Dredge 5

Sample Description

Cruise I.D: L5-83-HW Sample I.D: Sta: 8 D5-A2 Location: Necker Ridge

Size: 30x19x19cm Weight: 8.623 Kg

Mn crust thickness:

Total: min: 2mm max: 1cm ave: 1cm or top 2mm on bottom

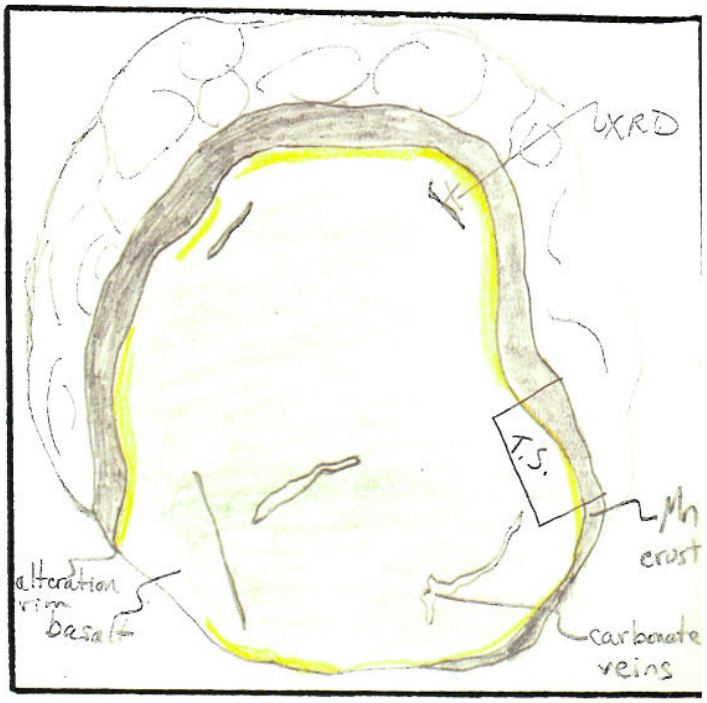
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: slightly Botryoidal & abraided smooth

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

I: Todorokite(?) + new Mn ??

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining in crust

Substratum:

Rock type: Basalt

Description: Mn crust completely surrounding large gray-green fresh-looking basalt boulder. Yellow alteration rim between crust & basalt. A few small veins of white, well-indurated* carbonate sediment. Crust falling off rock - tan sediment (phosphorus?) thinly coating basalt (& underneath crust)

* fizzes when scratched

Mineralogy (XRD):

II: CO_3-Apatite & Illite

III: CO_3-Apatite, Plagioclase, MnO_2 & Birnessite?

Analyses and subsamples:

analysis:	analyst:
XRD	Charlaine
I - Mn crust	
II - white vein	
III - basalt	
Doubly Polished Thin section to Mann Petro. thru all of upper crust & down into basalt	
Slab end piece given to: for flotation separation studies	Don. G. Foot Jr. Salt Lake City Research 729 Arapeen Dr. SLC, UT 84108

Sample Description

Cruise I.D: L5-83-HW Sample I.D: Sta: 8 D 5-A3-1 Location: Necker Ridge

Size: 25x17x12 Weight: 4.8 kg D = 2350 - 2100 m

Mn crust thickness:

Total: min: 0.3 max: 1½ cm ave: 0.6 cm

Inner crust: min: 0.2 max: 0.8 ave: 0.5

Outer crust: min: 0.2 max: 0.8 ave: 0.5

Surface texture: bumpy - smooth to porous areas

Internal structure:

layered: ✓
laminated: ✓
massive: inner crust
porous: outer crust
dendritic:
other:

Mineralogy (XRD):

I CO_3-Apatite, Qtz, MnO_2
VI ?

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type: phosphatic cemented breccia

Description: clasts of yellow-tan sst. and breccia and grey-brown basalt all with their own Mn crust in pinkish tan phosphorite matrix

Mineralogy (XRD):

I: Plagioclase, CO_3-Apatite, Smectite
II: Plagioclase, Smectite, CO_3-Apatite
III: CO_3-Apatite + ?
IV: CO_3-Apatite
VII CO_3-Fluorapatite

over

Analyses and subsamples:

analysis:	analyst:
microprobe polished section	
Slab given to: (mining possibilities)	James Wenzel (MDA)
Subsample — grams in crust	Lauren Mullineaux?
" " in sed.	Paula Quinterno U.S.
XRD:	Charlaine
I: gray volc.	
II: yellow volc.	
III: white matrix	
IV: pink matrix	
V: Mn matrix	
VI: Mn crust	
VII: phenocryst	
Doubly Polished T.S. to Mann Pet. thru upper crust down into breccia	
35mm slide	G. Smith

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5 A3-3

Location: Necker Ridge

Size: _____ Weight: 2.3 kg.

Mn crust thickness:

Total: min: 0.3 max: 2.0 cm ave: ~1 cm

Inner crust: min: 0.5 max: 1.5 ave: ~1 cm

Outer crust: min: 0.1 max: 0.5 ave: 0.3 cm

Surface texture: rough + porous

Internal structure:

layered:
laminated:
massive: inner crust
porous: outer crust
dendritic:
other:

Mineralogy (XRD):

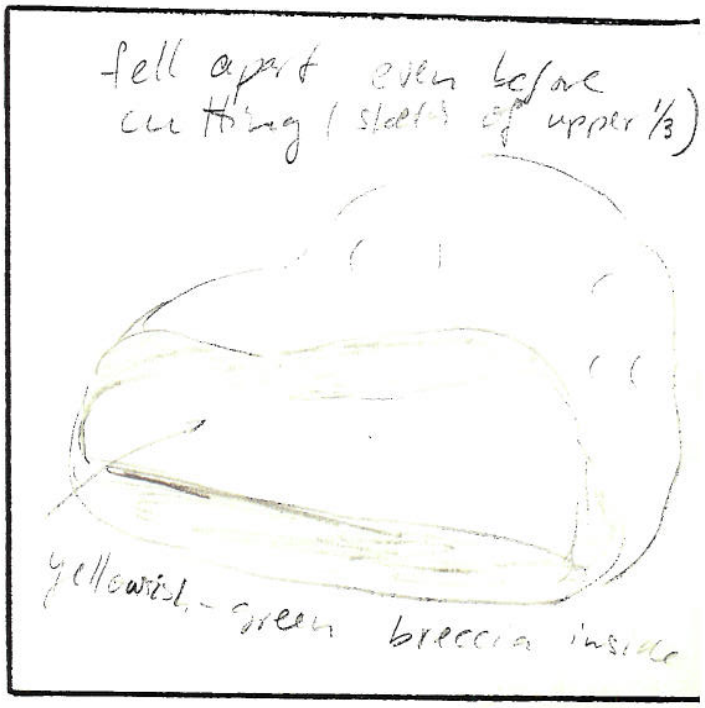
Associated alteration, phosphorite, or hydrothermal deposits:
veinlets of calcite(?) and phosph. running thru crust

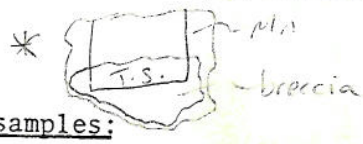
Substratum:

Rock type: volcaniclastic breccia

Description: yellowish sandy matrix w. irreg. clasts of volcanic rock most highly altered - phosphorite rich pieces (pinkish) + lots of broken Mn crust fragments

Mineralogy (XRD):





Analyses and subsamples:

analysis:	analyst:
XRD:	Charlaine
I - Mn crust	
II - White vein	
III - volc. breccia	

Doubly Polished T.S. sent to Mann Pet taken from * knob end - thick crust on top thinner Mn on all sides

Replace Page

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-4

Location: Necker Ridge

Size: _____ Weight: 2.5 Kg.

Mn crust thickness:

Total: min: 0.6 max: 2.0 ave: 1.0 cm

Inner crust: min: 1.0 max: 1.5 ave: 1.0

Outer crust: min: 0 max: 0.8 ave: 0.6

Surface texture: tiny bumps w. smooth surfaces

Internal structure:

layered:
laminated:
massive: ✓ inner crust
porous: ✓ outer crust
dendritic:
other: lower crust / sediment interface show "load structures"

Mineralogy (XRD):

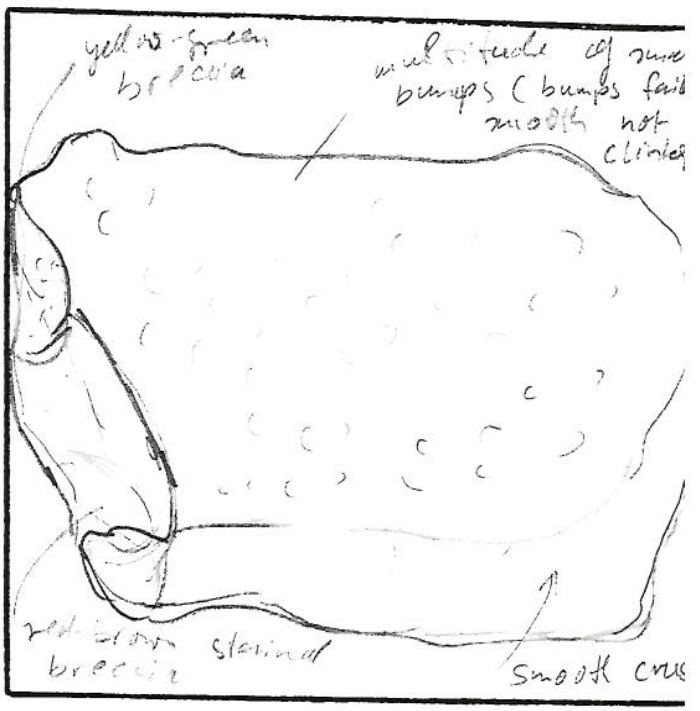
Associated alteration, phosphorite, or hydrothermal deposits:
phosph. nib. layer under crust (one side only) Fe oxide stains in porous crust

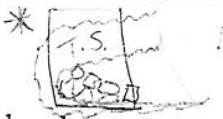
Substratum:

Rock type: volc. breccia

Description: gray-brown to greenish brown sltd. + clay matrix — highly altered volcanic clasts, Mn crust fragments + pinkish phosphorite rich layer

Mineralogy (XRD):





Analyses and subsamples:

analysis:	analyst:
XRD:	Charlene
I: Mn crust	
II: tan sst?	
III: Wh. sst?	
Doubly Polished T.S. to Mann Pet. thru* round end-all of upper crust + some of side + bottom crust	
Subsampled forams	Paula Quinteros
Density	

Sample Description

Cruise I.D: L5-83-HW Sample I.D: Sta: 8 D 5-A3-5 Location: Necker Ridge

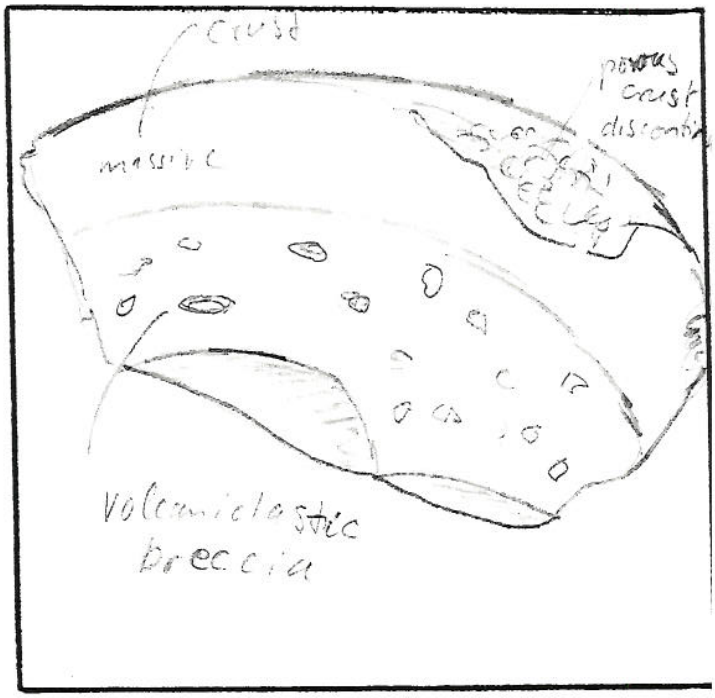
Size: 25x18x10 Weight: ~3.2 kg. Depth: 2350 - 2100 m

Mn crust thickness:

Total: min: 1 cm max: 3.5 ave: 2 cm

Inner crust: min: 1 cm max: 2.5 ave: 2 cm

Outer crust: min: 0 max: 0.5 ave: 0.3



Surface texture: fairly smooth w. porous rough areas

Internal structure:

layered: ✓
laminated: ✓
massive: ✓ (inner crust)
porous: ✓ discontinuous outer crust
dendritic:
other:

Mineralogy (XRD):

Major δMnO_2 [illegible]
Trace Qtz. & plg.

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type: volcaniclastic breccia

Description: yellow-green + pinkish tan clasts of foram siltstone and phosphorite - irregularly shaped many with their own Mn crust also lots of broken Mn crust fragments - well indurated

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
organic matter chem. >50 gm.	Bill Orem 3/23/8
XRD composite bulk crust	Lisa
Subsampled forams	Paula Quinterno

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-6

Location: Necker Ridge

Size: 12x9x8 cm Weight: 1.0 kg.

