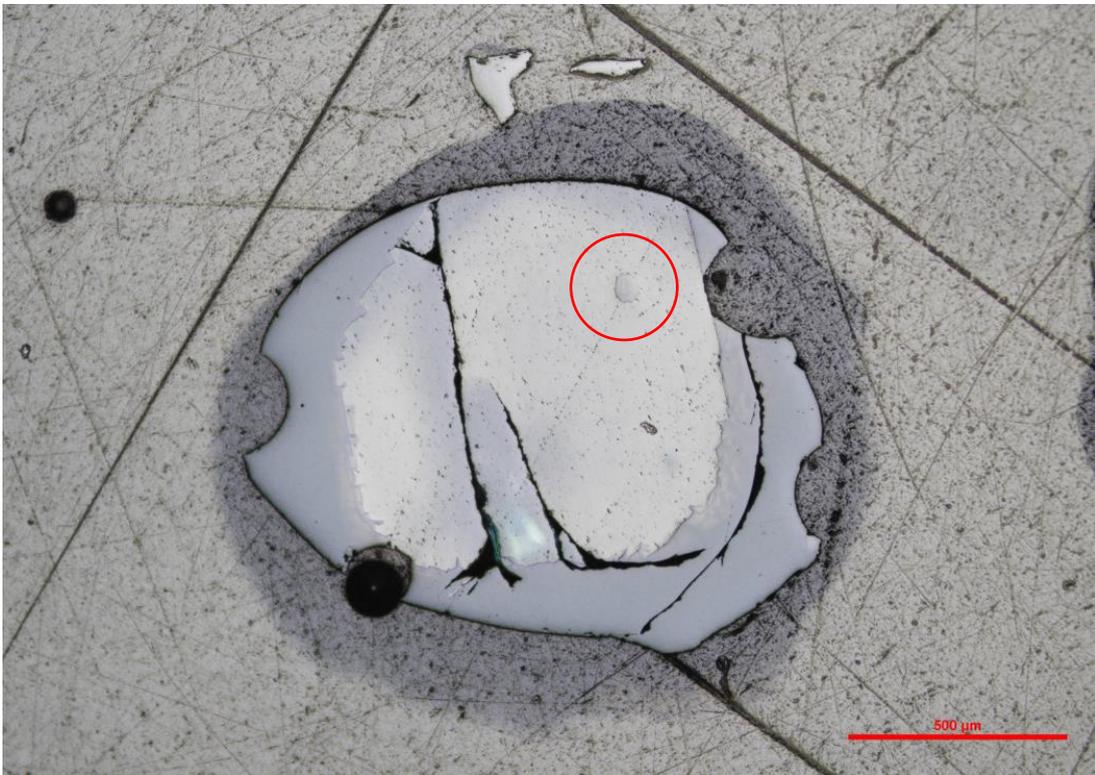


**Mount EW3.4 Miöfell melt inclusions**

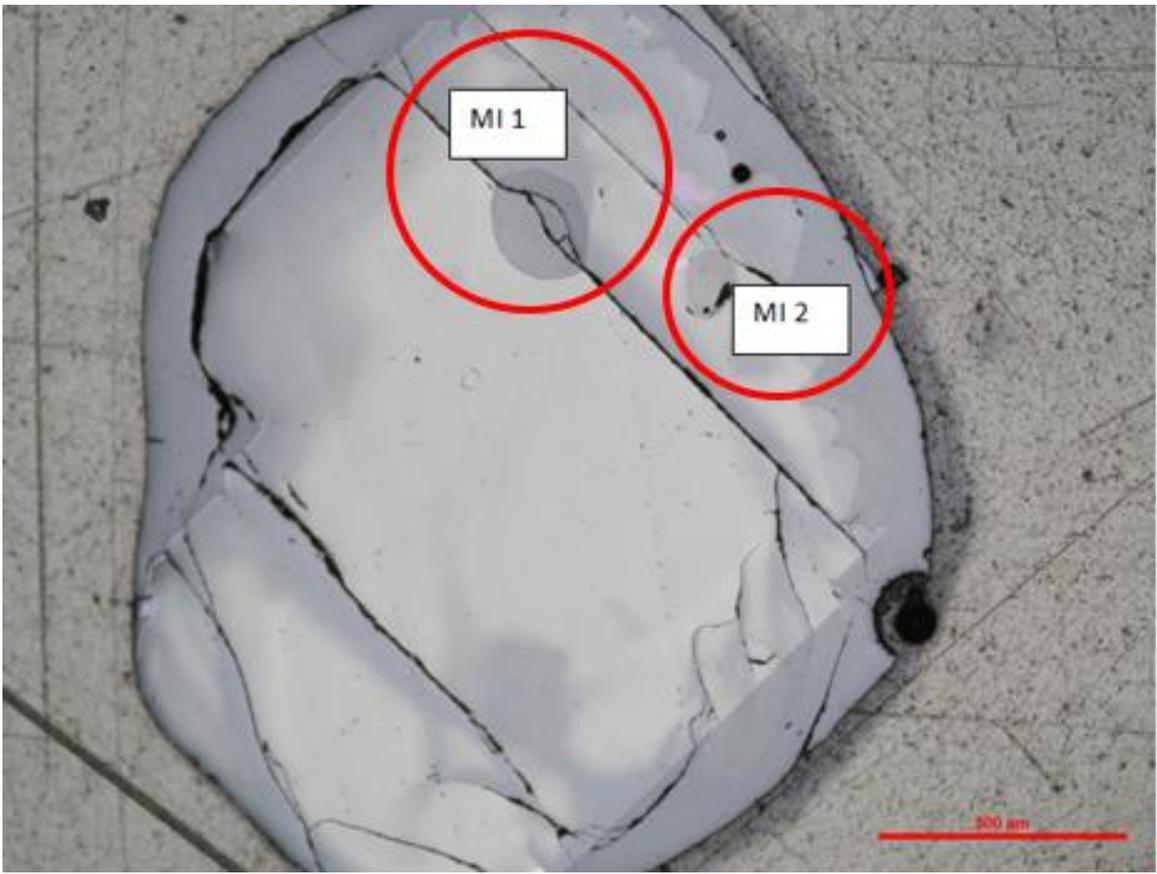
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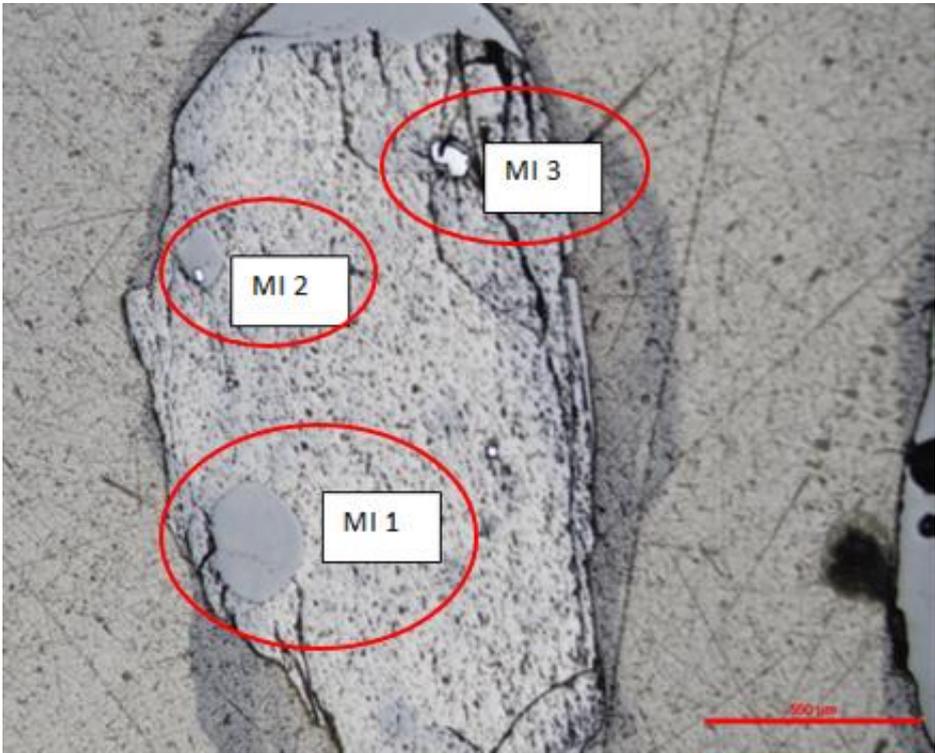
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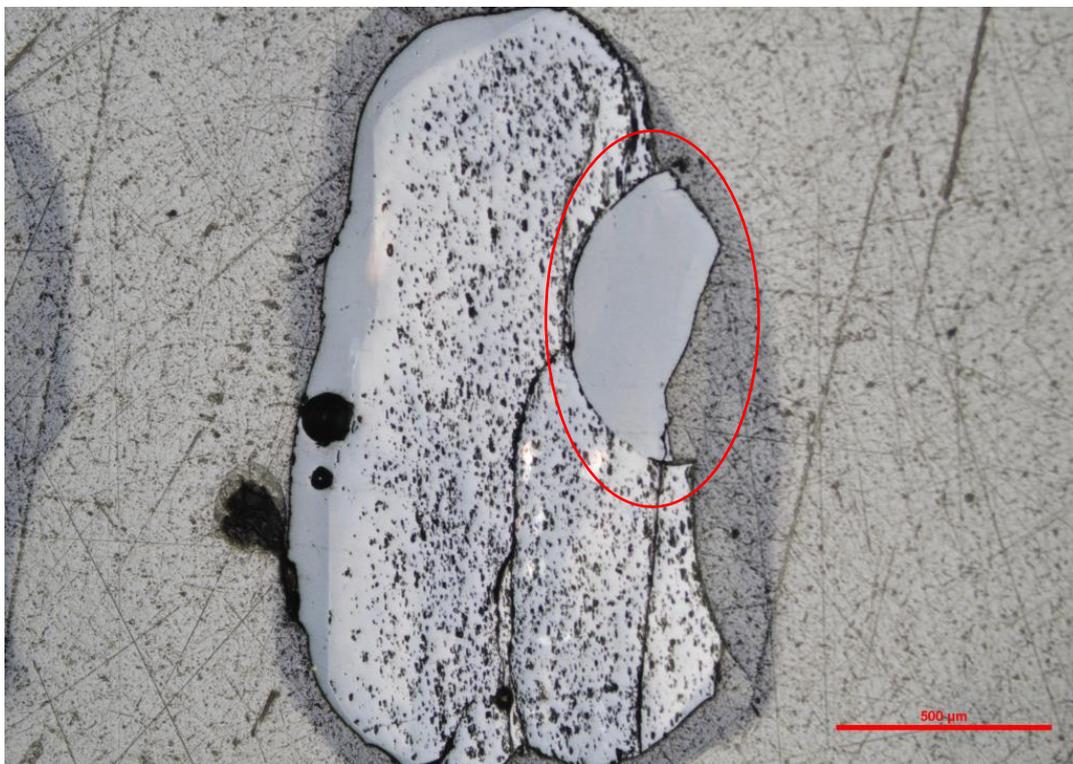
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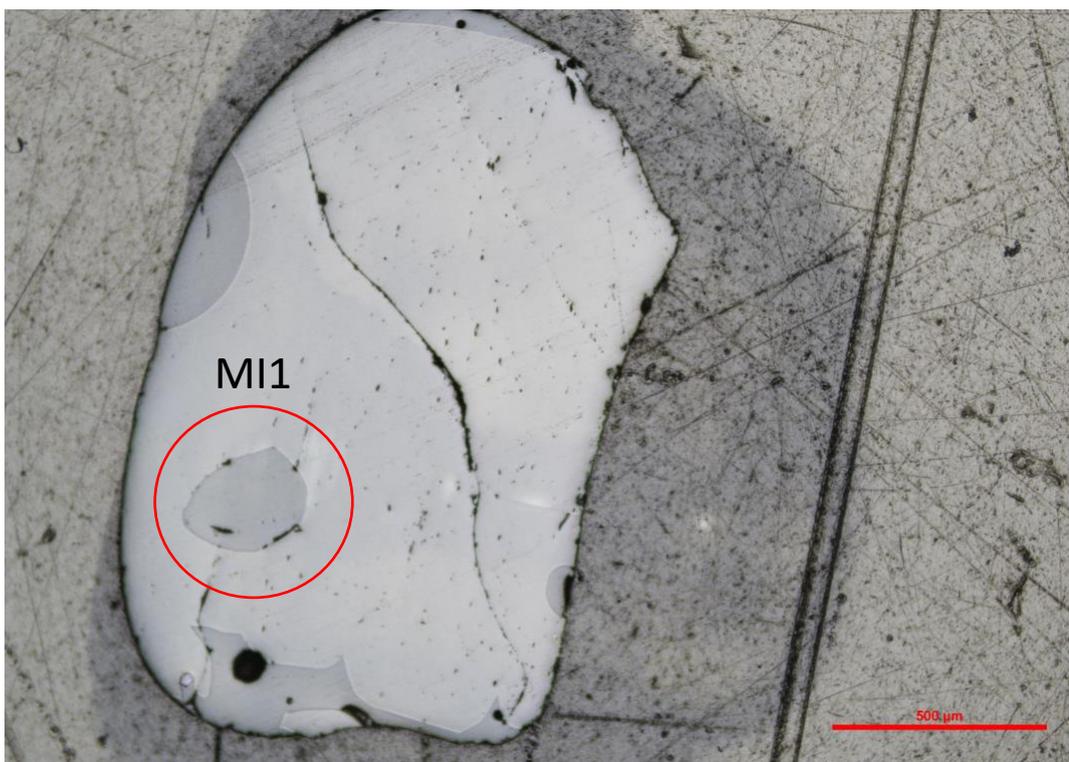
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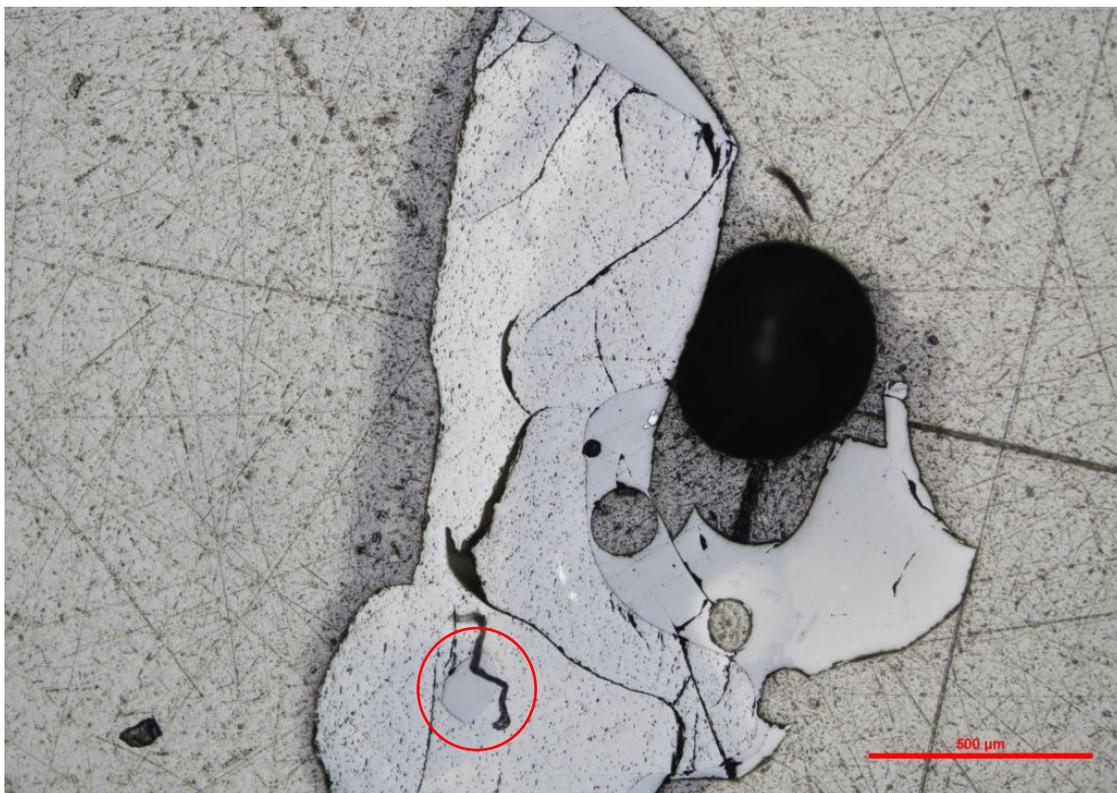
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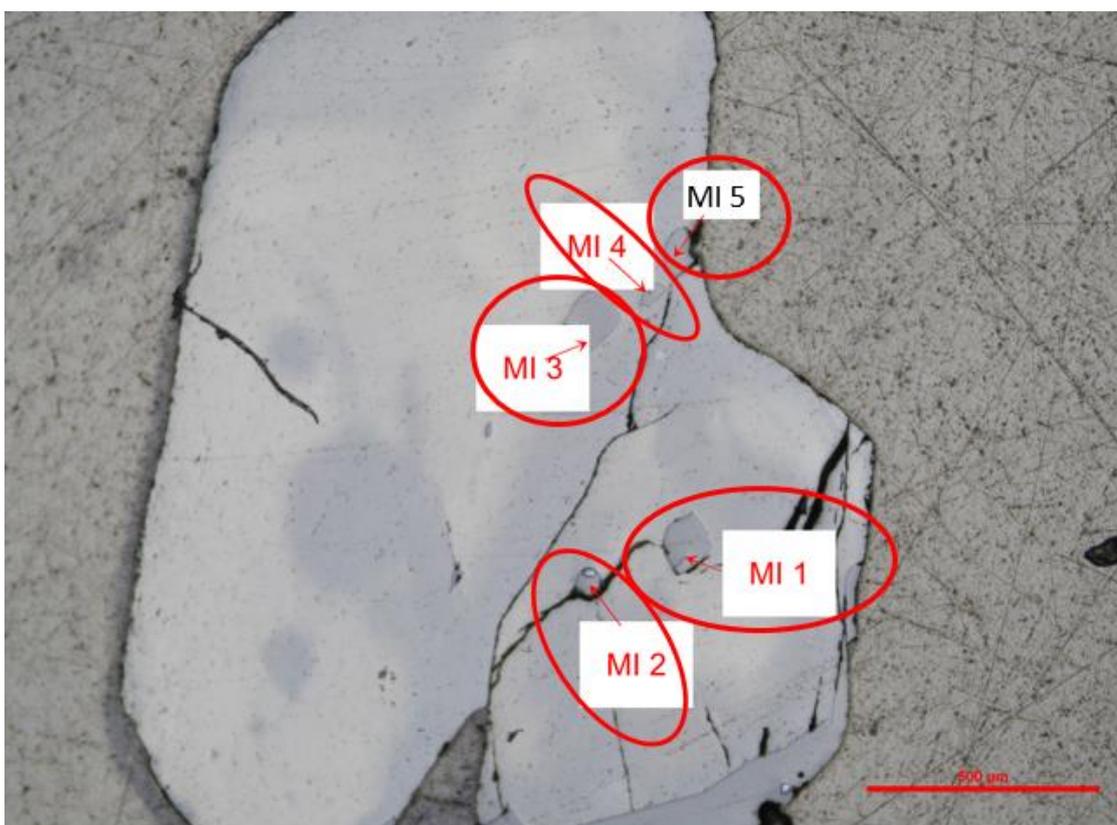
