Supplementary Materials: Mineralogical, Petrological, and Geochemical Characterisation of Chrysotile, Amosite and Crocidolite Asbestos Mine Waste From Southern Africa in Context of Risk Assessment and Re-habilitation

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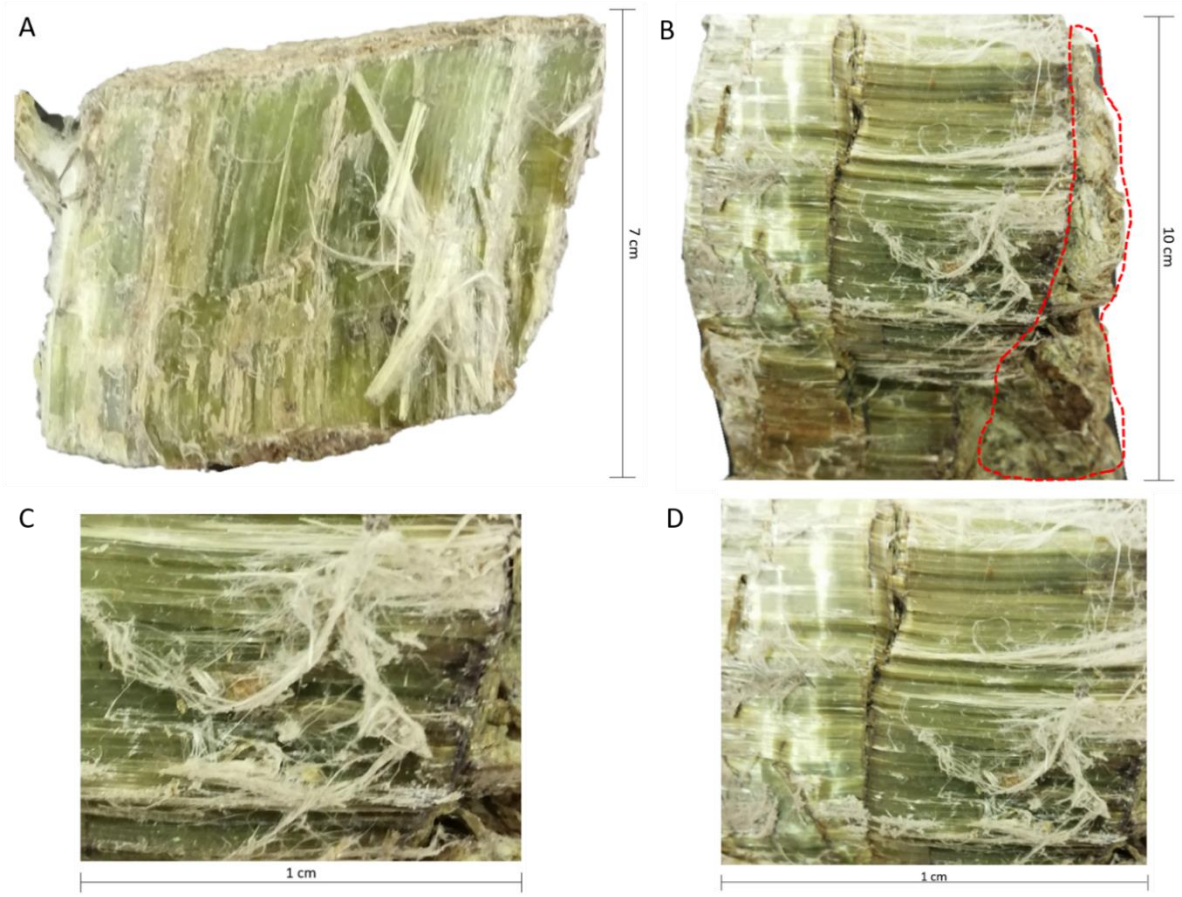


Figure S1. Sample Ch1. (A) Chrysotile rock sample; (B) length of fibres spanning the width of the veins; (C) shows individual masses of matted white, silky fibres and (D) a parting at the centre of the vein width halving the length of the cross-vein fibres.

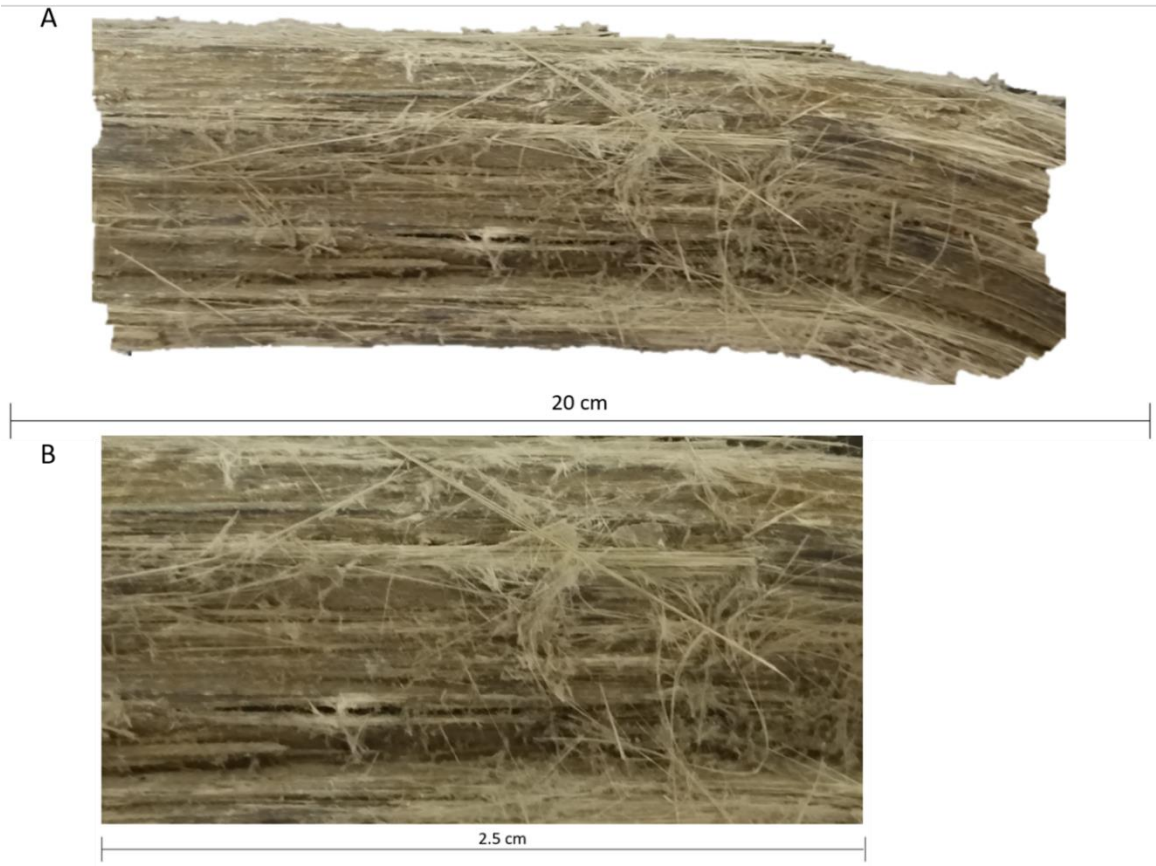


Figure S2. Sample Am2. (A) Amosite rock sample and (B) matted and splintery fibres.