Mn crust thickness:

Total: min: 0.5 max: 3. Cm ave: 2 cm

Inner crust: min: max: ave: 5mm

Outer crust: min: max: ave: 1.5cm

Surface texture: abraided smooth to granular porous in crevices

Internal structure:

layered: 4 layers ≈ 0.5cm each

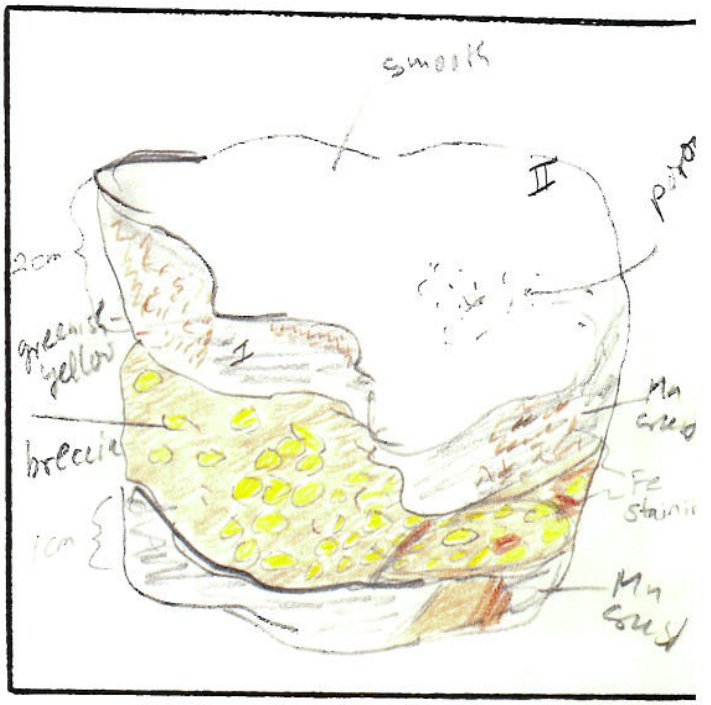
laminated:

massive:

porous:

dendritic:

other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

brown + tan clay layers + surface coating on crust

Fe oxide staining of worm tubes? in crust

Substratum:

Rock type: volcaniclastic breccia

Description: Mn crust on all sides yellow & tan altered volc. clasts

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
XRD	C. Daniel
I Inner Mn crust	
II outer " "	
* has Fe oxide & CO_3-Ap in crust	
Pt group (12/86)	Floyd Brown

LS-93-HW

D5-A3-6

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-13-7

Location: Necker Ridge

Size: 15x12x10 Weight: 1.5 kg

Mn crust thickness:

Total: min: 1.0 max: 3.0 ave: 2.0cm

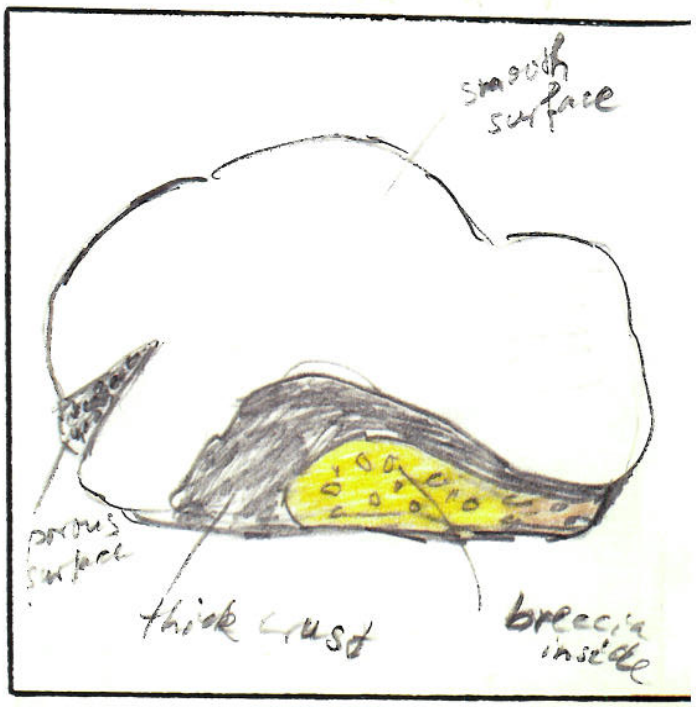
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: very smooth to granular in the depressions

Internal structure:

layered: ✓ at least 4 layers
laminated:
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

tan clay layers & coating on crust
Fe oxide staining on crust

Substratum:

Rock type: volc. breccia

Description: Mn crust on all sides
[illegible] (7cm) clast [illegible] altered
yellow ~~&~~ tan clay material [illegible]

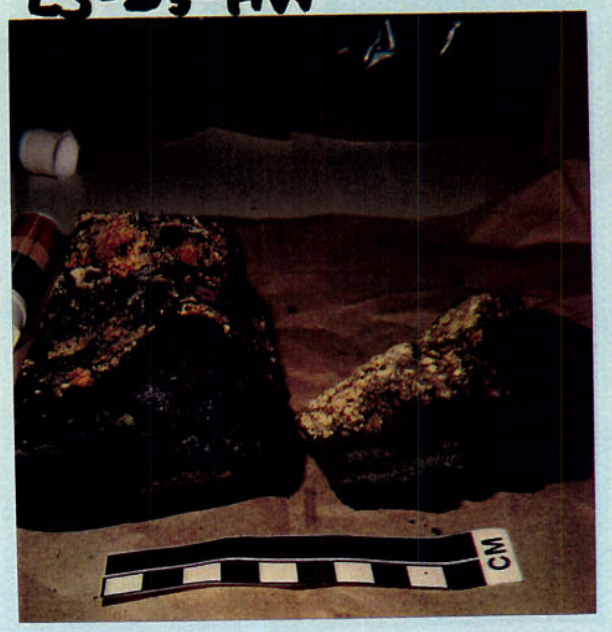
Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

LS-83-HW



D5-A3-7

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-8

Location: Necker Ridge

Size: 13x9x5cm Weight: 492g

Mn crust thickness:

Total: min: 2cm max: 2.8cm ave: 2.5cm

Inner crust: min: .6 max: .8 ave: .7cm

Outer crust: min: 1.2 max: 1.8 ave: 1.5cm

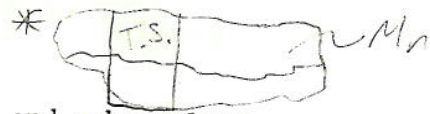
Surface texture: granular → smooth

Internal structure:

layered: ✓ ~4 layers
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:
soft yellow layer - altered volcanics
Fe oxide stain on crust



Substratum:

Rock type:

Description: Smooth Mn crust on top; ~1cm layer of altered volcanics in middle with some tan sed. (clay) coating; porous Mn crust on bottom

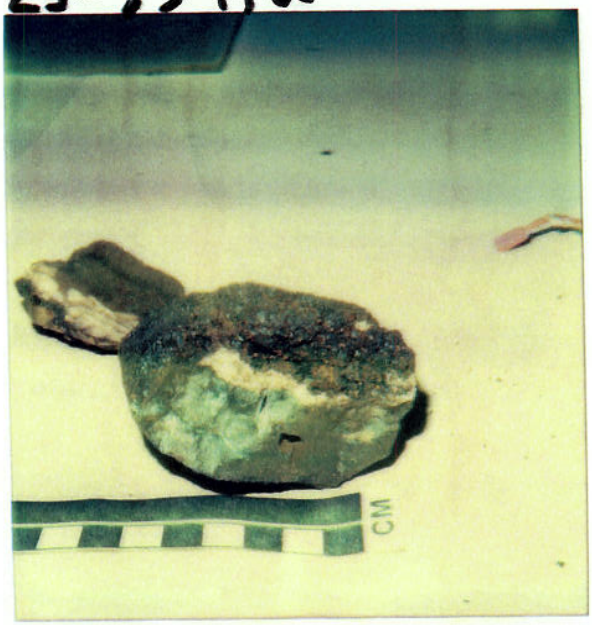
Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
XRD	C. Daniel
I inner Mn crust	
II outer Mn "	
*Polished T.S. to Mann Pet.	
Mn crust chem (Kestrn)	Jung-Keuk Kang 6/8
I 0-5 mm 4 gm	Job # BZ89
II 5-15 " 10 "	
III 15-25 " 8 "	

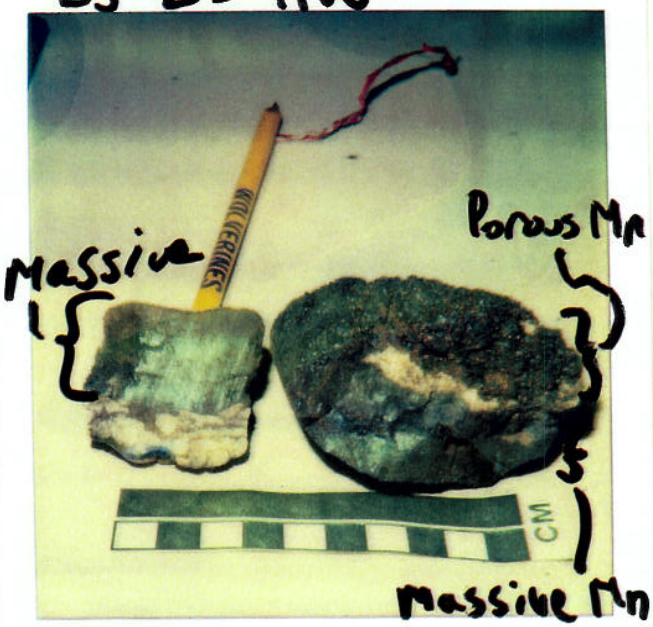
from subsampling sheet

L5-83-HW



D5-A3-8

L5-83-HW



D5-A3-8

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-A3-9

Location: Necker Ridge

Size: [illegible] Weight: [illegible]

Mn crust thickness:

Total: min: [illegible] max: [illegible] ave: [illegible]

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: slightly botryoidal & granular porous to abraided smooth [illegible]

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

small amount of prim phosphorite coating
Fe oxide stained, highly altered yellow
volc. clasts → can hardly see outline of
individual clasts

Substratum:

Rock type: [illegible]

Description: thin Mn crust on top
[illegible] of bottom surface; soft white
[illegible] *carbonate matrix [illegible] small amount
of a [illegible] clay-like matrix [illegible]
[illegible] of altered volcanics (?)

*fizzes when scratched

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
subsample forams	Scripps Lauren Mullineaux
" " "	USGS Paula Quinterno
XRD:	Charlaine
I: pink volc clast	
II: white sediment	
III: gray volc clast	
IV: Mn crust	
Chemistry - substrate	
Density	

LS-83-HW

DS-A3-9

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-10

Location: Necker Ridge

Size: 16x12x9 Weight: 1.6 kg

Mn crust thickness: thin coating all around

Total: min: ~1mm max: ~5mm ave: ~2mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: porous & granular to abraided smooth

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:
Fe oxide staining [illegible] volc. clasts

T.S. *

Substratum:

Rock type: Breccia

Description: Thin Mn crust on all sides
Clasts are surrounded by 2-5mm Mn.
one gray vesicular basalt? clast [illegible]
[illegible] clasts [illegible] volc. white
* Carbonate matrix & pinkish-tan phosphorite matrix

* fizzes when scratched & examined w/ hand lens

Mineralogy (XRD):

Analyses and subsamples:

analysis:

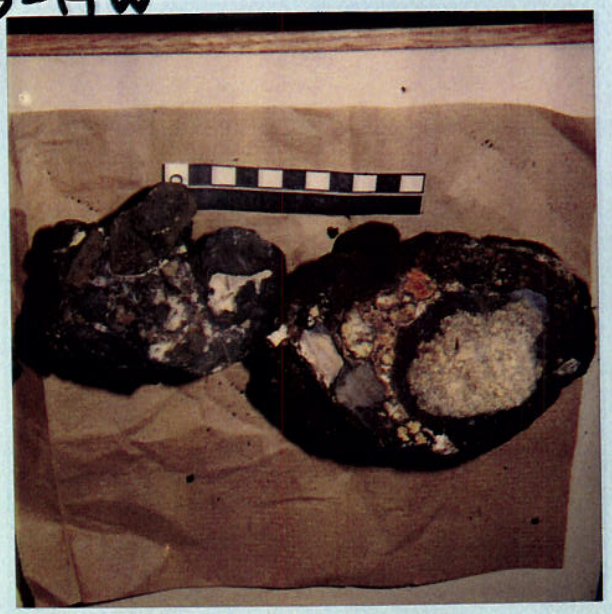
XRD:
I - gra. volc. clast
II - white sed.
III - Mn crust
IV - chert clast

* Doubly Polished T.S. to Mann Pet.

analyst:

45-83-HW

D5-
A3-
10



Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-11

Location:

Size: Weight:

Mn crust thickness:

Total: min: max: ave:

Inner crust: min: max: 13cm ave:

Outer crust: min: max: ave:

Surface texture:

Internal structure:

layered:
laminated:
massive:
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type:

Description:

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

* Doubly Polished T.S. to Mann Pet., taken from knob end

LS-83-HW

DS-A3-11

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-12 Location:

Size: Weight:

Mn crust thickness:

Total: min: max: ave:

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture:

Internal structure:

layered:
laminated:
massive:
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