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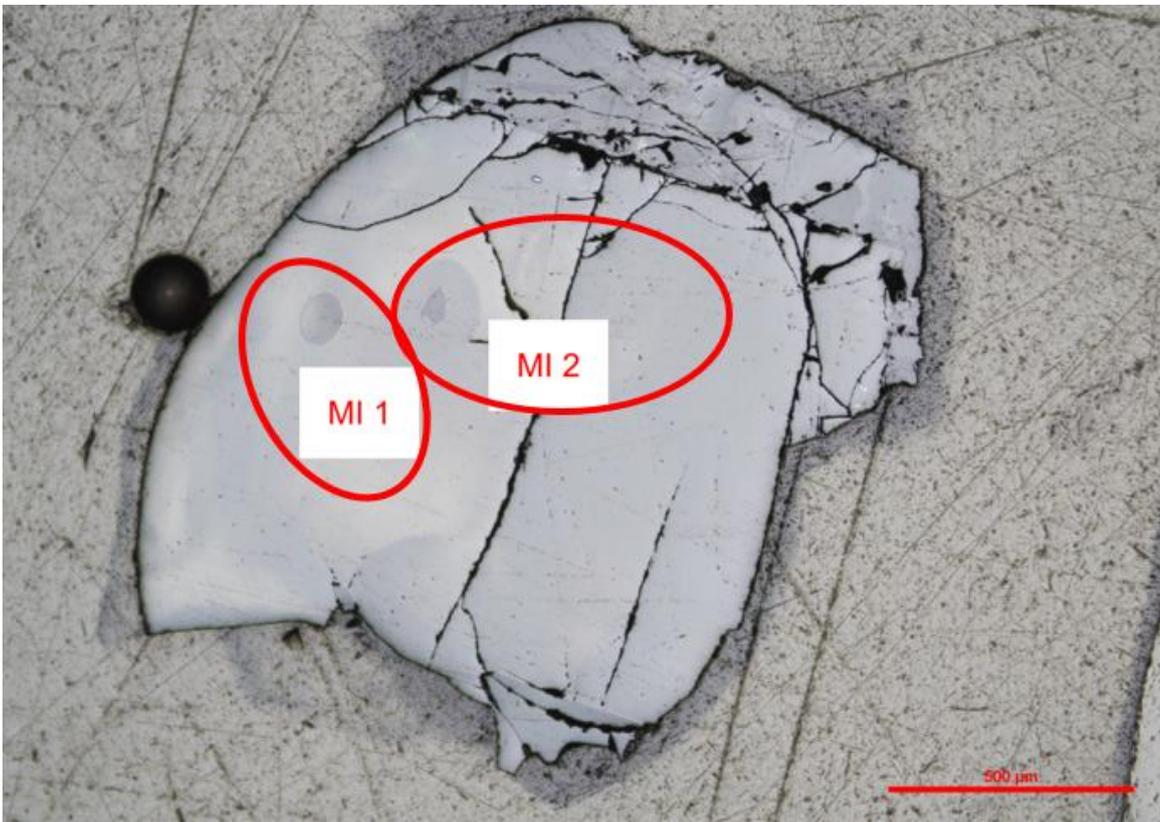
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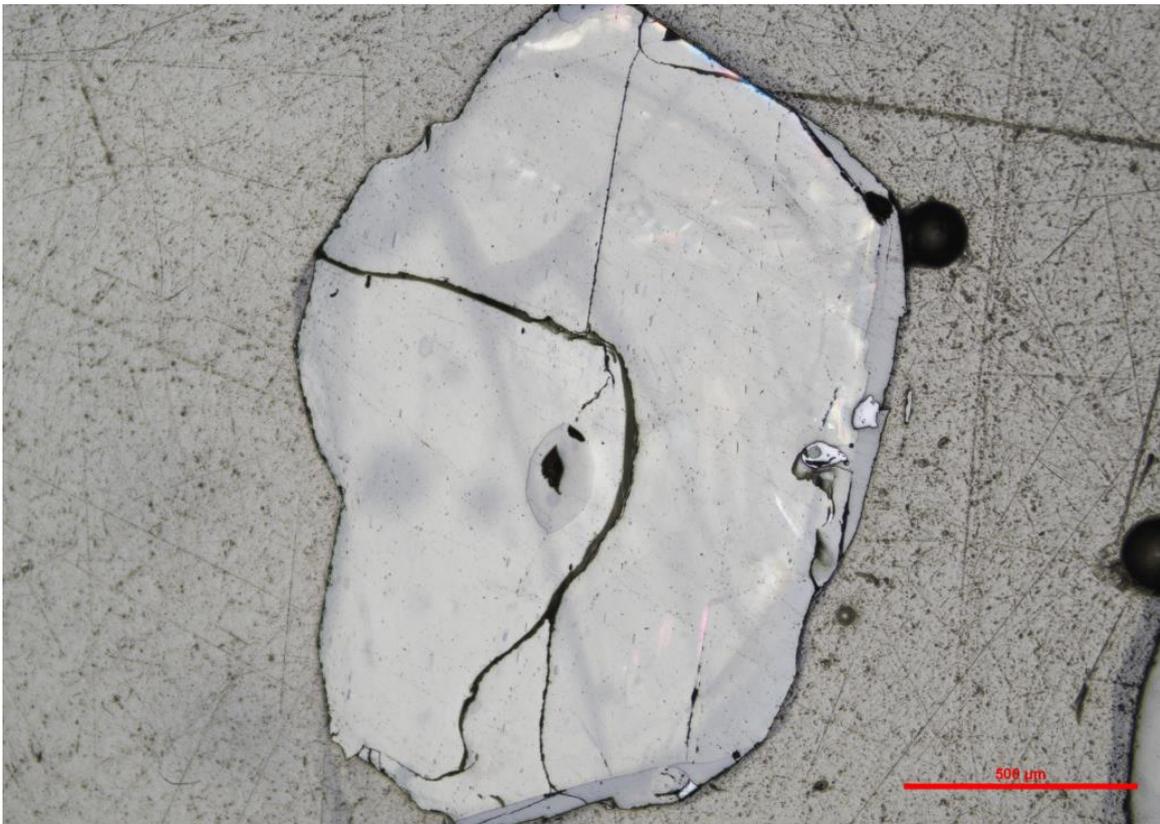
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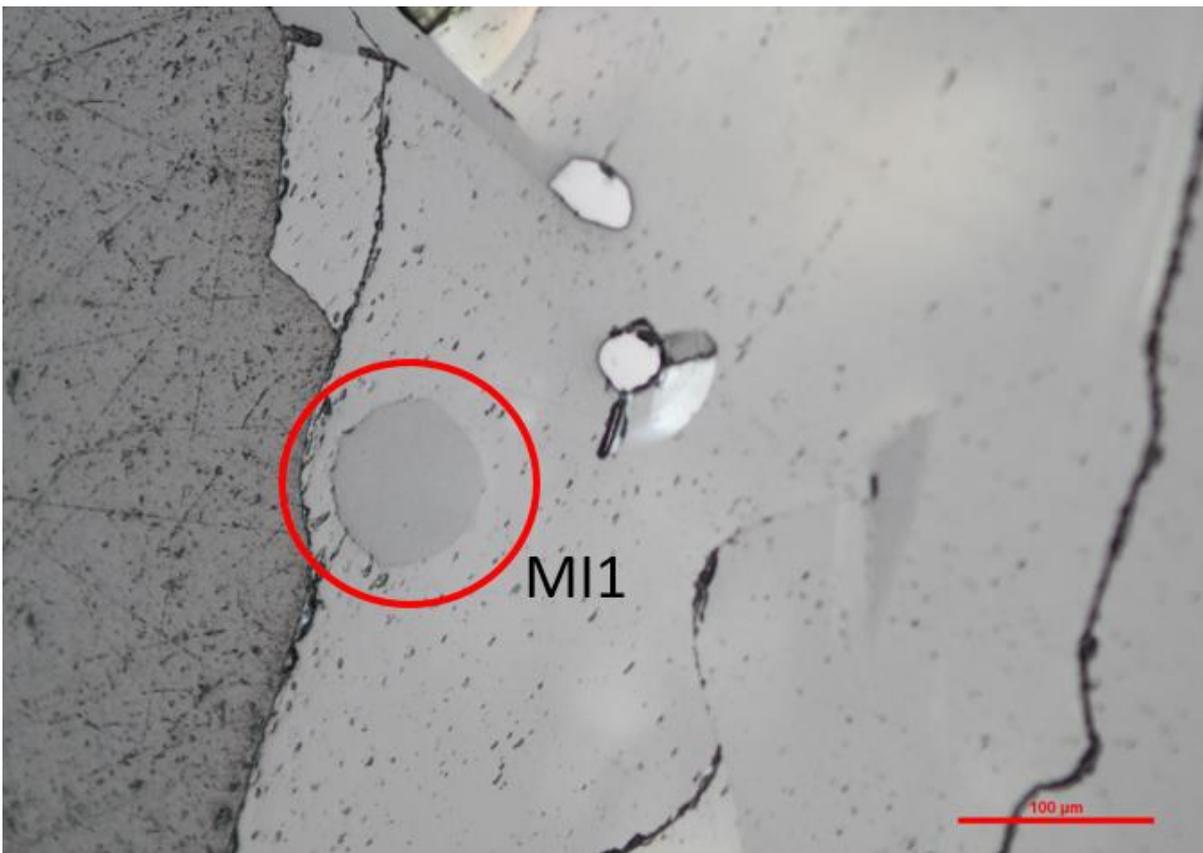
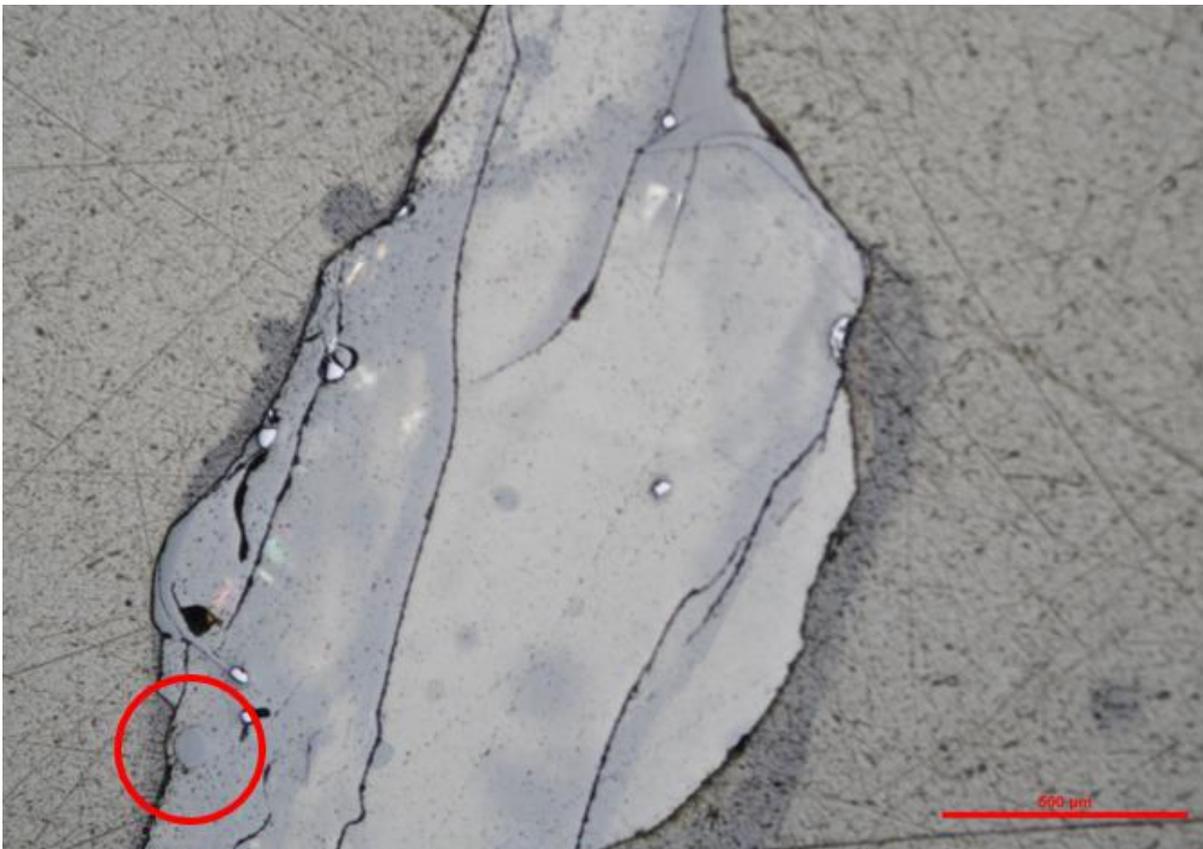
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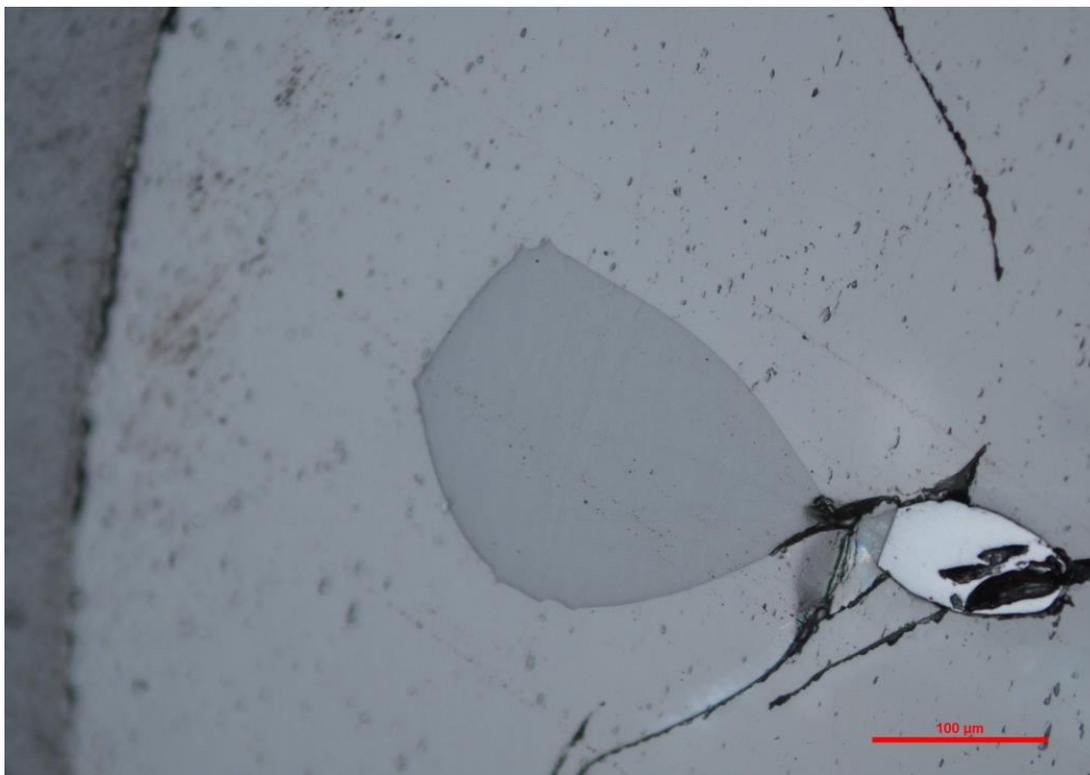
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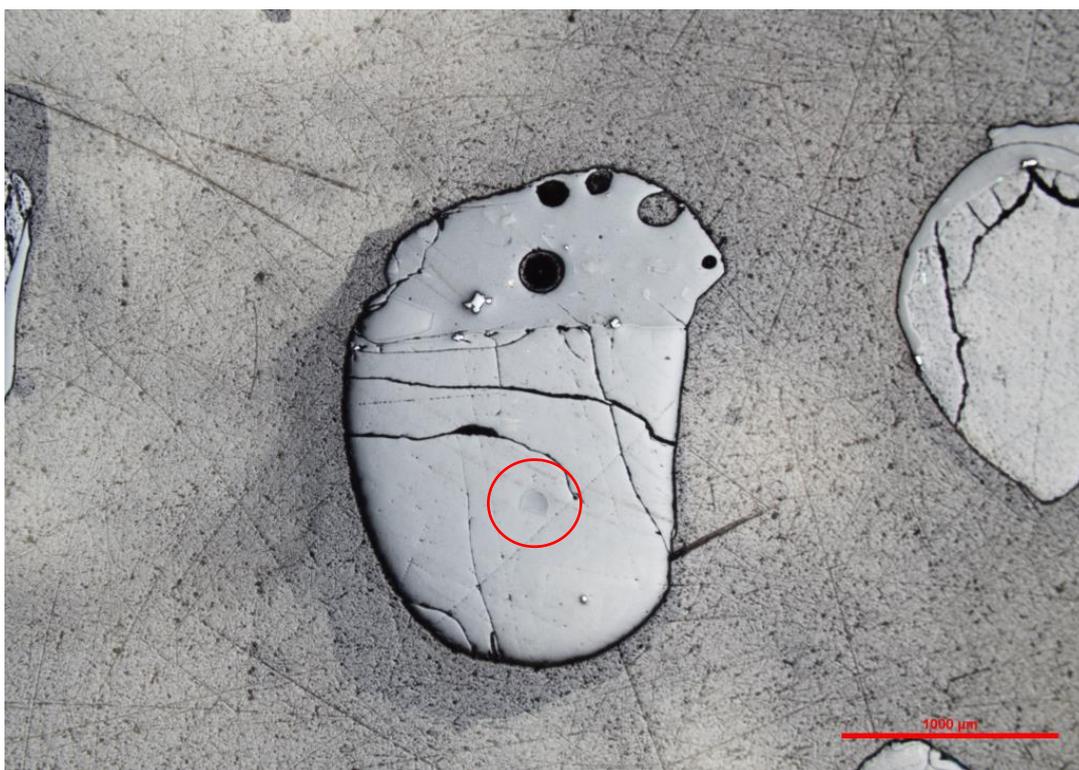
Host Crystal 15