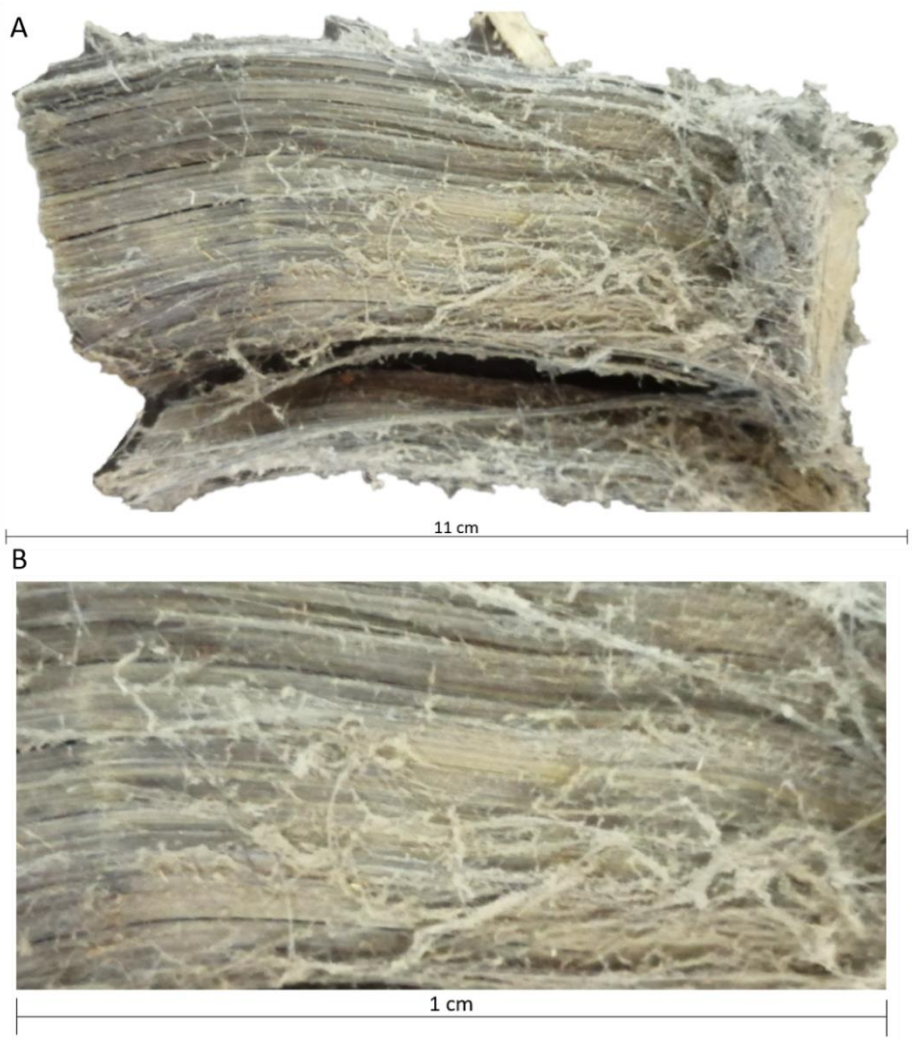


Figure S3. Sample Cr3. (A) Crocidolite rock sample and (B) showing slight curvature of poly-filamentous bundles.

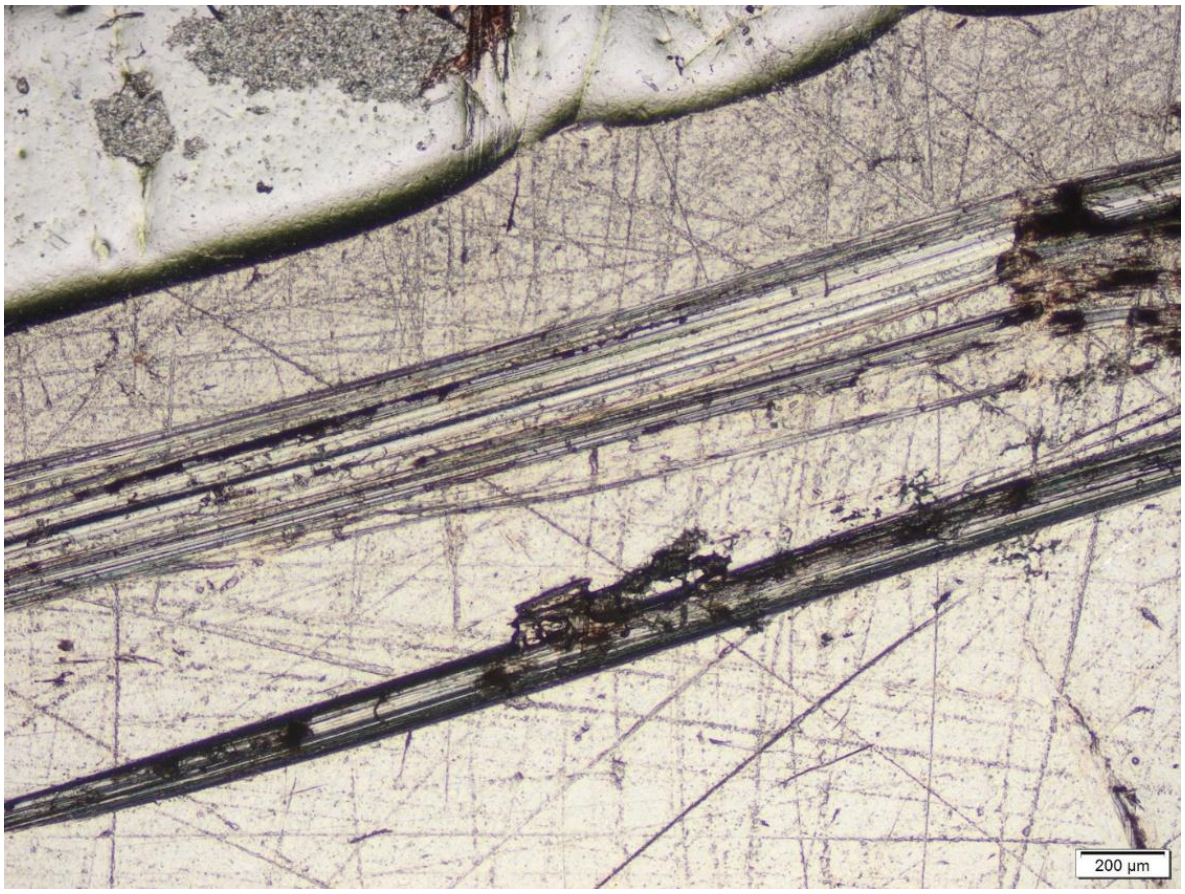


Figure S4. Sample Ch1. Chrysotile fibre bundle (PPL). Notice the break in the bundle in the top right.

