SAMPLE DESCRIPTION

Cruise Id: SP Lee 4/74 Size (cm): 14.5×11.5×6 Location: 32.08N, 117.82W

Sample Id: LCB-25-1-A Weight (kg): 0.730 Kg Depth (m): —

Mn Crust Description

Surface Texture: very sparsely botryoidal, mostly flat

LCB-25-1-A

Mn Crust Thickness (mm):

Min: 40 Max: 55 Ave: 50

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	10	18	15	finely laminated, dk brown, rust alternating
2	3	6	5	massive to porous, black, not, detrital
3	9	12	11	laminated to massive, fractures ⊥ to layering, black – dk brown
4				
5	6	11	8	laminated to massive (porous at edge), black/dk brown
~~6~~	10	22	20	porous friable w/ massive portion (remnant crust?) black, lt brown detrital crust

Comments and XRD Mineralogy:

layer 2 may be a month after 1+3 existed; layer 5 may contain older crust (more dense, massive than surrounding porous/friable material

Subsample N

none

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: Kari Winfield 10/18/96 Subsampled by:

LCB - 25 - 1 - A

SAMPLE DESCRIPTION

Cruise Id: SPLEC 4/74 Size (cm): 18 x 12 x 8" Location: 32.08N, 117.82W

Sample Id: LCB-25-1-B Weight (kg): 1.340 Kg Depth (m): —

Mn Crust Description

Surface Texture: smooth/flat + botryoidal

Mn Crust Thickness (mm):

Min: 65 Max: 85 Ave: 70

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	18	25	25	finely laminated (top) massive (base), dk brown, red to black
2	14	18	16	massive to porous, coarse laminae follow botryoidal pattern, black, lt brown, red
3				
4	25	35	30	1mm massive layers (black) separated by porous friable material (lt brown and black, red)
~~5~~				
6	20	33	20	porous friable, granular black, detrital (lt brown), contains manganese [illegible]

LCB-25-1-B

Comments and XRD Mineralogy:

growth direction appears to have changed due to accumulation of layers 4, 3, 2. Changing of growth of layer 1

Subsample No.

none

Substrate Description

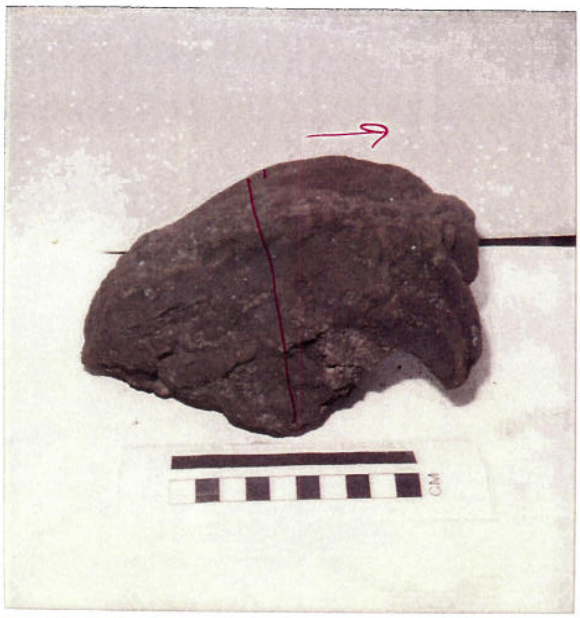
Rock Type:

Description:

Biology (?):

Described by: KWonfield 9/30/96

Subsampled by:



LCB-25-1-B

SAMPLE DESCRIPTION

Cruise Id: SP LEE 4/74 Size (cm): 16.5 × 11.5 × 8 Location: 32.08 N, 117.82 W

Sample Id: LCB-25-2-A Weight (kg): 1.345 Depth (m): —

Mn Crust Description

Surface Texture: sparsely botryoidal (large) granular

Mn Crust Thickness (mm):

Min: 40 mm Max: 80 mm Ave: 70

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	6	18	13	majority of outer crust finely laminated
2				(becomes porous on thinner edges); alternating
3				Lt + dk brown
4	60	80	—	extremely porous, mixed rock
5	Length min	Length max		frag. detrital material,
6				+ MnO_2, black to dk brown

inner core

LCB-25-2-A

Comments and XRD Mineralogy:

crust appears to wrap around completely or itself, although base (where crust is thinnest) may be pt of attachment to substrate (more porous here); rock frag. very angular

Substrate Description

Rock Type: unknown

Description:

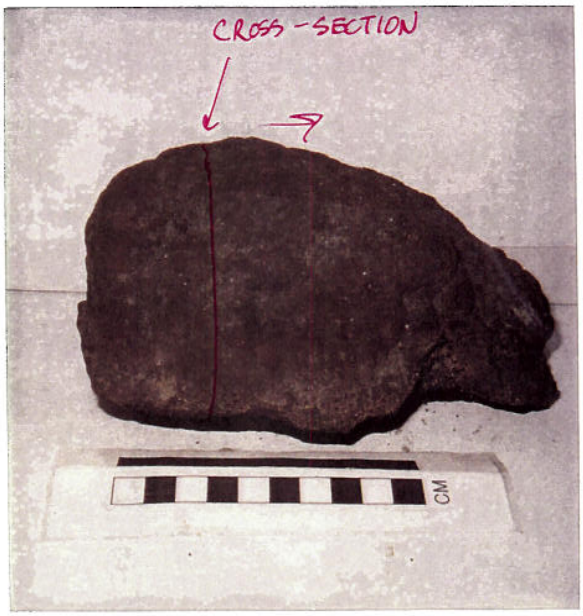
Biology (?):

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
none			

Described by: K. Winfield 9/30/96

Subsampled by:



LCB-25-2-A

SAMPLE DESCRIPTION

Cruise Id: SD LEE 4/74 Size (cm): 17 x 11 x 10 Location: 32.08N, 117.82W

Sample Id: LCB-25-2-B Weight (kg): 1.630 Depth (m): —

Mn Crust Description

Surface Texture: botryoidal (small, dense), granular to earthy

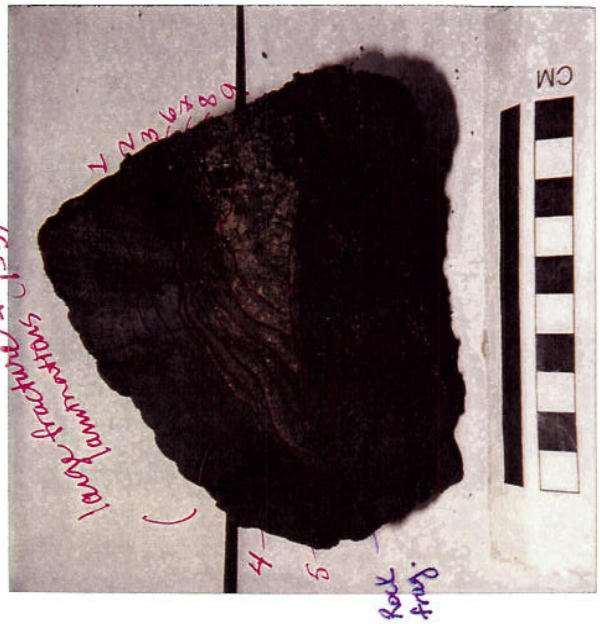
Mn Crust Thickness (mm):

Min: 80 Max: 110 Ave: 80

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	9	24	13	finely laminated; alternating dk/lt. brown
2	4	10	5	massive to porous; dk brown/black
3	4	6	5	massive to porous; dk brown/black
4	1	3	2	porous; black + bright yellow
5	1	4	2	porous w/ detrital; black + tan
6	1	5	3	porous; black; bright yellow, rus

↳ continued on back



LCB-25-2-B

Comments and XRD Mineralogy:

Some fractures in layers 1 + 2 mainly subparallel to laminations, a few perpendicular to laminations towards the outer edge; rock clast 4: 1.5mm within layer 2 (subangular)

Substrate Description

Rock Type: unknown

Description:

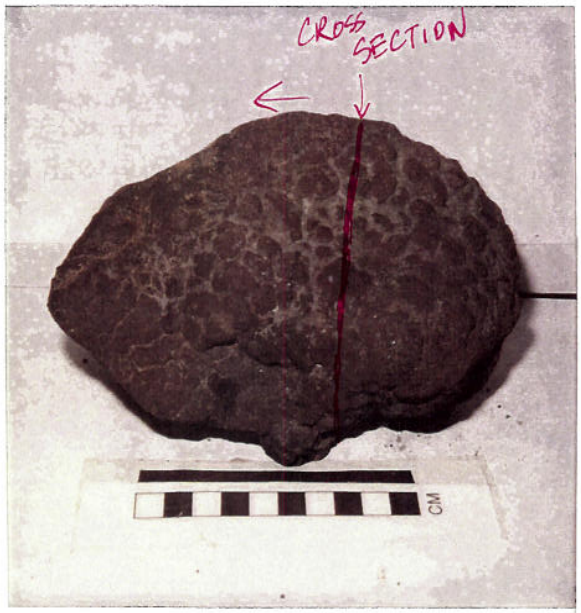
Biology (?):

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
none.			