Host Crystal 16



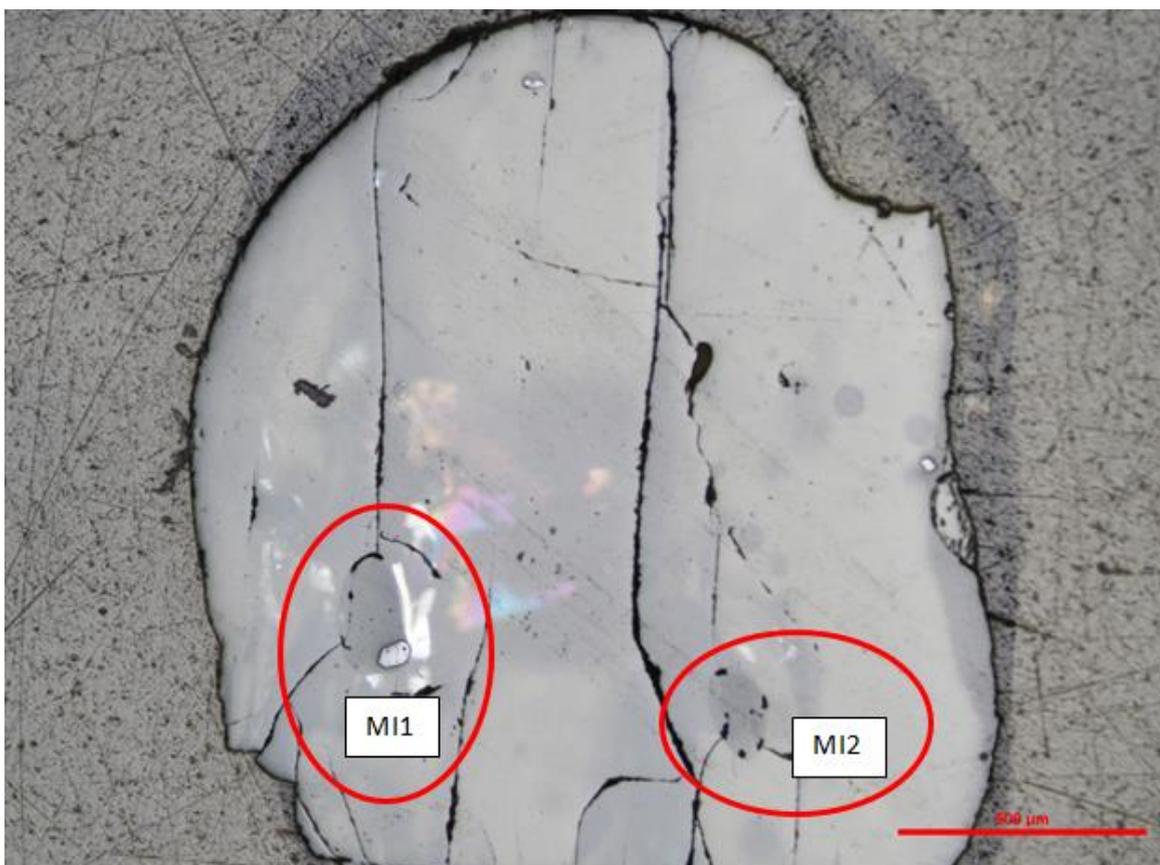
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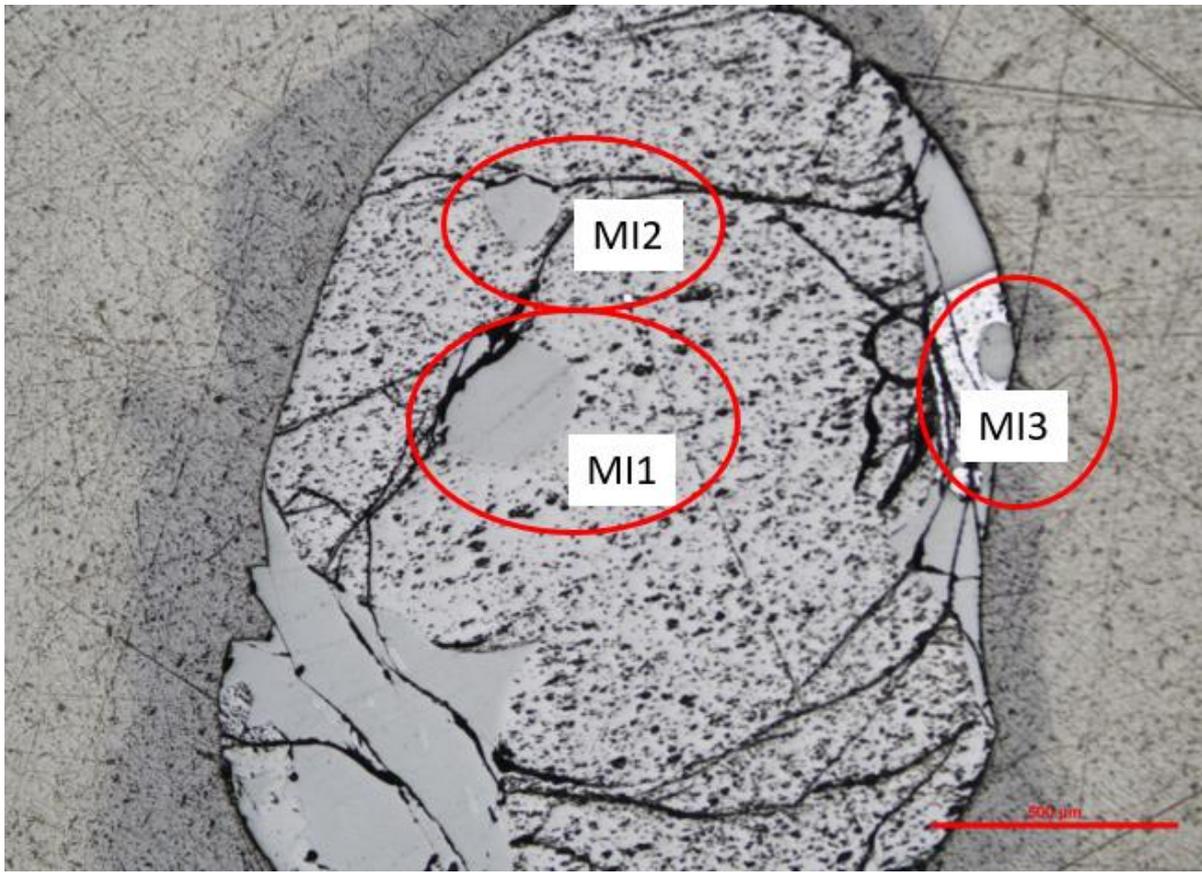
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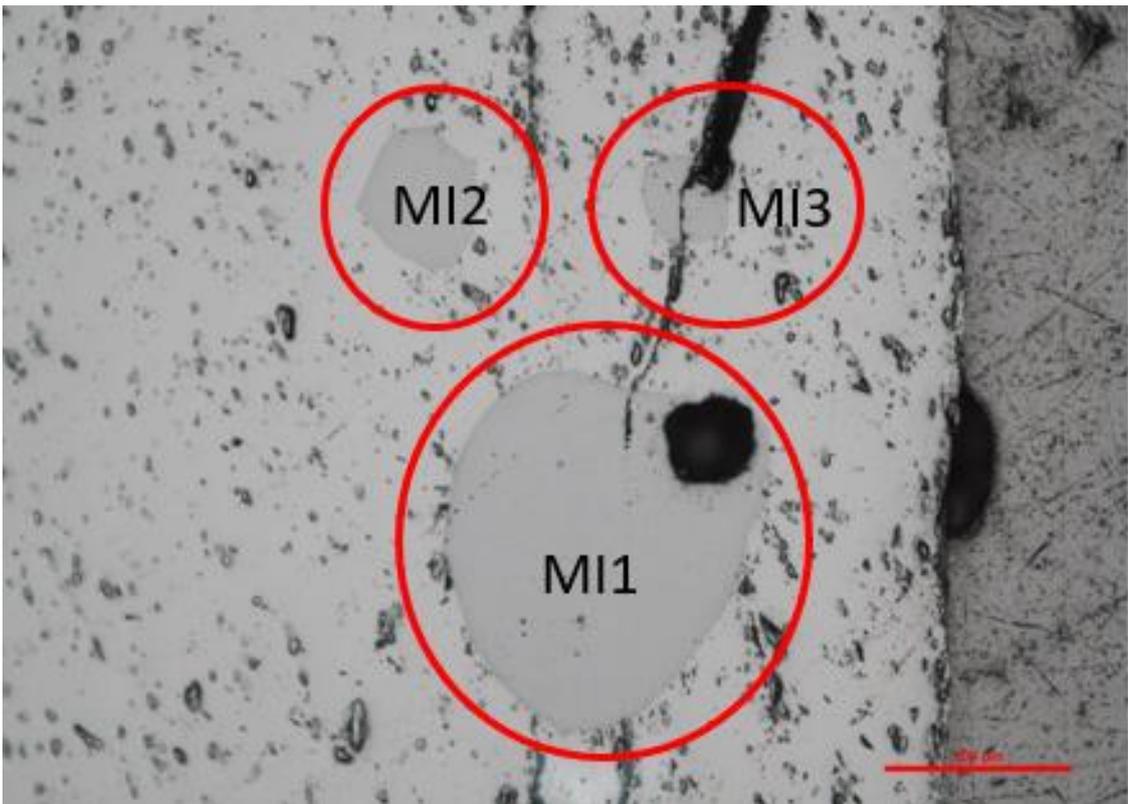
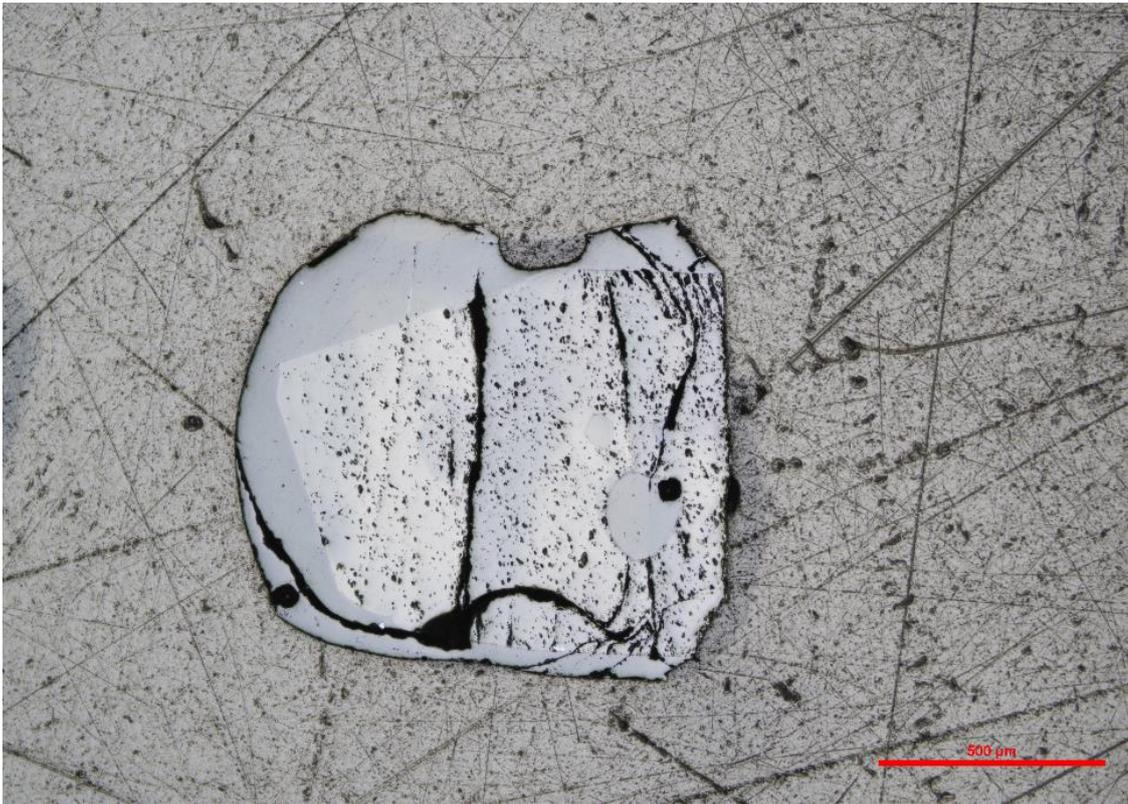
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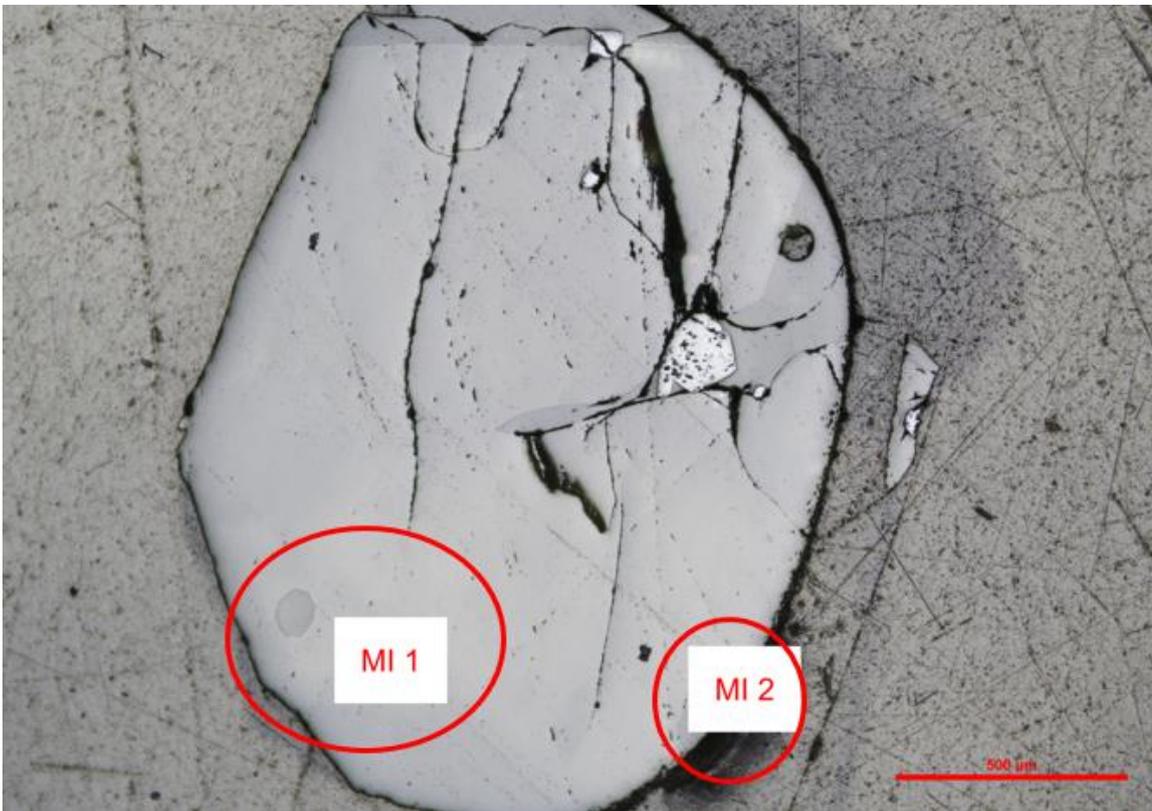
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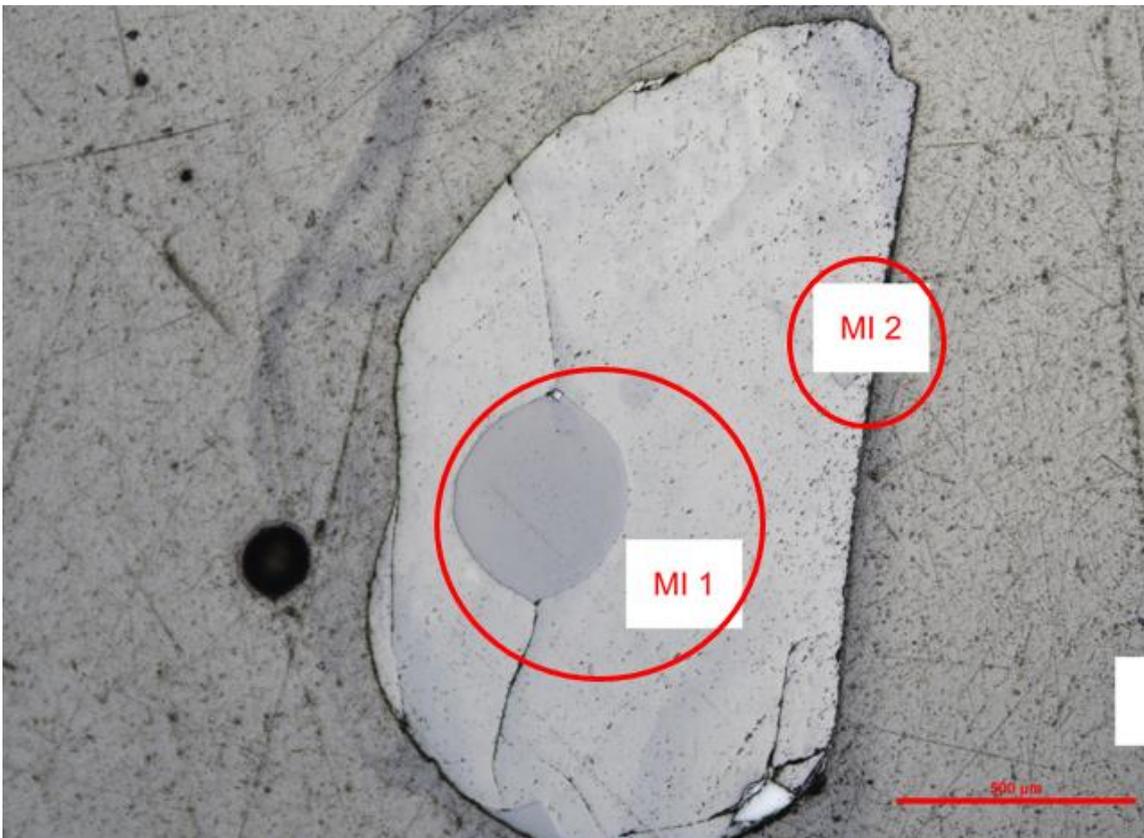
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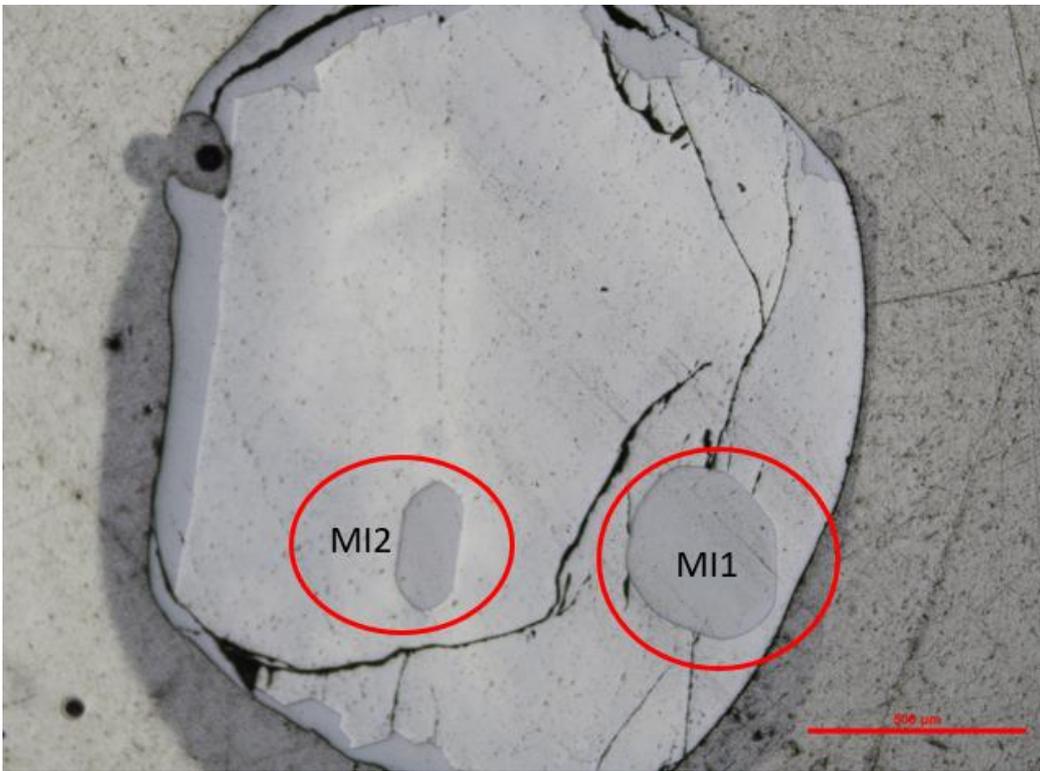
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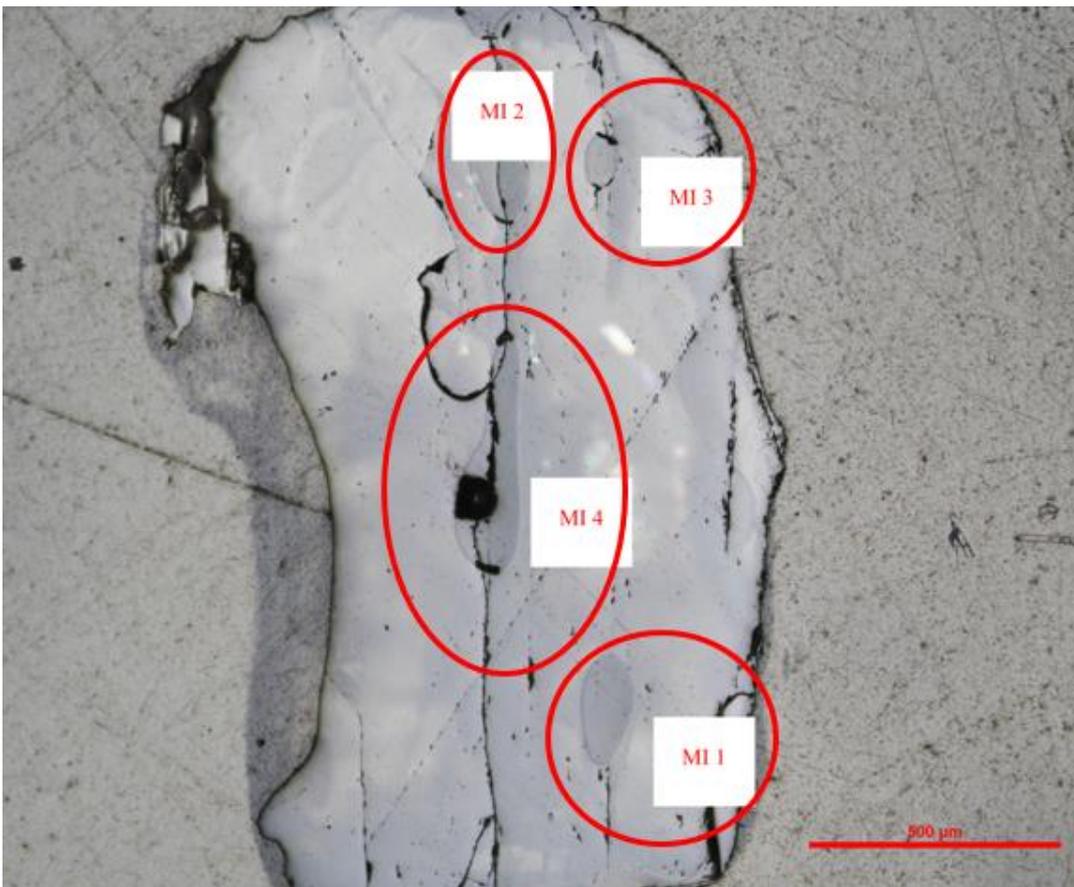
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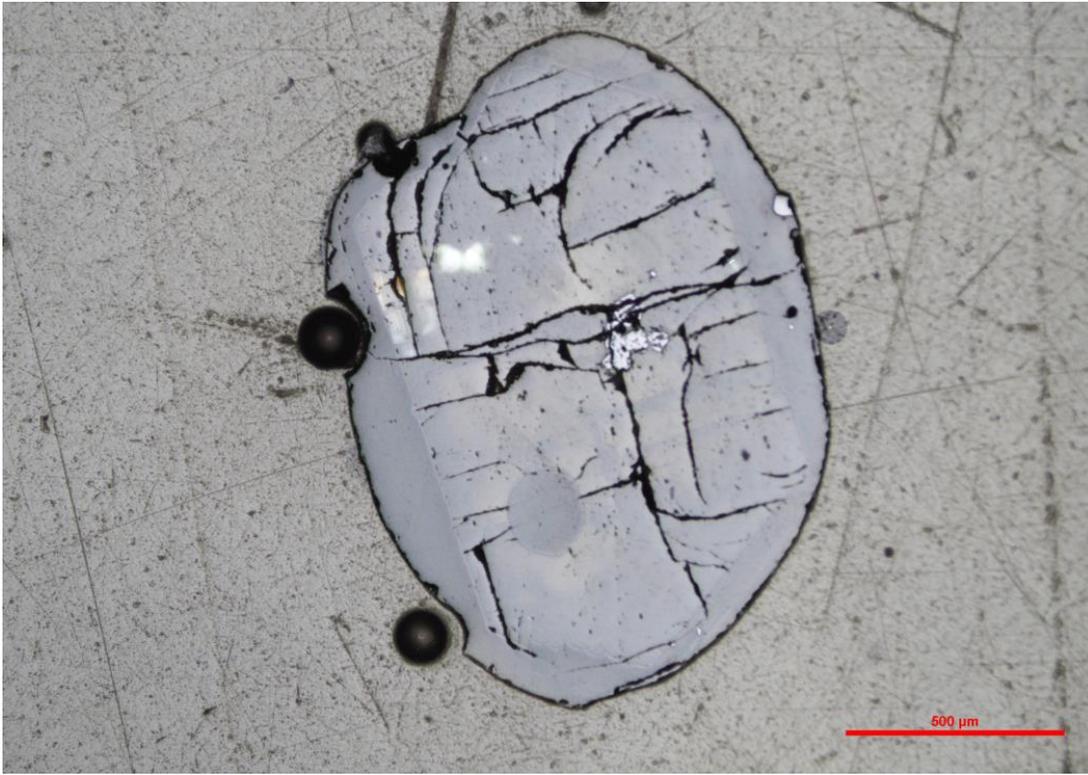
Host Crystal 30