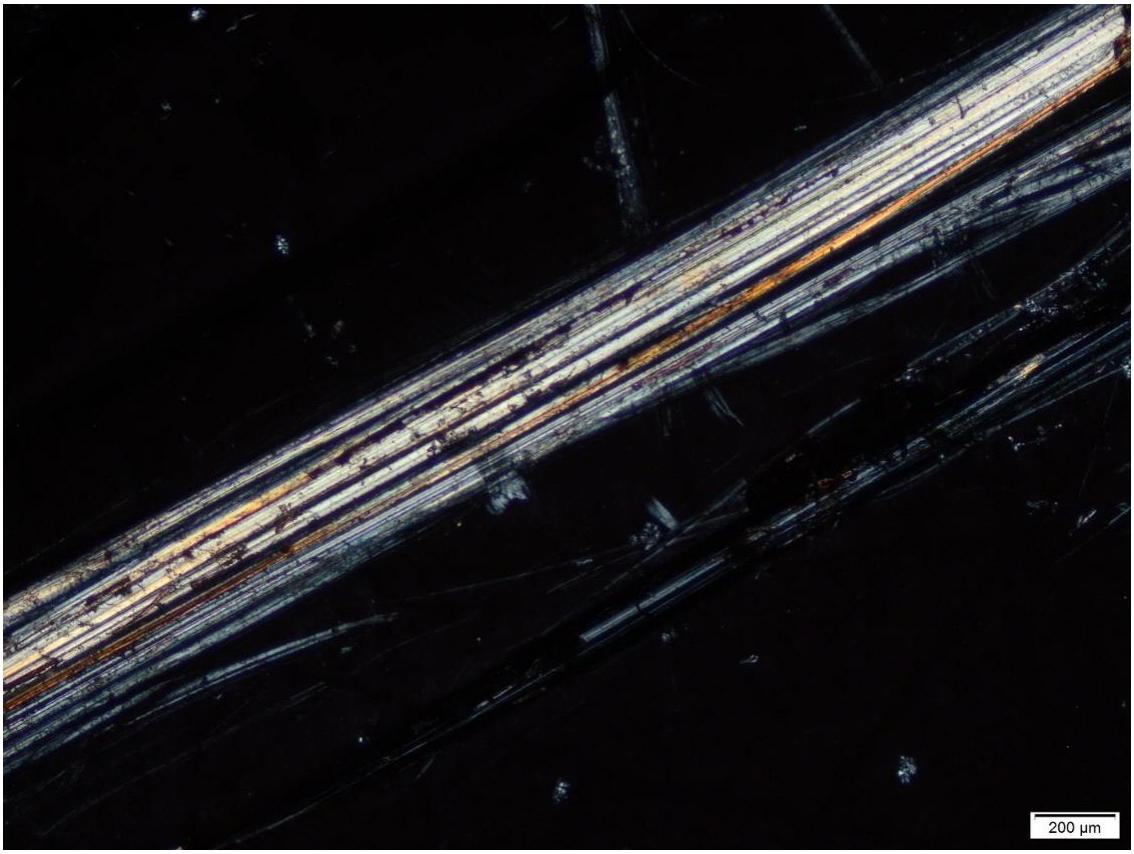


Figure S5. Sample Ch1. Chrysotile fibre bundle (XPL).

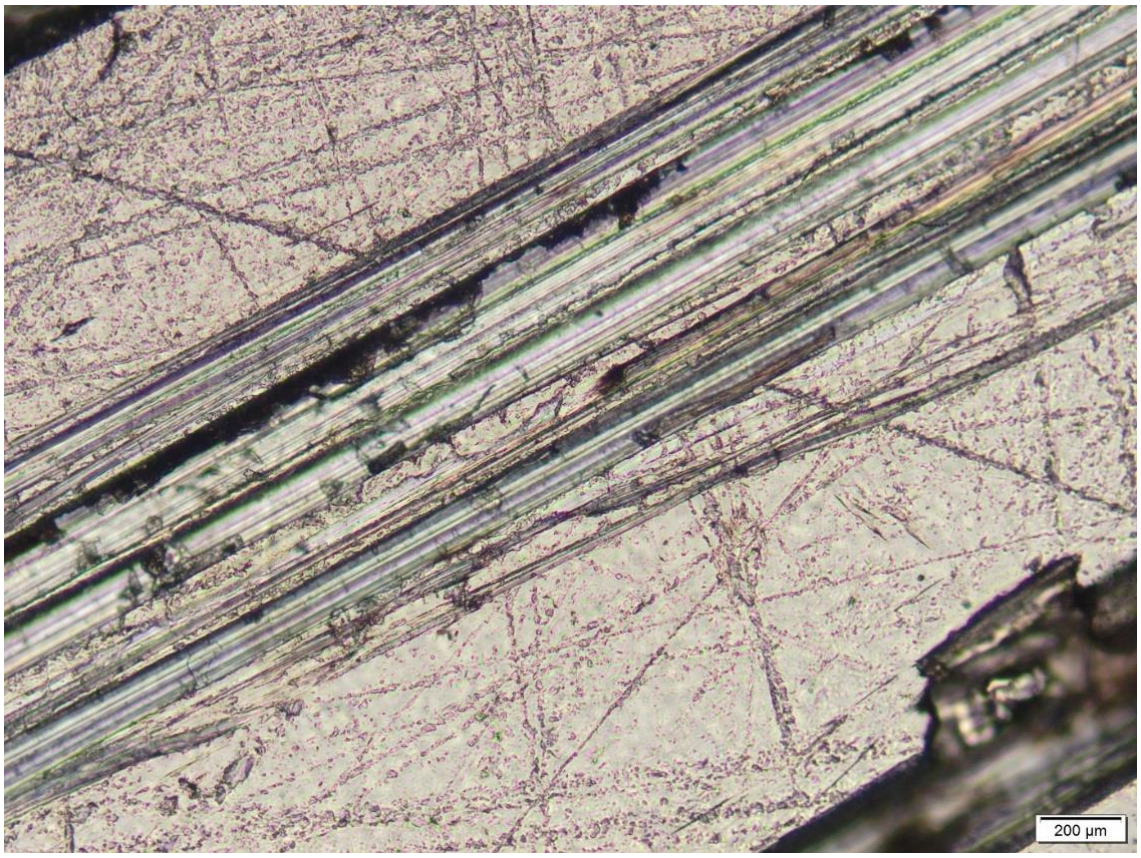


Figure S6. Sample Ch1. Partially altered chrysotile fibres shown by amorphous, irregular material and cloudiness (PPL).

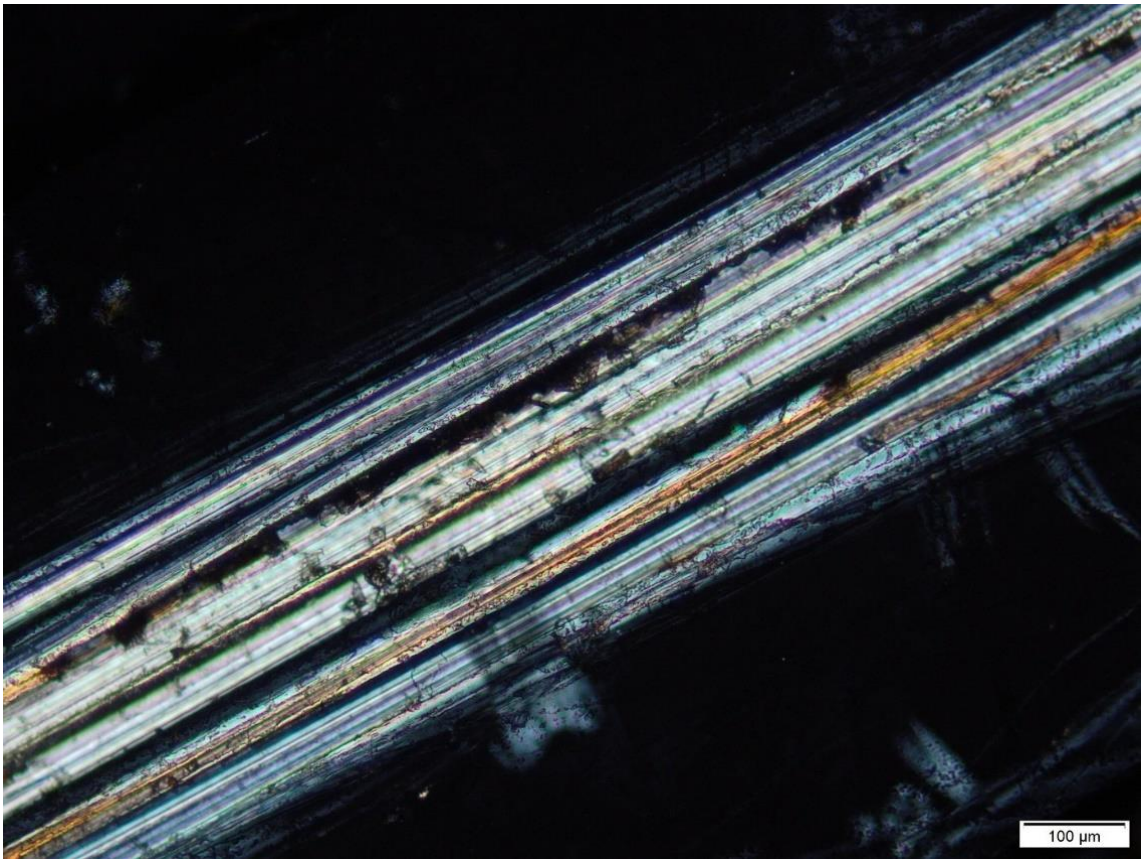


Figure S7. Sample Ch1. Partially altered chrysotile fibres shown by amorphous, irregular material and cloudiness (XPL).

