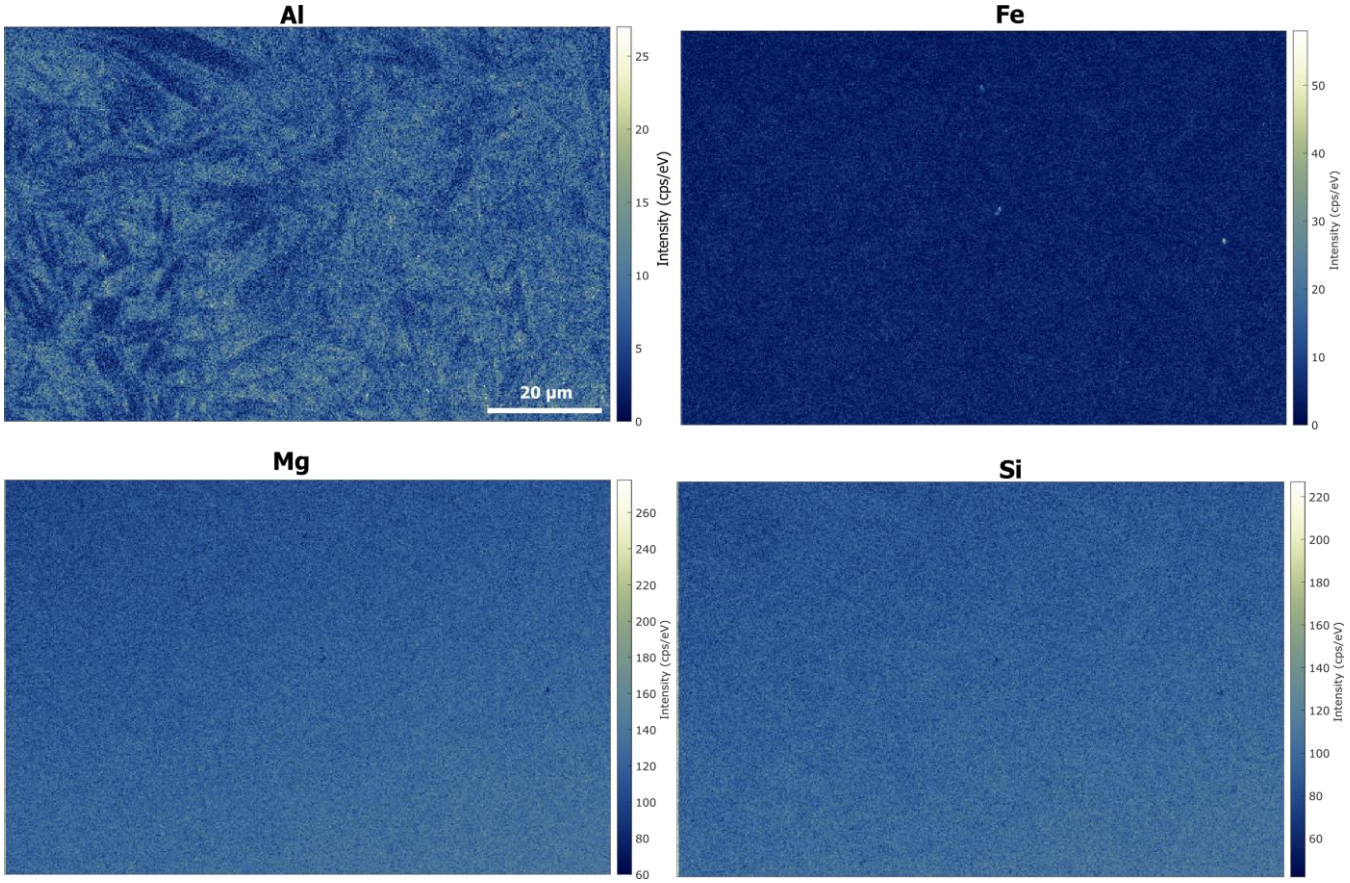