Host Crystal 32

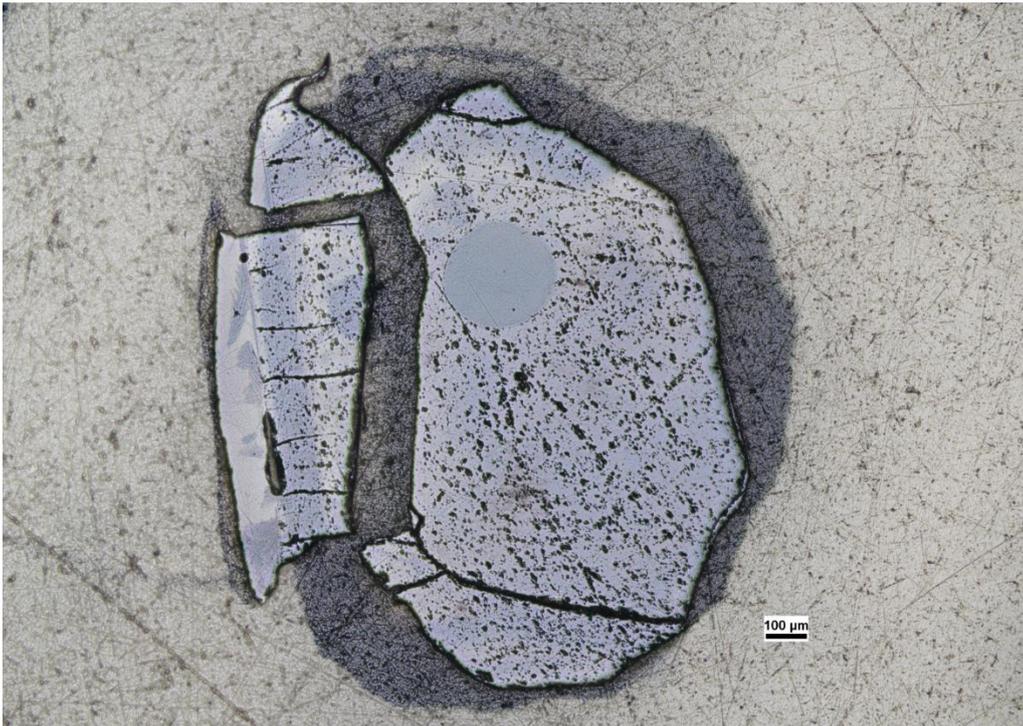


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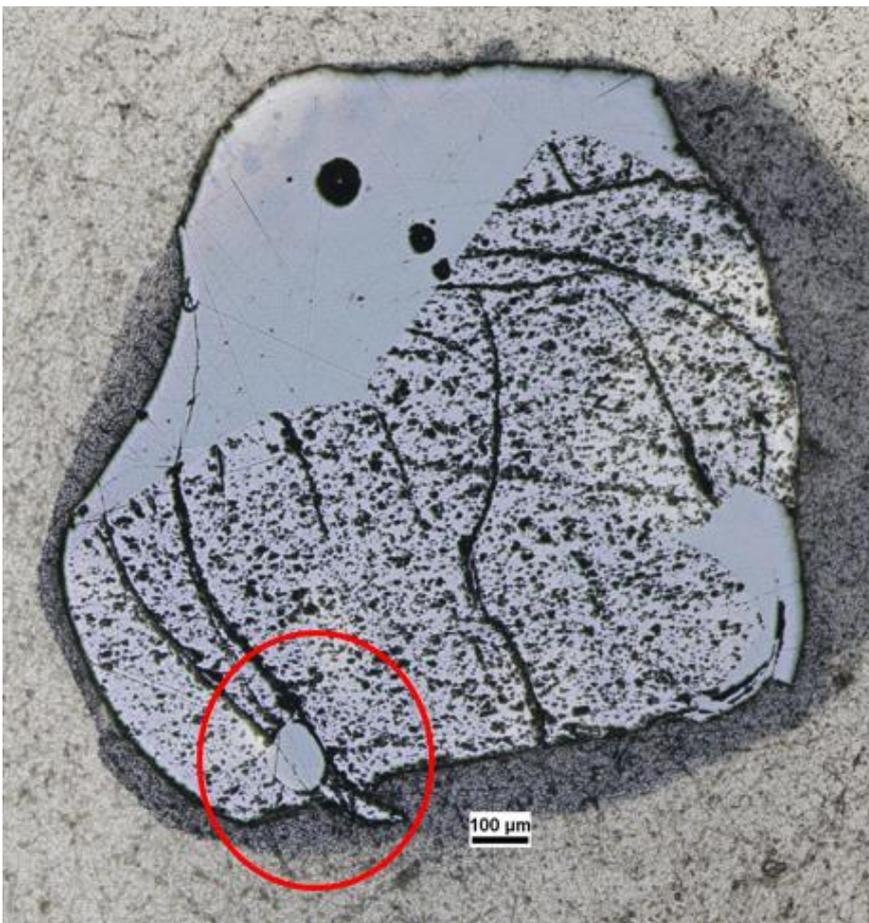


