Supplementary Figures

| Depth (cm) | Lithology | VF | F | M | C | VC | Features | 1567C 10X-3 Archive half |

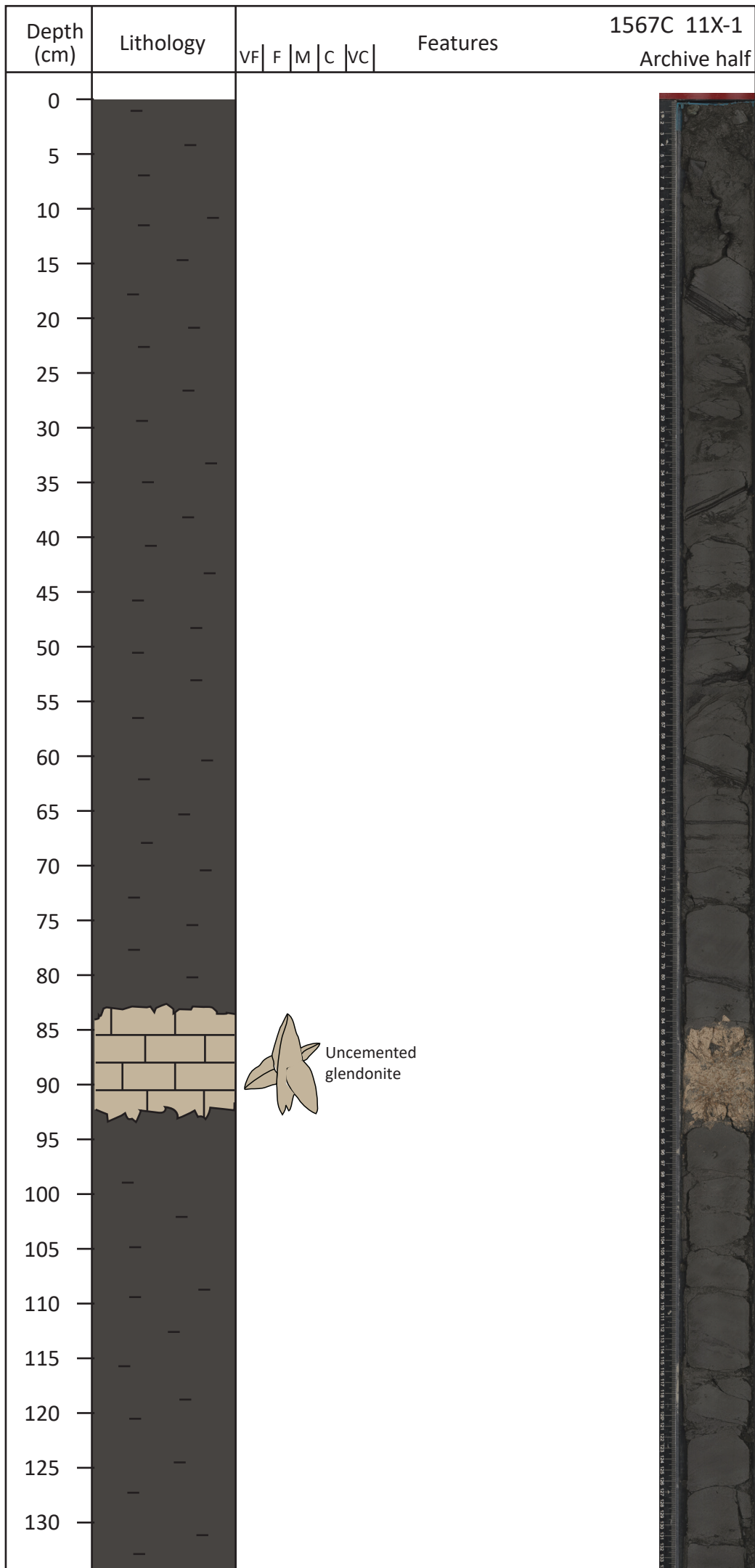
Depth scale (cm): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130

Uncemented glendonite

v v v v v v
v v v v v

**Supplementary Figure
S1:** High-resolution log of core section U1567C-10X-3.

KEY

- Glendonite
- v v v Volcanic ash
- · · · · Sand-sized ash grains
- _ ‒ _ Mud/clay
- Carbonate
- Laminations
- Sub-laminations
- Bioturbation
- "Water escape structures" /stress cracks

Depth (cm)	Lithology	VF	F	M	C	VC	Features	1567C 11X-1 Archive half

Uncemented glendonite

Supplementary Figure S2: High-resolution log of core section U1567C-11X-1.

