

Supplementary Materials

Nanoscale crystal fabric preserved in dolomite ooids at the onset of the Ediacaran Shuram excursion

Julia Wilcots, Kristin D. Bergmann, Pupa U. P. A. Gilbert, Andrew J. Cross

A subset of results are included in the Supplemental Materials. All analytical data including field photographs, EBSD crystallographic measurements, PIC mapping results, XRD patterns, SEM BSE acid-etched images, EDS elemental maps, EPMA elemental maps and spot analyses, PPL and XPL photomicrographs, stitched photomicrographs, UV fluorescence photomicrographs, and XPL movies supporting this study are available at Zenodo and Github: <https://zenodo.org/records/16884823>. The dataset includes raw and processed files from all samples analyzed.

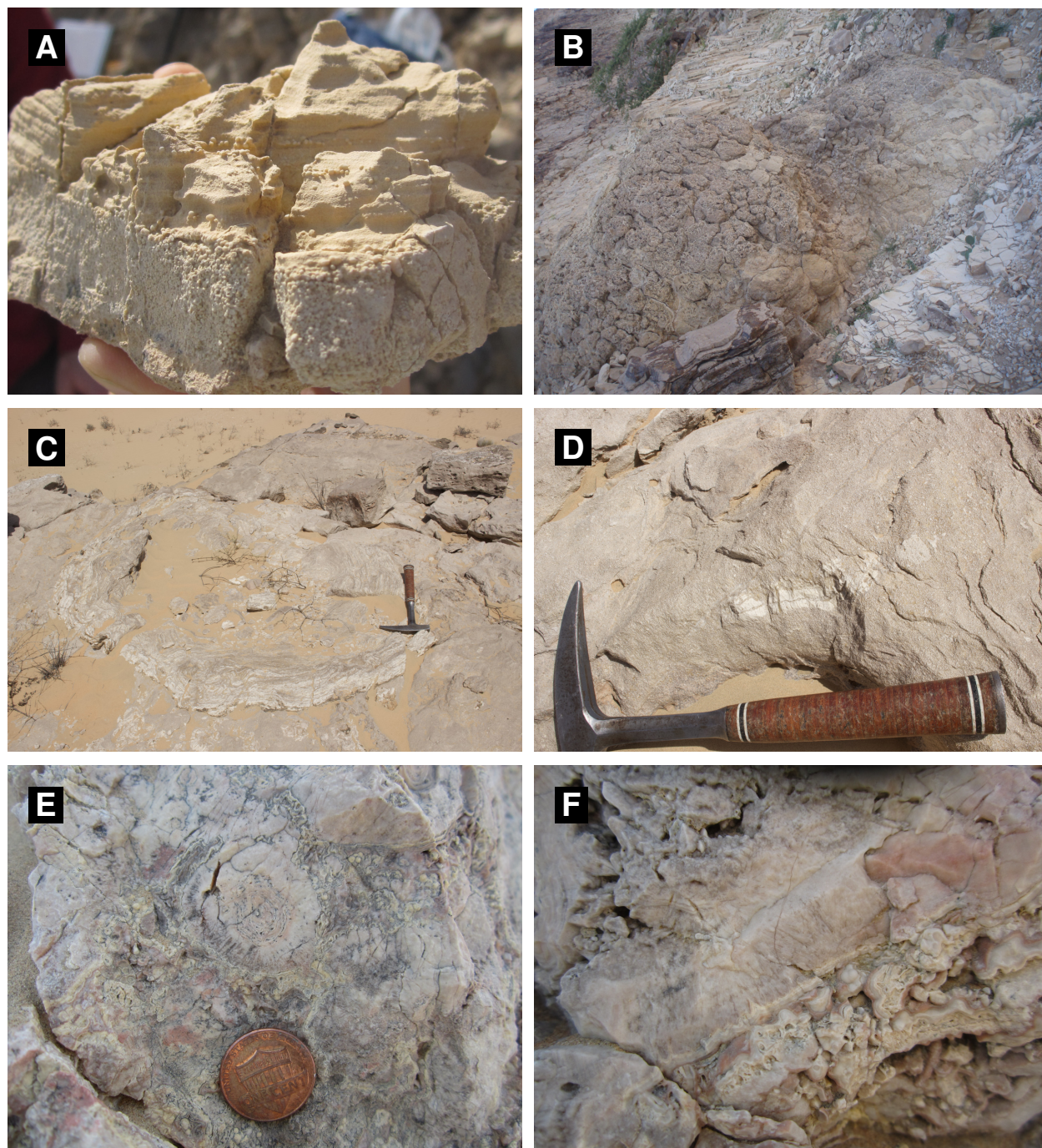
Citation: Wilcots, J., Bergmann, K.D., Gilbert, P.U.P.A., Cross, A. (2025). Data Repository associated with: Nanoscale crystal fabric preserved in dolomite ooids at the onset of the Ediacaran Shuram excursion (v1.0.0) [Data set]. 10.5281/zenodo.16884822

Contents

Supplemental Figures	3
Supplemental Figure 1: Field photographs of sampled facies	6
Supplemental Table 1: Sample mineralogy, location, and geochemical data	6
Supplemental Table 2: Analytical coverage	6
Supplemental Figure 2: Photomicrographs and SEM images of Ediacaran calcite oolite, Shuram Formation	7
Supplemental Figure 3: EBSD maps of Ediacaran calcite oolite, Shuram Formation	8
Supplemental Figure 4: Photomicrographs of Ediacaran dolomite oolite, Upper Khufai Formation	9
Supplemental Figure 5: Stitched plane polarized photomicrograph of Ediacaran dolomite oolite, Upper Khufai Formation	9
Supplemental Figure 6: Stitched cross polarized photomicrograph of Ediacaran dolomite oolite, Upper Khufai Formation	10
Supplemental Figure 7: Photomicrographs and SEM images of Ediacaran dolomite oolite, Upper Khufai Formation	11
Supplemental Figure 8: EBSD phase map and EDS elemental map of Ediacaran dolomite oolite, Upper Khufai Formation	12
Supplemental Figure 9: Photomicrographs and SEM images of Ediacaran dolomite spherulites from a Conophyton stromatolite, Buah Formation	13
Supplemental Figure 10: EBSD phase map and EDS elemental map of Ediacaran dolomite spherulites from a Conophyton stromatolite, Buah Formation	14
Supplemental Figure 11: Photomicrographs and SEM images of Ediacaran dolomite pisolite cements from a tepee-pisolite complex, Birba Formation	15
Supplemental Figure 12: EBSD phase map and EDS elemental map of Ediacaran dolomite pisolite cements from a tepee-pisolite complex, Birba Formation	16
Supplemental Figure 13: Photomicrographs and SEM images of calcite oolites from the Petit Jardin Formation (Port au Port Peninsula, Newfoundland; Cambrian)	17
Supplemental Figure 14: Baseline-corrected and quartz-aligned XRD patterns.	18
Supplemental Figure 15: Peak measurements for baseline-corrected and quartz-aligned XRD patterns.	19

Supplemental Figure 16: Histogram of dolomite ordering ratio $I(015)/I(110)$ across 47 samples and 3 dolomite standards.	20
Supplemental Figure 17: Cross-plot of $I(015)/I(110)$ versus $\text{FWHM}(104)$ for 47 samples and 3 dolomite standards.	21
Supplemental Figure 18: Difference between the sample 2 theta (104) reflection from a standard for 47 samples and 3 dolomite standards.	21