Described by: K. Winfield 9/30/96

Subsampled by:



LCB-25-2-B

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
7 ~~1~~	1	5	2	porous; black, some yellow
8 ~~2~~	2	4	2	porous; rust, black
9 ~~3~~	2	4	3	porous; yellow, black
4				porous; yellow, black
5				
6				

rest of interior

LCB-25-2-B

SAMPLE DESCRIPTION

Cruise Id: SP. LEE H174 Size (cm): 18.5 × 13 × 6 Location: 32.08N, 117.82W

Sample Id: LCB-25-2-C Weight (kg): 1,370 Depth (m): —

Mn Crust Description

Surface Texture: crust mainly flat w/ small botryoids malformed or damaged granular

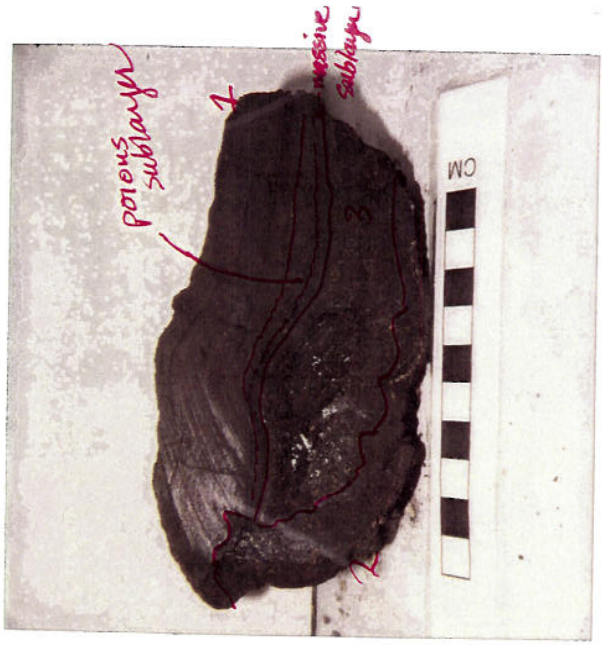
Mn Crust Thickness (mm):

Min: 55 Max: 75 Ave: 70

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	28	39	30	massive → porous → finely laminated (inner to outer); black → dk. brown alternating w/ tan
2				
3	3	14	8	granular/porous alternating w/ massive bands; black + rust
4				
5	8	30	20	friable, porous; black +
6				some tan detrital material

interior



LCB-25-2-C

Comments and XRD Mineralogy:

layer 1 partially truncated by layer 3; laminae in layer 1 are not truncated by fractures in upper half of layer 1; layer 2 includes sublayers too difficult to discern

Substrate Description

Rock Type: unknown

Description:

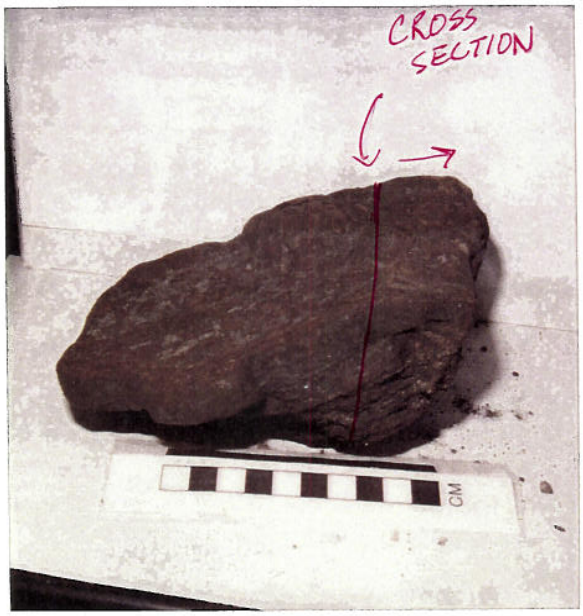
Biology (?):

Described by: K Winfield 9/30/96

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
none			

Subsampled by:



LCB-25-2-C

SAMPLE DESCRIPTION

Cruise Id: SP. LEE 4/74 Size (cm): 13×10×10 Location: 32.08N, 117.82W

Sample Id: LCB-25-2-D Weight (kg): 0.970 Depth (m): —

Mn Crust Description

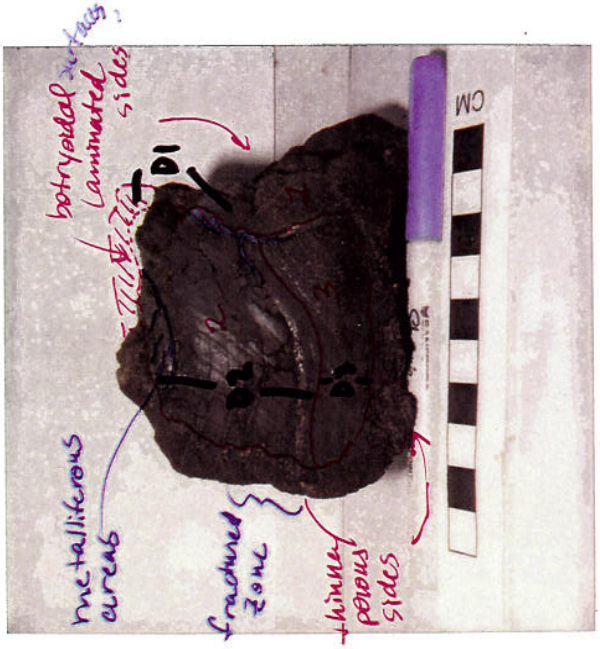
Surface Texture: small botryoids dense, granular

Mn Crust Thickness (mm):

Min: 65 Max: 80 Ave: 75

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	4	11	8	finely laminated (botryoidal sides); porous at base(?)
2				alternating lt + dk brown to black
3	20	45	30	laminated to massive w/ fractured zones, metalliferous material + detrital?; black to dk gray
4				
5	12	25	18	porous, black, brown, rust
6				



LCB-25-2-D

(see mirror half on back)

Comments and XRD Mineralogy:

Layer 2: laminations ⊥ to one pt. of attachment, ∥ to the other

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)	
LCB-25-2-D1	Chem, XRD	8 mm (0-8)	10.11	layer 1
D2	Chem, XRD	30 mm (9-38)	10.10	layer 2
D3	Chem, XRD	18 mm (39-56)	10.08	layer 3

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: K Winfield 9/30/96

Subsampled by: K Winfield 10/22/96

LCB-25-2-D

LCB-25-2-D

SAMPLE DESCRIPTION

Cruise Id: S.D. LEE 4/74 Size (cm): 17 × 12 × 8 Location: 32.08N, 117.82W

Sample Id: LCB-25-2-E Weight (kg): 1.255 Depth (m): —

Mn Crust Description

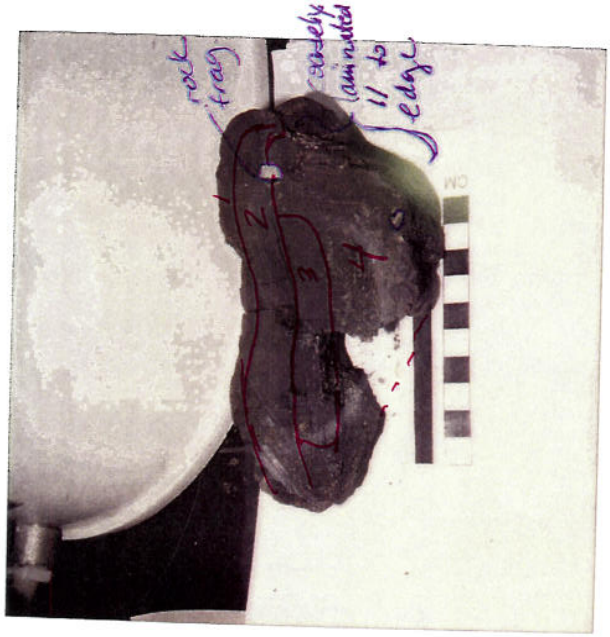
Surface Texture: sparsely botryoidal, granular / dull

Mn Crust Thickness (mm):

Min: ~30 Max: ~70 Ave: 50

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	6	8	7	finely laminated, brown, large interlayered
2	6	14	12	finely laminated, fractured, brown (dk.)
3	12	12	12	finely laminated to massive, dk brown
4	10	33	30	porous (friable), black, brown, [illegible]
5				with laminations (coarse) ∥ to edge
6				



LCB-25-2-E

Comments and XRD Mineralogy:

(Sample fractured when cutting)
angular rock fragment appears [illegible] in layer 2, but may be detrital & [illegible] in layer 4

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)	
LCB-25-2-E1	Chem	~7 mm (0-7)	10.06	layer 1
E2	Chem	~12 mm (8-19)	10.03	layer 2
E3	Chem	~12 mm (20-31)	10.02	layer 3
E4	Chem	~30 mm (32-61)	10.08	layer 4

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: K Winfield 10/10/96

Subsampled by: K Winfield 10/22/96

LCB-25-2-E

SAMPLE DESCRIPTION

Cruise Id: S.P. LEE 4/74 Size (cm): 10×12×12 Location: 32.08N, 117.82W

Sample Id: LCB-25-2-F Weight (kg): 1.810 Depth (m): —

LCB-25-2-F

Mn Crust Description

Surface Texture: fractured, smooth-granular, growth on 3 sides, botryoidal

Mn Crust Thickness (mm):