MLV 57, 97
1567C-11X-1A

glendonite

Depth (cm)	Lithology	VF	F	M	C	VC	Features	1568A 15X-1 Archive half

Heavily sampled. much missing

VOID

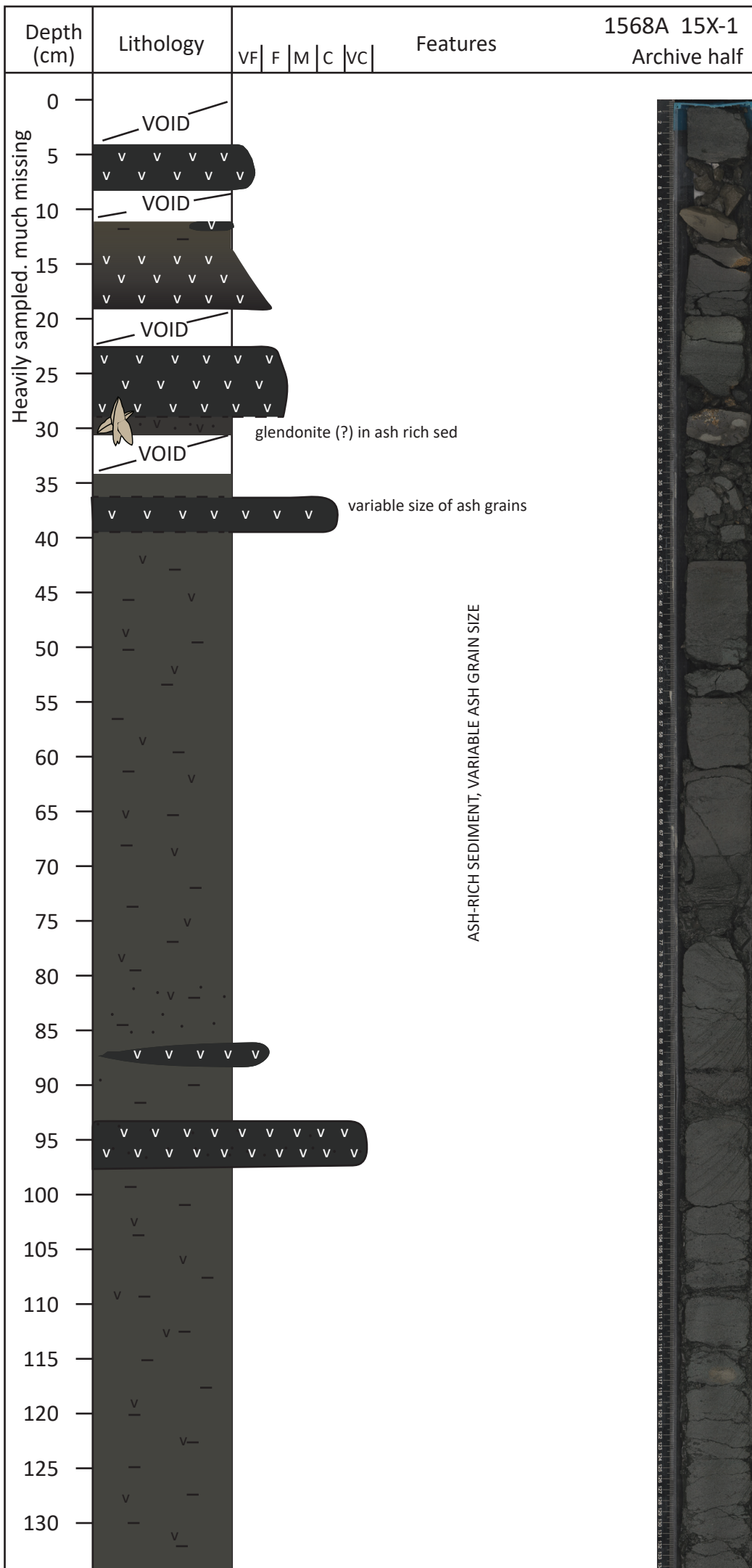
VOID

VOID

glendonite (?) in ash rich sed

VOID

variable size of ash grains

ASH-RICH SEDIMENT, VARIABLE ASH GRAIN SIZE

Supplementary Figure
S3: High-resolution log of core section U1568A-15X-1.

Depth (cm)	Lithology	VF	F	M	C	VC	Features	1568A 15X-4 Archive half

0
VOID
5
10
VOID
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130

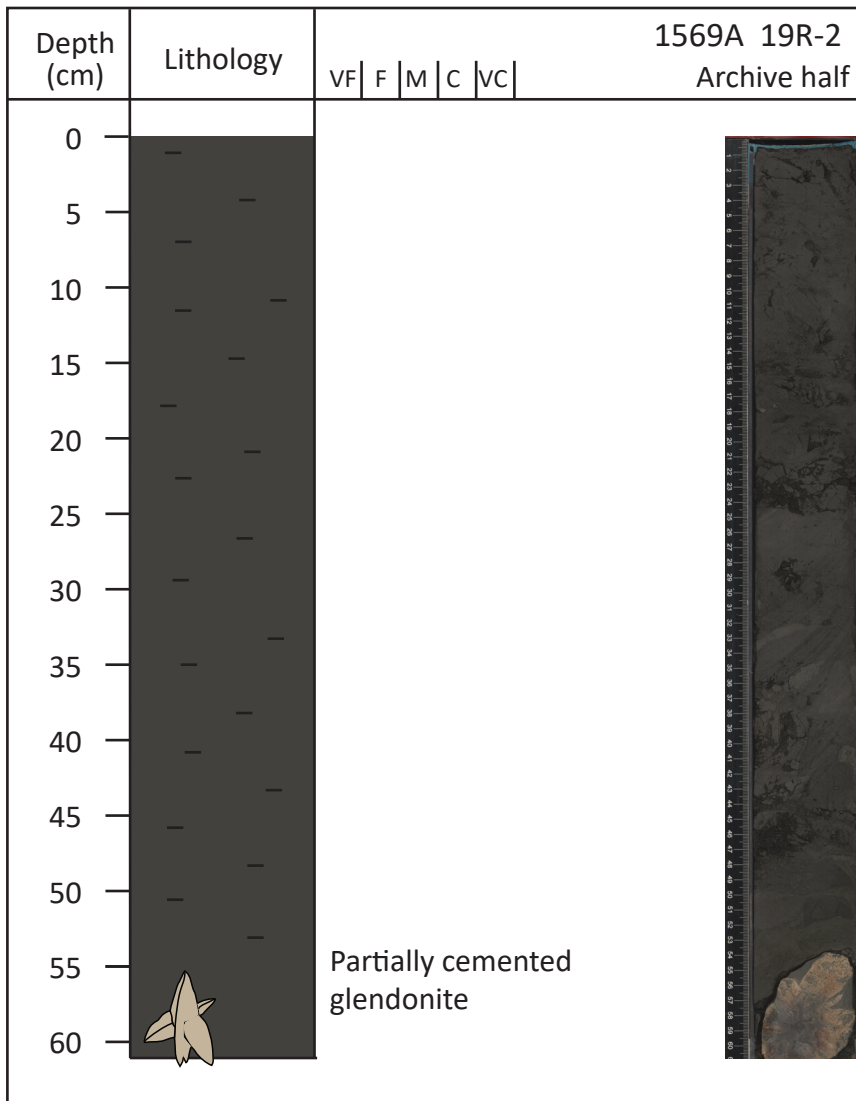
coarser ash-sand in mud uncemented glendonites crumbled into the ash-mud mix