## Mount EW3.5 Miöföll melt inclusions

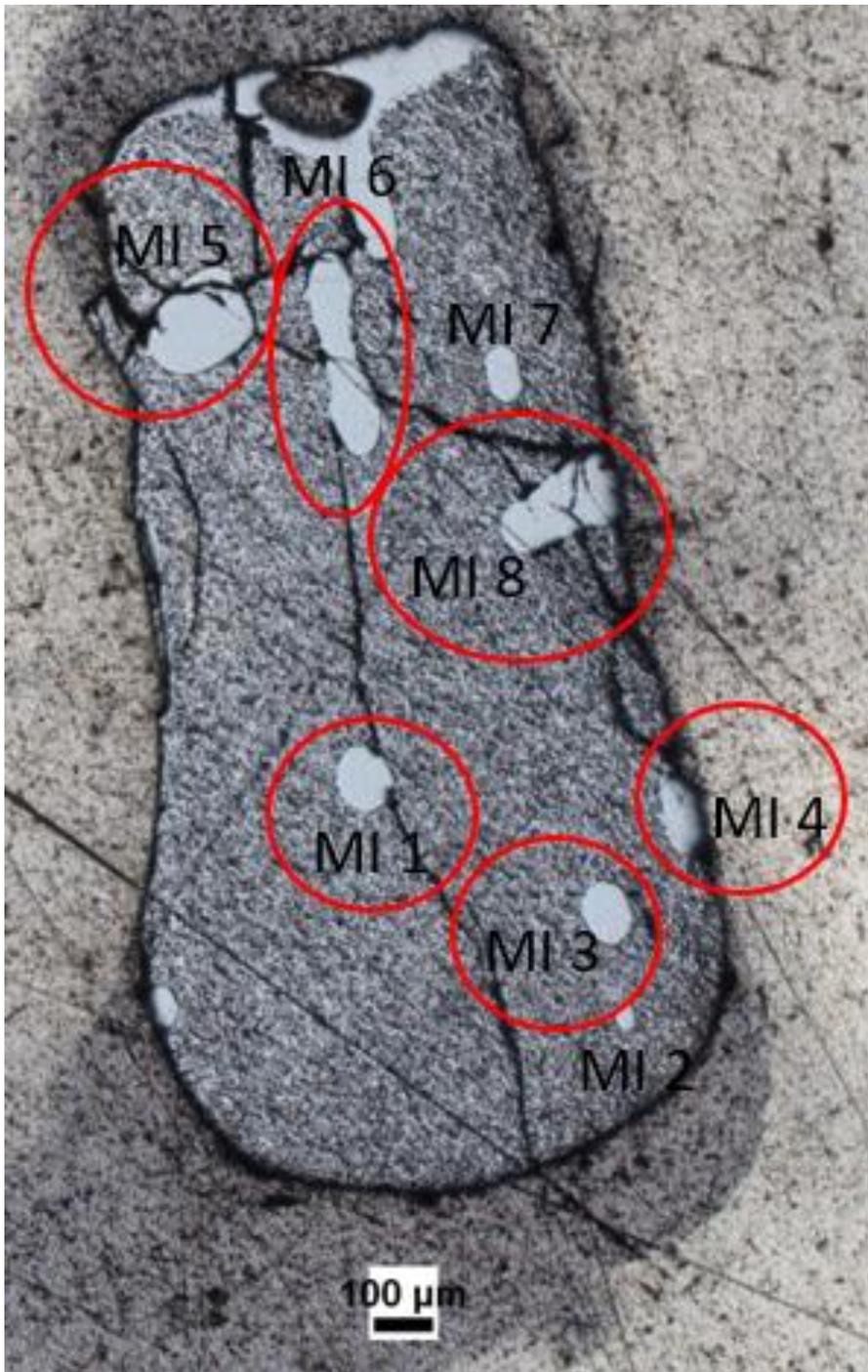
Host Crystal 2



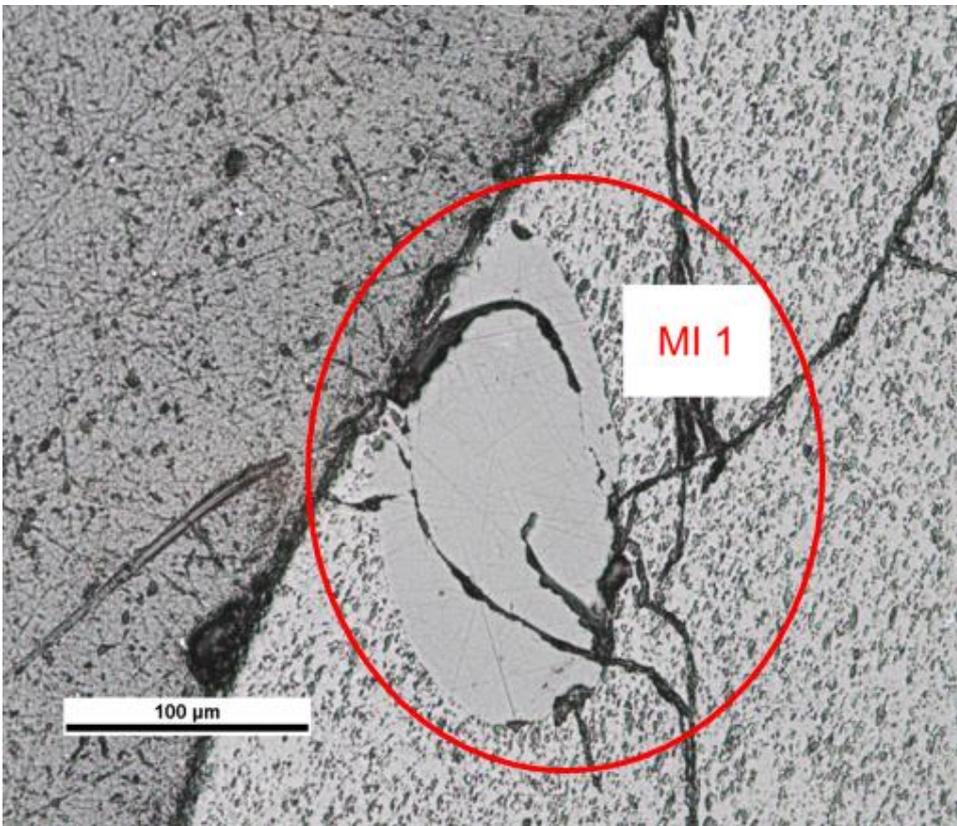
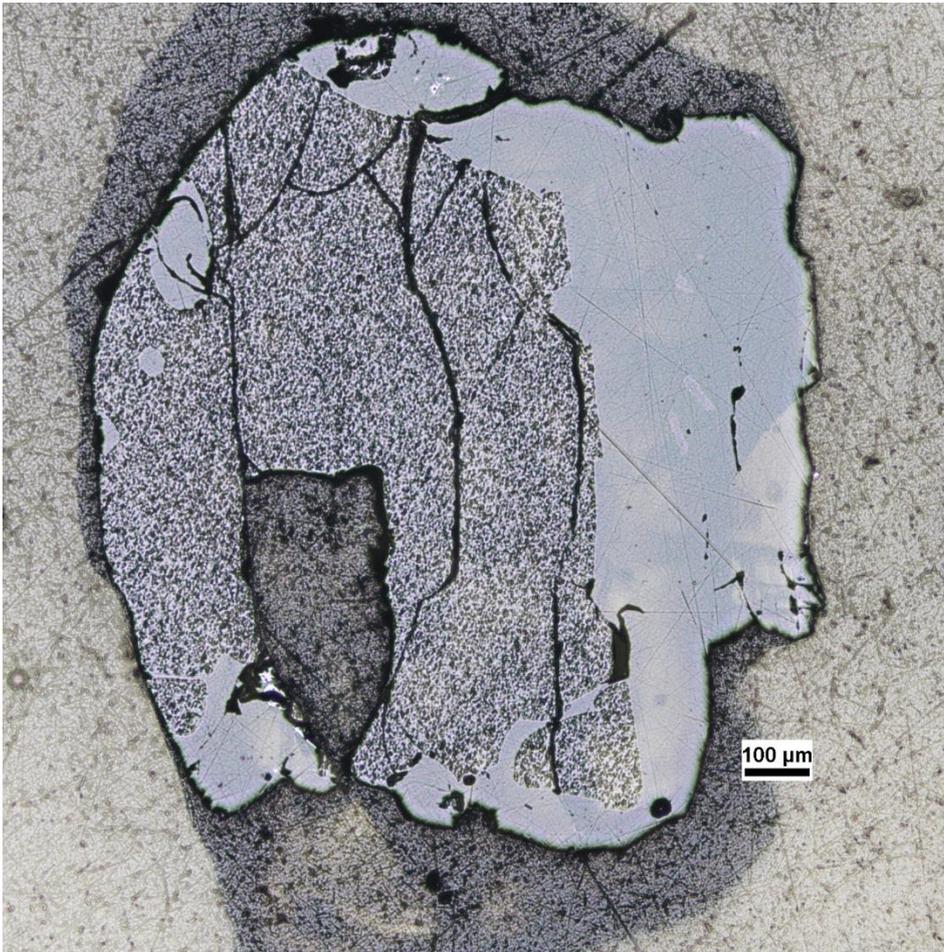
Host Crystal 9



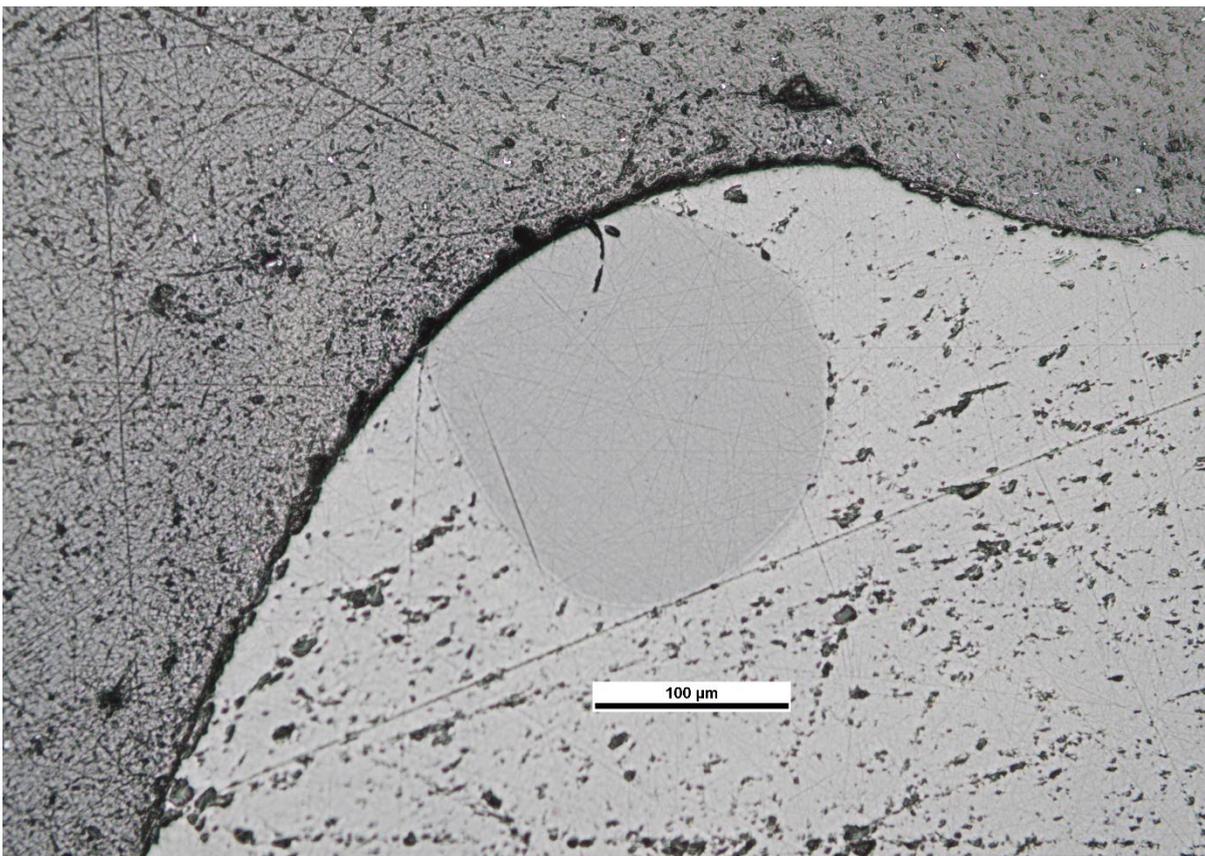
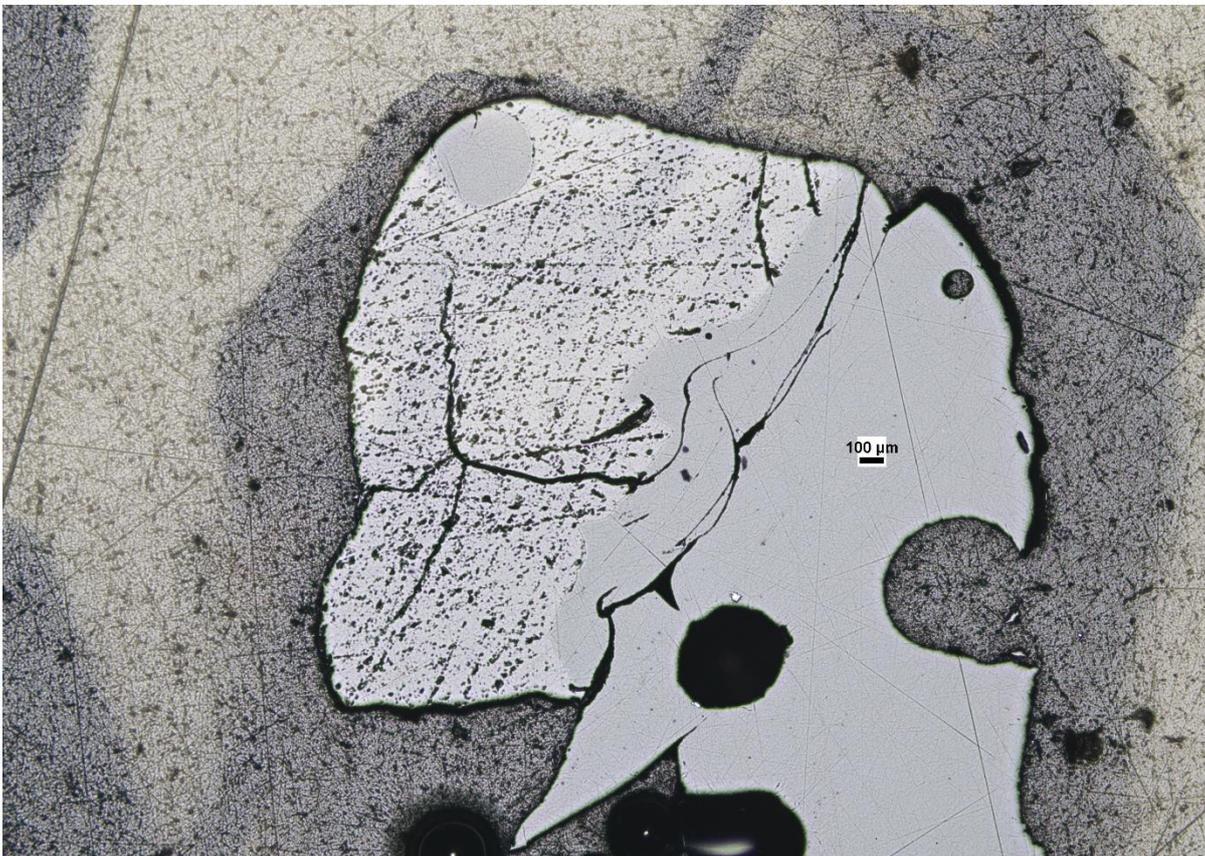
Host Crystal 11