Min: 40 Max: 105 Ave: 95

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	8	15	10	finely laminated, brown/orange
2	5	5	5	laminated, slightly porous/granular, dk brown
3	25	30	25	porous/friable, black/orange, detrital + large clasts
4	15	25	20	finely laminated to massive, brown → black, fractured
5	10	12	10	finely laminated, fractured; brown/orange
6	12	20	18	porous/granular, black, orange, lt brown, detrital + volcanic clasts.

may just be part of layer 3 but laminated

may be same as 3

Comments and XRD Mineralogy:

Sample broken during cutting due to large angular clasts at crust center

mafic volcanics (aphanitic w/ <1% crystals observable); layers 4 + 5 truncated by 1; can 4 tell where 1 ends due to volcanic clast

Subsampl

none

25-2-F substrate chem 1pc clast 9g.

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: K Winfield 10/10/96 Subsampled by: B McIntyre 6/12/03

LCB-25-2-F

SAMPLE DESCRIPTION

Cruise Id: S.P. LEE 4174 Size (cm): 10×9×7 Location: 32.08 N, 117.82 W

Sample Id: LCB-25-2-G Weight (kg): 0.710 Depth (m): —

Mn Crust Description

Surface Texture: botryoidal granular

Mn Crust Thickness (mm):

Min: 25 Max: 75 Ave: 65

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	10	15	13	finely laminated partially fractured, alternate dk + lt brown
2				
3	3	23	6	porous; black, rust, lt brown (detrital)
~~4~~	20	55	40	uppa 2 mm → massive black; interior → porous,
~~5~~			(3A)	disordered. w/ detr. tar + old crust pieces, black, lt
~~6~~				brown, rust
(3A)	4	6	5	preserved lam. nated crust piece, fractured black (may just be metalliferous part of 3)

LCB-25-2-G

Comments and XRD Mineralogy:

layer 2 + 3 probably same but separated by boundary between growth periods; basalt fragment found in layer 3 (gray, crystalline (massive))

Analyses

Subsample No.	Analysis	Avg. Layer Thick.	Wt.(g)	
LCB-25-2-G1	Chem + Pt group	13 mm (0-13)	26.52	layer 1
G2	Chem + Pt group	45 mm (10-58)	38.10	layer 2+3

Substrate Description

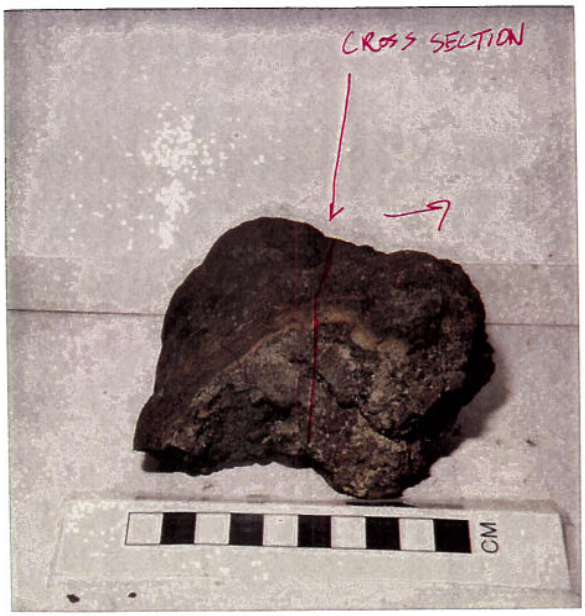
Rock Type:

Description:

Biology (?):

Described by: K Winfield 10/2/96

Subsampled by: K Winfield 10/22/96



LCB-25-2-G

SAMPLE DESCRIPTION

Cruise Id: SP LEE 4/74 Size (cm): 16 × 10 × 9.5 Location: 32.08 N, 117.82 W

Sample Id: LCB-25-3-A Weight (kg): 1.660 Depth (m): –

Mn Crust Description

Surface Texture: flat + smooth on 1 side densely botryoidal on adjacent side, flat side – surficial layer flakes off easily (subsample #1)

Mn Crust Thickness (mm):

Min: 80 Max: 100 Ave: 90

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	10	10	10	finely laminated, brown, orange
2	10	20	15	finely laminated to massive, porous at base, dk brn
3	2	8	6	porous, friable, black, orange, lt brown
4	4	12	8	porous, friable black, brown, orange
5	5	15	10	porous, friable black, brown, orange
6	3	20	15	porous – massive, black, brown

LCB-25-3-A

Comments and XRD Mineralogy:

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
LCB-25-3-A1	XRD	(0-2)	outer thin surface

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: Kari Winfield 9/27/96 Subsampled by: Kari Winfield 9/27/96

LCB-25-3-A

SAMPLE DESCRIPTION

Cruise Id: S.P. LEE 4/74 Size (cm): 23 X 16.5 X 12 Location: 32.08, 117.82W

Sample Id: 1.CB-25-3-B Weight (kg): 4.685 Depth (m): —

Mn Crust Description

Surface Texture: finely botryoidal (on larger botryoids), granular, irregular shape growth on 3 sides?