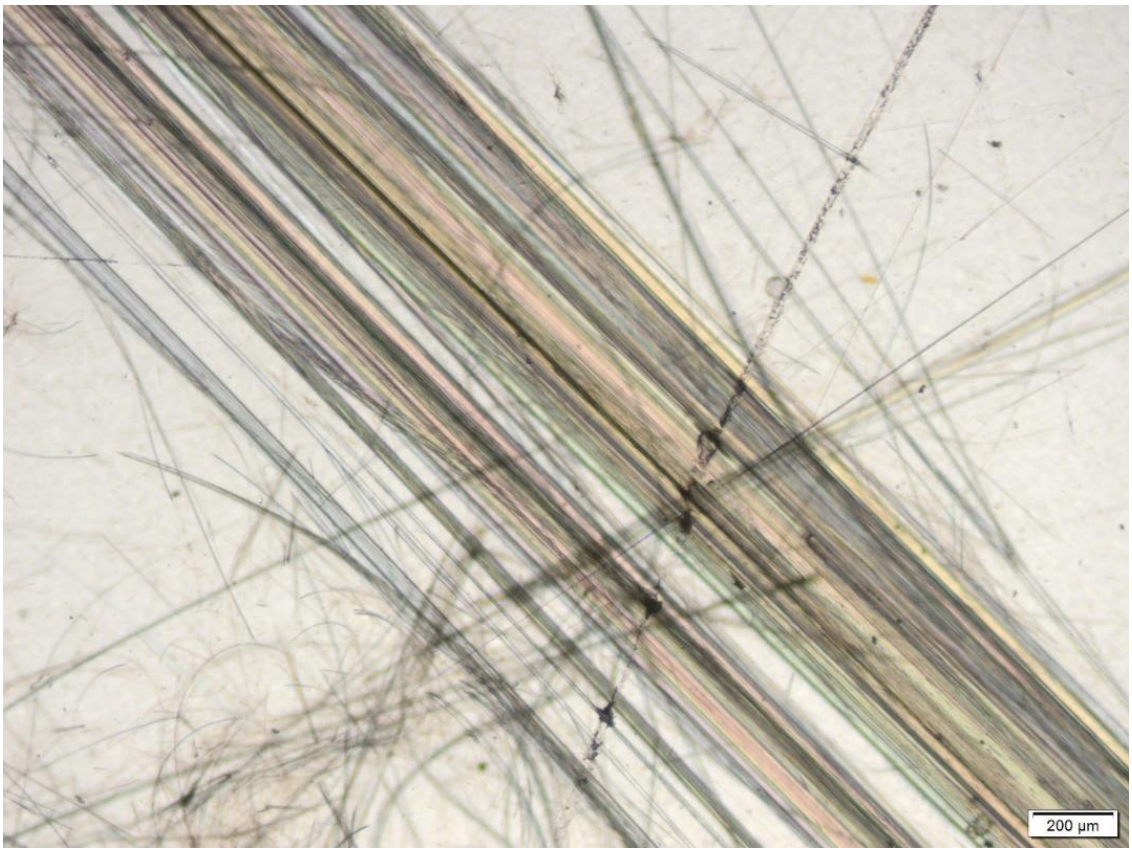


Figure S8. Sample Am2. Extremely fine amosite fibres showing parallel alignment and matting (PPL).

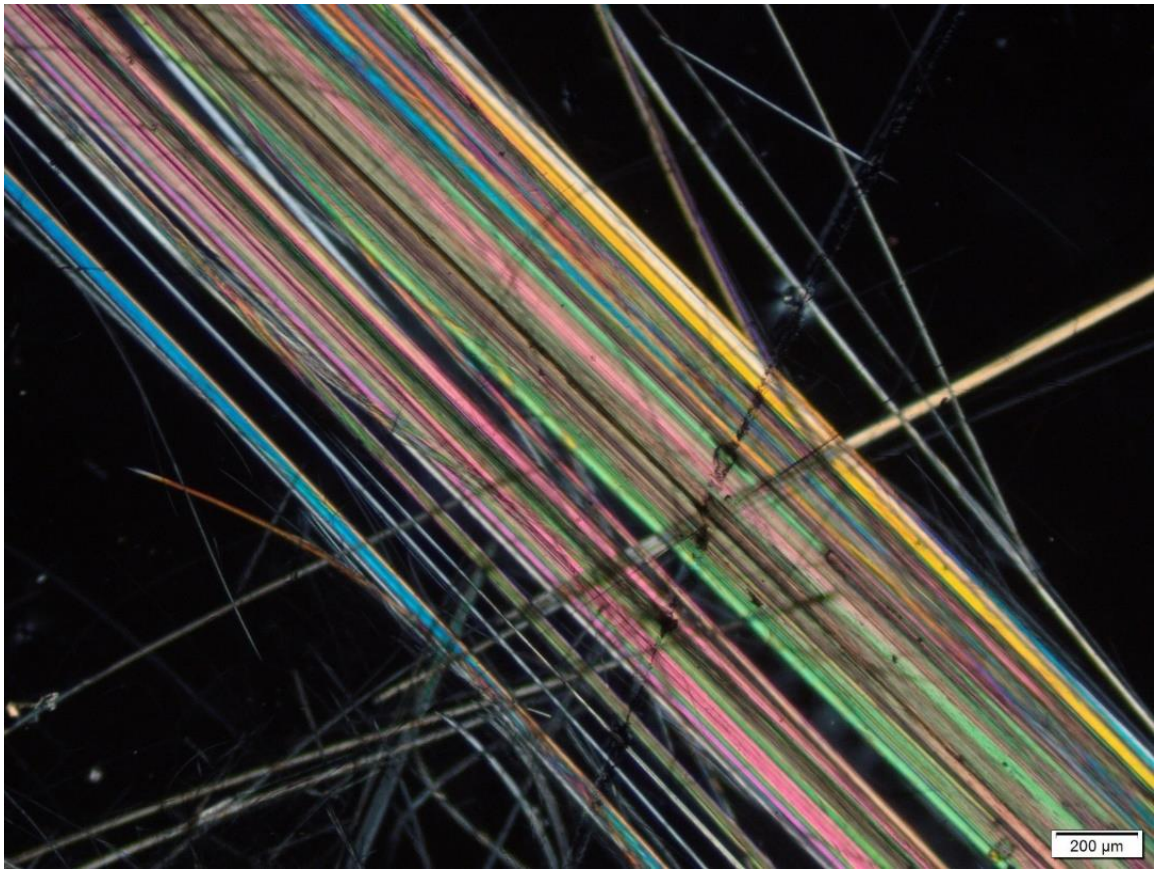


Figure S9. Sample Am2. Extremely fine amosite fibres showing parallel alignment and matting (XPL).