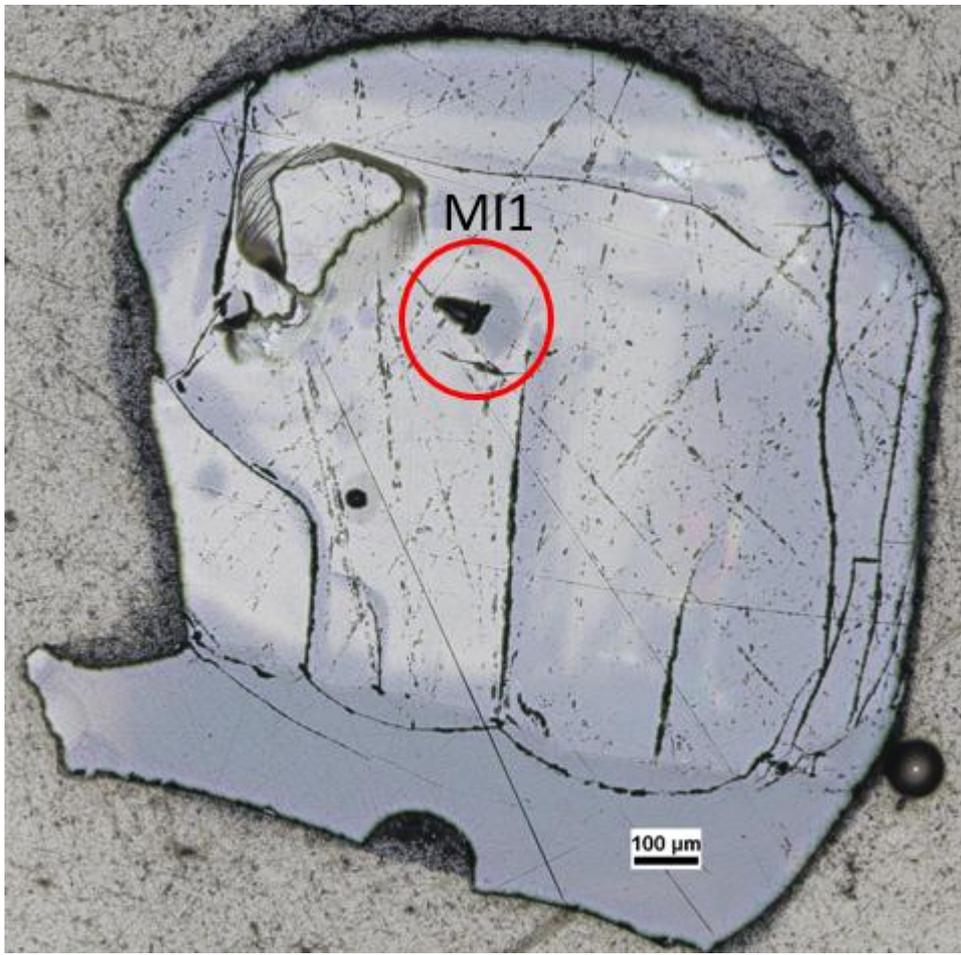
Host Crystal 16

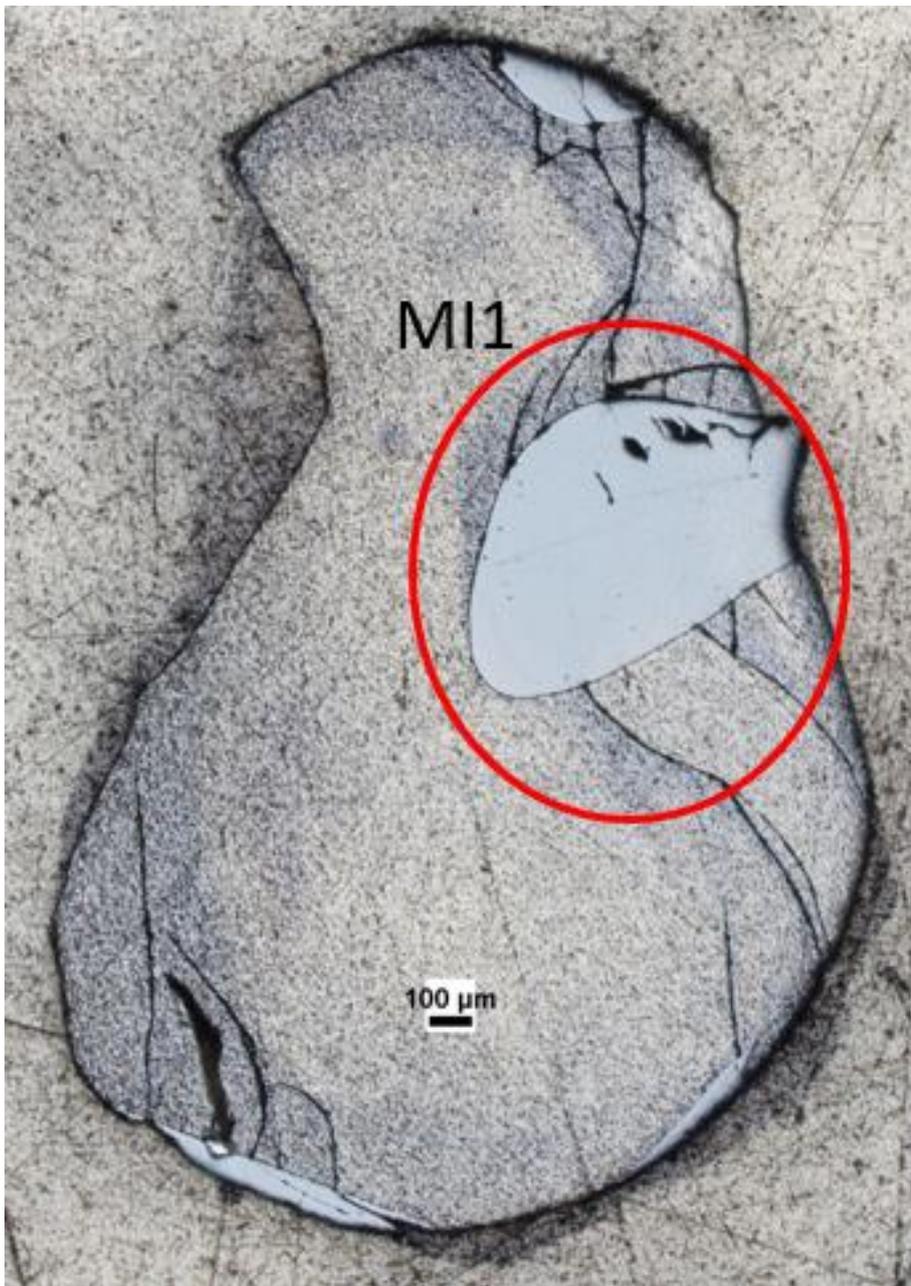


Host Crystal 17

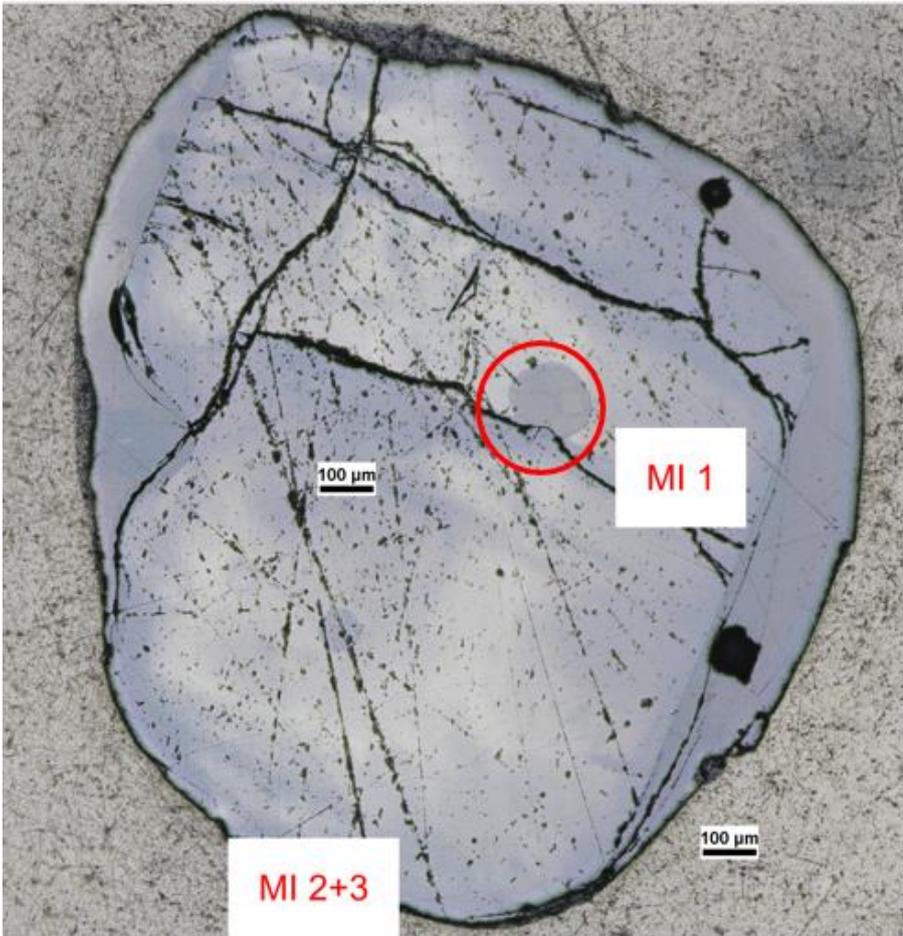


Host Crystal 18

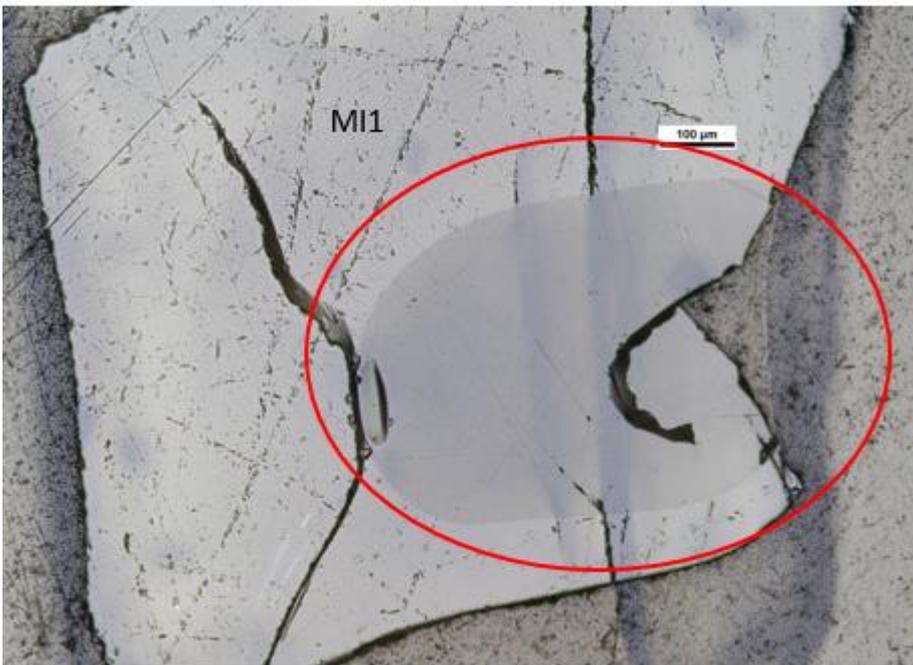




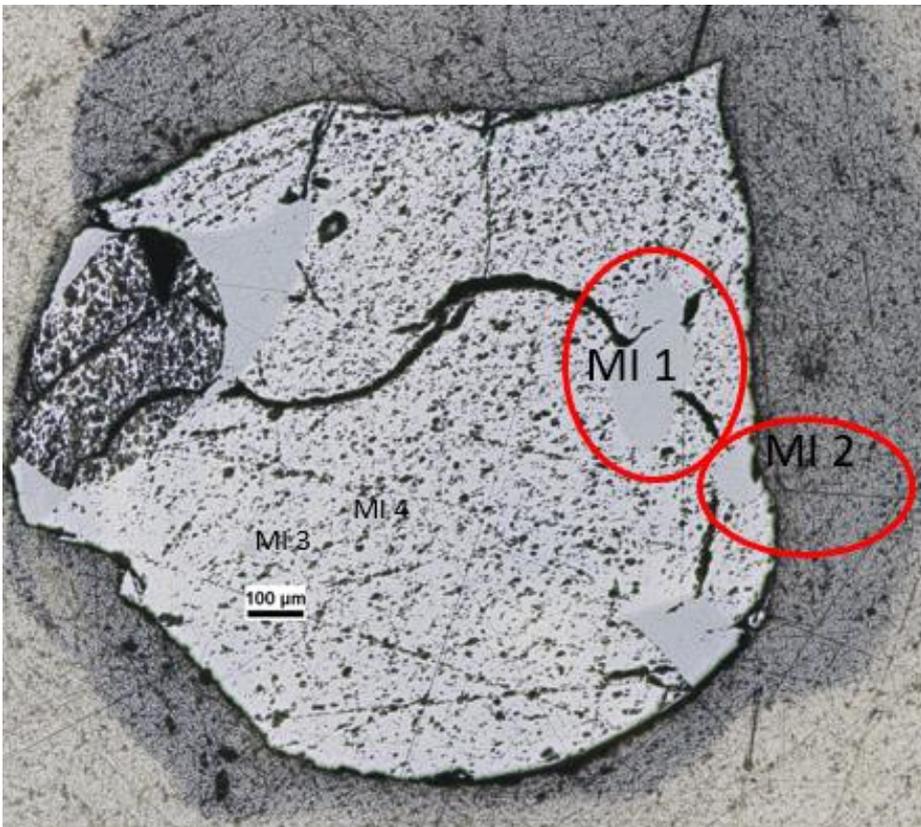
Host Crystal 20



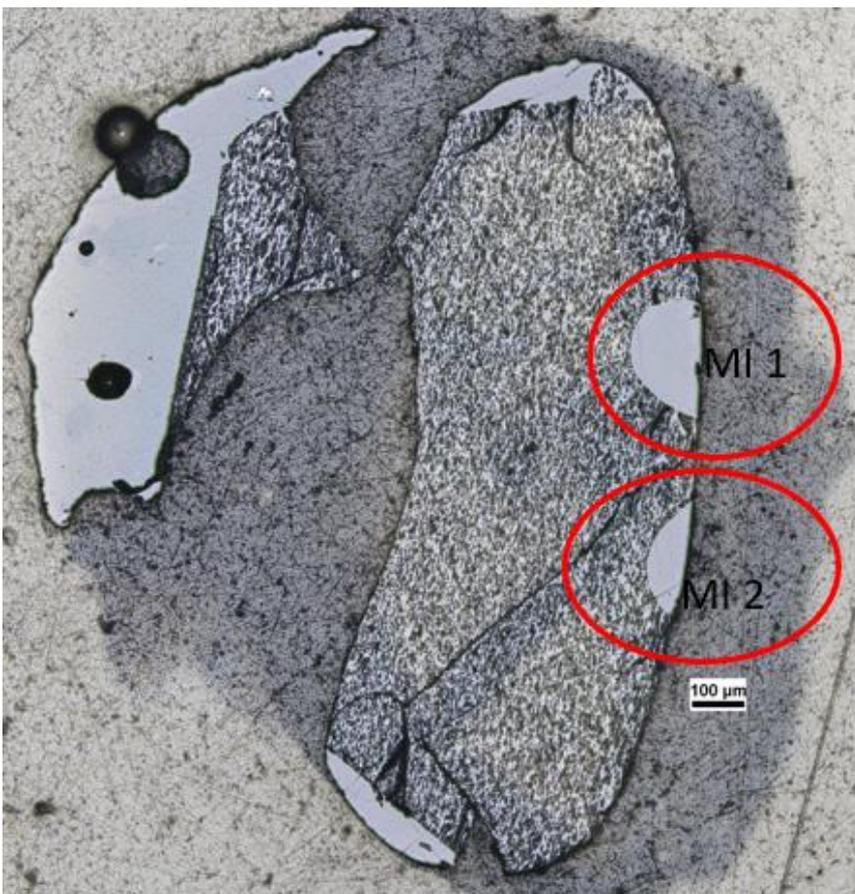
Host Crystal 21



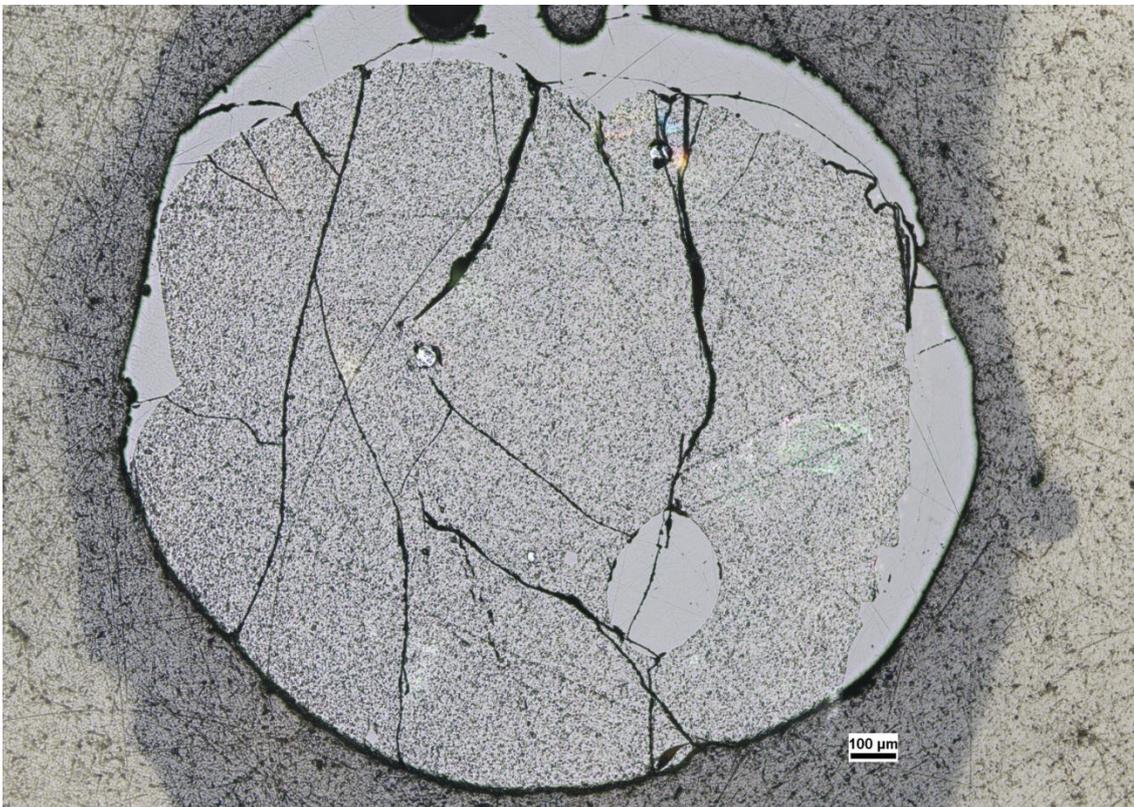
Host Crystal 22



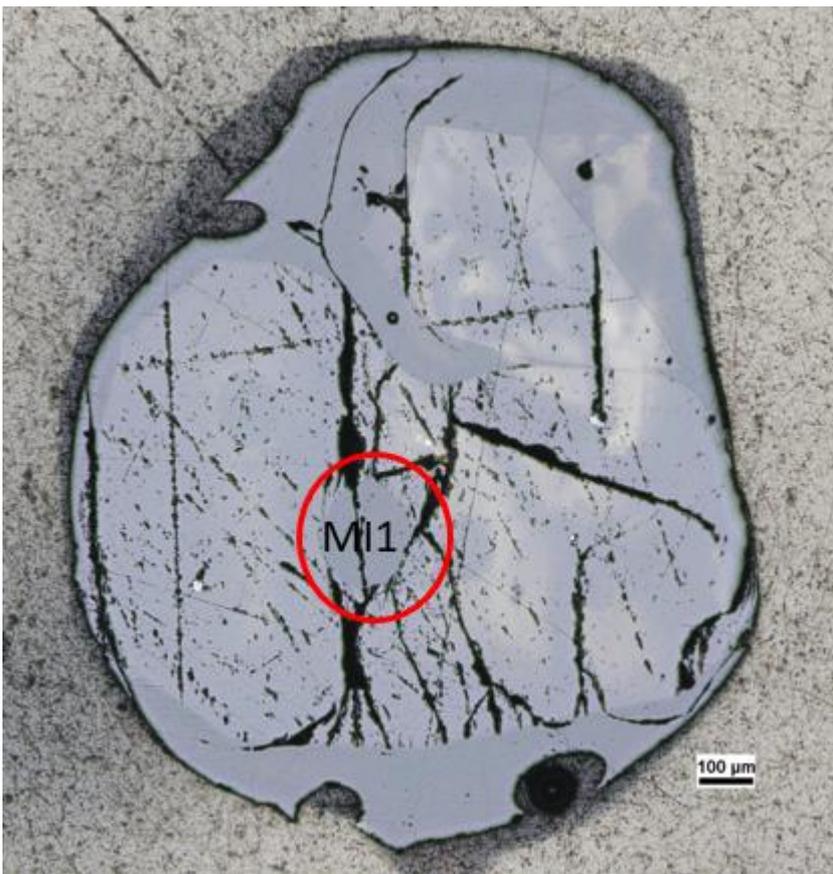