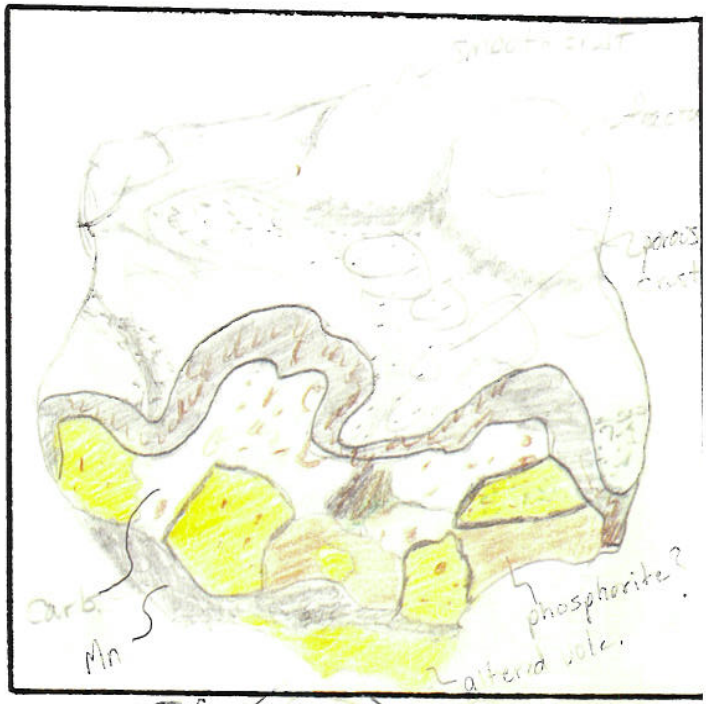
Substratum:

Rock type:

Description:

* fizzes when scratched; observed w/ hand lens

Mineralogy (XRD):



Analyses and subsamples:

analysis:	analyst:
Subsampled forams U.S.G.S.	Paula Quinterno
Few small pieces mining possibilities	John Halkyard for mechanical strai
*Doubly Polished T.S. to Mann Pet.	

LS-83-HW DS-A3-12

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-13

Location: Necker Ridge

Size: [illegible] Weight: 800g

Mn crust thickness:

Total: min: 2mm max: 10mm ave: 5mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: [illegible]

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

brown phosphorite coating on Mn altered [illegible]

Substratum:

Rock type: volc. breccia

Description: [illegible]

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

LS-83-HW

DS-A3-13

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-14

Location: Necker Ridge

Size: _____ Weight: _____

Mn crust thickness:

Total: min: 6mm max: 9mm ave: 8mm

Inner crust: min: ____ max: ____ ave: ____

Outer crust: min: ____ max: ____ ave: ____

Surface texture: smooth

Internal structure: _____

layered: _____
laminated: _____
massive: _____
porous: _____
dendritic: _____
other: _____

Mineralogy (XRD): _____

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type: _____

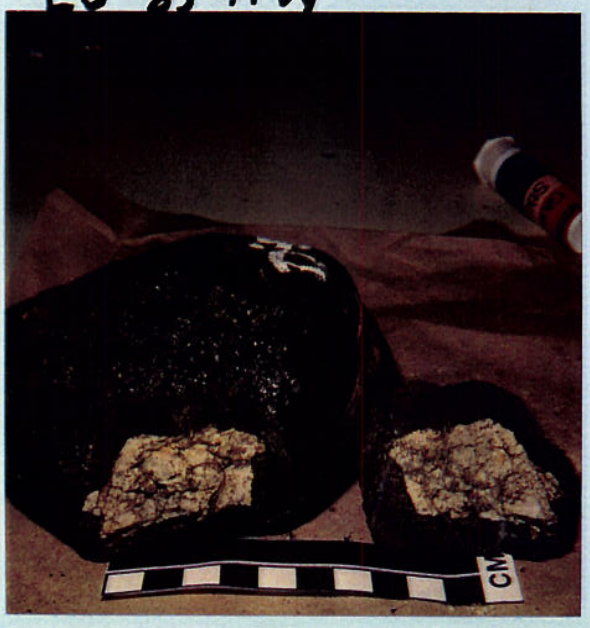
Description: _____

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

LS-83-HW



DS-A3-14

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-15

Location: Necker Ridge

Size: 15x12x7 Weight: ~2kg.

Mn crust thickness:

Total: min: 7mm max: 3cm ave: 5cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth

Internal structure:

layered:
laminated:
massive:
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

thin carbonate sediment on one side of crust
Fe oxide staining

Substratum:

Rock type: Volc breccia

Description: Thick Mn crust on all sides one brown vesicular basalt in last one yellow altered volc crust

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Pt Group (12/86)	Floyd Brown
* Doubly Polished T.S. to Mann Pet.	

L5-83-HW

D5-A3-15

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-16 Location:

Size: Weight:

Mn crust thickness:

Total: min: max: ave:

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture:

Internal structure:

layered:
laminated:
massive:
porous:
dendritic:
other:

Mineralogy (XRD):

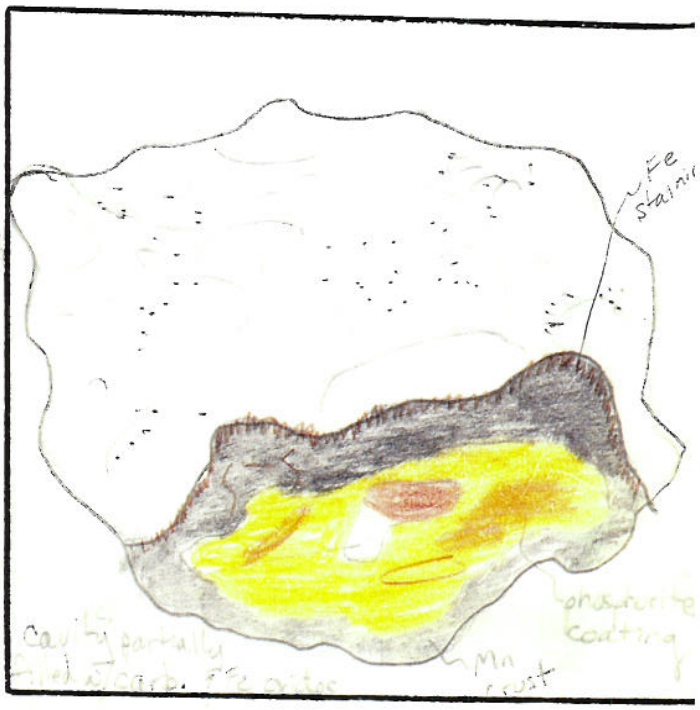
Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type:

Description:

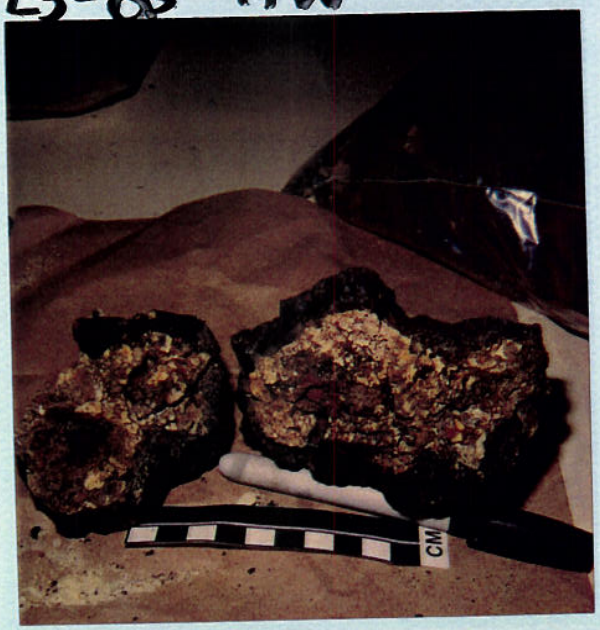
Mineralogy (XRD):



Analyses and subsamples:

analysis:	analyst:

L5-83-HW



D5-A3-16

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-17

Location: Necker Ridge

Size: 16x12x9cm Weight: 1561 kg

Mn crust thickness:

Total: min: 2mm max: 4mm ave: 3mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: porous - granular

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

tan sediment coating
white carbonate replacing & [illegible] filling
[illegible] altered clasts

Substratum:

Rock type: [illegible]

Description: Thin mn crust on [illegible] sides & part of bottom; soft green powdery altered volc. 2) "clasts" - hard to define boundary of (individual "clasts") partial coating of tan phosphorite (maybe clay? - soft) & white *carbonate material - soft & powdery.

* fizzes when scratched & observed w/hand lens

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
subsample - foram	Scripps Lauren Mullineaux
" "	U.S.G.S. Paula Quinterno

L5-83-HW

D5-A3-17

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-18

Location: Necker Ridge

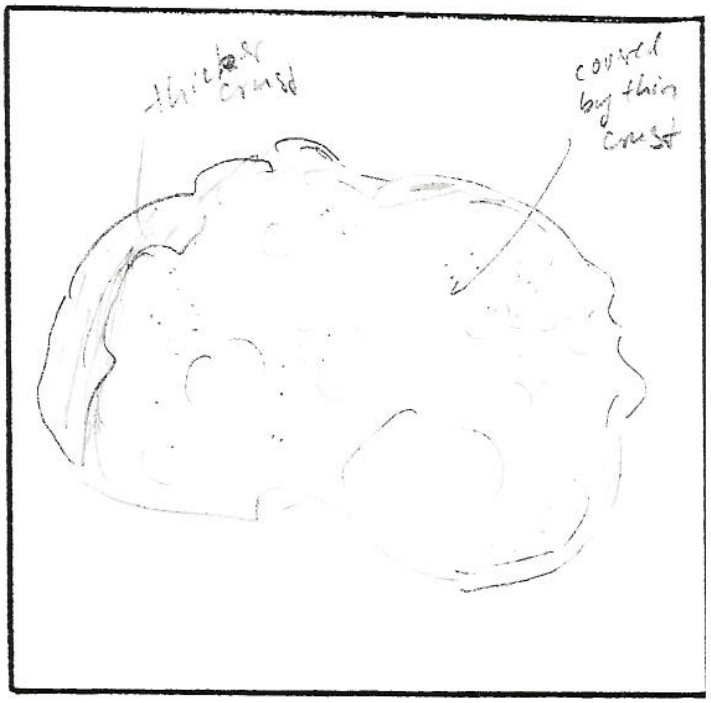
Size: 15x9x9 Weight: 1.3 kg

Mn crust thickness:

Total: min: 1mm max: 2cm ave: [illegible]

Inner crust: min: max: ave:

Outer crust: min: max: ave:



Surface texture: rough + porous

Internal structure:

layered:
laminated:
massive:
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

white carbonate coating on surface of crust; Fe oxide staining; white phosphorite(?) replacing matrix & filling pinlets; yellow altered volc. clasts

Substratum:

Rock type: Volc breccia

Description: Mn crust all around thicker on top [illegible] vesicular basalt clasts w/in one (?) large yellow altered volc. clast; some calcite(?) [illegible] that phosphorite is replacing [illegible] in the crust, one pinkish-tan phosphorite [illegible] tan sediment coating [illegible] of rock

* Not sure which [illegible] thick crust, porous surface [illegible] coating bottom [illegible] surface sediment coating.

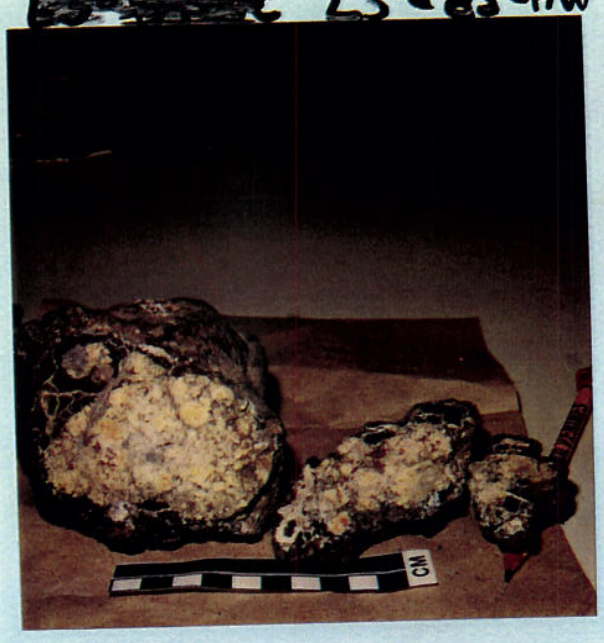
Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Subsampled forams	Paula Quinterno
* Doubly Polished T.S. to Mann Pet.	