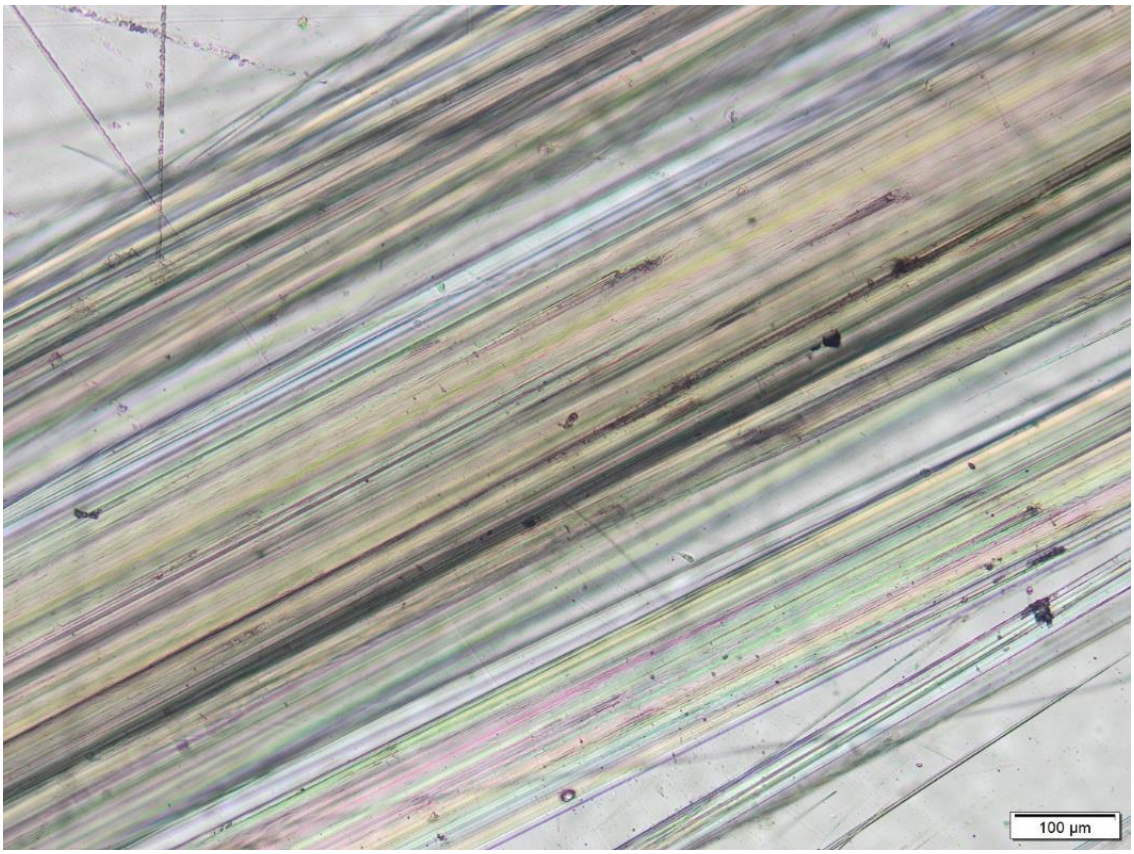


Figure S10. Sample Am2. Amosite fibres at maximum angle of pleochroism showing heterogenous colours (PPL).

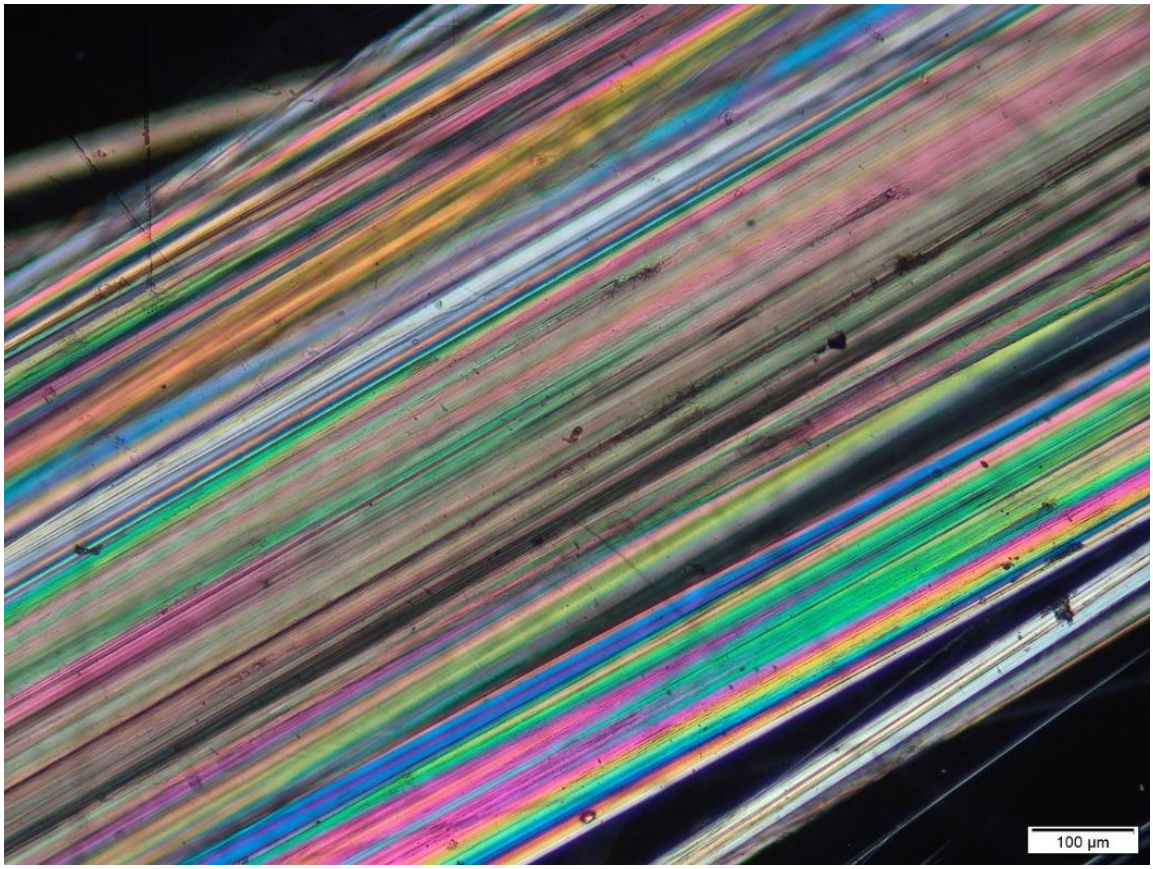


Figure S11. Sample Am2. Amosite fibres at maximum angle of birefringence showing heterogenous interference colours (XPL).