Host Crystal 23



Host Crystal 25

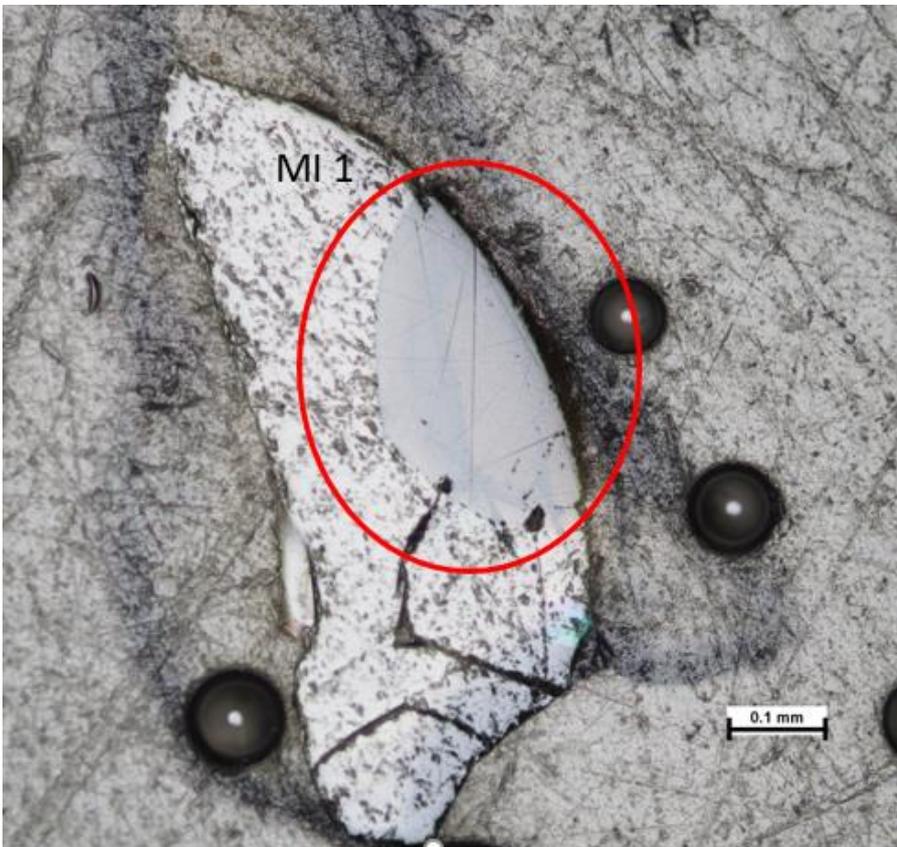


Host Crystal 26

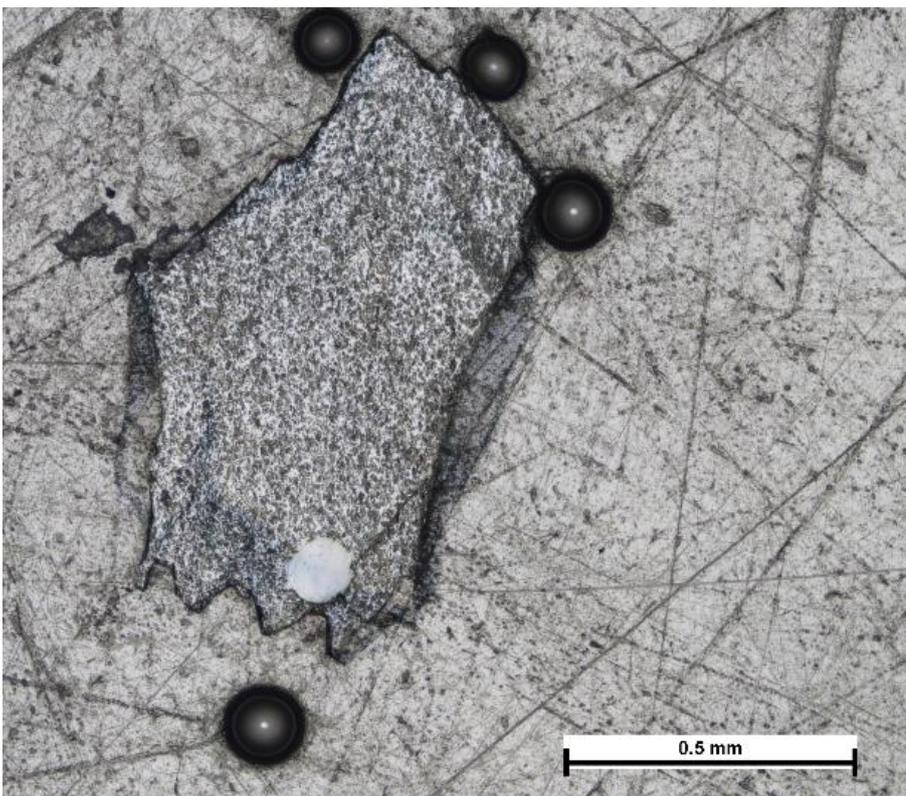


Mount EWB6.1 Oræfajökull melt inclusions

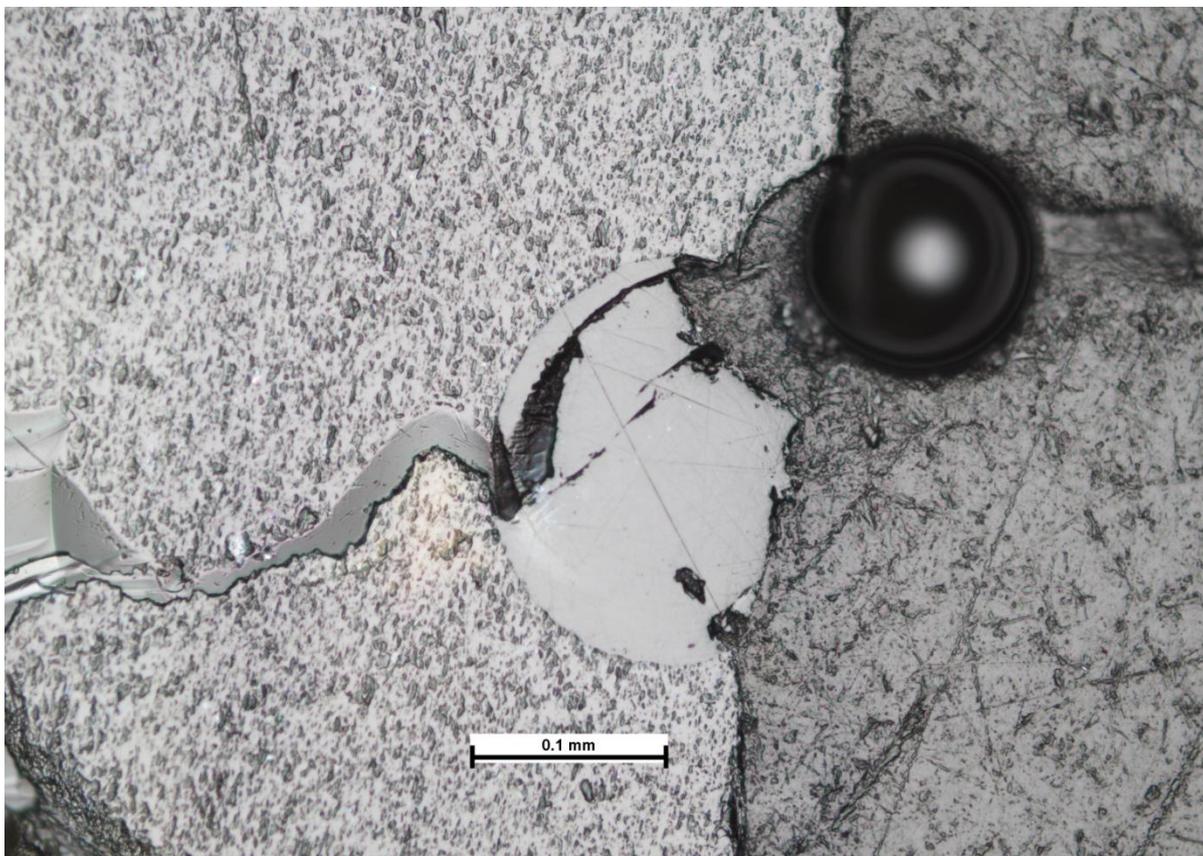
Host Crystal 4



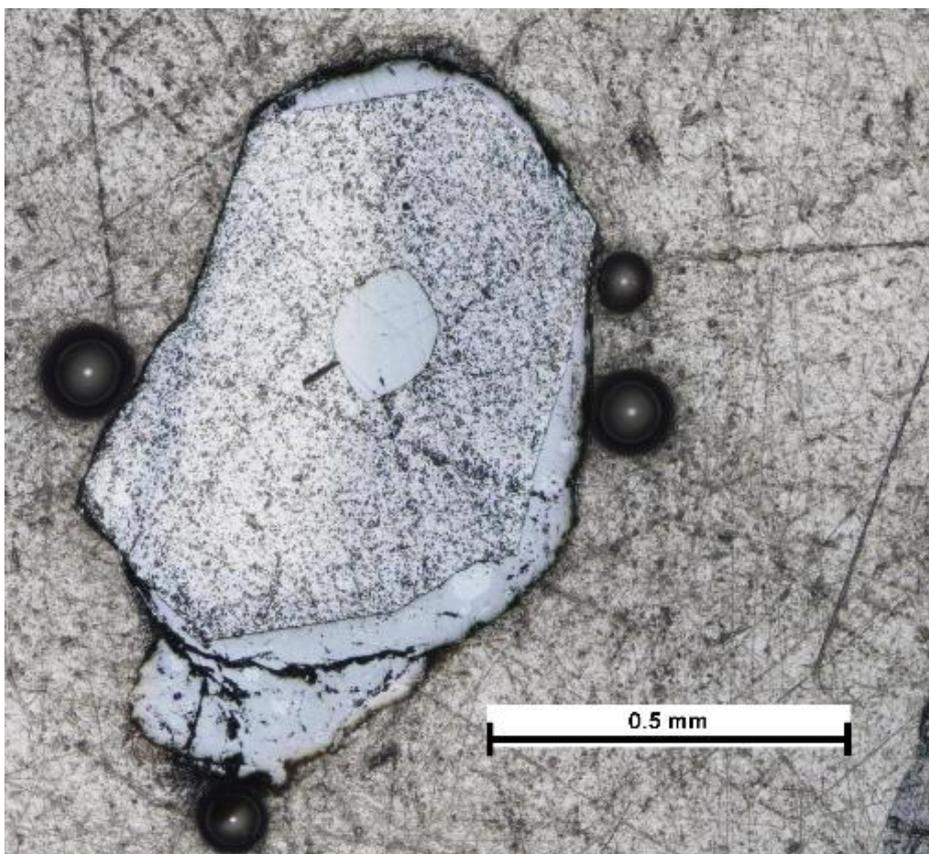
Host Crystal 5



Host Crystal 8



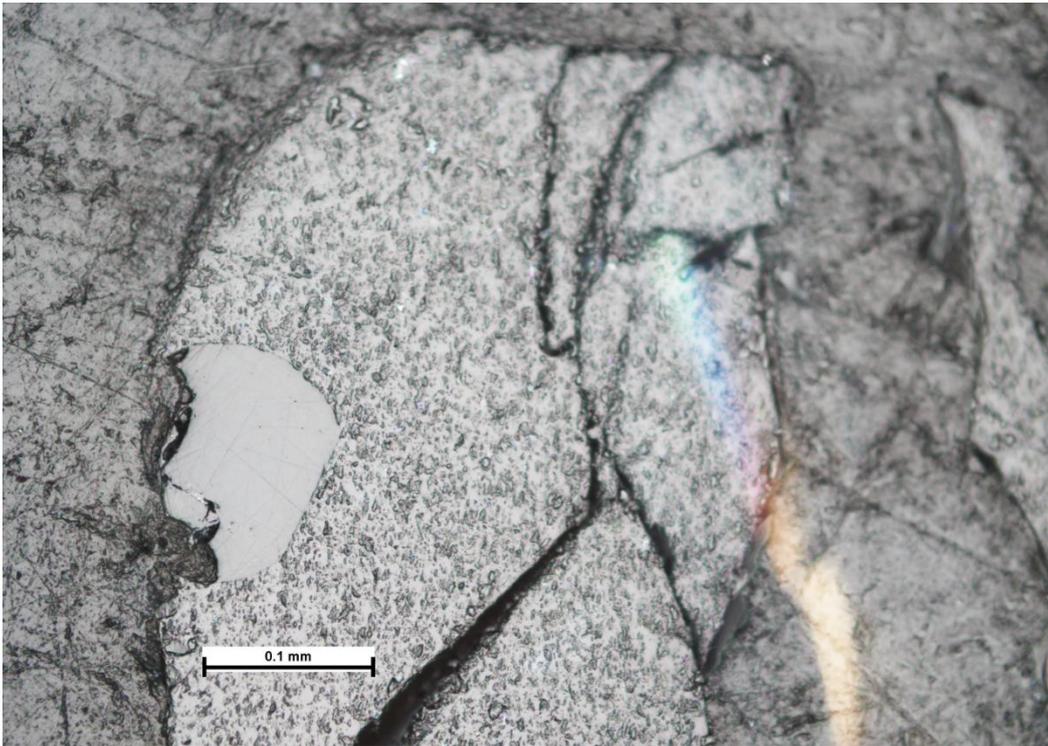
Host Crystal 9



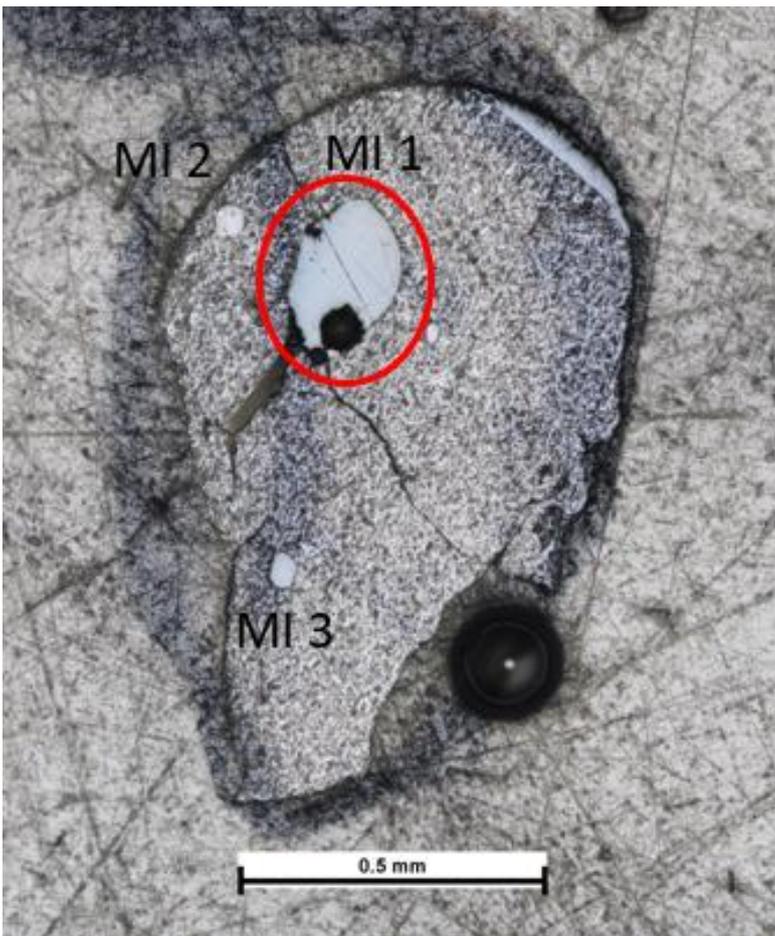
Host Crystal 10



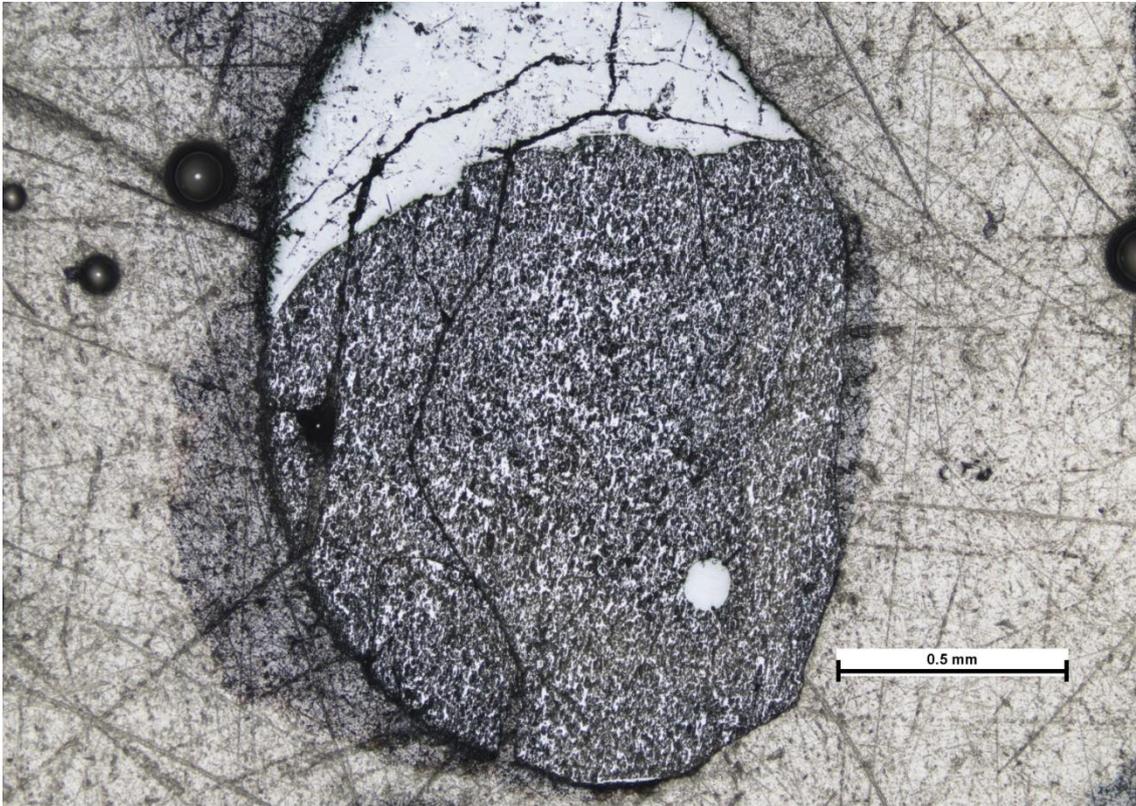