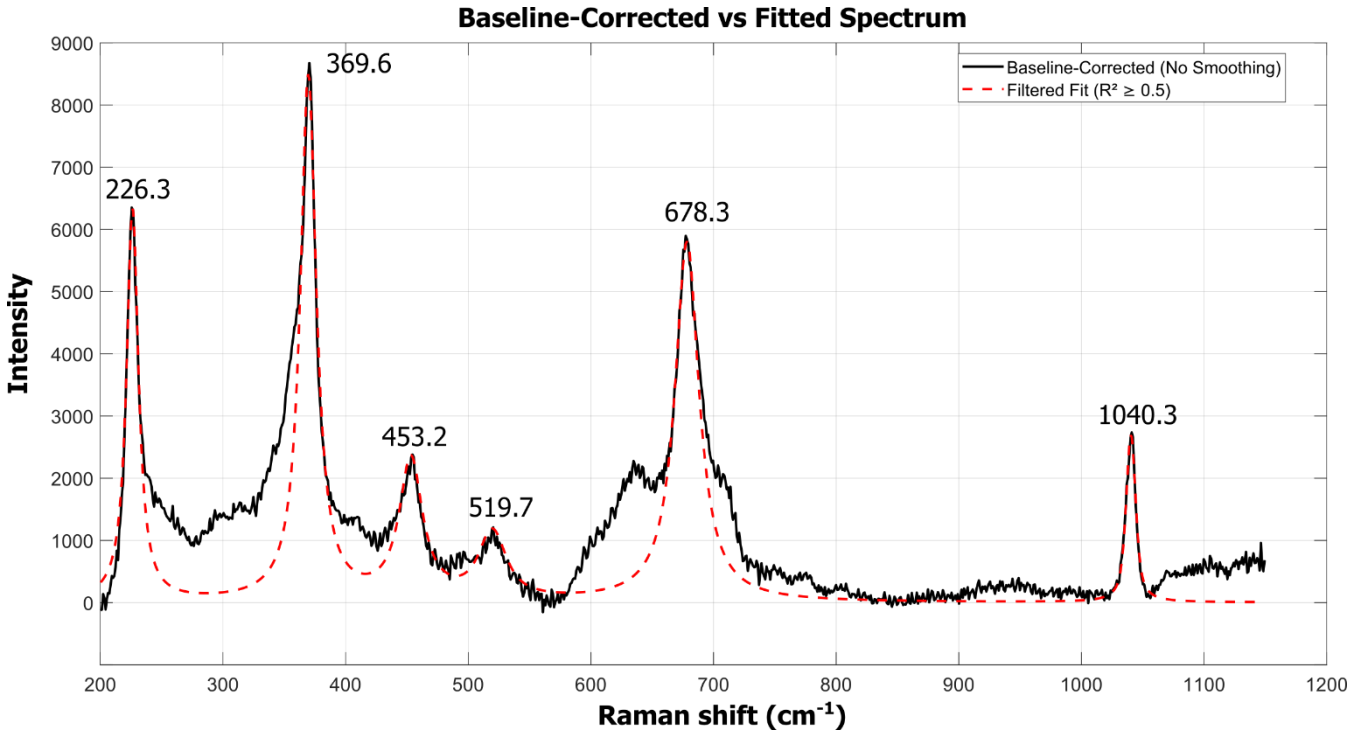
Supplementary material