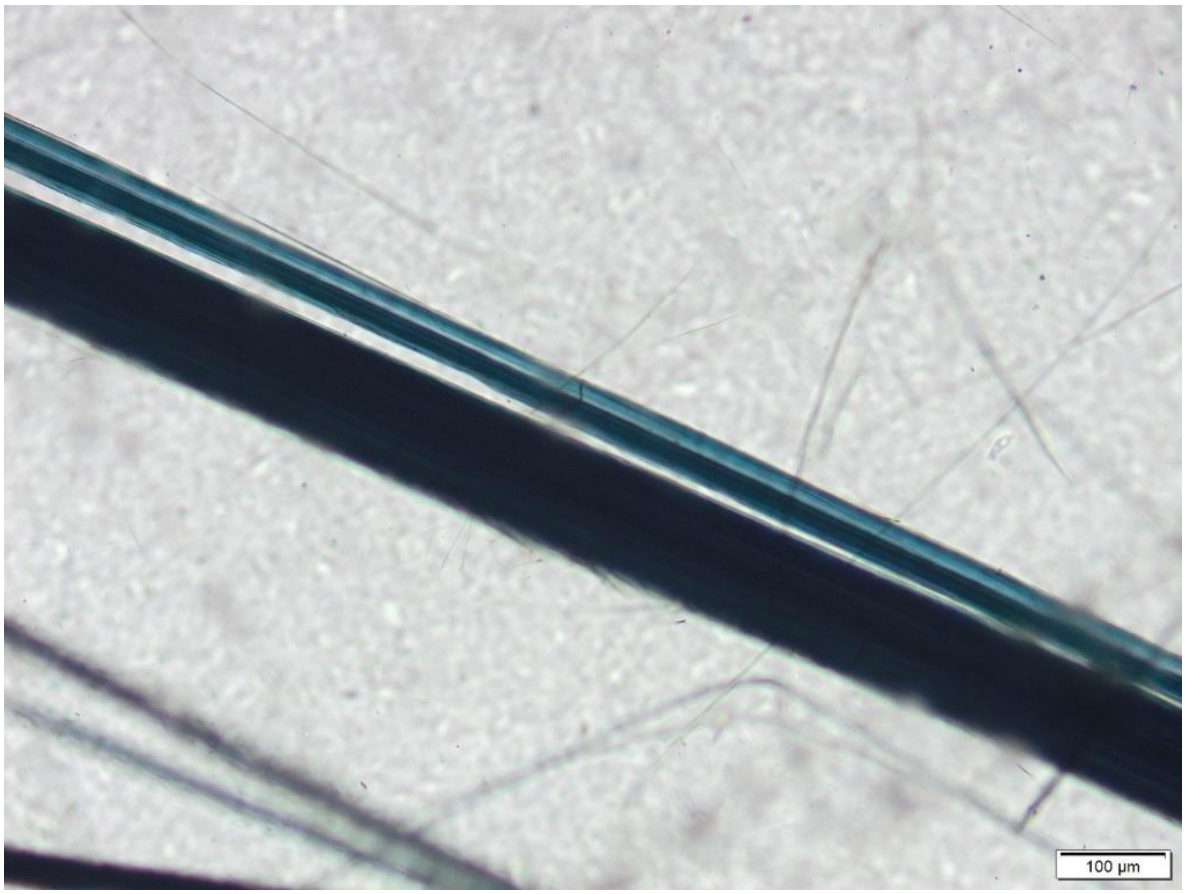


Figure S12. Sample Cr3. Poly-filamentous crocidolite (PPL).

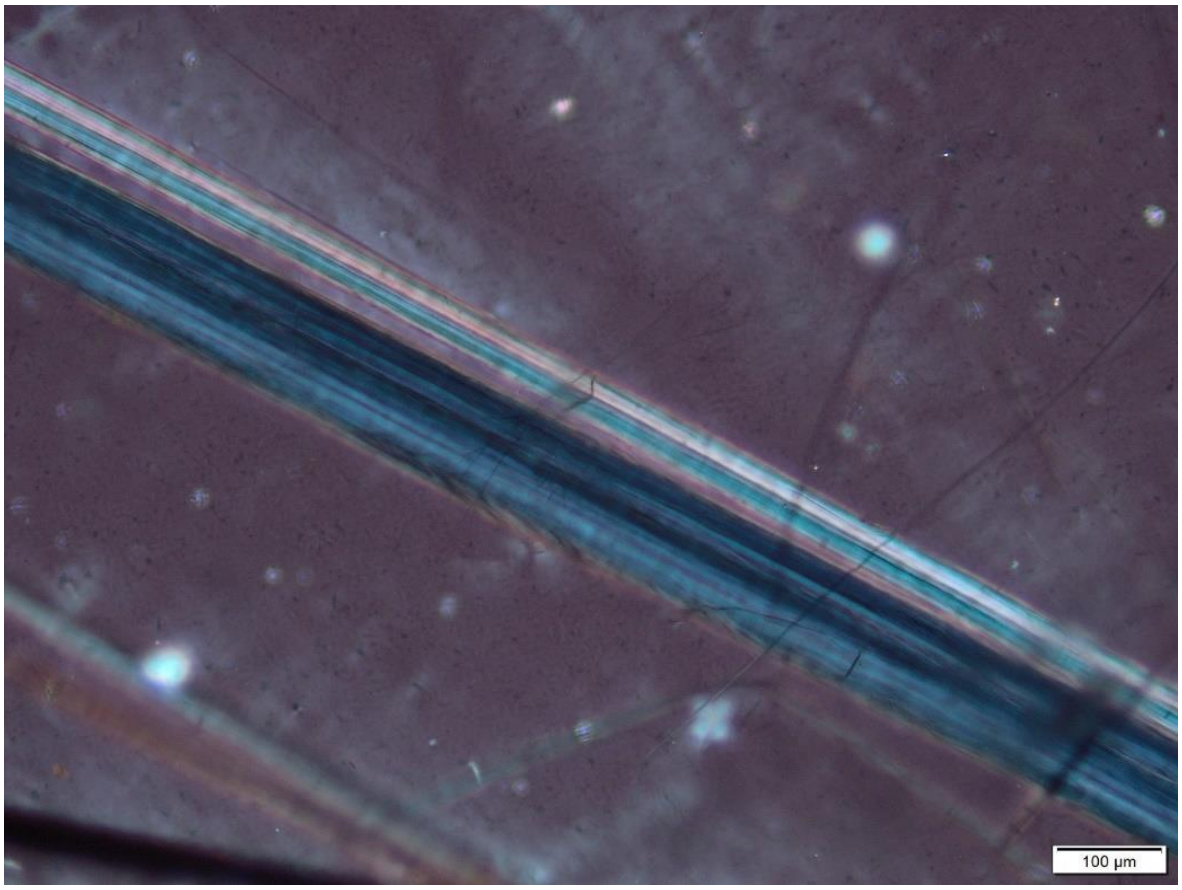


Figure S13. Sample Cr3. Poly-filamentous crocidolite (XPL).

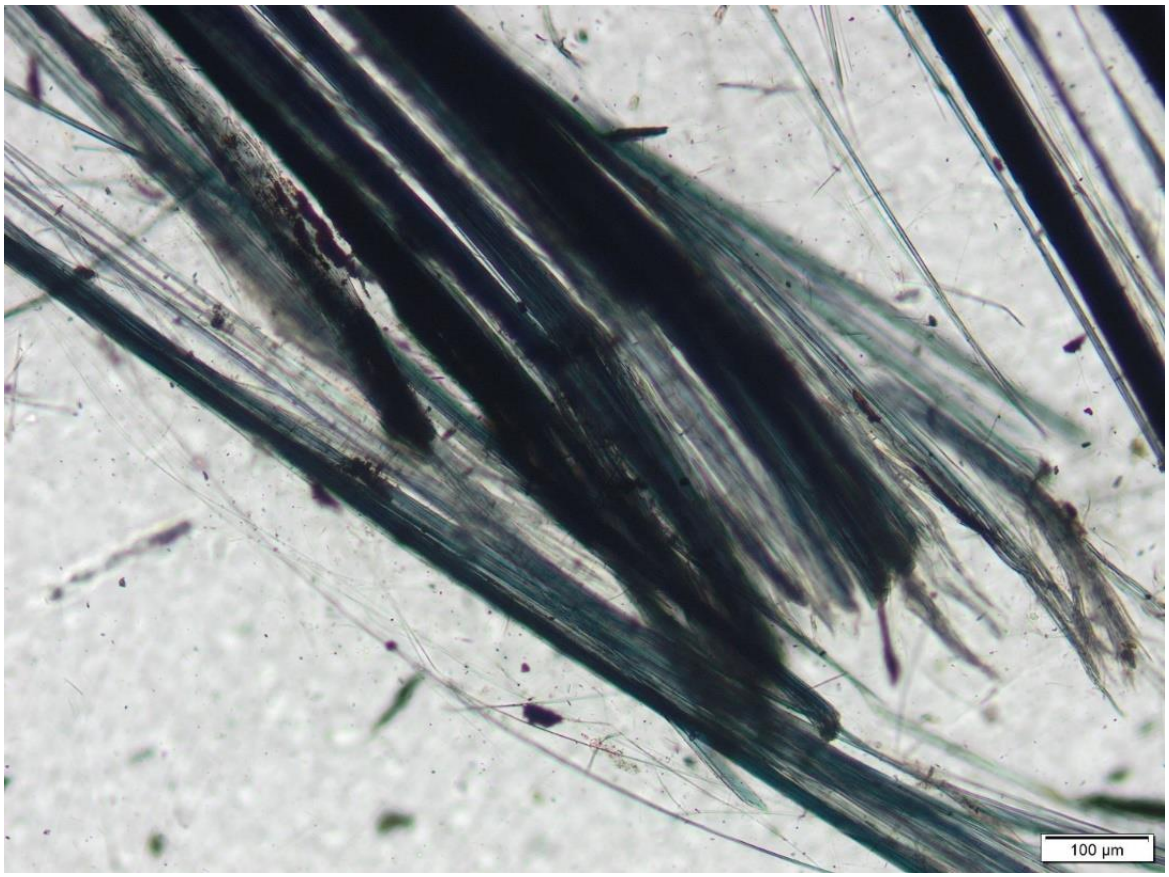


Figure S14. Sample Cr3. Crocidolite fibres with splayed ends (PPL).