Supplemental Figures



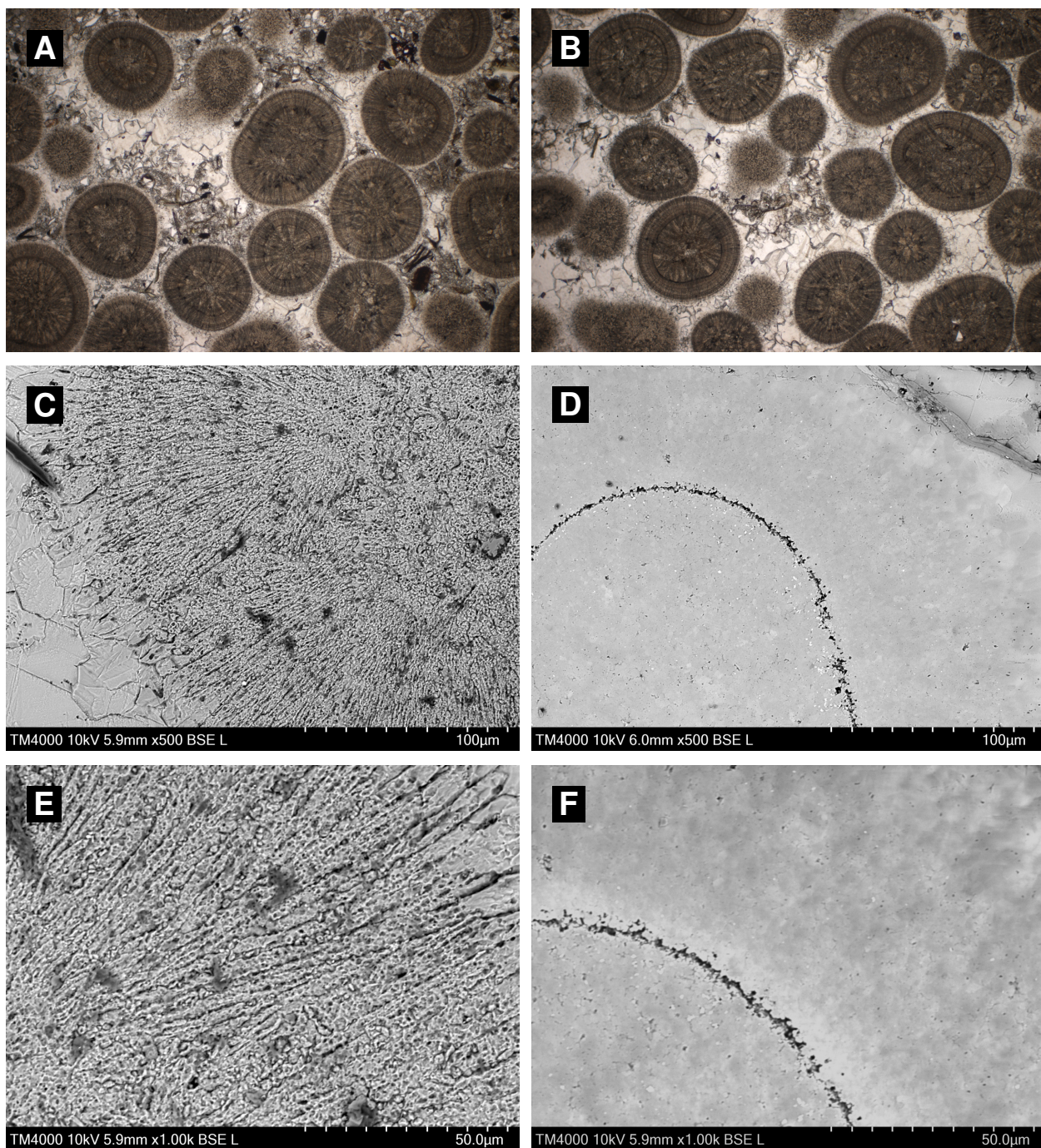
Supplemental Figure 1: Field photographs of sampled facies. (A–B) Dolomite oolite and stromatolitic bioherm, Upper Khufai Formation (Mukhaibah Dome) (C) Dolomite oolite and stromatolitic bioherm, Upper Khufai Formation (Khufai Dome). (D) Dolomite oolite with intraclasts, Upper Khufai Formation (Khufai Dome). (E–F) Pisolite cements, Birba Formation (near Khufai Dome).

Table 1: Sample mineralogy, location, and geochemical data

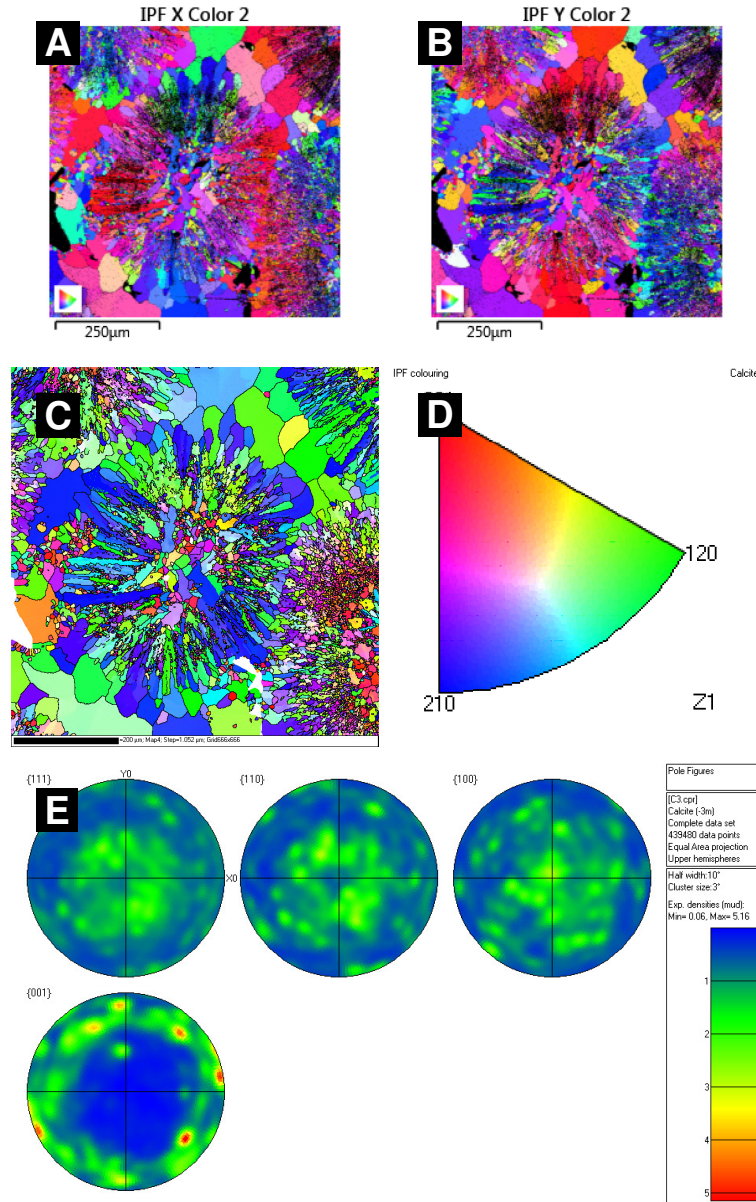
Sample ID	Min.	Site	Country	Age	Lat.	Long.	Comp. Height	Lithology	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$	Fm	Notes
MD6 258.6	DOL	Mukhaibah Dome	Oman	Ediacaran	19.98114	57.71297	343.2	Oolite	-2.62	-6.62	Khufai	sample from the Shuram excursion onset oolite
SB1 CON	DOL	Khufai Dome	Oman	Ediacaran	20.199734	57.739245	1105.4	Conical stromato- lite	7.59	-2.34	Buah	Comparison sample explored in the main text
SB1 ONC	DOL	Khufai Dome	Oman	Ediacaran	20.185878	57.756415	1204.8	Tepee- pisolite complex	4.96	1.23	Birba	Comparison sample explored in the main text
WS7.7	CAL	Khufai Dome	Oman	Ediacaran	20.107298	57.600929	491	Oolite	-9.89	-8.48	Shuram	Comparison radial calcite sample with data (EBSD, SEM etched and unetched images, thin section photomicrographs) shared in the supplemental materials
CC 5_5	CAL	Port-au- Port Penin- sula	Canada	Cambrian	48.525333	-58.858436		Oolite	-	-	Campbell's Member, Petit Jardin	Comparison radial calcite sample with partial dolomitization with data (SEM etched and unetched images, thin section photomicrographs) shared in the supplemental materials
FC8	CAL	Port-au- Port Penin- sula	Canada	Cambrian	48.531193	-58.79182	-	Oolite	-	-	Felix Mem- ber, Petit Jardin	Comparison radial calcite sample with partial dolomitization with data (SEM etched and unetched images, thin section photomicrographs) shared in the supplemental materials