* See x-sec on back

[redacted] L5-83-HW



D5-A3-18

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-19 Location: Nectar Ridge

Size: 11x8x6 Weight: 0.8 kg

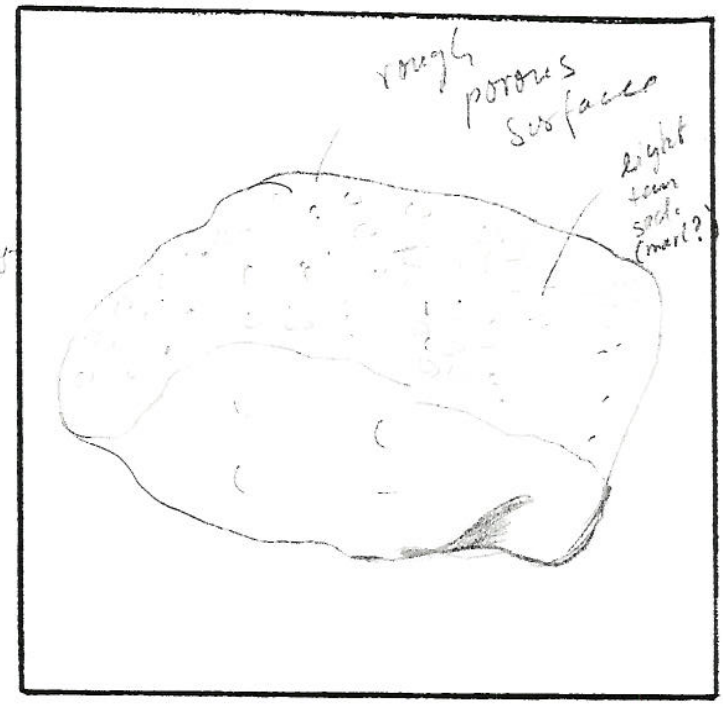
Mn crust thickness:

Total: min: 2mm max: 6mm ave: 4mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: porous & granular, small botryoids



Internal structure:

layered:
laminated:
massive:
porous: ✓
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining of worm tubes(?) all over crust. White carbonate(?) sediment on crust

Substratum:

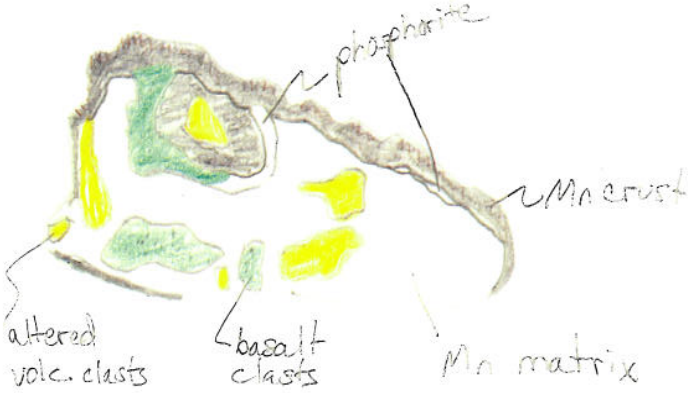
Rock type: Volc. breccia

Description: Mn crust all around & Mn matrix, yellow soft, vesicular, vole. clasts; grey vesicular basalt clasts, Tan & white phosphorite in veinlets

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:



Cross Section

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-A3-20 Location: Necker

Size: 9x7x4cm Weight: 150 g

Mn crust thickness:

Total: min: 1cm max: 4cm ave:

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth

Internal structure:

layered:
laminated:
massive: /
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:
Dark brown phosphorite

Substratum: None

Rock type:

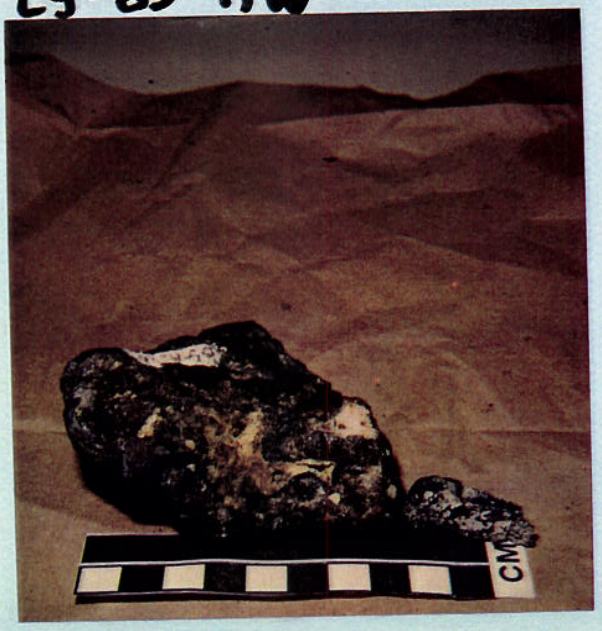
Description: Solid Mn crust with a few cavities on one side which are filled with a tan clay? sediment White carbonate sediment coating on half of upper surface. Dark brown phosphorite? thin coating on underneath & side w/ cavities.

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
subsample - foram	Lauren Mullineaux

L5-83-HW



D5-A3-20

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-A3-21

Location: Necker Ridge

Size: 11x10x6cm Weight: 1.17 Kg

Mn crust thickness:

Total: min: 3mm max: 1cm ave: 1cm-top 3mm-bottom

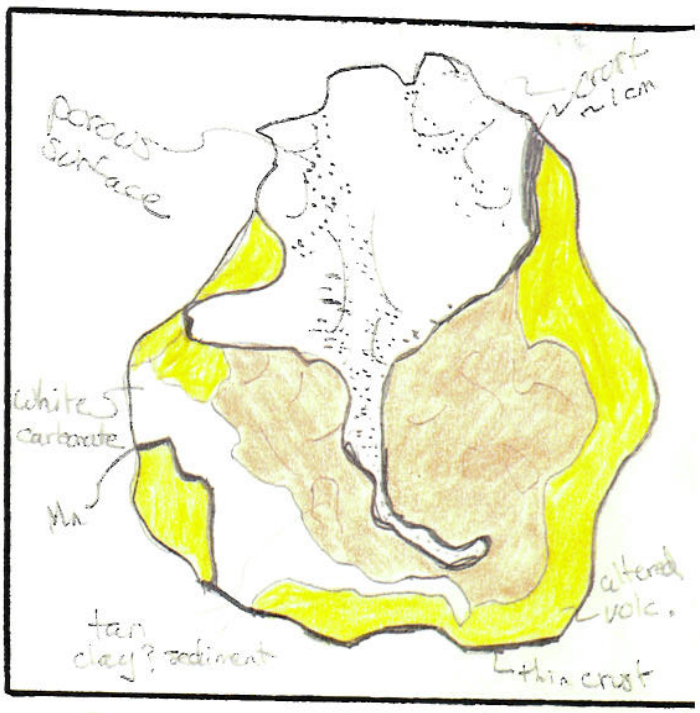
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: rough & porous

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:



2 pieces - could have broken apart

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe Staining of worm tubes? in crust

Substratum:

Rock type: volc. breccia

Description: Mn crust covers only part of top & bottom (crust seems to have broken off in places). Clast (s?) are highly altered soft yellow, granular. Fairly large amounts of tan clay? sediment coating & white powdery carbonate material (fizzes when scratched)

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Subsampled foram's	Paula Quinteros

LS-83-HW

DS-A3-21

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-A3-22

Location: Necker Ri

2 pieces; 8x4x6 cm

Size: 15x12x8 cm Weight: 1.425 Kg

Mn crust thickness:

Total: min: 4mm max: 2cm ave: 7mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: porous/granular to abrasive smooth

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

a little Fe staining in crust
yellow highly altered volc. clasts
white carbonate sed. coating

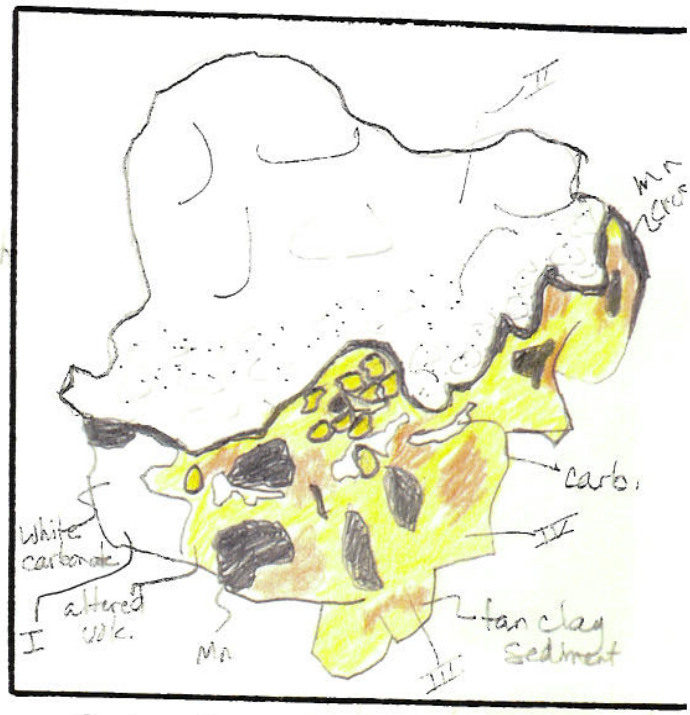
Substratum:

Rock type: volc. breccia

Description: Mn crust on top & sides
Mn is incorporated throuout rock as clasts(?)
Yellow highly altered volc. clasts, many
small ones surrounded by Mn. Some white
* carbonate material & tan clay sediment coating

* fizzes when scratched & observed w/ hand lens

Mineralogy (XRD):



2 pieces could have broken apart

Analyses and subsamples:

analysis:	analyst:
XRD:	Charlaine
I - White sed.	
II - Mn	
III - Tan sed.	
IV - yellow volc.	
Subsampled forams	Paula Quinterno

LS-83-HW

D5-A3-22

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-A3-23

Location: Necker Ridge

Size: 27x14x12 Weight: 2.730 Kg

This rock is the same as A3-22

Mn crust thickness:

Total: min: max: ave:

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture:

Internal structure:

layered:
laminated:
massive:
porous:
dendritic:
other:

Mineralogy (XRD):

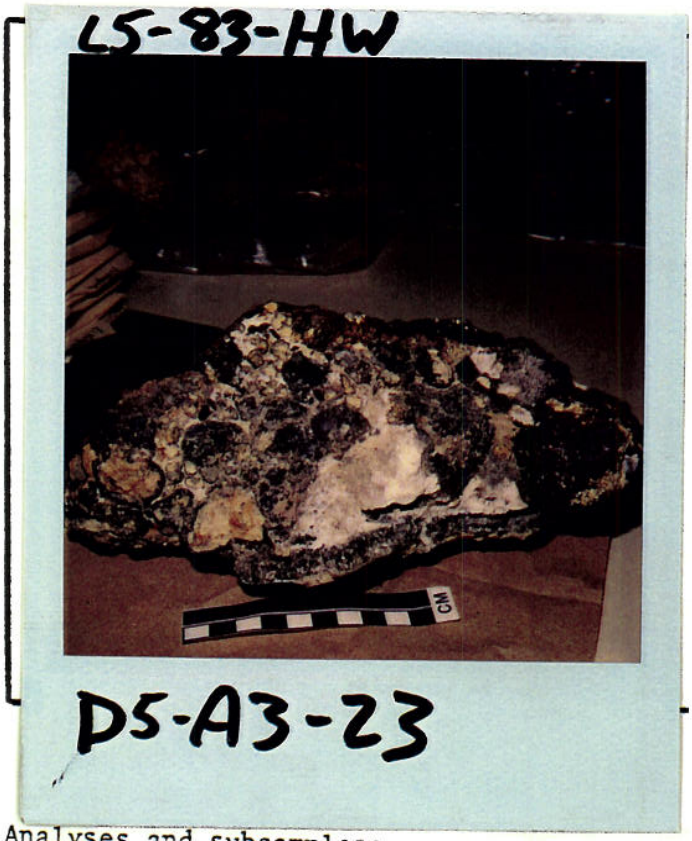
Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type:

Description:

Mineralogy (XRD):



Analyses and subsamples:

analysis:	analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-83-24 Location: Necker

Size: _____ Weight: _____

Mn crust thickness:

Total: min: _____ max: _____ ave: _____

Inner crust: min: _____ max: _____ ave: _____

Outer crust: min: _____ max: _____ ave: _____

Surface texture: _____

Internal structure: _____

layered: _____
laminated: _____
massive: _____
porous: _____
dendritic: _____
other: _____

Mineralogy (XRD): _____

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type: _____

Description: _____

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Whole Rock Taken	Lauren Mullineaux

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-83-25

Location: Necker Ridge

Size: 32x18x8cm Weight: 3Kg

Mn crust thickness:

Total: min: 8mm max: 2cm ave: 1.4cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Botryoidal & porous

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

over →

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

minor Fe ox. de staining in crust

Substratum:

Rock type: volc.

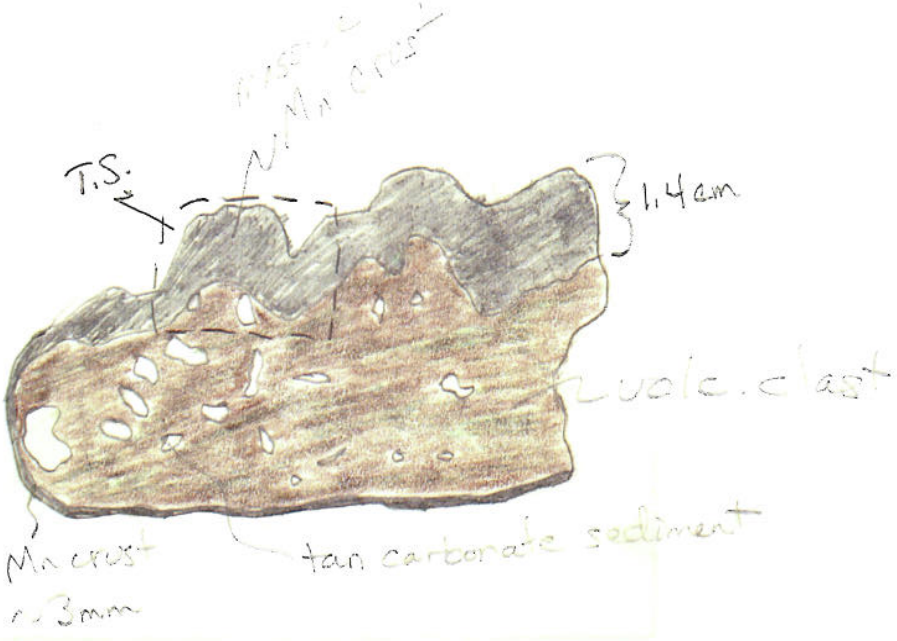
Description: Mn crust all around - thins out on sides & bottom. A lot of cavities in crust on bottom. One large (13x5cm) greenish brown aphanitic clast also with cavities which are filled with tan carbonate (fizzes easily) sediment. Also a lot of black Mn grains around edge of cavities.