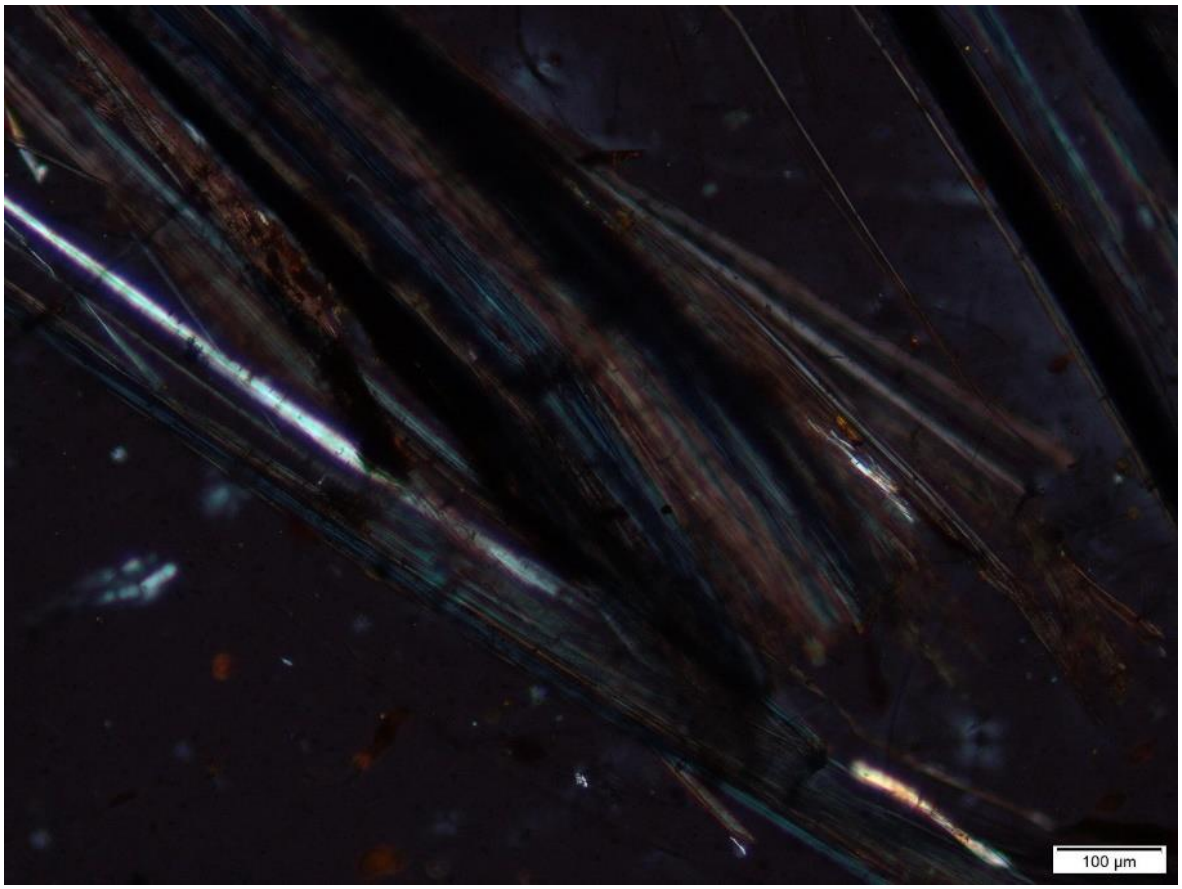
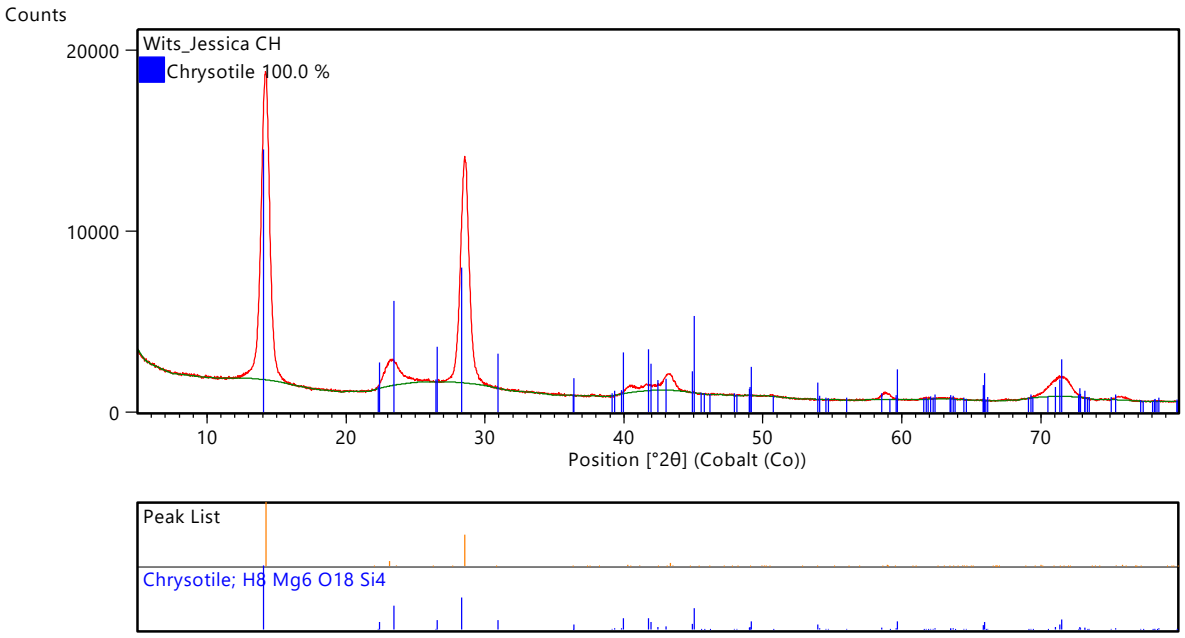
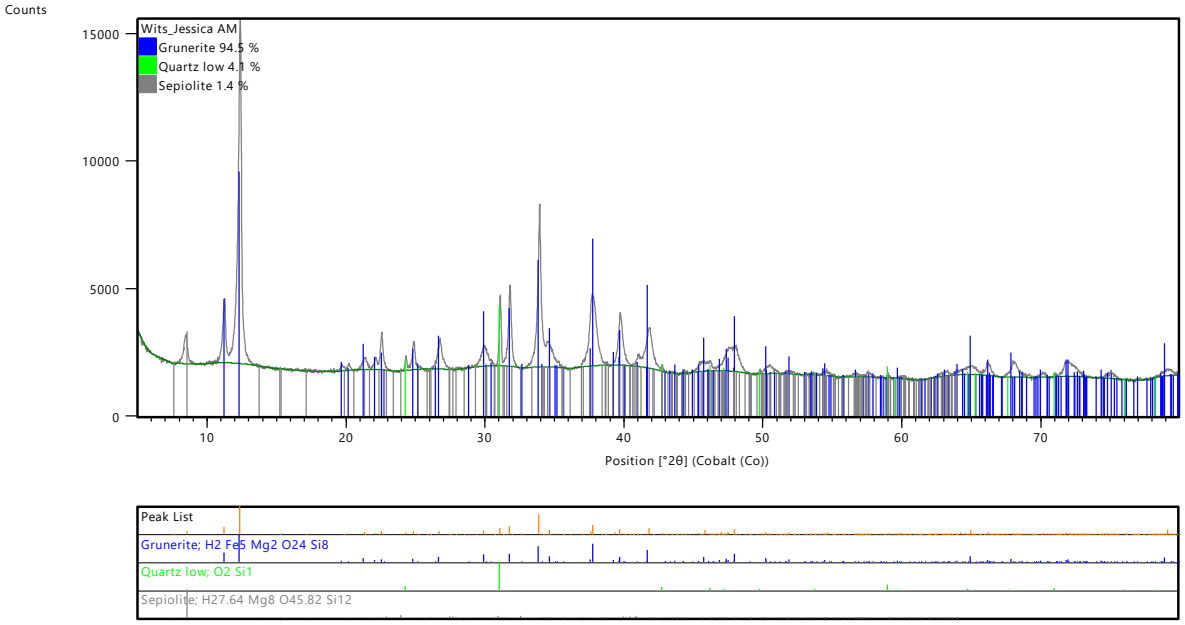