Table 2: Summary of analytical techniques and sample coverage

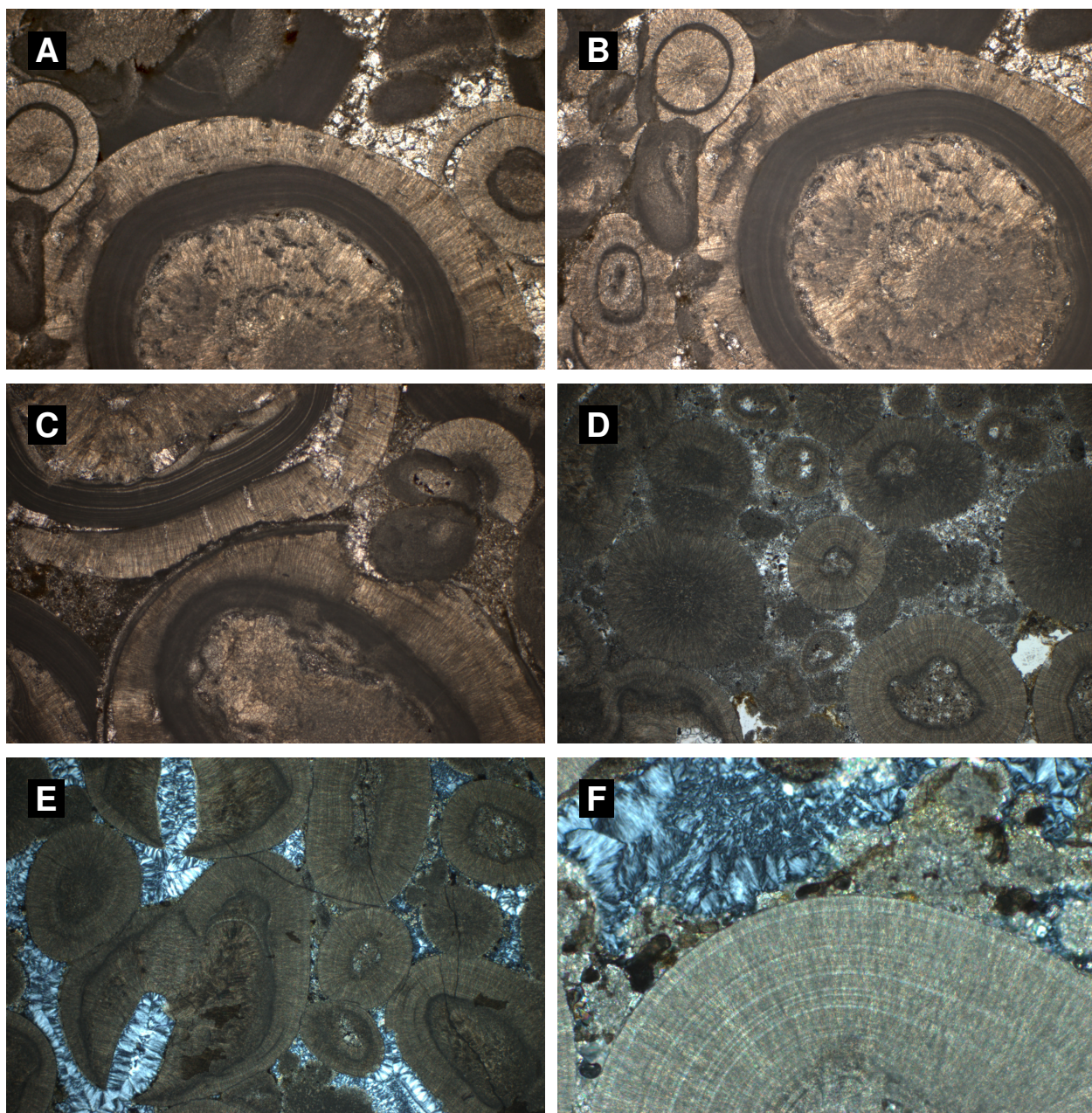
Technique	Number of Samples	Number of Regions	Number of Analyses	Notes
Thin Section Microscopy	6 slides (all)	69 images	–	6 sections total (plane polarized & cross-polarized)
Extinction Movies	3 (MD6_258.6, SB1_CON, SB1_ONC)	4 regions	4 movies	cross polarized light with stage rotation clockwise
UV Microscopy	1 slide (MD6_258.6)	6 images	–	430 nm excitation
Stitched Photomicrograph	1 (MD6_258.6)	1 image (full section)	–	5X magnification entire section
SEM BSE of unetched fabric	5 (MD6_258.6, SB1_CON, SB1_ONC, WS_7_7, CC_5_5)	37 images	–	MD6_258.6: 21 images, SB1_CON: 1 image, SB1_ONC: 9 images, WS_7_7: 4 images, CC_5_5: 2 images
SEM BSE of etched fabric	5 (MD6_258.6, SB1_CON, SB1_ONC, WS_7_7, CC_5_5)	34 images	–	MD6_258.6: 13 images, SB1_CON: 5 images, SB1_ONC: 9 images, WS_7_7: 3 images, CC_5_5: 4 images
EPMA spot analyses	1 (MD6_258.6)	2 regions	51 spot analyses, 5 elements	37 ooid spots + 14 sediment spots, Ca, Mg, Sr, Fe, Mn
EPMA elemental maps	1 (MD6_258.6)	2 regions	5 elements	Ca, Mg, Fe, Mn, Si
EDS elemental maps	3 (MD6_258.6, SB1_CON, SB1_ONC)	3 regions	all elements	Coupled with EBSD (MD6_258.6, SB1_CON, SB1_ONC only)
PIC	3 (MD6_258.6, SB1_CON, SB1_ONC)	4 regions	4 maps	1 ooid quarter (MD6) + 2 subspherulite regions (SB1_CON) + 1 cement region (SB1_ONC)
EBSD	4 (MD6_258.6, SB1_ONC, SB1_CON, WS_7_7)	7 regions	8 maps	2 ooid regions (MD6_258.6) + 1 spherulite (SB1_CON), 1 cement region (SB1_ONC), 4 calcite ooids (WS_7_7)
XRD	47 samples, 3 standards	–	50 patterns	5 oolite patterns from samples at Mukhaibah Dome and Khufai Dome (including MD6_258.6), SB1_CON, SB1_ONC, 9 other samples from the onset of the excursion, 3 dolomite standards
Field Photos	39 images	4 field sites	39 images	Mukhaibah Dome East, Mukhaibah Dome 6, Khufai Dome West



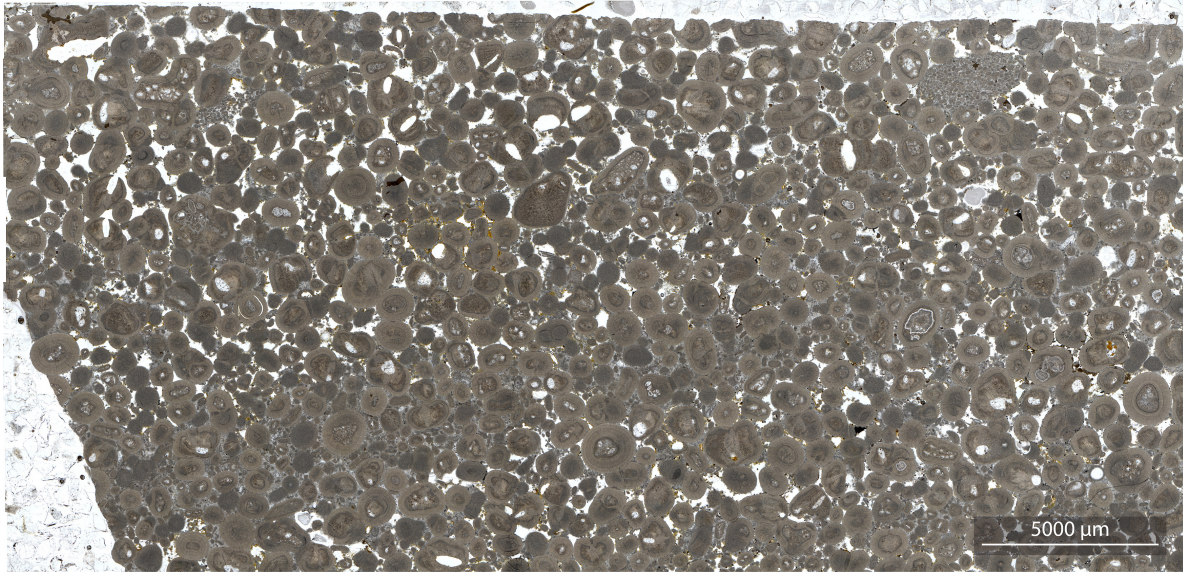
Supplemental Figure 2: Calcite oolite from the Shuram Formation (Khufai Dome, Oman; Ediacaran). (A-B) PPL photomicrographs at 5× magnification. (C-D) SEM images at 500× magnification; etched vs. unetched). (E-F) SEM images at 1000× magnification; etched vs. unetched).



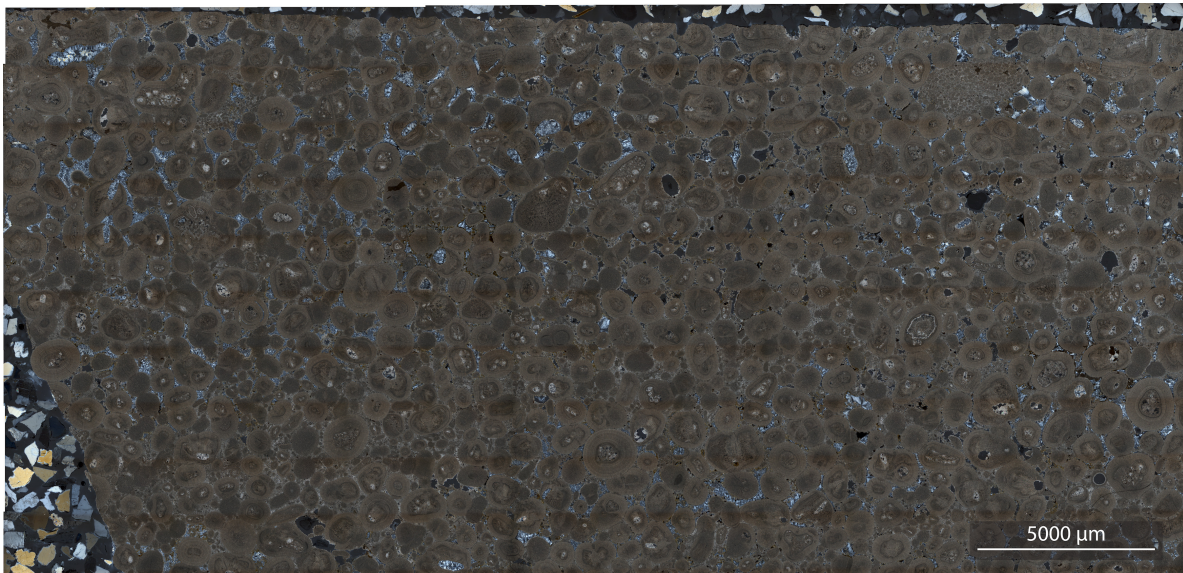
Supplemental Figure 3: Calcite oolite from the Shuram Formation (Khufai Dome, Oman; Ediacaran). (A) EBSD map of the X inverse pole figure (X-IPF) with the c-axis (001) shown in red aligned with crystals elongated in the in-plane x-direction consistent with length-fast orientation. (B) EBSD map of the Y inverse pole figure (Y-IPF) with the c-axis (001) shown in red. (c) EBSD map of the Z inverse pole figure (X-IPF) with the c-axis (001) shown in red and a-axes shown in blues and greens. The c-axis is never in or out of the plane. (D) Legend. (E) Pole figures.