Mn Crust Thickness (mm):

Min:_____ Max:_____ Ave:_____

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1				
2				
3				
4				
5				
6				

Comments and XRD Mineralogy:

not cut

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)

Substrate Description

Rock Type:

Description:

Biology (?):

Described by:

Subsampled by:

LCB-25-3-B

LCB-25-3-B

SAMPLE DESCRIPTION

Cruise Id: S.P. LEE 4/74 Size (cm): 14.5 x 12 x 9 Location: 32.08N, 117.82W

Sample Id: LCB-25-3-C Weight (kg): 1.475 Depth (m): —

Mn Crust Description

Surface Texture: Small botr voids (3 sides)

granular/porous - 1 side

Mn Crust Thickness (mm):

Min: 70 Max: 120 Ave: 100

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	5	12	10	finely laminated, dk brown + rust colored
2	9	15	10	laminated to massive dk brown
3	45	53	45	laminated to porous to massive, dk brown, lt brown, black + detrital
4				
5	10	35	20	porous, friable granular black, yellow/orange, lt brown detrital
6				

LCB-25-3-C

Comments and XRD Mineralogy:

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
none			

Substrate Description

Rock Type:

Description:

Biology (?):

Described by: K Winfield 9/30/96

Subsampled by:

LCB-25-2-E

LCB 25-3-C

SAMPLE DESCRIPTION

Cruise Id: S.P. LEE 4/74 Size (cm): 14 x 13.5 x 8.5 Location: 32.08N, 117.82W

Sample Id: LCB-25-3-D Weight (kg): 1.215 Depth (m): —

Mn Crust Description

Surface Texture: small dense botryoids, growth on 2 sides, granular

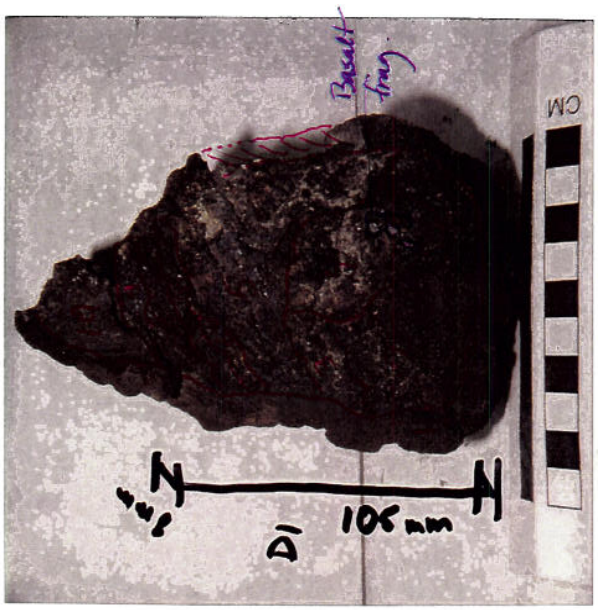
Mn Crust Thickness (mm):

Min: 25 Max: 90 Ave: 70

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	5	15	10	finely laminated, brown, orange
2	3	25	10	porous, friable, granular, black, orange, lt brown
3	4	6	5	porous, friable, granular, black, lt. brown
4	10	40	20	porous, granular, black, lt. brown
5 (highly metalliferous)	8	25	20	porous → massive, black, orange, yellow, lt.
6	2	3	3	porous, black, orange, lt. brown

cont. on back



LCB-25-3-D

Comments and XRD Mineralogy:

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
LCB-25-3-D1	Chem, XRD	all (105mm x 8mm slab) (10-105) x 45mm	10.08, bulk
D2	XRD	metallic pieces in layers ~2-10 (w/in friable mass)	—

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: KWinfield 9/30/96

Subsampled by: KWinfield 10/22/96

LCB-25-3-D

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
7 ~~1~~	2	4	3	porous to laminated, black, orange, dk brown
8 ~~2~~	2	5	3	Slightly porous to massive, black, orange
9 ~~3~~	2	5	4	porous, granular black, lt brown, orange
10 4	10	12	10	porous, friable, granular, black, orange, lt. brown
5				
6				