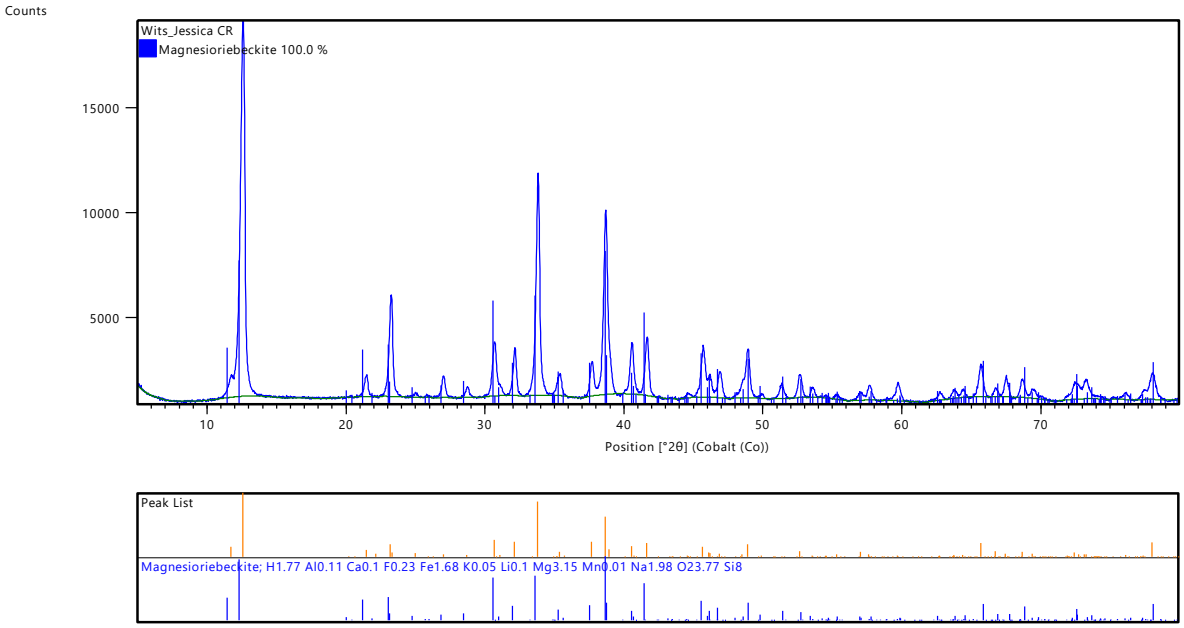
Figure S15. Sample Cr3. Crocidolite fibres with splayed ends (XPL).



Graph S1: Sample Ch1**.** Chrysotile asbestos XRD diffractogram and Rietveld refinement phases .



Graph S2: Sample Am2. Amosite asbestos XRD diffractogram and Rietveld refinement phases .



Graph S3: Sample Cr3**.** Crocidolite asbestos XRD diffractogram and Rietveld refinement phases .

Table S1. X-Ray diffractogram data (λ (Co$K\alpha$) = 1.78892). The value of I/I$_1$ (relative intensity %) is determined from equation 1, where I$_1$ is intensity of the highest peak of the phase and d (Å) is calculated from equation 2 assuming n = 1. .

Peak #	Chrysotile sample		Amosite sample						Crocidolite sample	
			Amosite (grunerite)		Quartz low		Sepiolite			
	I/I_1	d (Å)	I/I_1	d (Å)	I/I_1	d (Å)	I/I_1	d (Å)	I/I_1	d (Å)
1	100	7.34	47.4	9.3	100	3.35	63.5	22.8	15	8.9
2	20	4.6	100	8.6	48.9	1.8	100	15.3	100	8.3
3	43.33	4.4	42.1	3.5					5	5.15
4	26.7	3.9	47.4	3.3					15	5.15
5	53.3	3.6	64.2	3.1					7.5	3.8
6	19.3	3.35	21.1	2.97					9	3.6
7	13.3	2.9	74.7	2.7					30	3.4
8	8	2.7	54.7	2.5					12.5	3.25
9	20	2.6	32.6	2.3					60	3.1
10	20.7	2.5	42.1	2.2					47.5	2.7

Table S2. The values of 2 and intensity (I) recorded for each the peaks of each phase from the X-Ray Diffraction record (λ (Co$K\alpha$) = 1.78892).

Peak #	Chrysotile rock sample	Amosite rock sample			Crocidolite rock sample
		Amosite (grunerite)	Quartz low	Sepiolite	

	Intensity (counts)	Position [°2Θ] (Cobalt (Co))	Intensity (counts)	Position [°2Θ] (Cobalt (Co))	Intensity (counts)	Position [°2Θ] (Cobalt (Co))	Intensity (counts)	Position [°2Θ] (Cobalt (Co))	Intensity (counts)	Position [°2Θ] (Cobalt (Co))
1	**15000**	14	4500	11	**4500**	31	2000	4.5	3000	11.5
2	3000	22.5	**9500**	12	2200	59	**3150**	6.5	**20000**	12.5
3	6500	23.5	4000	30					1000	20
4	4000	26.5	4500	31.5					3000	21
5	8000	28.5	6100	33.8					1500	27
6	2900	31	2000	35					1800	28.5
7	2000	36	7100	38					6000	30.5
8	1200	39	5200	41.5					2500	32
9	3000	40	3100	45.5					12000	33.5
10	3100	42	4000	48					9500	38.5

Table S3. BET surface area report.

	Rock Sample		
BET Surface Area Report	**Chrysotile**	Amosite	Crocidolite
BET SSA (m^2/g)	29.6746 ± 0.1572	10.2856 ± 0.0535	18.9009 ± 0.1048
Slope (g/cm^3 STP)	0.145628 ± 0.000768	0.421158 ± 0.002177	0.229281 ± 0.001263
Y-intercept (g/cm^3 STP)	0.001070 ± 0.000116	0.002074 ± 0.000329	0.001035 ± 0.000191
C	137.071472	204.057744	222.422981
Qm (cm^3/g STP)	6.8167	2.3628	4.3418
Correlation coefficient	0.9998330	0.9998398	0.9998180
Molecular cross-sectional area (nm^2)	0.1620	0.1620	0.1620
STP – Standard temperature and pressure			

Table S4. The dissolved mass fraction (DMF) calculated for the asbestos samples.

Time (hours)	**Chrysotile**	**Amosite**	**Crocidolite**
0	0	0	0
24	0.5	0.22	0.25
48	0.52	0.23	0.33
168	0.58	0.27	0.35
334	0.63	0.29	0.37
720	0.67	0.292	0.38