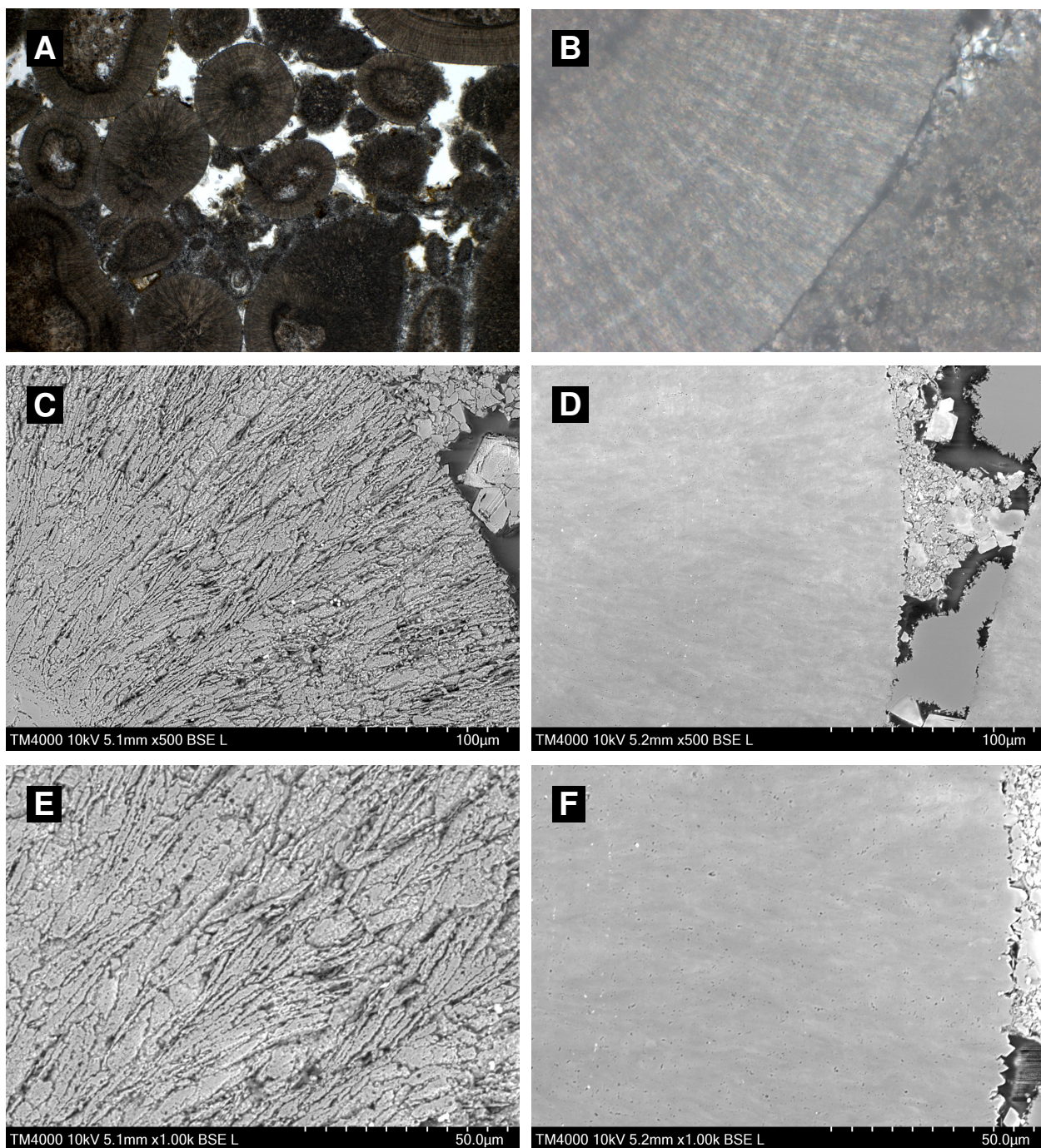
Supplemental Figure 4: Petrographic images of dolomite oolite from the Upper Khufai Formation, Huqf region, Oman. (A-C) Photomicrographs of large ooids with alternating dolomite cortices and micritic cortices in PPL light at 5 $\times$ magnification (Khufai Dome). Note cortical spalling. (D) Photomicrograph of ooids in PPL light at 5 $\times$ magnification (MD6 258.6, Mukhaibah Dome). (E) Photomicrograph of ooids in XPL light at 5 $\times$ magnification (MD6 258.6, Mukhaibah Dome). Note silica cement. (F) Photomicrograph of ooids in XPL light at 20 $\times$ magnification (MD6 258.6, Mukhaibah Dome). Note silica cement.



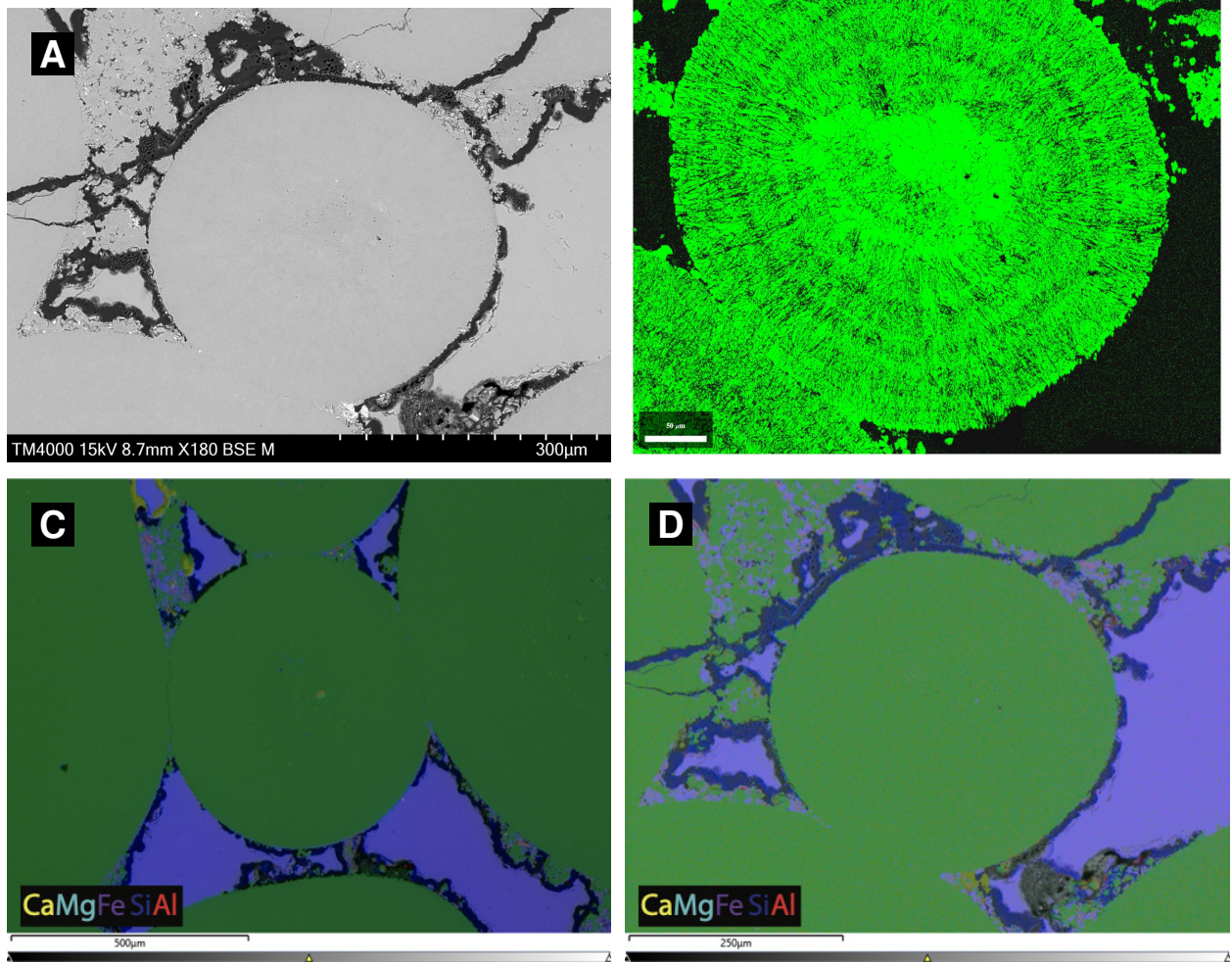
Supplemental Figure 5: Dolomite oolite from the Upper Khufai Formation (Mukhaibah Dome, Oman; Ediacaran). Stitched mosaic from overlapping 5× magnification with plane-polarized light (PPL). Photomicrographs acquired on a Zeiss Axio Imager.M2m; alignment and stitching by the Zeiss automated stitching tool.