Section S1

Chemical characterization and phase identification of starting material



Supplementary figure S 1- Energy Dispersive X-ray Spectroscopy (EDS) map of aluminum (Al); Iron(Fe);Magnesium (Mg) and Silica(Si) in the serpentine matrix.



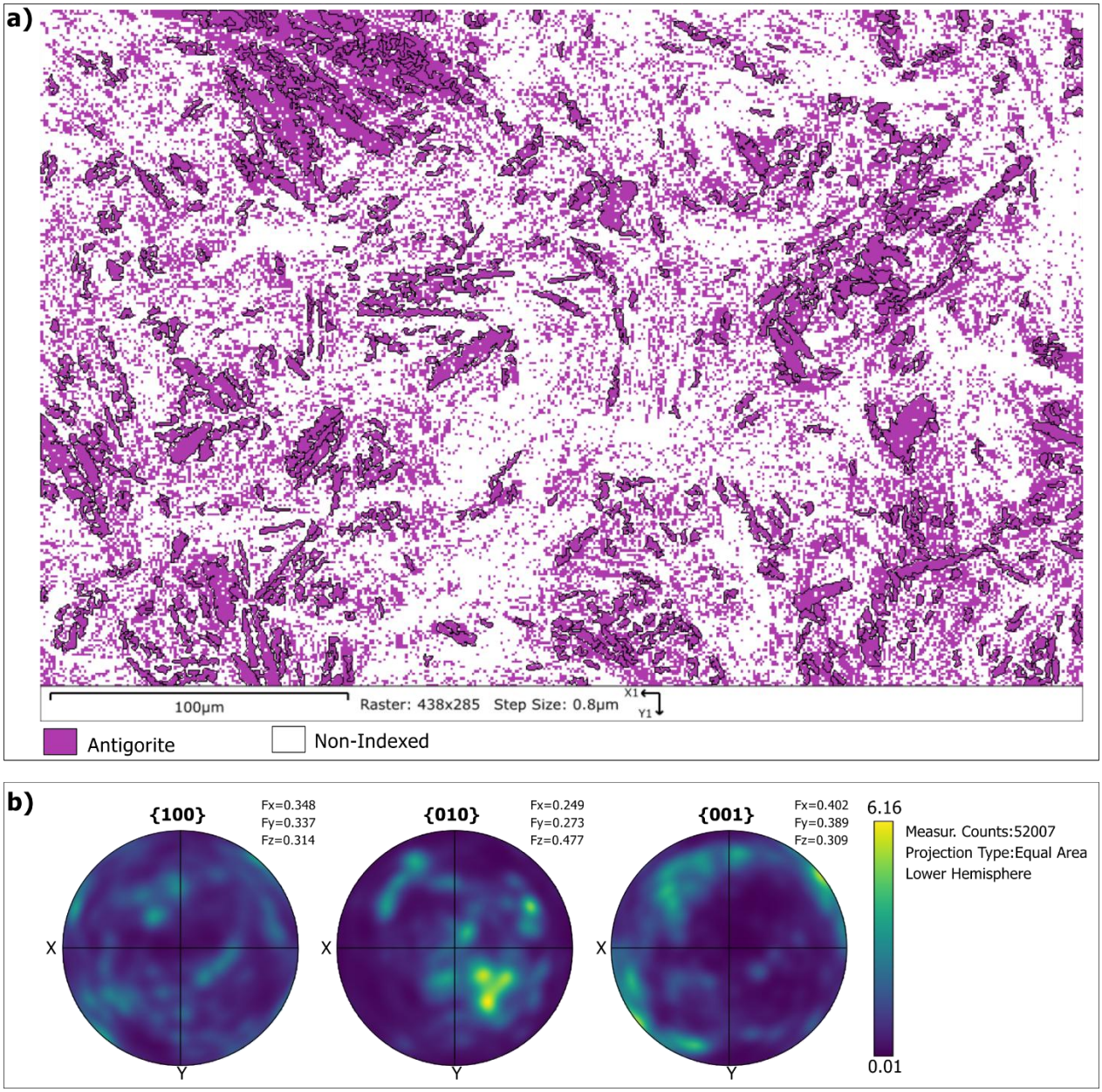
Supplementary figure S 2 - Raman spectrum of antigorite. Although the peaks are slightly lower than characteristic peaks of antigorite (688, 520, 378 cm^{-1}), they are distinct from lizardite peak positions (690,510, 378 cm^{-1}).

Electron Probe Micro-Analysis (EPMA) of mineral phases

Supplementary Table S 1 - Elemental composition of serpentine minerals in the starting material.

Elements	Antigorite (wt%)	σ	Al-Antigorite (wt%)	σ	Diopside (wt%)	σ	Magnetite (wt%)	σ	Pentlandite (wt%)	σ
Na	b.d.l	b.d.l	b.d.l	b.d.l	0.709	0.60	b.d.l	b.d.l	b.d.l	b.d.l
Si	19.994	0.27	16.076	1.47	25.041	0.64	1.238	1.92	b.d.l	b.d.l
Mg	23.372	0.34	20.847	1.01	9.687	1.00	1.778	2.64	b.d.l	b.d.l
Al	0.770	0.32	6.971	2.37	1.666	1.51	0.237	0.38	b.d.l	b.d.l
Fe	2.730	0.45	2.697	0.35	1.465	0.29	64.939	8.68	21.652	4.88
Cr	b.d.l	b.d.l	0.189	0.18	0.270	0.17	0.230	0.03	b.d.l	b.d.l
Ni	0.127	0.02	0.180	0.04	b.d.l	b.d.l	0.316	0.05	41.195	4.70
Ca	b.d.l	b.d.l	b.d.l	b.d.l	16.513	1.23	b.d.l	b.d.l	b.d.l	b.d.l
S	b.d.l	b.d.l	b.d.l	b.d.l	b.d.l	b.d.l	b.d.l	b.d.l	32.591	0.62
O	48.243	0.64	47.817	0.84	42.276	0.50	29.854	4.36	b.d.l	b.d.l
Total	95.287	0.70	94.854	0.71	97.656	0.54	98.626	0.62	95.649	0.83