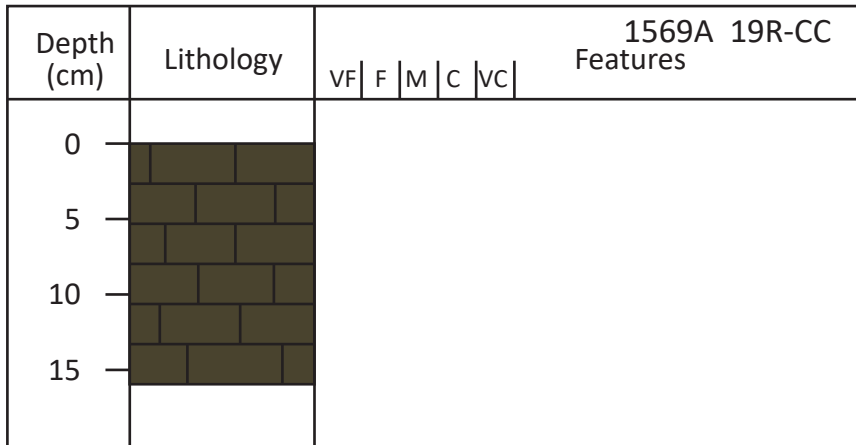
Lenses of brown mud, streaks of ash

Ash sand in mud

Supplementary Figure
S4: High-resolution log of core section U1568A-15X-4.

Depth (cm)	Lithology	VF	F	M	C	VC	1569A 19R-2 Archive half

Partially cemented glendonite

Supplementary Figure
S5: High-resolution log of core section U1569A-19R-2.

Depth (cm)	Lithology	VF	F	M	C	VC	1569A 19R-CC Features

(A1) Fig. A6: High-resolution log of core section U1569A-19R-CC.

Depth (cm) | Lithology | VF F M C VC | Features

1570A 15R-1
Archive half

Small glendonite fragment

SS (22)

SS (30)
SSS (33)
SS (37)

SSSS (45)
SSS (47)
SS + pyrite (50)

SS (55)

SSSS (62)
SSS (69)

SS (75)
SS (78)
SSSS (82)

SSSS (88)
SSSS (89)

SSS SS (94)
SSSS (96)

S – SS (100)

Porous, uncemented glendonite

SSS (112)

SS (123)

1570A 15R1W
MLV 91

KEY

Symbol	Description
Glendonite	Glendonite
v v v	Volcanic ash
· · · ·	Sand-sized ash grains
_ ‾ _	Mud/clay
⊞	Carbonate
═	Laminations
══	Sub-laminations
SS	Bioturbation
(	"Water escape structures" /stress cracks

Supplementary Figure
S7: High-resolution log of core section U1570A-15R-1.

1570A 15R 1W
MLV 92

Depth (cm)	Lithology	VF	F	M	C	VC	Features	1570A 22R-2 Archive half

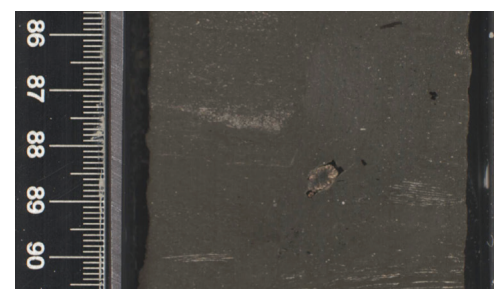
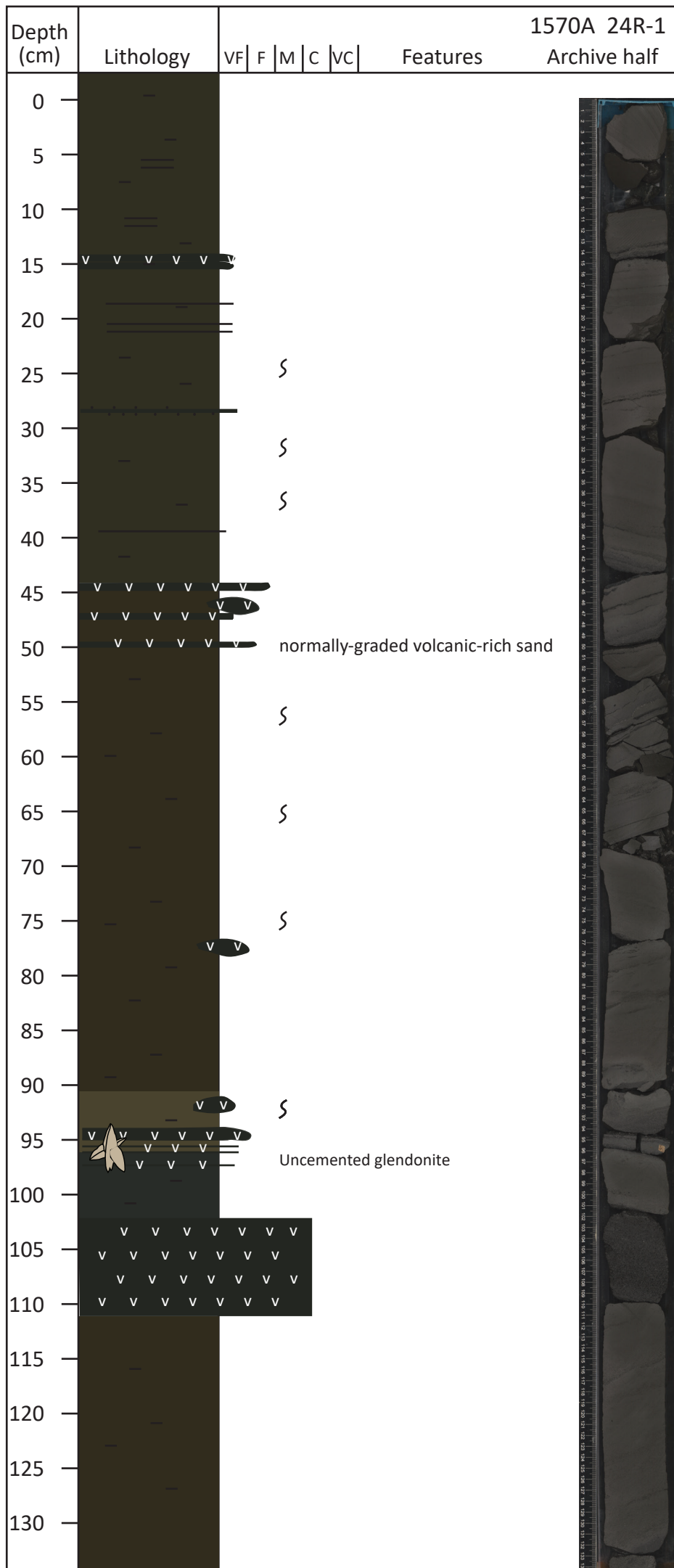
Sub-laminated mud/claystone.
Laminations defined by colour.