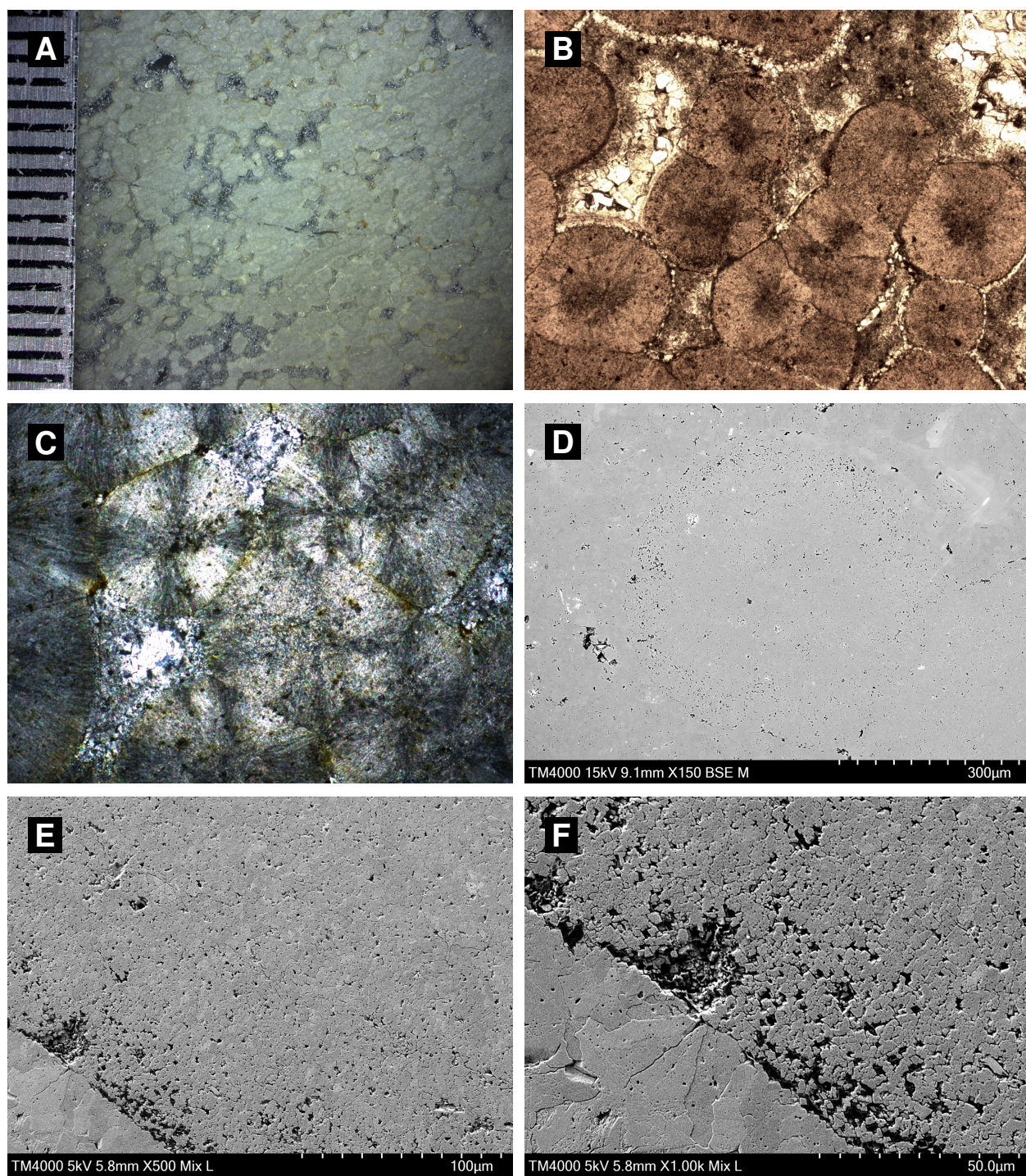
Supplemental Figure 6: Dolomite oolite from the Upper Khufai Formation (Mukhaibah Dome, Oman; Ediacaran). Stitched mosaic from overlapping 5× magnification with cross-polarized light (XPL). Photomicrographs acquired on a Zeiss Axio Imager.M2m; alignment and stitching by the Zeiss automated stitching tool.



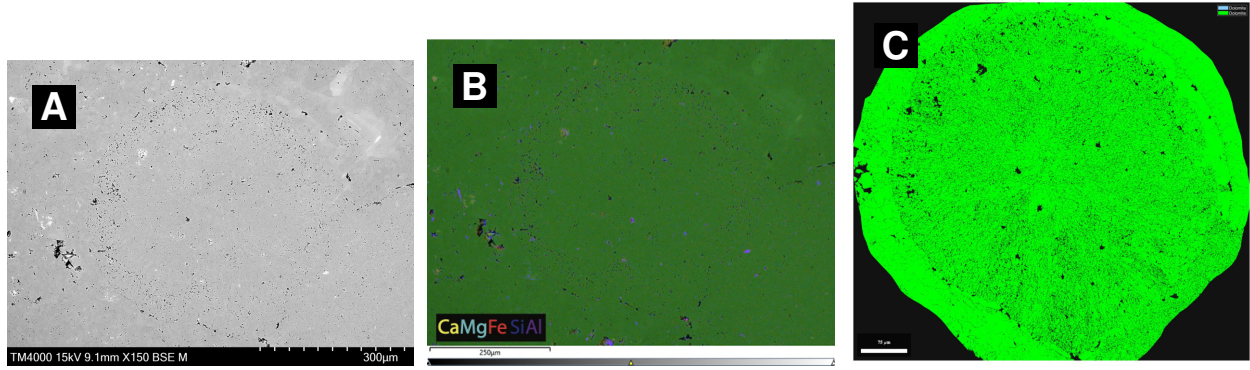
Supplemental Figure 7: Upper Khufai Formation dolomite oolite (MD6 258.6, Mukhaibah Dome, Oman; Ediacaran). (A) Photomicrograph of ooids in PPL light at 5× magnification. (B) Photomicrograph of ooids in PPL light at 40× magnification. (C-D) SEM BSE images at 500× magnification; etched and unetched. (E-F) at 1000× magnification; etched and unetched. Note porosity created during etching.