SAMPLE DESCRIPTION

Cruise Id: S.P. LEE 4/74 Size (cm): 12.5×10×8 Location: 32.08N, 117.82W

Sample Id: LCB-25-3-E Weight (kg): 0.635 Depth (m): —

Mn Crust Description

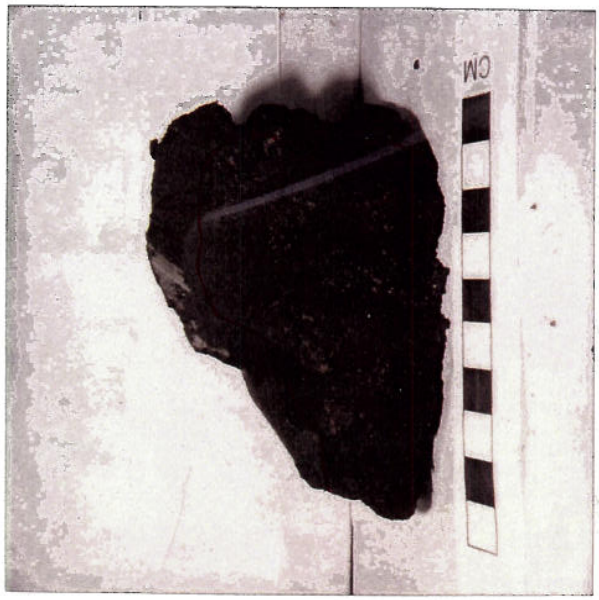
Surface Texture: granular, botryoidal

Mn Crust Thickness (mm):

Min: 40 Max: 75 Ave: 65

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	5	12	8	finely laminated, brown/orange fractures + tolamellae
2				
3	20	60	55	porous, granular, friable, black, orange, yellow, lt. brown "detrital" laminations? or bedding
4				
5				irregular/more massive
6				



LCB-25-3-E

Comments and XRD Mineralogy:

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
none			

Substrate Description

Rock Type: unknown

Description:

Biology (?):

Described by: KWinfield 9/30/96 Subsampled by: K Winfield 10/22/96

LCB 25-3-E

SAMPLE DESCRIPTION

Cruise Id: S.D. LEE 4/74 Size (cm): 19 x 11.5 x 10 Location: 32.08N, 117.82W

Sample Id: LCB-25-4-A Weight (kg): 3.040 Depth (m): —

Mn Crust Description

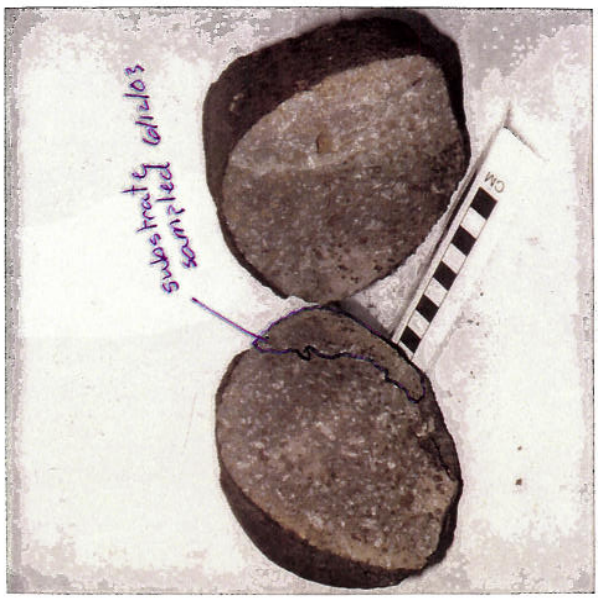
Surface Texture: slight development of botryoidal form

Mn Crust Thickness (mm):

Min: <1 Max: 4 Ave: 3

Outer to Inner Layers (mm)

	Min	Max	Ave	Texture & Color
1	0.5	4	3	alternating med-dk brown
2				
3				
4				
5				
6				



LCB-25-4-A

Comments and XRD Mineralogy:

Analyses

Subsample No.	Analysis	Layer Thick.	Wt.(g)
LCB-25-4-A1	Chem	3-4 mm (0-3)	10.19, Bulk (Layer 1)
LCB-25-4 substrate	chem		12g

Substrate Description

Rock Type: altered basalt cobble

lt grayish brown

med. grained

some show zonation or outer rim

Description: porphyritic w/ aphanitic groundmass; phenocrysts avg. size 4mm, sub-euhedral qtz. (5), plag. laths? (20), spherical pockets altering to green clay? mineral (15)