Interval of sand-bearing mud

Ash with mud worked in by btb

Btb top of pale layer
Pale grey ash/sediment?

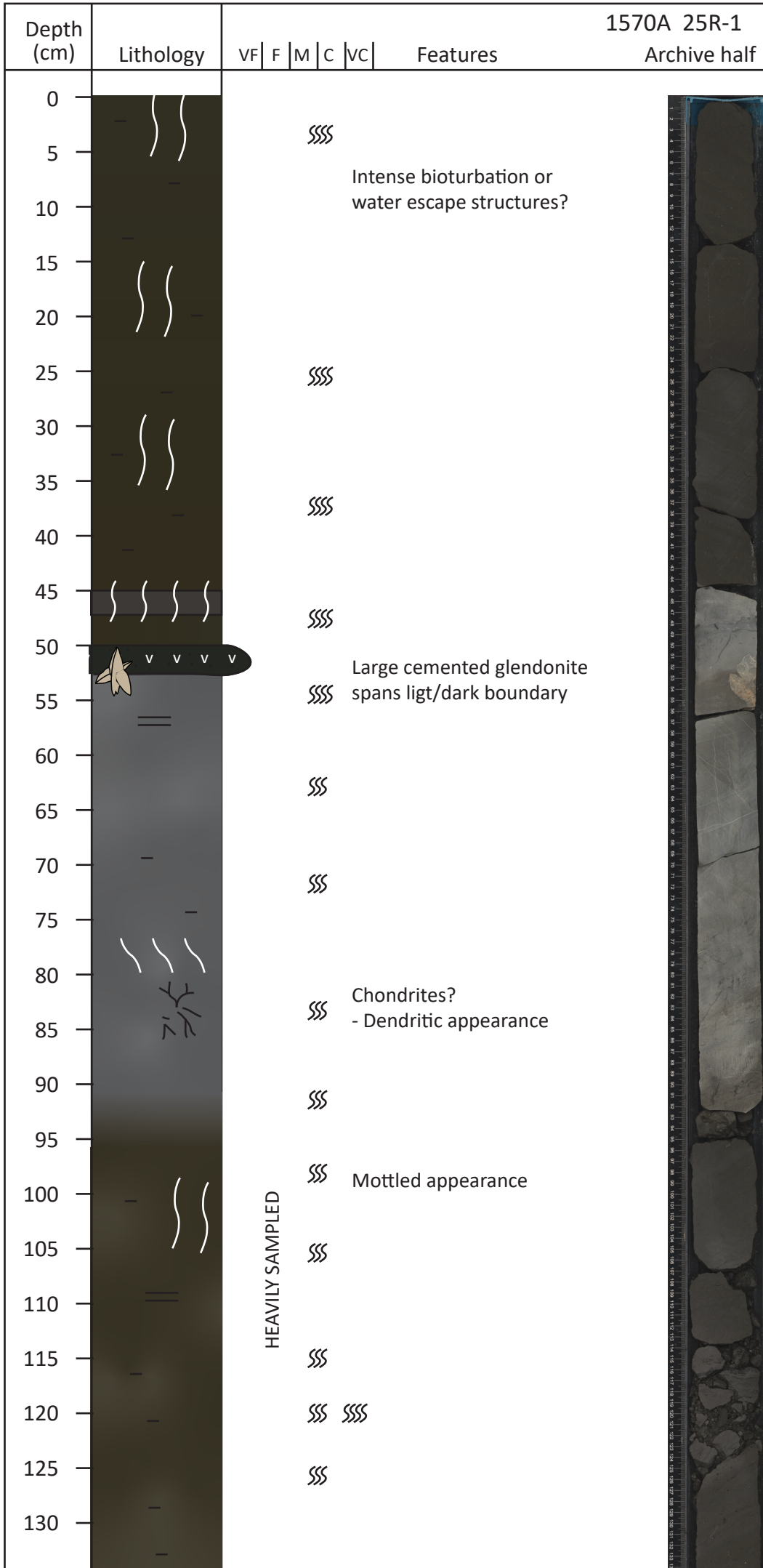
Small fragment of glendonite

Supplementary Figure S8: High-resolution log of core section U1570A-22R-2.

Supplementary Figure S9: High-resolution log of core section U1570A-24R-1.

Depth (cm)	Lithology	VF	F	M	C	VC	Features	1570A 24R-1 Archive half

normally-graded volcanic-rich sand

Uncemented glendonite

Depth (cm)	Lithology	VF	F	M	C	VC	Features	1570A 25R-1 Archive half

Supplementary Figure S10: High-resolution log of core section U1570A-25R-1.

Intense bioturbation or water escape structures?

Large cemented glendonite spans ligt/dark boundary

Chondrites?
- Dendritic appearance

Mottled appearance

HEAVILY SAMPLED

Supplementary Figure S11: Powder X-Ray diffraction patterns for powdered bulk glendonite samples