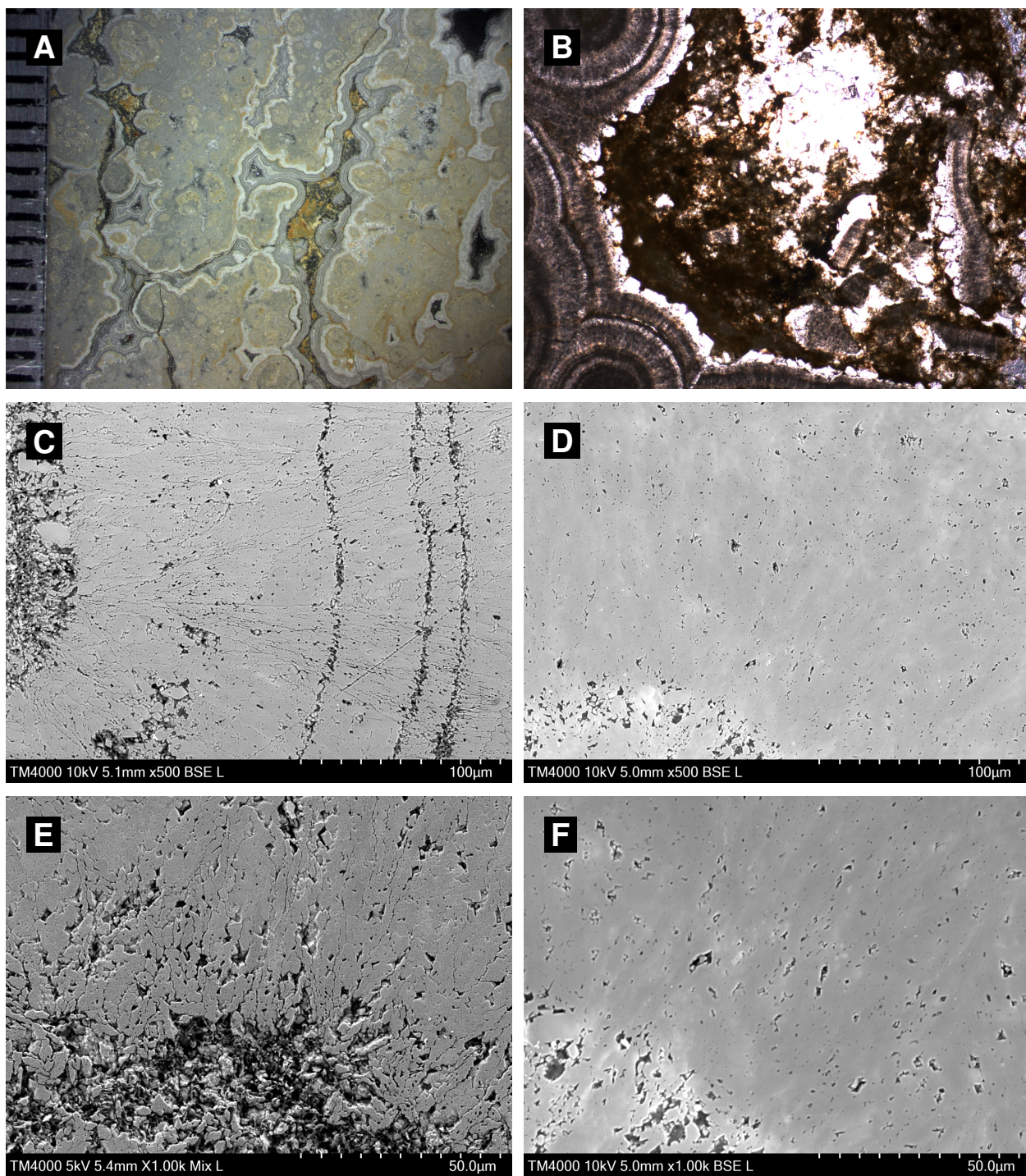
Supplemental Figure 8: (A) EBSD phase map (250 nm step) showing dolomite in ooid cortices; (B–C) EDS elemental maps (Mg, Ca, Si, C, Al)—note high C from epoxy; (D) unetched SEM BSE overview at $\sim 180\times$.



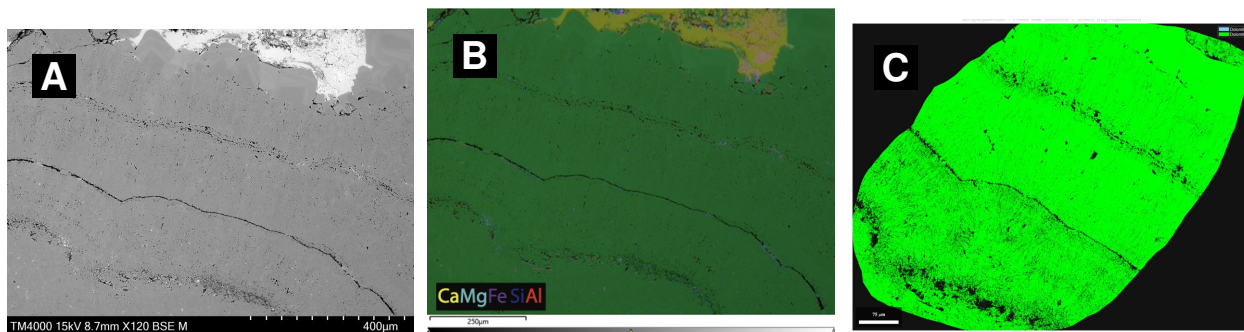
Supplemental Figure 9: Dolomite spherulites from *Conophyton* stromatolites, Buah Formation (Khufai Dome, Oman; Ediacaran). (A) Scan of polished slab. (B) Photomicrograph of spherulites in PPL light at 5 $\times$ magnification. (C) Photomicrograph of dolomite spherulites in XPL light at 5 $\times$ magnification. Note pseudo-uniaxial crosses. (D) SEM BSE at $\sim$ 150 $\times$ magnification, unetched. (E-F) SEM BSE image of acid-etched spherulites at 500 $\times$ magnification and 1000 $\times$ magnification.



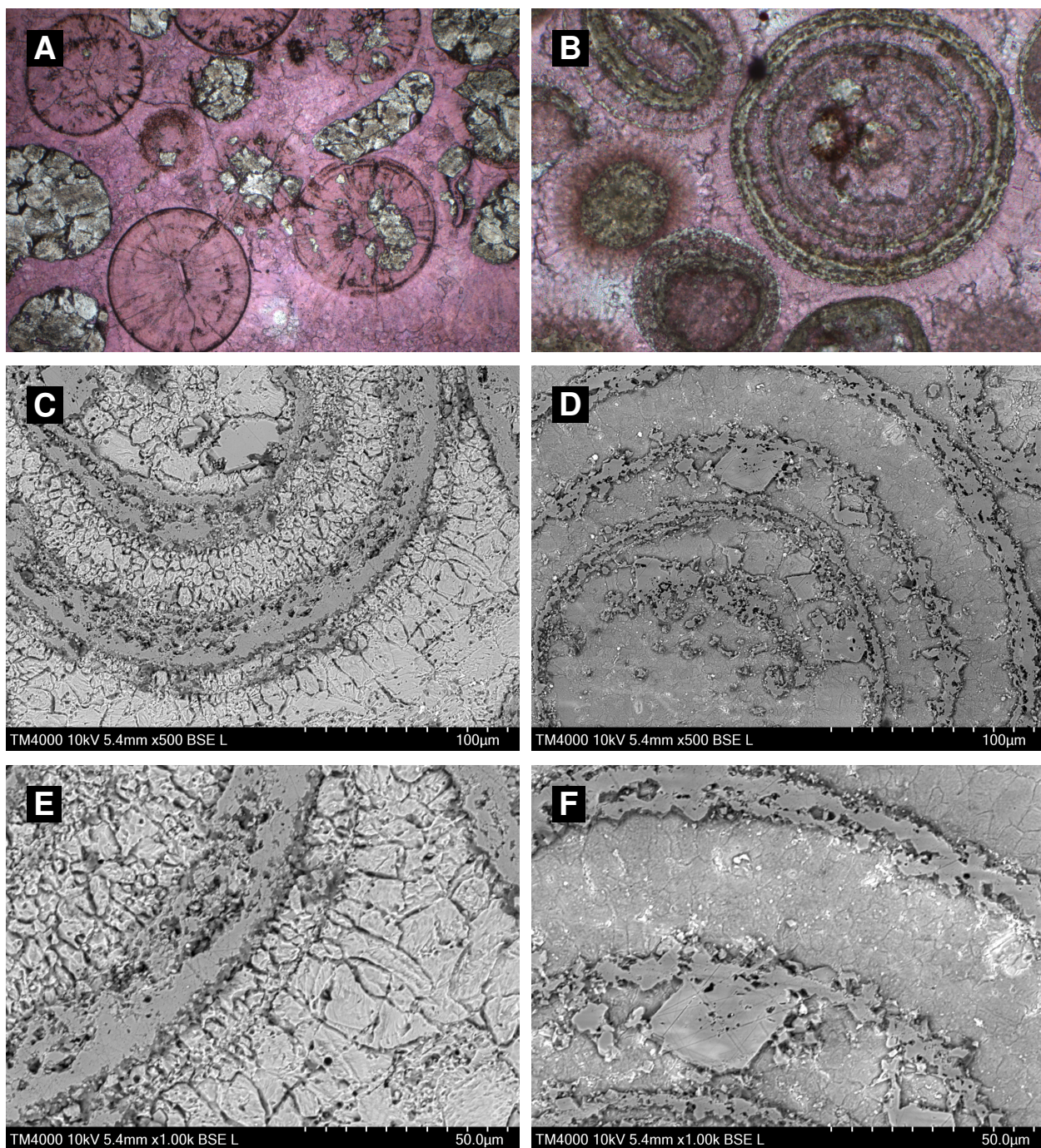
Supplemental Figure 10: Spherulite from a Conophyton stromatolite from the upper Buah Formation (Huqf Outcrops, Oman). (A) SEM BSE image at 150 $\times$ magnification. (B) EDS elemental map with Mg (cyan), Ca (yellow), Si (blue), Al (purple), and Fe (red). (C) EBSD phase map (250 nm step) showing dolomite in spherulite cortex.