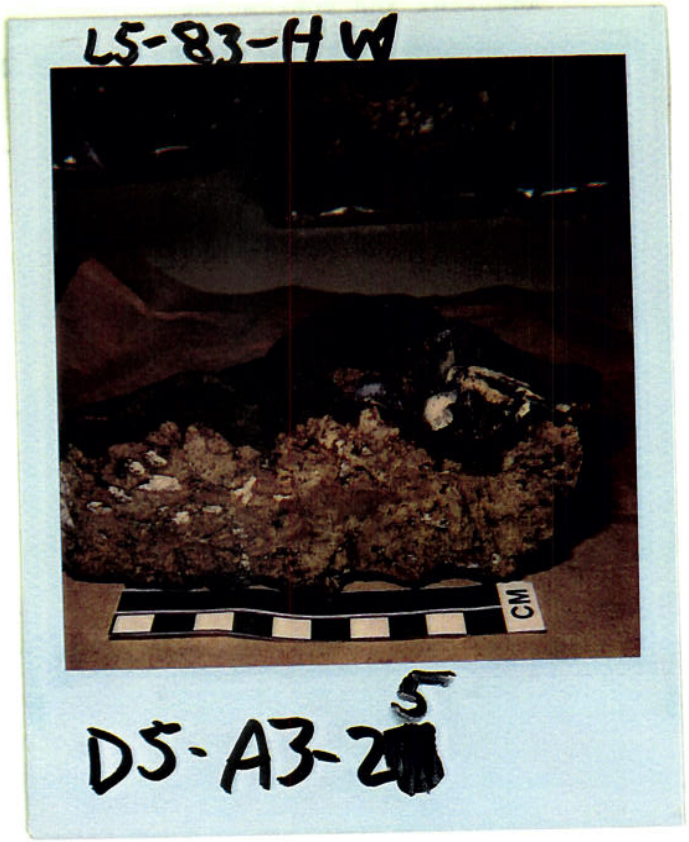
Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Pt. group (12/66)	Floyd Brown
*Doubly Polished T.S. to Mann Pct.	

* See x-ser on back


T.S.
1.4cm
Mn crust
~3mm
tan carbonate sediment


L5-83-HW
CM
D5-A3-2

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-A3-26 Location: Necker Ridge

Size: 9x7x4cm Weight: 240g

Mn crust thickness:

Total: min: 1.8cm max: 3cm ave: 3cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

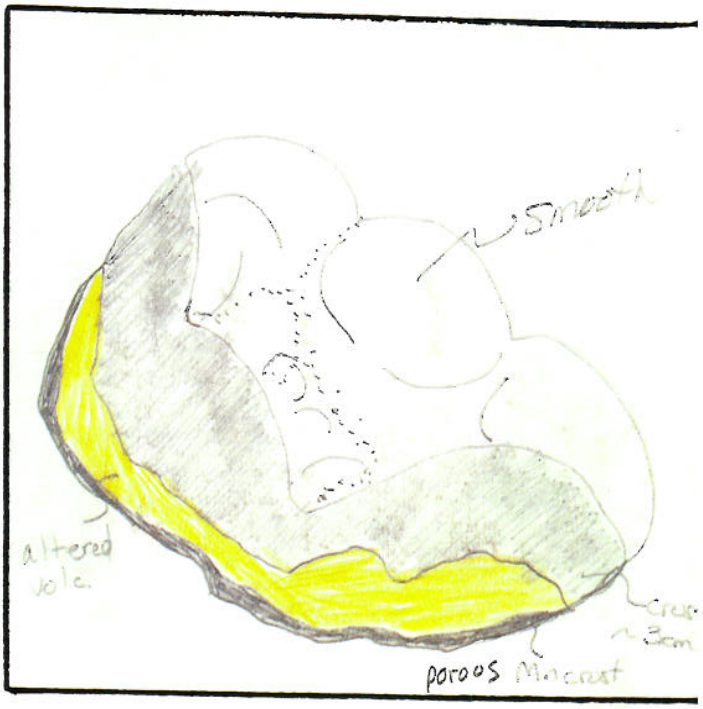
altered volc. w/ Fe-staining

Substratum:

Rock type: volc.

Description: Almost all Mn crust. Yellow-brn. greenish altered volc.

Mineralogy (XRD):



Analyses and subsamples:

analysis:	analyst:

LS-83-HW

D5·A3-26

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D 5-13-27 Location: Necker Ridge

Size: 13x10x6cm Weight: 524 g

Mn crust thickness:

Total: min: 3.8cm max: 4.5cm ave: 4.2cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

not sure where to separate

Surface texture: smooth

Internal structure:

layered: ✓ 2-3?

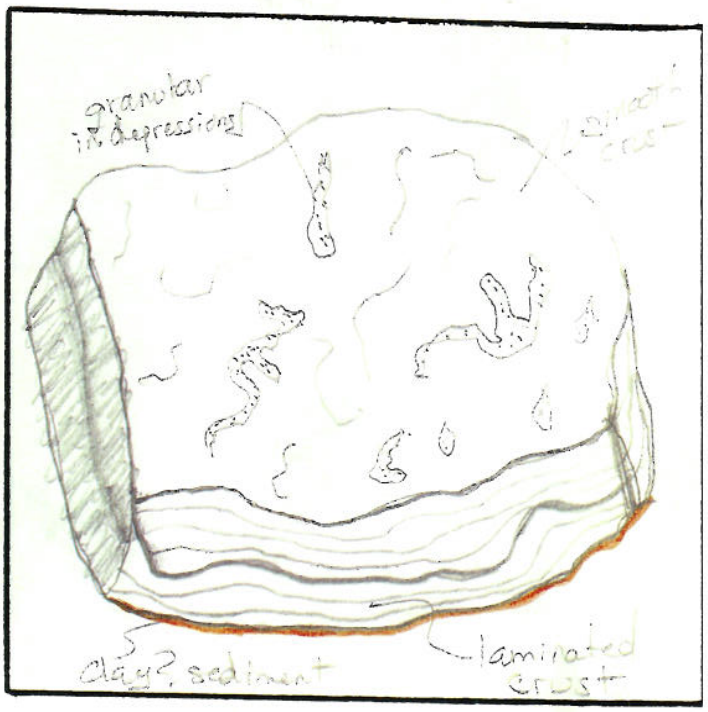
laminated: ✓ 6-7?

massive: ✓

porous:

dendritic:

other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type:

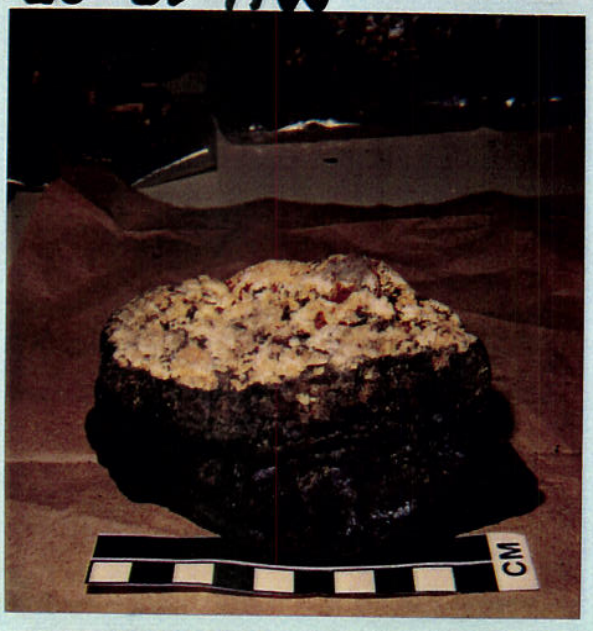
Description: All Mn crust with ~ 2mm orange, soft, clay?, sediment on bottom

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

L5-83-HW



D5-A3-27

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D 5-13-28

Location: Nuckers Ridge

Size: 19x15x9 cm Weight: 1.69 kg

Mn crust thickness:

Total: min: 3mm max: 6mm ave: 3mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: porous

Internal structure:

layered:
laminated:
massive: ✓
porous: ✓
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

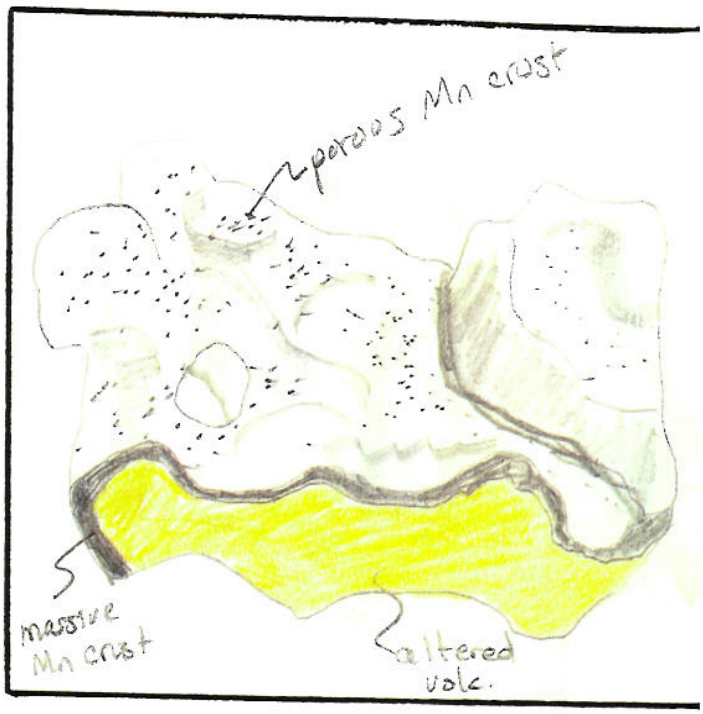
Yellow highly altered volc. clasts
Fe oxide staining

Substratum:

Rock type: volc. breccia

Description: Thin Mn crust on top; tan, gray, & orange-brown vesicular, volcanic clasts (1-4.5cm) & soft, yellow, highly altered volc. clasts. Some clasts are rimmed with Mn. Also Mn grains mixed in w/ clasts & matrix. Pinkish-tan, soft, clay? sediment matrix. A few Mn clasts & pods?

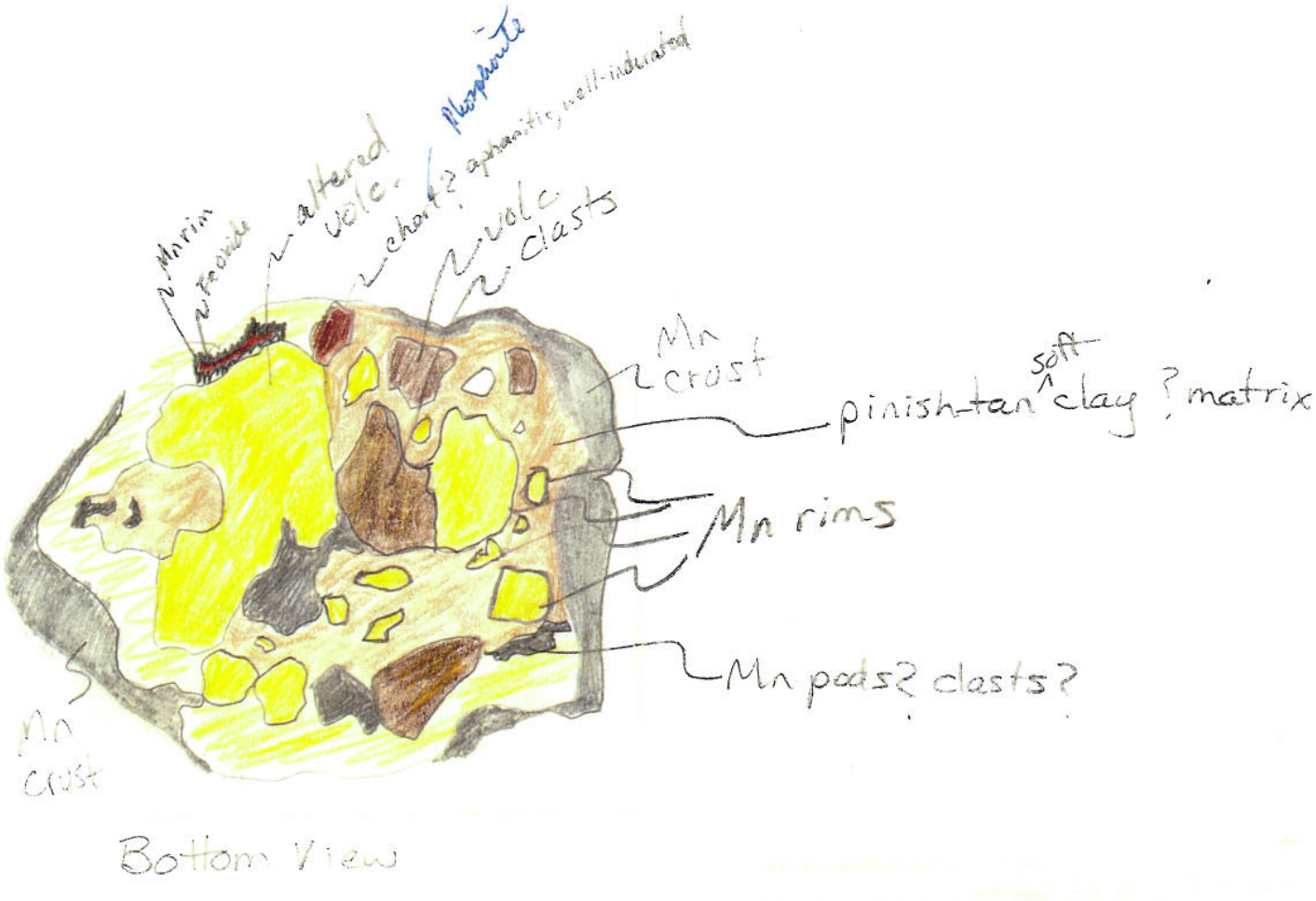
Mineralogy (XRD):



over

Analyses and subsamples:

analysis:	analyst:
Subsampled foraams	Paula Quinterno


Phosphorite
Marine microfossils
altered volc.
chert? opaline, well-indurated
volc clasts
Mn crust
pinish-tan soft clay? matrix
Mn rims
Mn pods? clasts?
Mn crust