1570A 25R 1 50 - 55 white cemented part

1570A 5R 1 108 - 112 "fudgy", uncemented

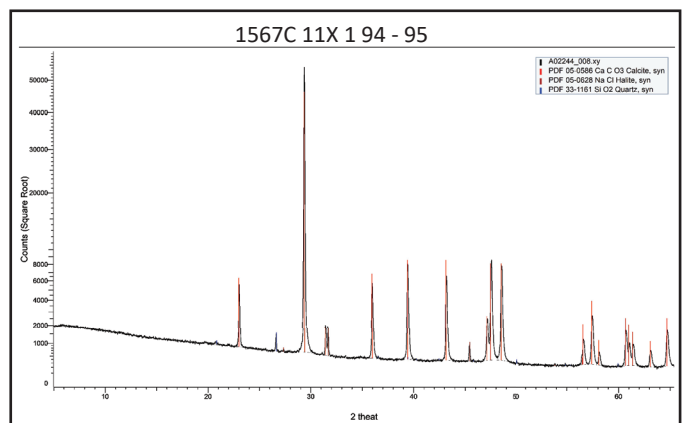
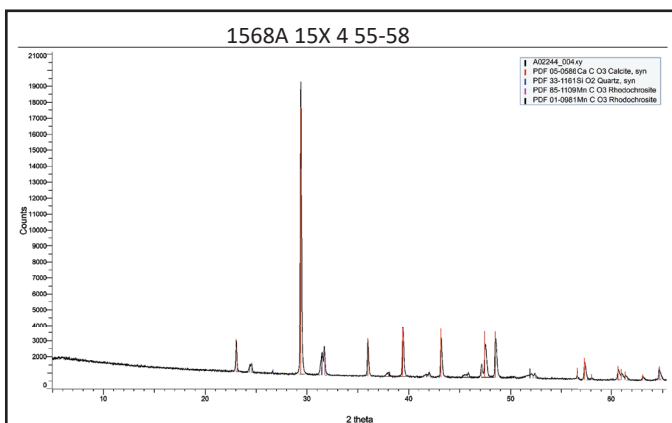
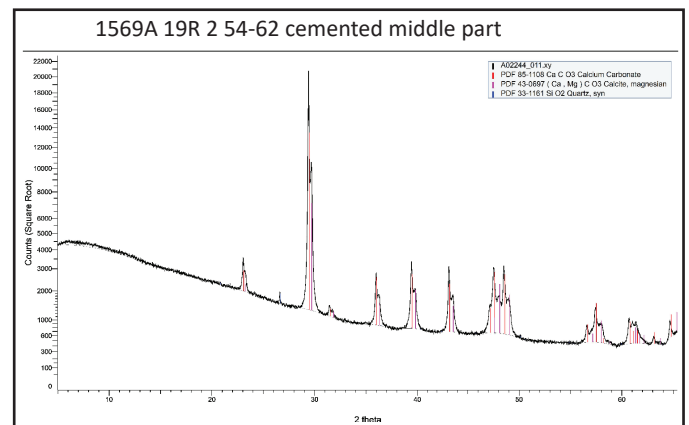
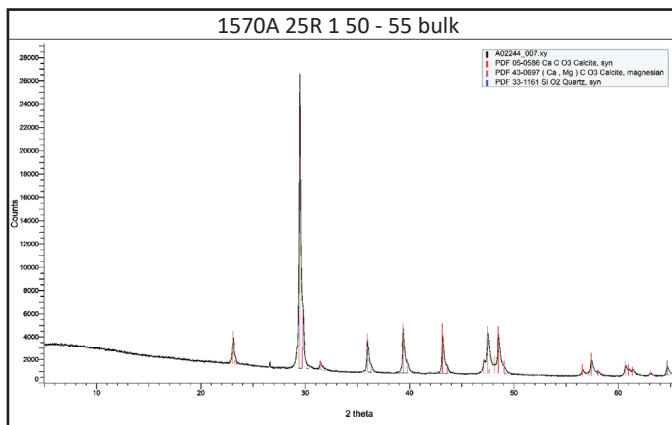
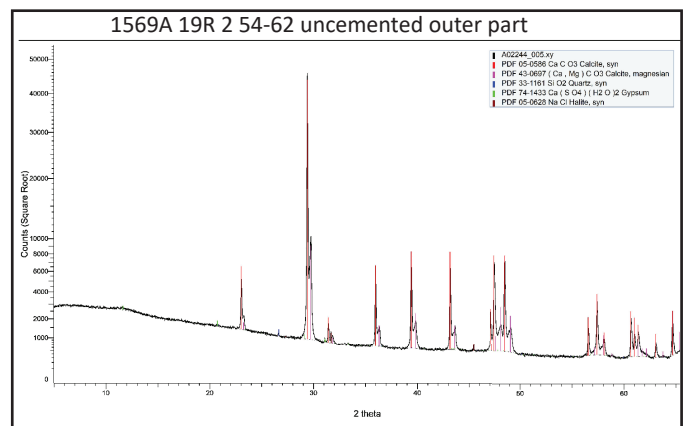
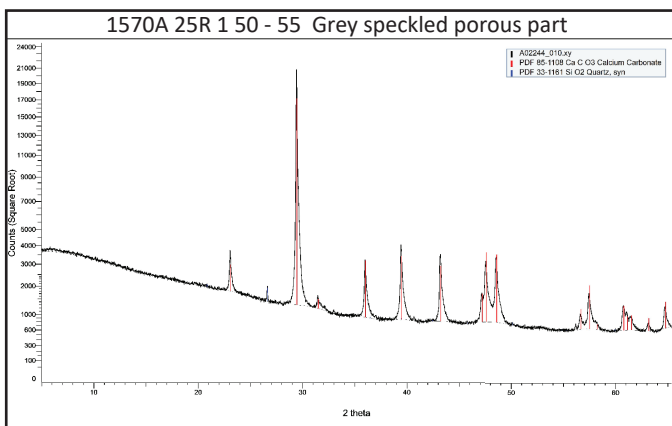
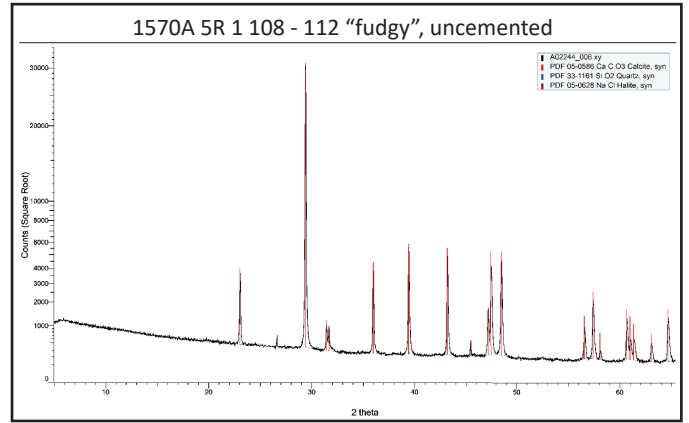
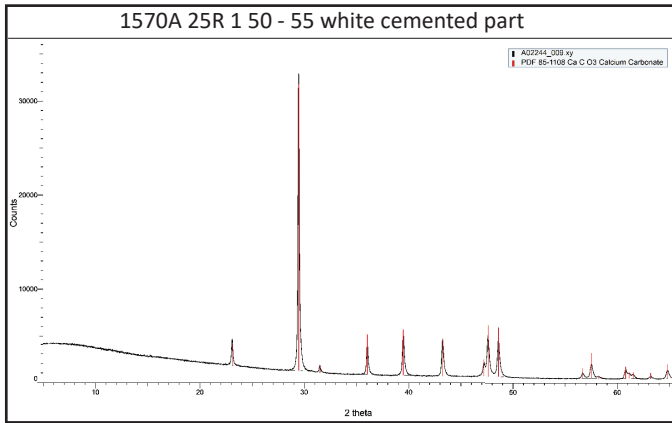
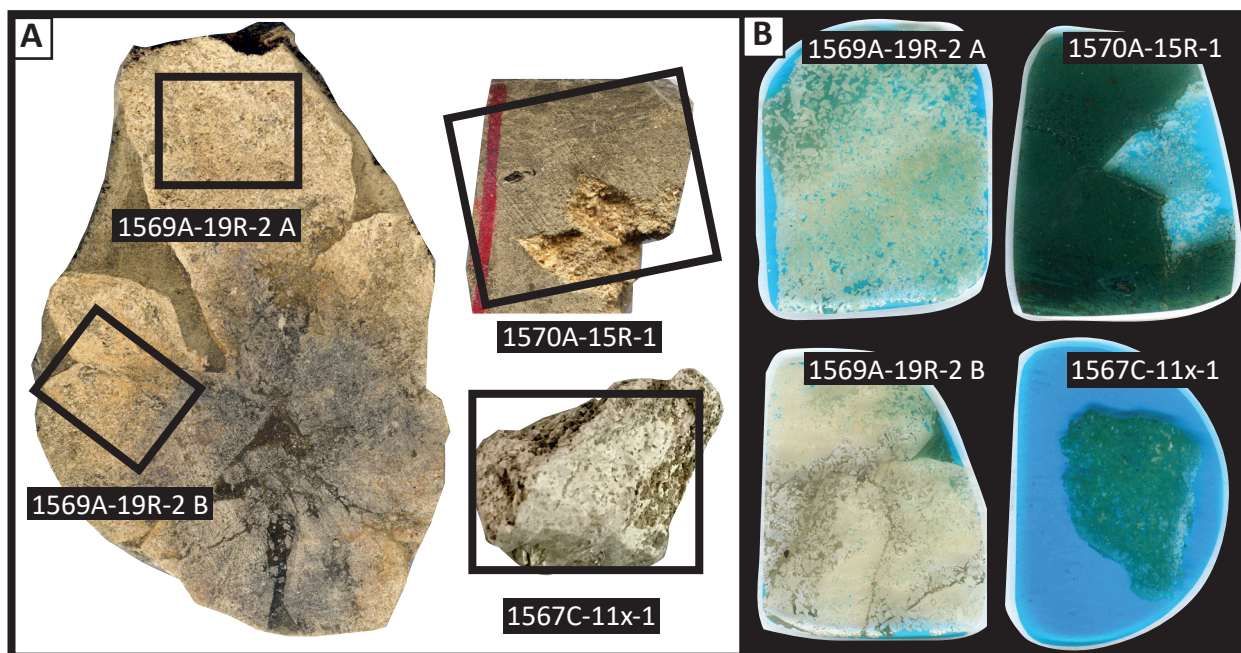
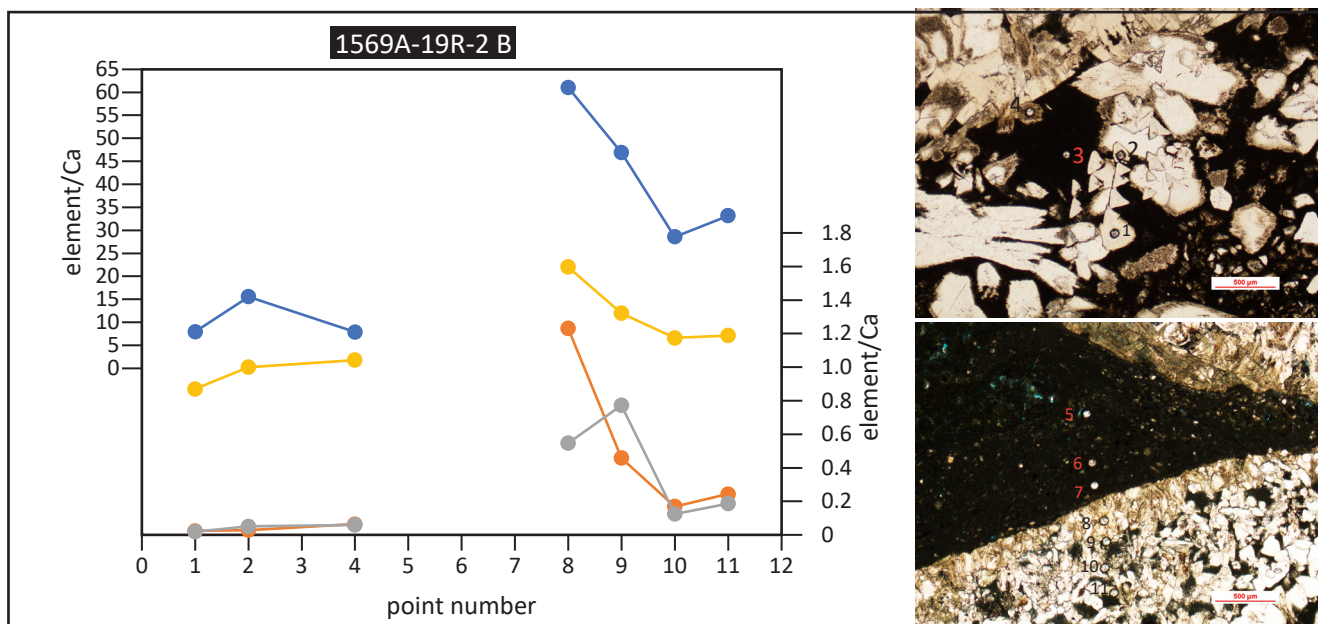