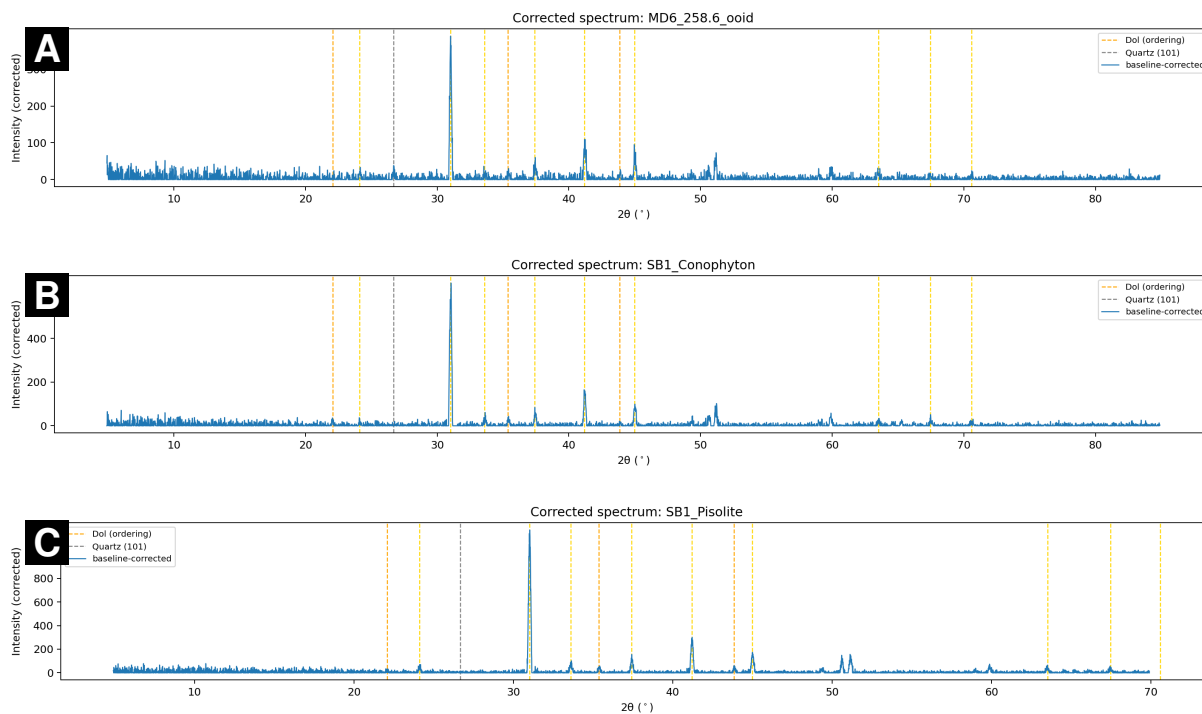
Supplemental Figure 11: Dolomite pisolite, Birba Formation (tepee-pisolite complex near Khufai Dome, Oman; Ediacaran). (A) Scan of polished slab. (B) Photomicrographs in PPL light at $5\times$ magnification with cavity lining cements, including broken cement isopachs. (C-D) SEM BSE images at $500\times$ magnification; etched and unetched. (E-F) SEM BSE images at $1000\times$ magnification; etched and unetched.



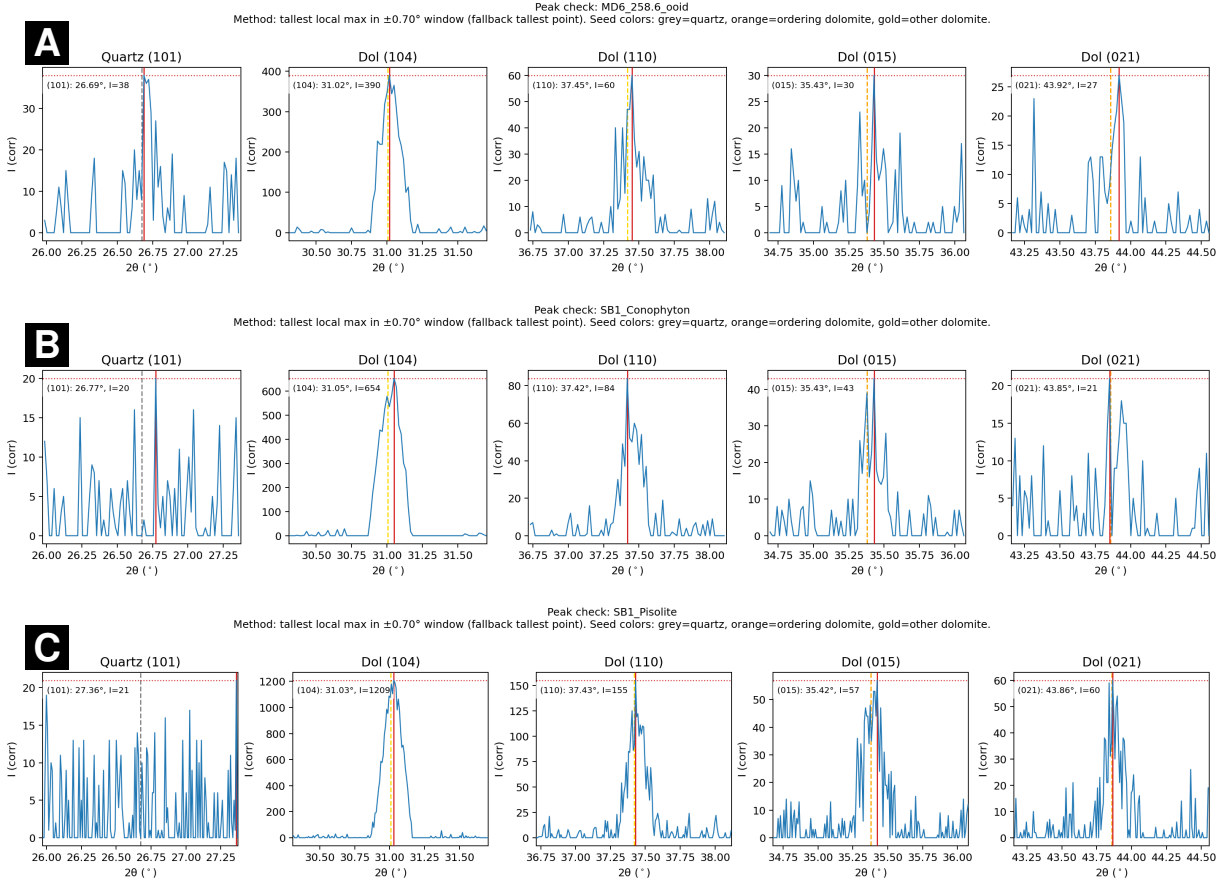
Supplemental Figure 12: Pisolite cement generations, Birba Formation (tepee–pisolite complex near Khufai Dome, Oman; Ediacaran). All images correspond to the EBSD map region described in the main text. (A) SEM BSE overview at $\sim 120\times$ magnification. (B) EDS elemental map with Ca (yellow), Mg (cyan), Fe (purple), Si (blue), and Al (red). (C) EBSD phase map (250 nm step) of dolomite.



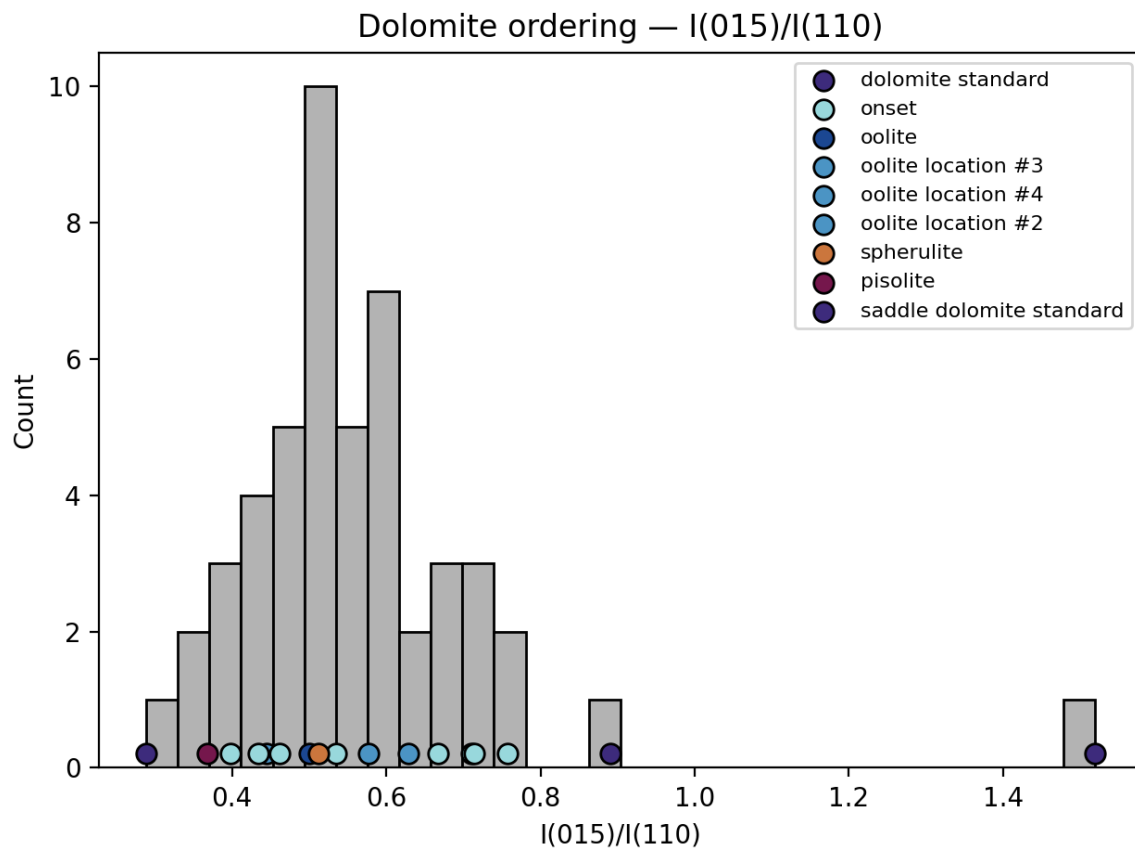
Supplemental Figure 13: Calcitic oolite from the Petit Jardin Formation (Port au Port Peninsula, Newfoundland; Cambrian). (A) Photomicrograph in PPL light at 5× magnification (Felix Member). (B) Photomicrograph in PPL light at 20× magnification (Campbell's Member) (A-B) SEM BSE images at 500× magnification; etched and unetched. (C-D) SEM BSE images at 1000× magnification; etched and unetched.