Host Crystal 11



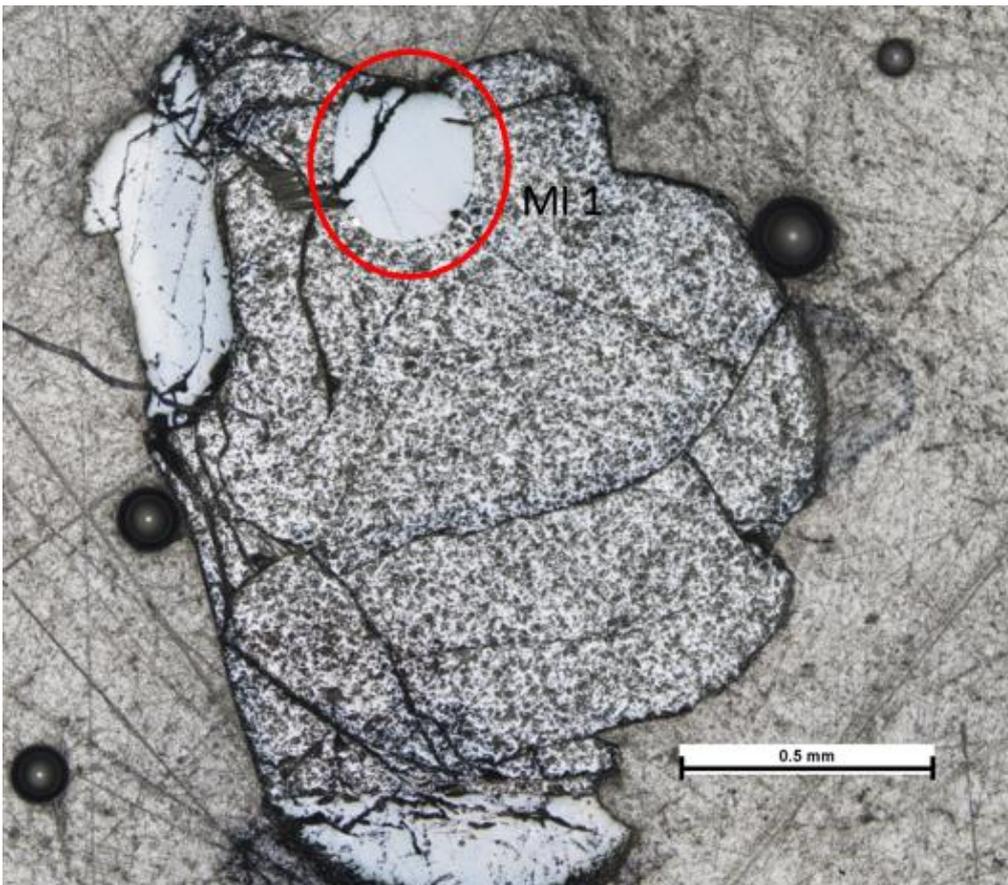
Host Crystal 14



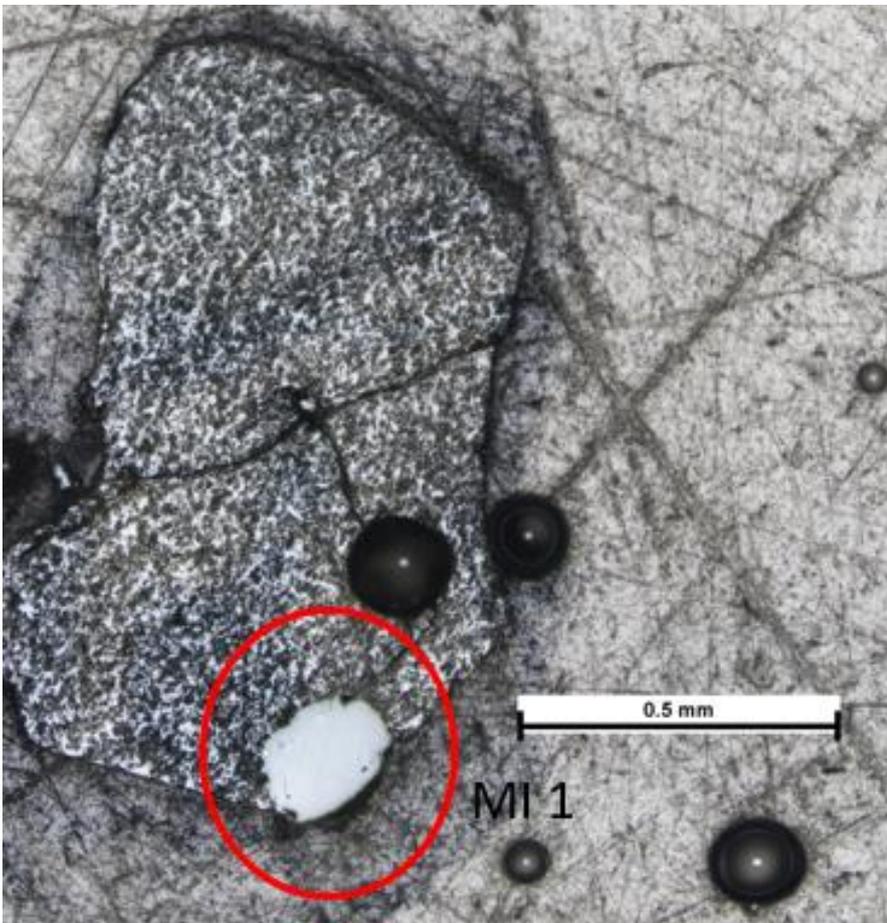
Host Crystal 15



Host Crystal 16

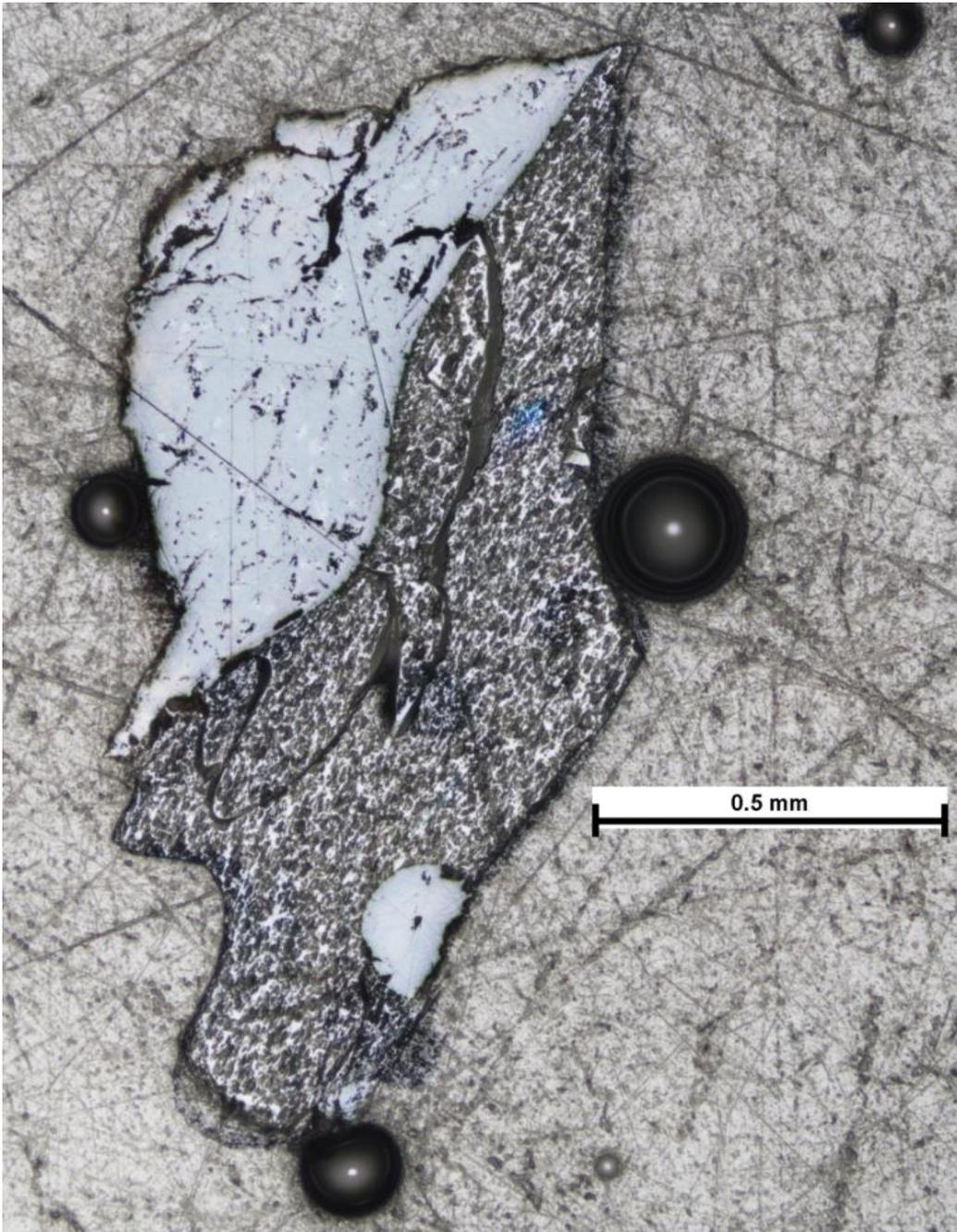


Host Crystal 17

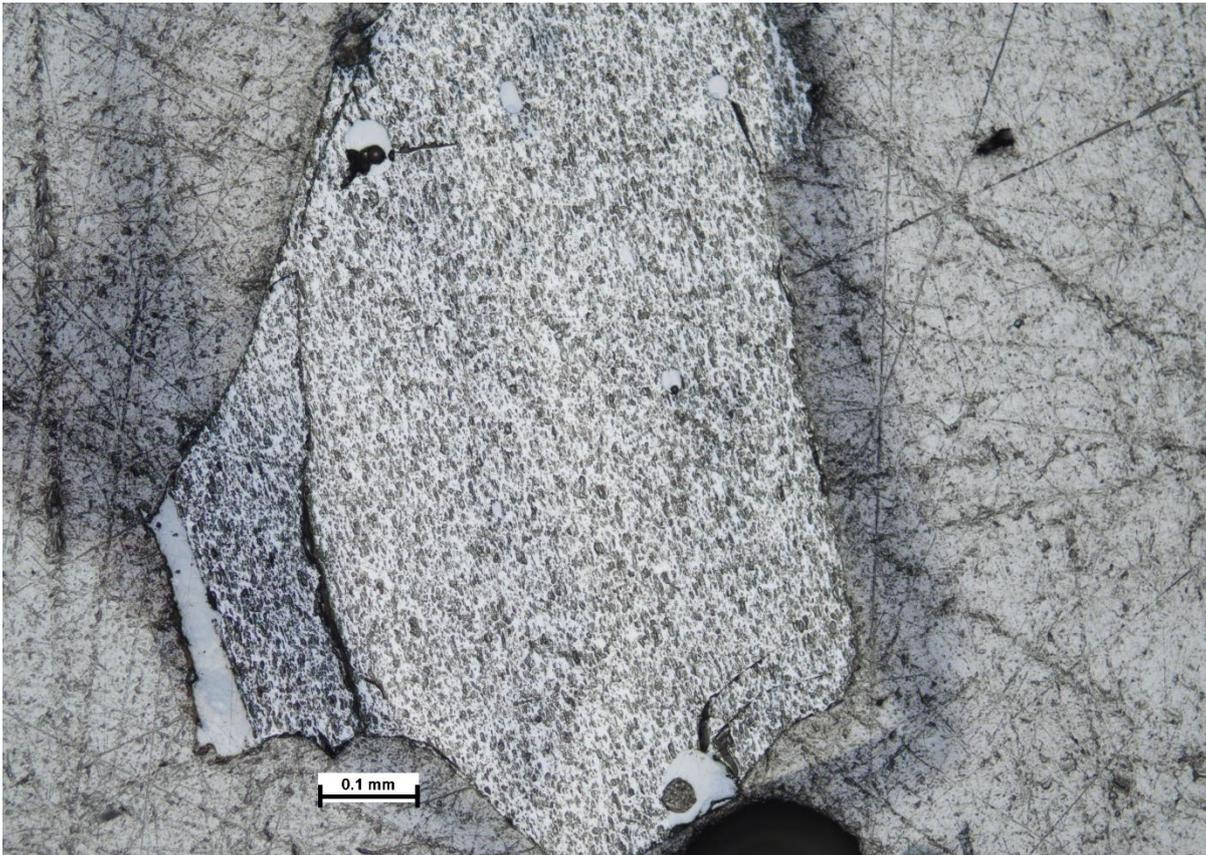


Host Crystal 19

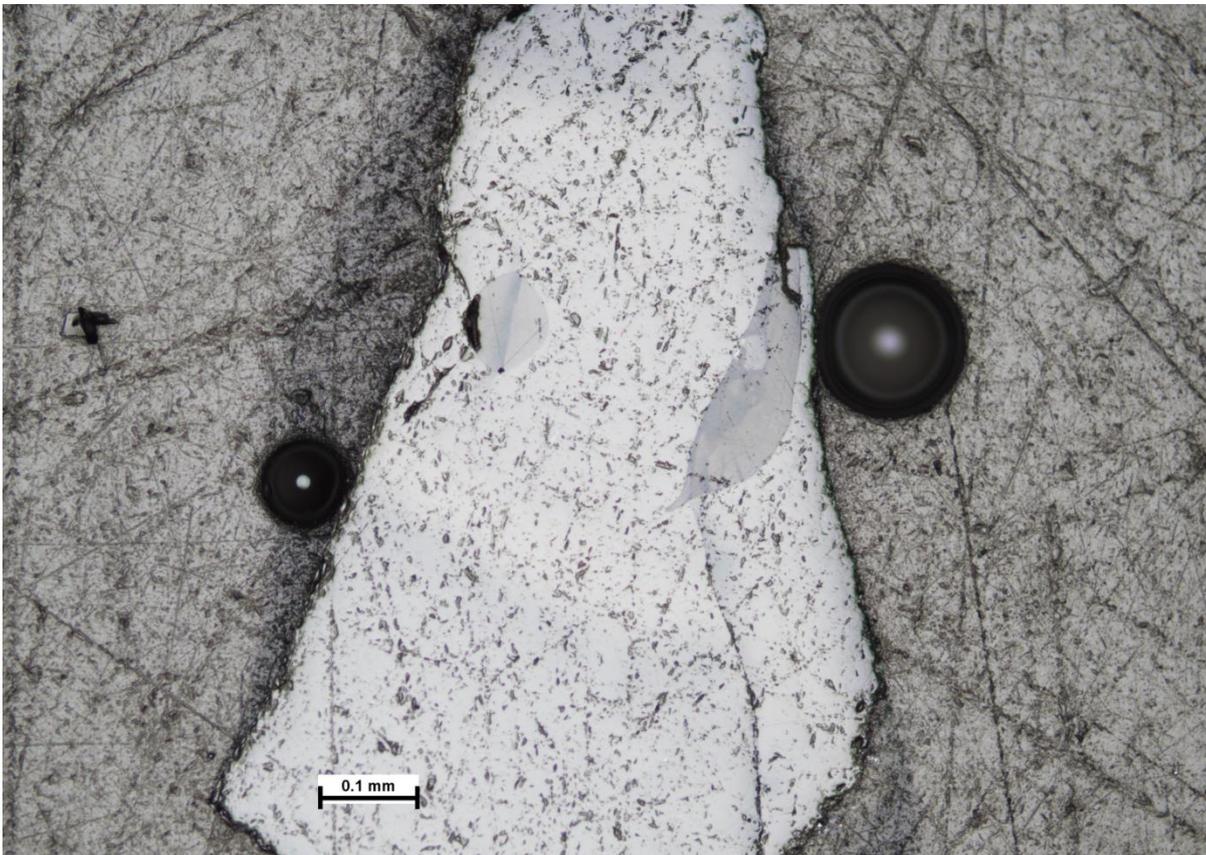




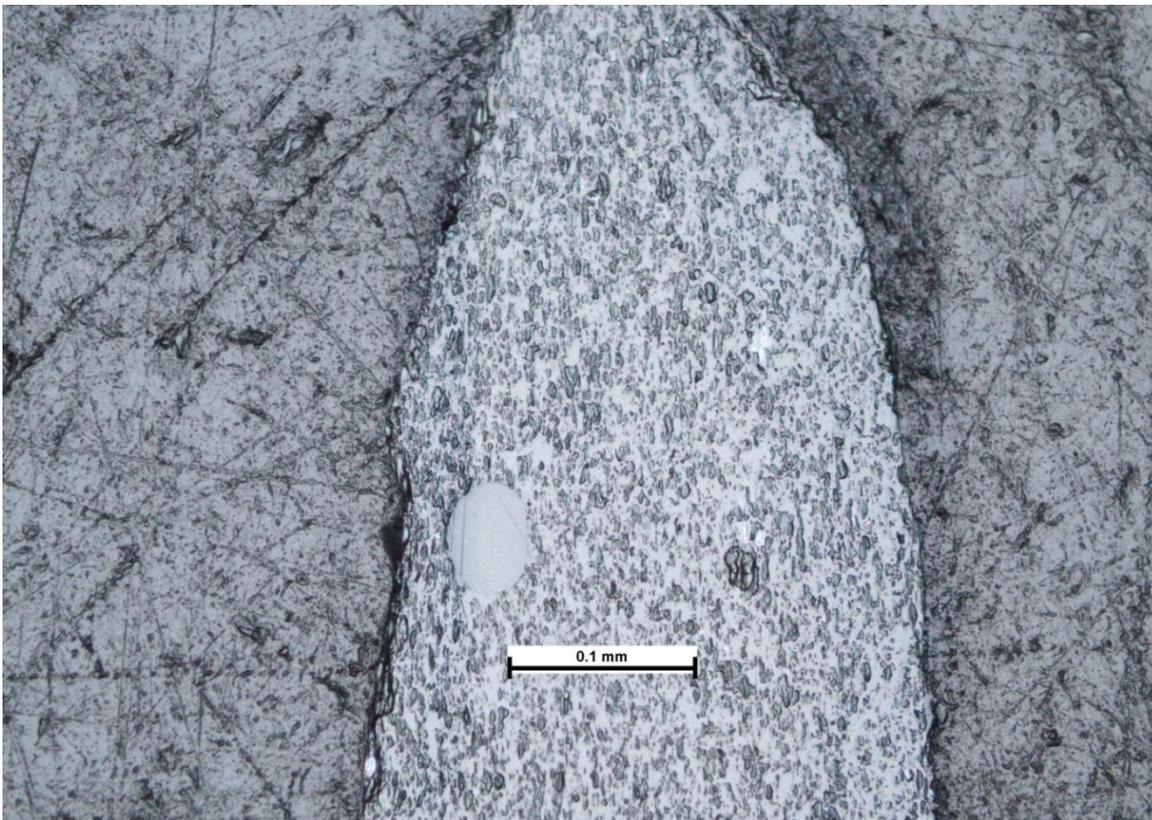
Host Crystal 21



Host Crystal 22



Host Crystal 24



Host Crystal 25