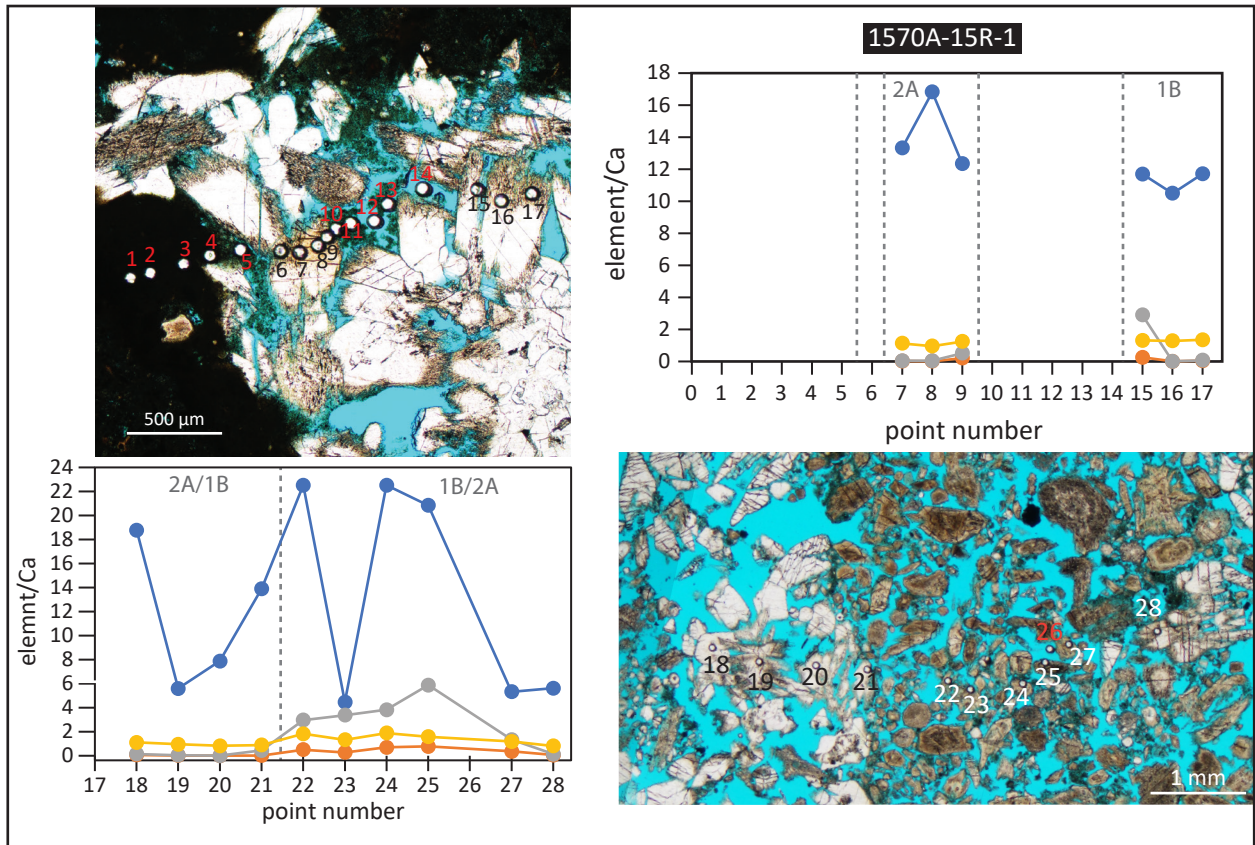
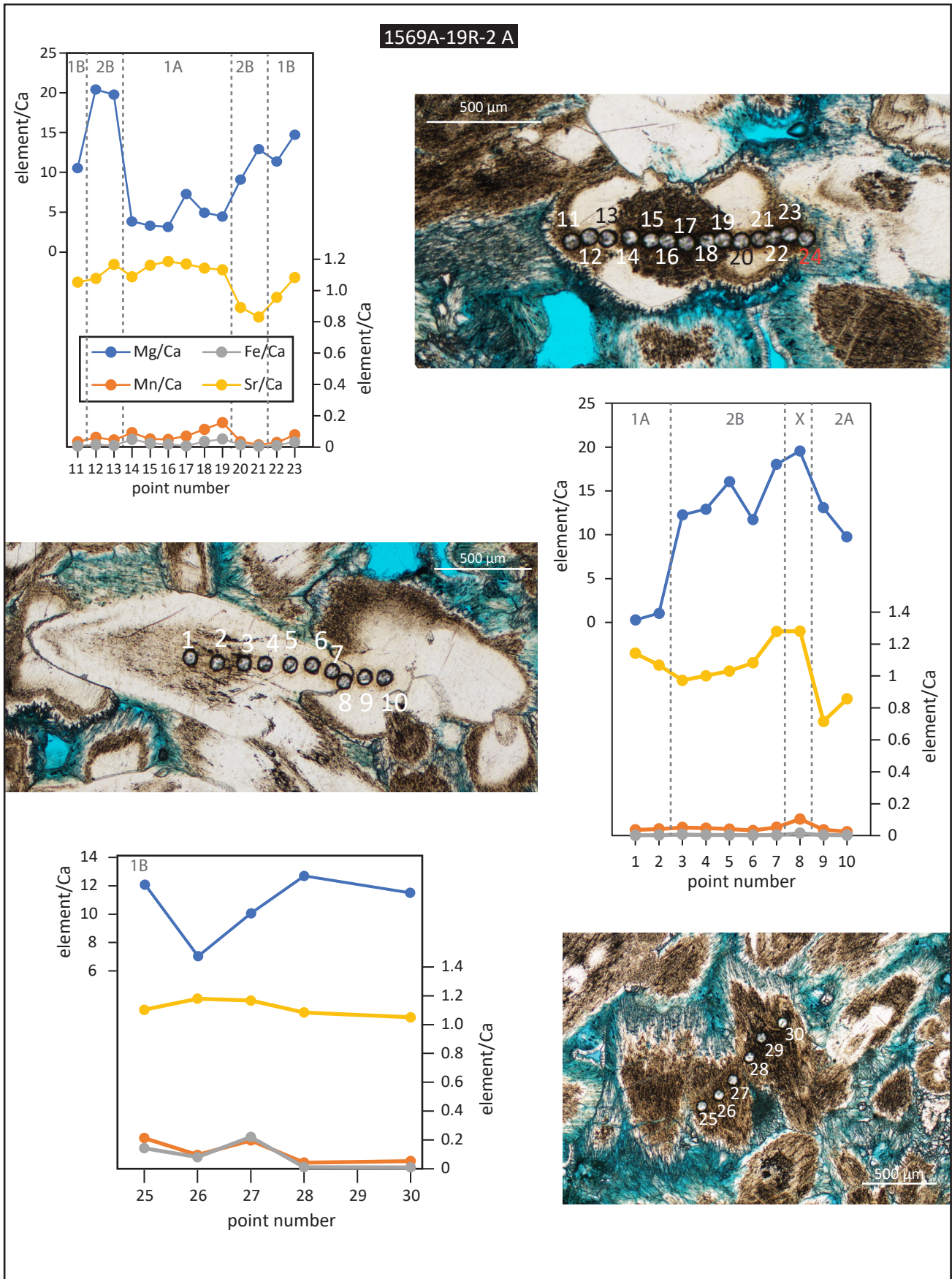
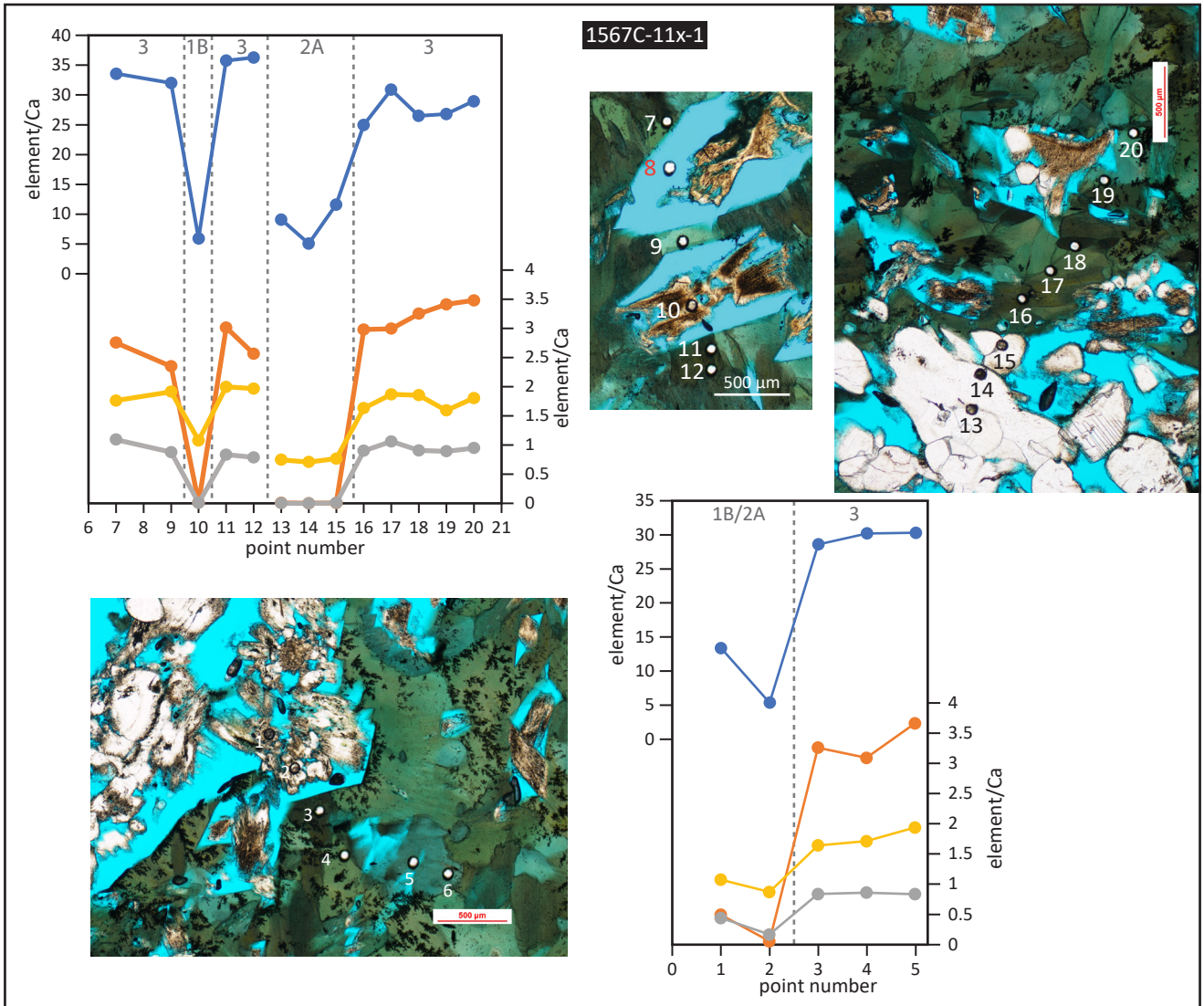
1570A 25R 1 50 - 55 Grey speckled porous part

1569A 19R 2 54-62 uncemented outer part

1570A 25R 1 50 - 55 bulk

1569A 19R 2 54-62 cemented middle part

1568A 15X 4 55-58

1567C 11X 1 94 - 95

Supplementary Figure S12: (A) Overview of where thin sectins were made from 3 selected glendonites.**(B)** Scans of the entire thin sections.

Supplementary Figure S13: (Left) Element/Ca profiles measured by LA-ICPMS across two areas of thin section B of the glendonite from U1569A-19R-2. **(Right)** Photomicrographs of the areas analysed, with labelled sample points,under plane polarised light.

Supplementary Figure S14: Element/Ca profiles measured by LA-ICPMS across two areas of thin section of the glendonite from U1570A-15R-1, shown next to photomicrographs of the sections with labelled sample points, under plane polarised light.

Supplementary Figure S15: Element/Ca profiles measured by LA-ICPMS across areas of thin section A of the glendonite from U1569A-19R-2, shown next to photomicrographs of the sections with labelled sample points, under plane polarised light.

Supplementary Figure S16: Element/Ca profiles measured by LA-ICPMS across two areas of thin section of the glendonite from U1567C-11X-1, shown next to photomicrographs of the sections with labelled sample points, under plane polarised light.