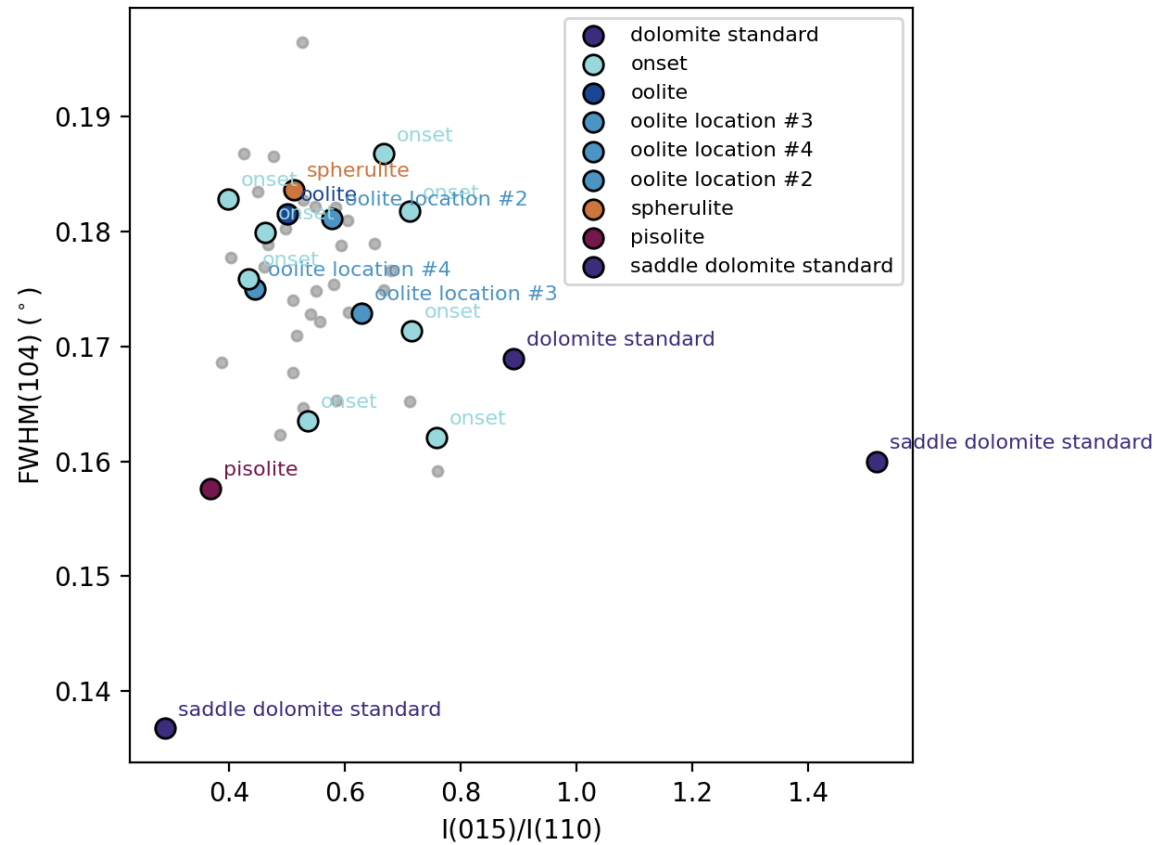
Supplemental Figure 14: Baseline-corrected XRD patterns with reference bars (grey: quartz (101); orange: dolomite (015)/(021); gold: other dolomite). 2θ values were corrected by a constant $+0.09^\circ$, equal to the average deviation of the quartz (101) reflection from the standard, computed from 17 of 47 scans with strong quartz (101) reflections (mean 26.76° ; $1\sigma = 0.05^\circ$; $I > 50$ after baseline correction).



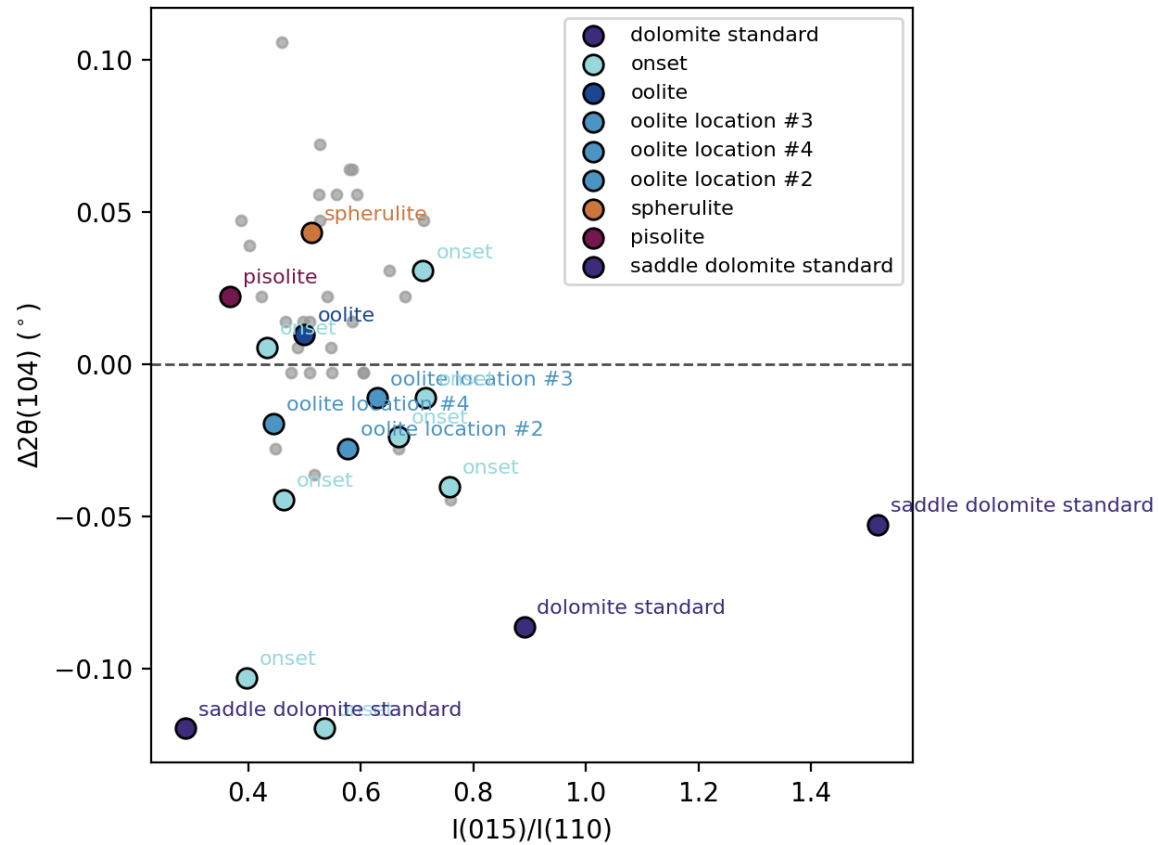
Supplemental Figure 15: Peak-check composites for three representative samples. Reference reflections: grey, quartz(101); orange, dolomite ordering (015, 021); gold, other dolomite (yellow). The identified peak location (red solid line) and measured intensity (red dotted line) shown. Baseline-corrected and quartz-aligned XRD patterns.



Supplemental Figure 16: Distribution of dolomite ordering ratio $I(015)/I(110)$ across processed scans. Intensities derive from baseline-corrected patterns after 2θ alignment (per-scan quartz(101) or manual offset); peaks are the tallest local maxima within $\pm 0.30^\circ$ of seeds; FWHM by half-height interpolation.



Supplemental Figure 17: Cross-plot of $I(015)/I(110)$ versus FWHM(104) obtained via linear interpolation at half height from baseline-corrected, quartz-aligned patterns.



Supplemental Figure 18: Cross-plot of $I(015)/I(110)$ versus $\Delta 2\theta(104)$ (measured minus expected from standard). Inputs from baseline-corrected, quartz-aligned; peak positions from tallest local maxima within $\pm 0.30^\circ$.