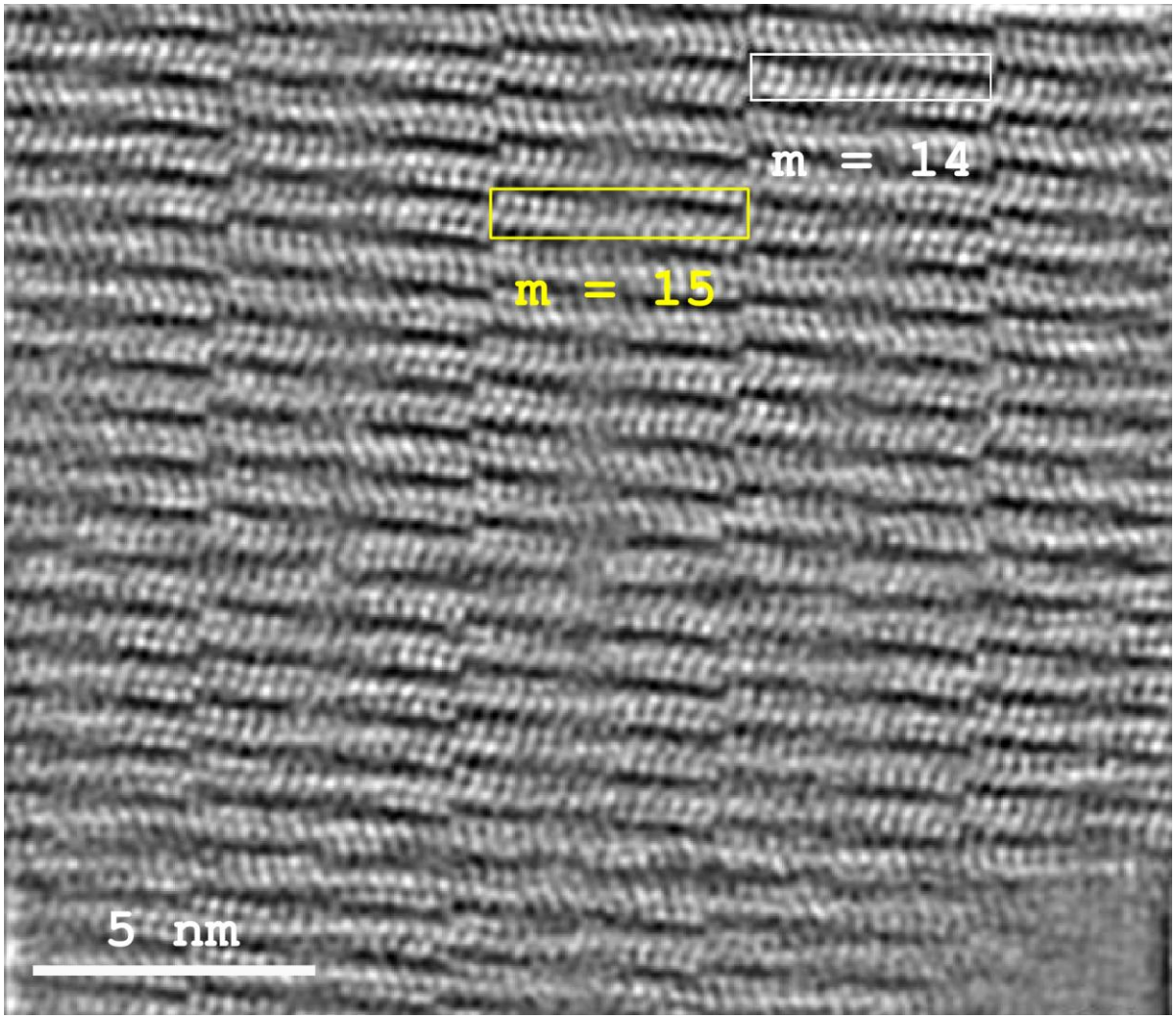
EBSD analysis of starting material



Supplementary figure S 3 - -(a) Phase map of serpentine; the Oxford database antigorite superstructure provided the best indexing results. (b) Pole figures of serpentine. Data processed with MTEX, pole figres are showing upper hemispheres.

Section S2

HR-TEM of antigorite in the short deformation experiment M928



Supplementary figure S 4 - The direct observation of the tetrahedral and octahedral sites in a deformed antigorite (m = 14 and15): high-resolution STEM-HAADF images using non-Cs corrected STEM.