Biology (?): —

Described by: Kari Winfield 9/26/96

Subsampled by: Klowfield 10/22/96
B. McIntyre 6/12/03

Dredge Logs SPLee 4/74
LCB 1,2,6,14,20,25

Recal: [illegible]
fo phosphorite
removed before
log

DREDGE LOG

		JD	LOCAL
CRUISE	Samuel P Lee 4/74	DATE	197404
STATION		GMT	LOCAL
DREDGE	LCB 1	TIME	
DEPTH INTERVAL (m)	unknown	LATITUDE	34.03
DEPTH (m) CORRECTED	unknown	LONGITUDE	-120.54

TOTAL WEIGHT: DREDGE 259 kg CRUST —

% OF ROCK COVERED BY CRUST 0

% BROKEN FROM: OUTCROP <1% TALUS 99%

THICKNESS OF CRUST: MAX _____ MIN _____ AVG _____

DOMINANT SURFACE TEXTURE _____

% Rock type
~~SUBSTRATE LITHOLOGY~~

phosphorite	68%
mudstone	23%
erratics	9%

NODULES PRESENT _____

REMARKS: Bag 1 of 9 - phosphorite, black/brown, bioturbated & pitted, ~ 80 lbs
Bag 4 of 9 - phosphorites some conglomeratic angular, bioturbated, dark brown pitted, weight ~ 40 lbs.
"Bag 2 of 9 - fine-grained, laminated, mudstone, light tan, fossil imprint, bioturbated, chert inclusions, weather pittings, ~ 60 lbs
Bag 3 of 9 - phosphorites, dark brown bioturbated, conglomeratic, massive, 5% from outcrop, ~ 50 lbs.
Bag 6 of 9 - phosphorites, bioturbated, conglomeratic, dark brown/black, massive looking, ~ 80 lbs.
Bag 8 of 9 - phosphorites, bioturbated, brown/black, ~ 70 lbs
Bag 7 of 9 - mudstone, massive, slightly bioturbated, light tan, ~ 70 lbs
"Bag 5 of 9 - phosphorite, brown/black, bioturbated, one laminated, pitted, ~ 60 lbs
Bag 9 of 9 - weathered erratics (90%), phosphorite (10%), ~ 60 lbs.
rounded to cobbles
└ bioturbated, laminated, conglomeratic

DREDGE LOG

		JD	LOCAL
CRUISE _____	DATE	_____	_____
STATION _____		GMT	LOCAL
DREDGE LCB-14	TIME	_____	_____
DEPTH INTERVAL (m) _____	LATITUDE _____		
DEPTH (m) CORRECTED _____	LONGITUDE _____		

TOTAL WEIGHT: DREDGE _____ CRUST _____

% OF ROCK COVERED BY CRUST _____

% BROKEN FROM: OUTCROP _____ TALUS _____

THICKNESS OF CRUST: MAX _____ MIN _____ AVG _____

DOMINANT SURFACE TEXTURE _____

SUBSTRATE LITHOLOGY _____

NODULES PRESENT _____

REMARKS:

Bag 1 of 6 – aphanitic mafic cobbles, subangular, (40%) phosphatized mudstone, dense, bioturbated (60%) ~80lbs

Bag 2 of 6 – mafic subangular cobbles (100%) ~ 80lbs

Bag 4 of 6 – mafic subangular cobbles (100%) ~ 110lbs

Bag 5 of 6 – aphanitic mafic cobbles, sub-angular, oxidized surfaces (orange) (97%) phosphorite (3%), ~ 100lbs.

Bag 6 of 6 – erratics (rounded cobbles, sandstone) (80%), phosphorite (20%) ~ 50lbs.

DREDGE LOG

	JD	LOCAL
CRUISE Samuel P. Lee 4/74	DATE	197404
STATION	GMT	LOCAL
DREDGE LCB 25	TIME	
DEPTH INTERVAL (m) —	LATITUDE 32.08	
DEPTH (m) CORRECTED unknown	LONGITUDE -117.82	

TOTAL WEIGHT: DREDGE 82 kg CRUST 50 kg

% OF ROCK COVERED BY CRUST 4 %

% ROCK BROKEN FROM: OUTCROP ~57% TALUS ~43%
(crusts most likely from outcrop)

THICKNESS OF CRUST: MAX ____ MIN ____ AVG ____

DOMINANT SURFACE TEXTURE Botryoidal (massive) → crusts

SUBSTRATE LITHOLOGY

Mn crust 61%
Erratics 28%
Schist 11%

NODULES PRESENT

REMARKS:

Bag 1 of 5 - Mn-Crust (50lbs total)
Bag 2 of 5 - Mn Crust ~ 110lb + 48lbs
Bag 3 of 5 - Mn Crust ~ 21b +
Bag 4 of 5 - Erratics, ~ 50lbs.
Bag 5 of 5 - Schist, ~ 20lbs