Bottom View

L5-83-HW
DS-A3-28

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-B3-1

Location: Necker Ridge

Size: 23x15x6cm Weight: 1.80 Kg

Mn crust thickness:

Total: min: 2.2cm max: 3cm ave: 2.5cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: fairly smooth - granular in depressions

Internal structure:

layered: / ~3-5

laminated:

massive: ✓

porous:

dendritic:

other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

highly altered volcanic clasts

Substratum:

Rock type: volc. breccia

Description: Thick Mn crust on top; thinner substratum consisting of yellow soft, highly altered volcanic material one clast ~18x23cm; one gray vesicular clast (~5cm) Some soft tan & brown sediment (clay?) coating

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Whole rx given to: (mining possibilities)	John Halkyard

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-83-2

Location: Necker Ridge

Size: 7x6x3cm Weight: 1.63 kg

Mn crust thickness:

Total: min: 2.8cm max: 3cm ave: 3cm

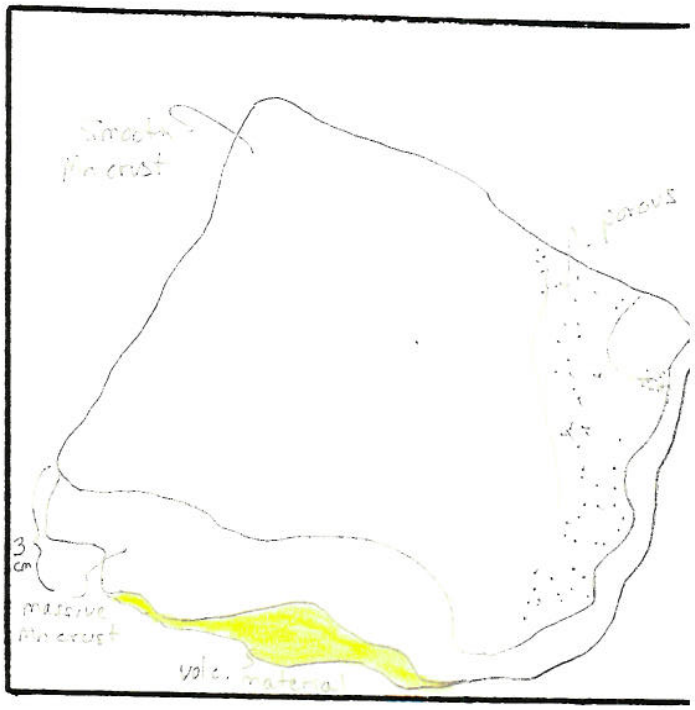
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth to porous on one end

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

highly altered volcanic material

Substratum:

Rock type: volc. breccia

Description: Thick Mn crust with little substratum (~2-5mm) which consists of grayish-brown volcanic clasts & highly altered to yellowish-white soft sediment

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
whole rx given to	Bob Willard Minneapolis

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-83-3

Location: Necker Ridge

Size: 19x15x4cm Weight: 1.10 kg

Mn crust thickness:

Total: min: 2cm max: 4cm ave: 3cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth to porous on one side

Internal structure:

layered: ✓?

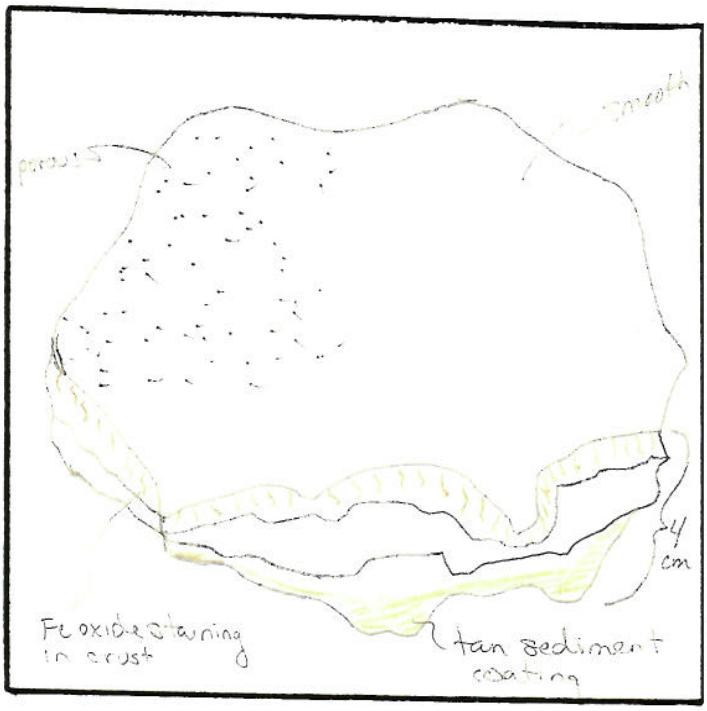
laminated:

massive: ✓

porous:

dendritic:

other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining on sides of crust

Substratum:

Rock type: Mn crust - No substratum!

Description: Thin layer? of tan soft sediment in crevices on bottom of crust

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 2 D5-83-4

Location: Necker Ridge

Size: 9x15x5cm Weight: 0.913kg

Mn crust thickness:

Total: min: 1.9cm max: 3cm ave: 2.5cm

* Inner crust: min: 1.0 max: 1.5 ave: 1cm

hard to define inner/outer

Outer crust: min: 1.0 max: 1.3 ave: 1.2cm

Surface texture: Smooth w/ tiny granules

Internal structure:

layered: ✓ ~4

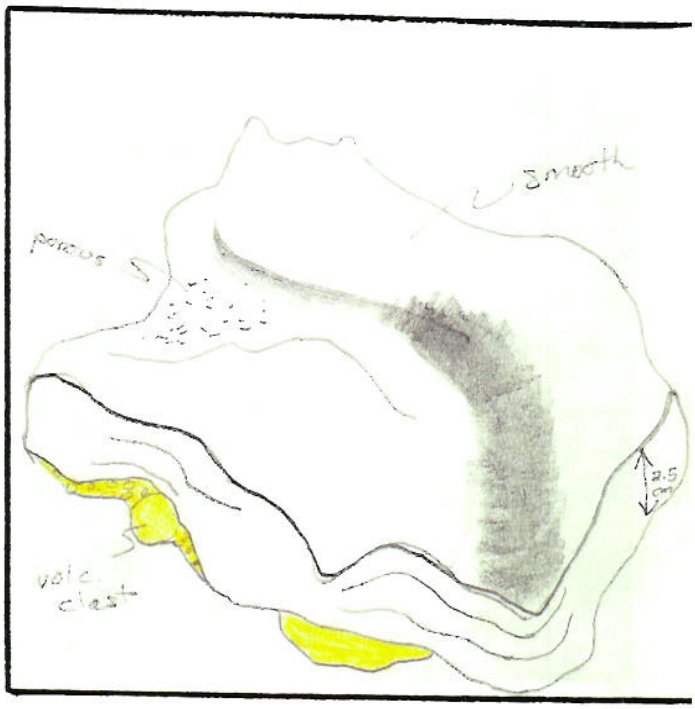
laminated:

massive: ✓

porous:

dendritic:

other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining of crust & breccia

altered volcaniclastics

Substratum:

Rock type: volc. breccia

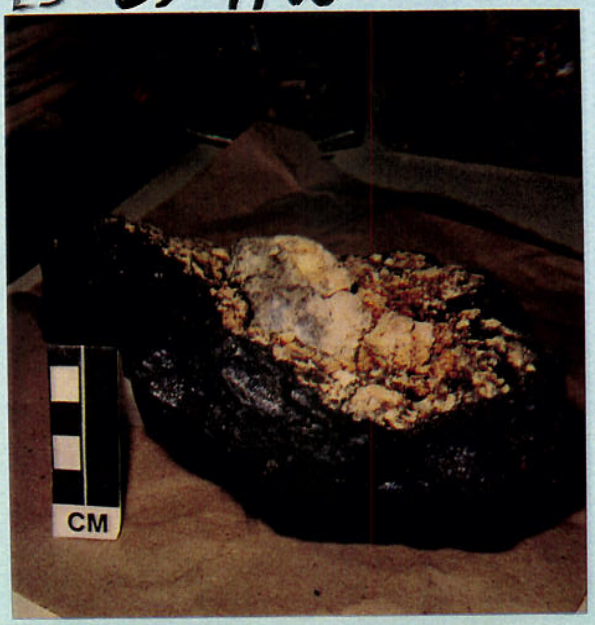
Description: Thick Mn crust on top; thin (few mm) breccia underneath, only one large (3x1cm) clast & two smaller (<1cm) clasts; all are gray volcanic altering to red sediment; rest of underneath consists of soft, yellow, pebbles (2-6mm) highly altered

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
subsampled → forams	Lauren Mullineaux

L5-83-HW



D5-B3-4

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-B3-5

Location: Vecsar Ridge

Size: 14x14x7cm Weight: 1.042kg

Mn crust thickness:

Total: min: 1.3cm max: 3cm ave: 2.5cm

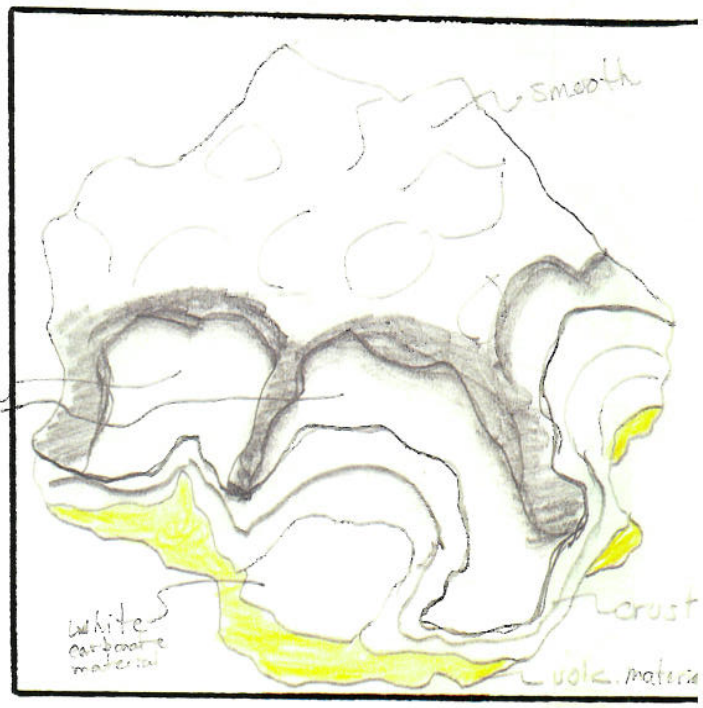
Inner crust: min: 0.5cm max: 1.5cm ave: 1.2cm

Outer crust: min: 0.5cm max: 1cm ave: 0.8cm

Surface texture: Botryoidal-smooth

Internal structure:

layered: ✓ ~2 → 3?
laminated:
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining in crust & breccia

Substratum:

Rock type: volc breccia

Description: Thick Mn crust on top; very little substratum consisting of soft yellow, altered volcanic material; one pocket (or clast?) of white, soft, carbonate material (~4cm). A little tan, soft, sediment coating

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Subsampled forams	Paula Quinterno

LS-83-HW

DS-B3-5

for better perspective on substrate -
se D5-B3-9

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-6

Location: Necker Ridge

Size: 14x11x5cm Weight: 772g

Mn crust thickness:

Total: min: 2.5 max: 3.0cm ave: 3cm

Inner crust: min: ___ max: ___ ave: 1.5cm

Outer crust: min: ___ max: ___ ave: 1cm

Surface texture: Smooth-w/ tiny granules

Internal structure: ___

layered: ✓ ~2-4

laminated: ___

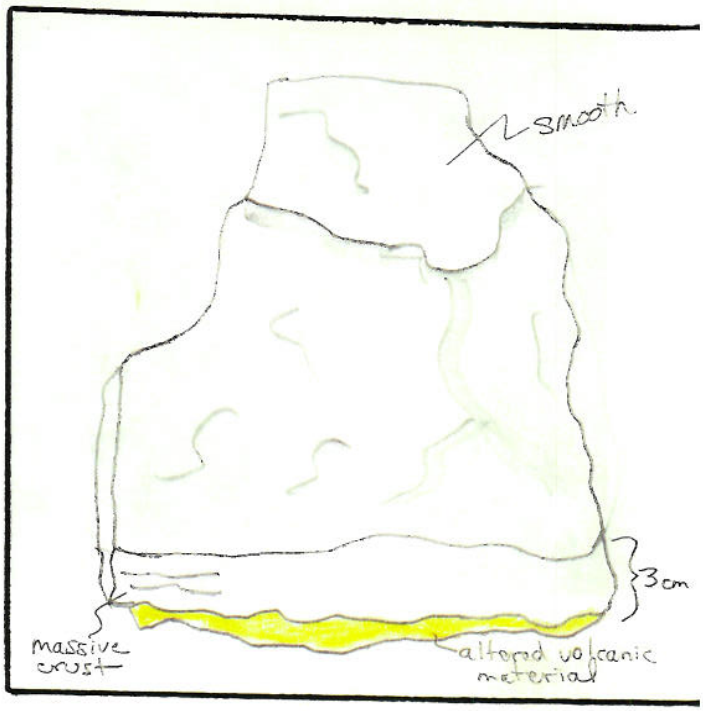
massive: ✓

porous: ___

dendritic: ___

other: ___

Mineralogy (XRD): ___



Associated alteration, phosphorite, or hydrothermal deposits:

Small amount of Fe oxide staining in crust

Substratum:

Rock type: volc. breccia

Description: Thick Mn crust w/ thin substratum of fine volcanic (vesicular) clasts (1-2.5cm) highly altered. Mostly soft yellow highly altered volcanic material & little soft white & tan sediment in matrix (?)

Mineralogy (XRD): ___

Analyses and subsamples:

analysis:	analyst:

LS83-HW

DS-B3-6

for better perspective on substrate –
see photo for DS-B3-9

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-B3-7

Location: Necker Ridge

Size: 12X11X7cm Weight: 797g

Mn crust thickness:

Total: min: 2cm max: 4.5cm ave: 3cm

Inner crust: min: max: ave: 2.5cm

Outer crust: min: max: ave: .5cm

Surface texture: Smooth

Internal structure:

layered: ✓ 2?

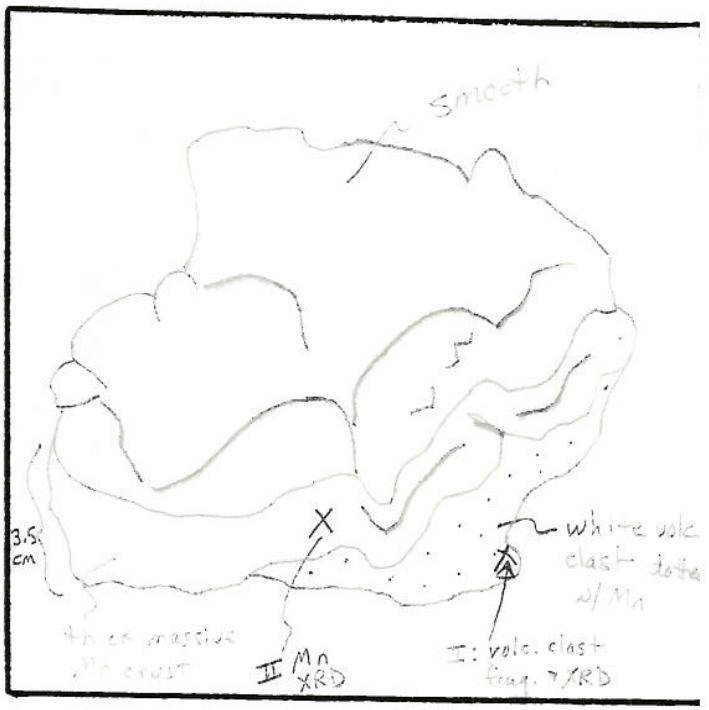
laminated:

massive: ✓ inner

porous: ✓ outer

dendritic:

other:



Mineralogy (XRD):

B3-7-II: Mn crust

Associated alteration, phosphorite, or hydrothermal deposits:

Brown phosphorite coating (thin)

Substratum:

Rock type: Volc. breccia

Description: Thick massive Mn crust underneath side has pockets where clasts fell out which have thin yellow & tan sediment coatings. One large (7x6cm) white soft volcanic (vesicles (?) filled w/ Mn) clast

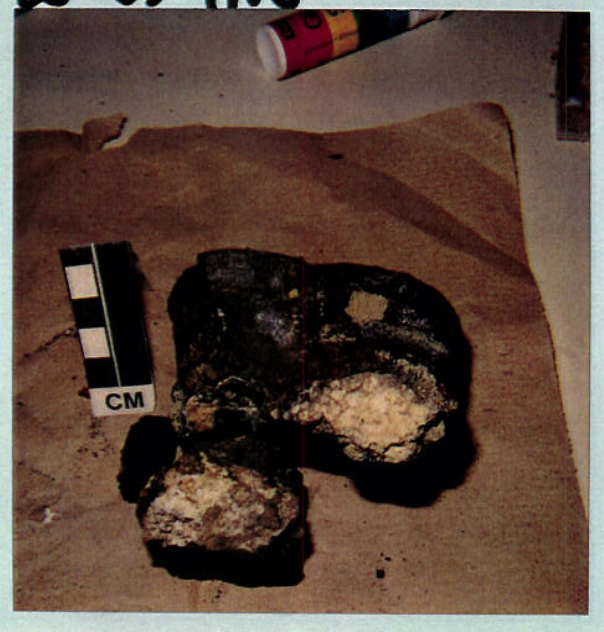
Mineralogy (XRD):

B3-7-I: white volc. frag.

Analyses and subsamples:

analysis:	analyst:
XRD:	Charlaine
D5-B3-7-I: volc. clast	
B3-7-II: bulk Mn	
*Polished T.S. to Mann Pet	
Mn crust chem. (Reston)	Jung-Keak Kang 6/8
I 0-12 mm 10 gm	Job #BZ88
II 12-24 " " "	
III 24-36 " " "	
Bulk 0-36 for Hg Chem	
Pt group (12/86)	Floyd
D5-B3-7A outer	
D5-B3-7B inner	

LS-83-HW



DS-B3-7

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-83-8

Location: Necker Ridge

Size: 16x8x5cm Weight: 494 g

Mn crust thickness:

Total: min: 2cm max: 2.5cm ave: 2.5cm

Inner crust: min: ___ max: ___ ave: 1.5cm

Outer crust: min: ___ max: ___ ave: 1cm

Surface texture: Botryoidal & granular

Internal structure: ___

layered: ✓? ~?

laminated: ___

massive: ✓

porous: ___

dendritic: ___

other: ___

Mineralogy (XRD): ___

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining in Mn crust
Small amount of brown phosphorite on sides of crust

Substratum:

Rock type: volc. breccia

Description: Thick Mn crust; not much of a substratum: thin yellow sediment coating one broken, altered volcanic clast (~1.6x3.5cm)

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Whole rx given to: for mining research studies	James Wenzel (MDA

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-B3-9 (representative piece)

Location: Necker Ridge D= 2350 – 2100 m

* Size: 14x9x4 cm Weight: 0.5 kg.

Mn crust thickness:

Total: min: 2cm max: 3 cm ave: 2 cm

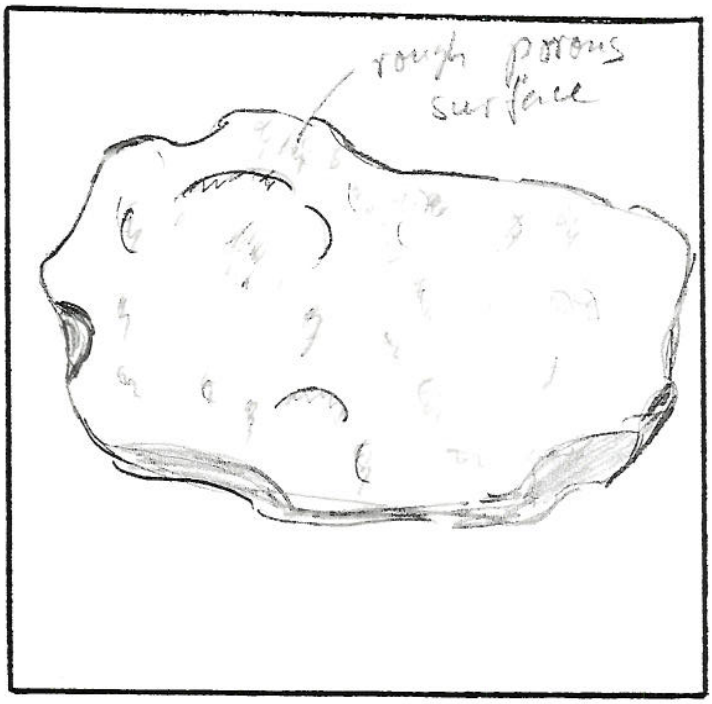
Inner crust: min: ____ max: ____ ave: ____

Outer crust: min: ____ max: ____ ave: ____

Surface texture: rough + porous

Internal structure:

layered: ✓ ~4 layers (faint)
laminated:
massive:
porous: ✓ filled with sediment
dendritic:
other:



Mineralogy (XRD):
All δ MnO_2

Associated alteration, phosphorite, or hydrothermal deposits:
Fe oxide stains of sand grains in pores of crust.

Substratum:

Rock type: volcaniclastic breccia

Description: yellowish-tan sand matrix with irreg. shaped pebbles (volcanic) to ~1cm lots of Mn crust pieces + specks thruout

Mineralogy (XRD): (sample for XRD)

Analyses and subsamples:

analysis:	analyst:
polished section microprobe 6 samples (golf ball size) send to politicians (MMS)	A. Davis (?)
XRD - porous crust	LISA

* green burlap bag of B3-9 ~ wt. 7.7 kg

LS-83-HW

DS-B3-9

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-10

Location: Necker Ridge

Size: 22x15x5 Weight: ~1.5 kg

Mn crust thickness:

Total: min: 1.5cm max: 2.8cm ave: 2.2cm

Inner crust: min: .9 max: 1.5cm ave: 1.3

Outer crust: min: .4 max: .8 ave: .7

Surface texture: smooth botryoidal

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

yellow to brownish tan altered volcaniclastics

Substratum:

Rock type: volcaniclastic breccia

Description: Mn crust continues around to bottom, covering half of it & surrounding clasts. Crust on bottom is porous, on top its smooth & botryoidal

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
forams	whole rock given to: Lauren Mullineaux Scripps Inst.

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-83-W

Location: Necker Ridge

Size: 9x15x12cm Weight: 1.916 Kg

Mn crust thickness:

Total: min: 4mm max: 9mm ave: 5mm

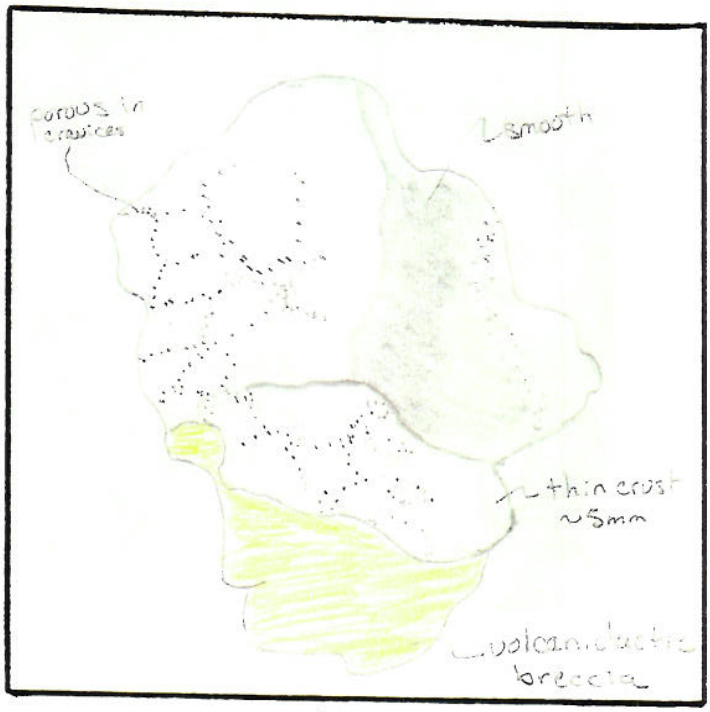
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth to porous in crevices

Internal structure:

layered:
laminated:
massive: ✓
porous: ✓ on one side
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining of crust + substratum
highly altered volcanic material

Substratum:

Rock type: volc. breccia

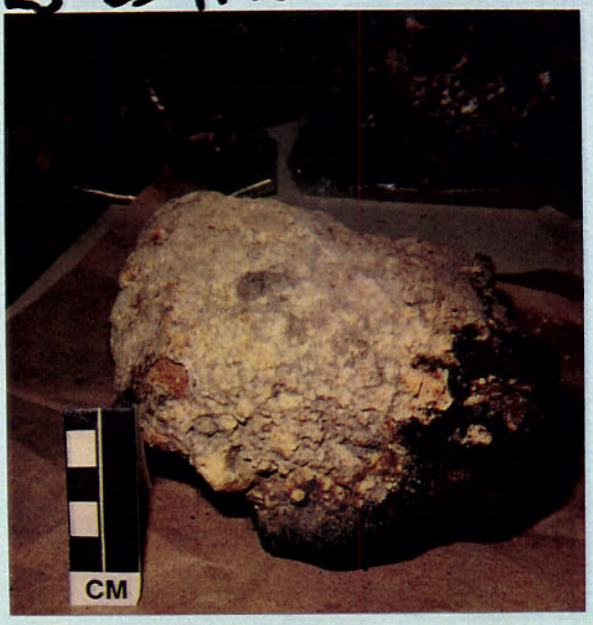
Description: Thin Mn crust on top ½ of one side; highly altered volcanic breccia w/ a few volcanic clasts (1-2cm) that you can easily see. Matrix of white, tan, yellow soft sediment. Whole rock looks like conglomerate, sub-rounded cobbles

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Chemistry: substrate	C. Jones

LS-83-HW



D5-B3-11

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 2 D 5-33-12

Location: Necker Ridge

Size: 30X15X3.5 cm Weight: 1.13 kg

Mn crust thickness:

Total: min: max: ave:

* Inner crust: min: 2 cm max: 2.5 cm ave: 2.5 cm

* hard to decide

* Outer crust: min: 1.5 cm max: 2 cm ave: 2 cm

Surface texture: Smooth & granular (crust)

Internal structure:

layered: ✓ 3-5

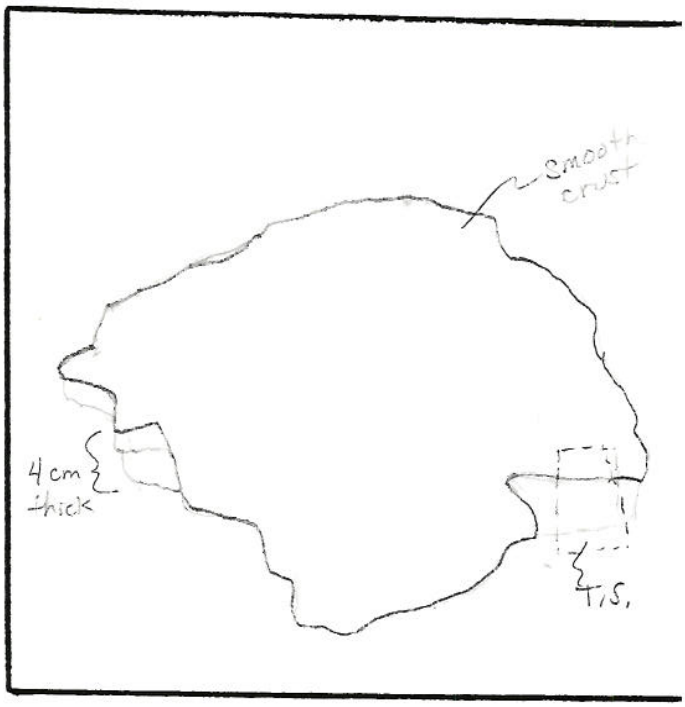
laminated: ✓ on one side

massive:

porous: ✓ on other side

dendritic:

other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining

Substratum: None

Rock type: Mn Crust

Description:

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Polished T.S. to Mann Pet.	

L5-83-HW

D5-B3-12

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: DS-83-13 Location: Yen Kor

Size: 12x12x3cm Weight: 235g

Mn crust thickness:

Total: min: 1.3 max: 2.5 ave: 2 cm

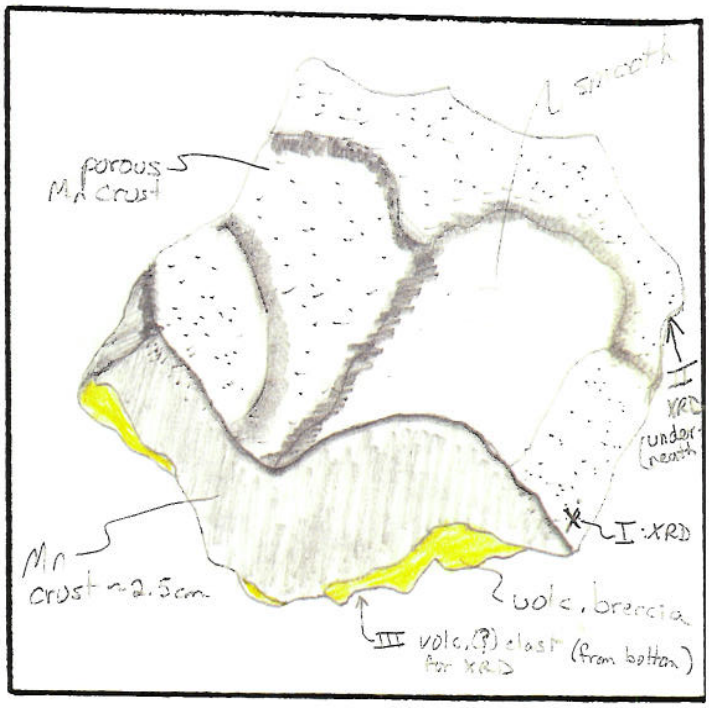
Inner crust: min: max: ave: 1

Outer crust: min: max: ave: 1.2

Surface texture: Smooth & porous (mostly)

Internal structure:

layered:
laminated:
massive: ✓
porous: ✓
dendritic:
other:



Mineralogy (XRD):

I porous Mn crust IV inner crust
II Mn (bottom)

Associated alteration, phosphorite, or hydrothermal deposits:

yellow altered volcaniclastics
Fe oxide staining in crust & breccia

Substratum:

Rock type: volcaniclastic breccia

Description: Mn crust on top wrapping around to bottom on one side; thin breccia dirty orange-yellow matrix grayish-brown volcanics (altered) clasts (1cm) Some tan sediment coating

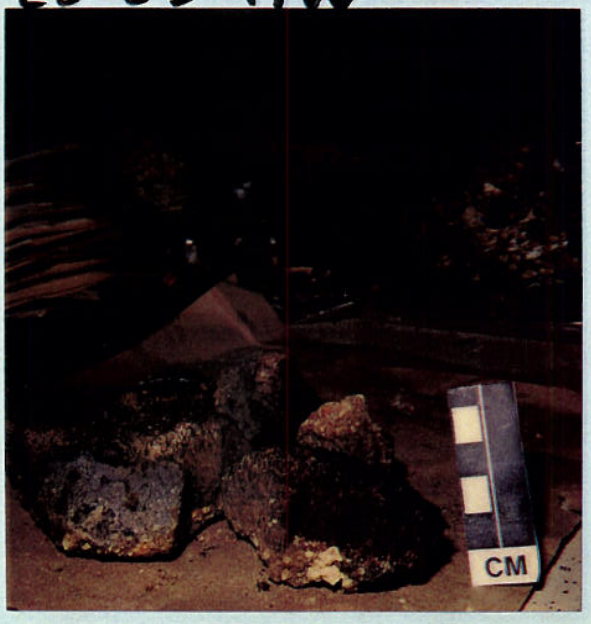
Mineralogy (XRD):

III gray volc(?) clast:

Analyses and subsamples:

analysis:	analyst:
piece given to	Chi Wei Koo Shanghai, China
XRD:	
DS-83-13-I: porous volc. Mn (0.5mm)	
II bottom Mn. (2-2.5cm)	
III: volc. clast	
IV: inner Mn (1-2cm)	

LS-83-HW



DS-B3-13

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-R3-14

Location: Necker

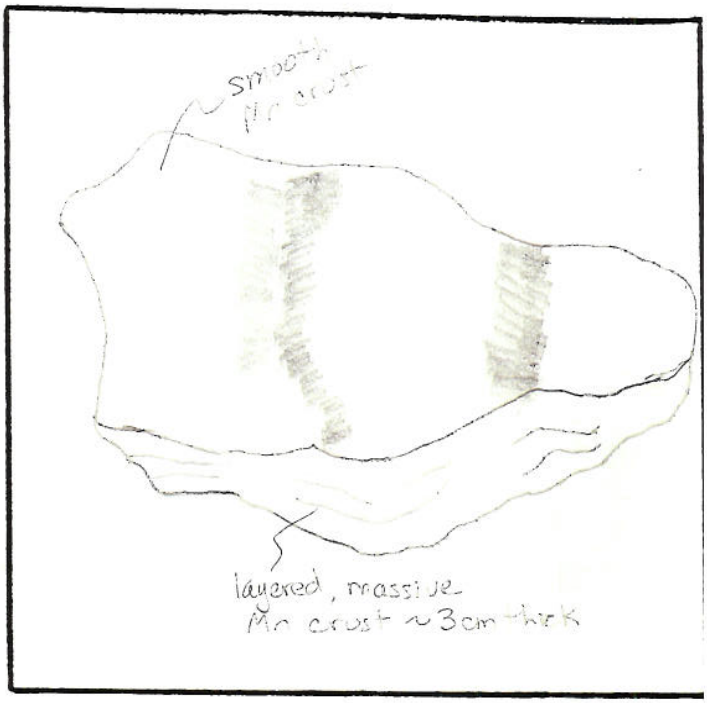
Size: 19x10x4cm Weight: 860.

Mn crust thickness:

Total: min: 2 max: 3.2 ave: 3 cm

Inner crust: min: max: 1.2 ave:

Outer crust: min: max: 2 ave:



Surface texture: Smooth

Internal structure:

layered: ✓ ~3

laminated:

massive: ✓ on one side

porous: ✓ on the other side

dendritic:

other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

yellow altered volcanic clastics.
Fe oxide staining in crust & breccia

Substratum:

Rock type: volc. breccia

Description: Mn crust wrapping around 2 sides to bottom. Crust is porous on bottom. One "clast" (4x8cm) → more like thin layer of sediment; "clast" is yellow-orange, soft, altered volcanic?

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

LS-83-HW

DS-B3-14

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-15

Location: Necker
D = 2350 - 2100 m

Size: 5-12cm Weight: ~2 Kg total wt. of bag

Mn crust thickness:

Total: min: max: ave: 2-3cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture:

Internal structure:

layered: ?
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Substratum:

Rock type: Mostly Mn crust

Description: 4 of the 12 pieces have a little reddish yellow volc. breccia on the bottom

Mineralogy (XRD):

Mn crust
bag of ~12 pieces (12)
with mostly
smooth crust

* irregular scraped fragments

Analyses and subsamples:

analysis:	analyst:
6 pieces to Congress via MMS	

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-B3-16

Location: Necker Ridge

Size: 14x10x3cm Weight: 607 g

Green bar ap seg fe of rocks - total weight: 9.818 Kg

Mn crust thickness:

Total: min: 2cm max: 3cm ave: 2.5cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth to granular in crevices

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

One representative rock:

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining in crust & breccia

Substratum:

Rock type: volc. breccia

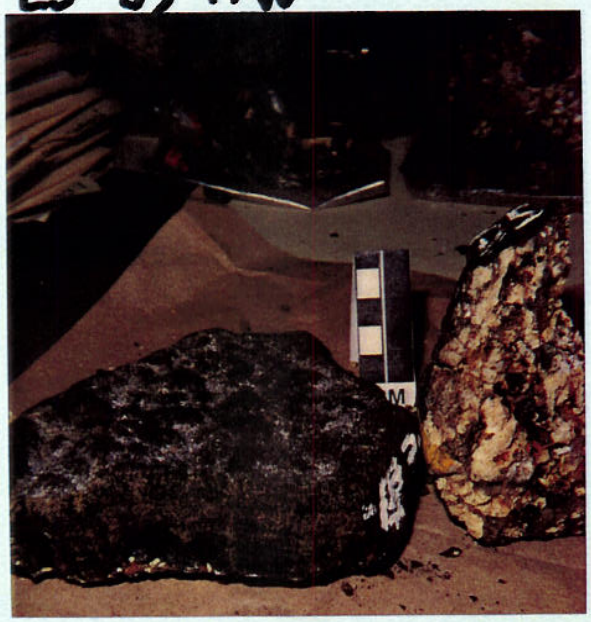
Description: Thick massive Mn crust w/thin "coating" (or speckling of clasts) of breccia on bottom. Clasts (2-30mm) are yellow & gray altered volcanics.

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Subsampled - forams	Lauren Mullineaux Scripps

L5-83-HW



DS-B3-16

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-B3-17

Location: Necker Ridge

Size: 19x17x8cm Weight: 1.93 Kg

Mn crust thickness:

Total: min: 5mm max: 1cm ave: 7.5mm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: rough & porous

Internal structure:

layered:
laminated:
massive: ✓
porous: ✓
dendritic:
other:

Mineralogy (XRD):

IV Mn crust

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining

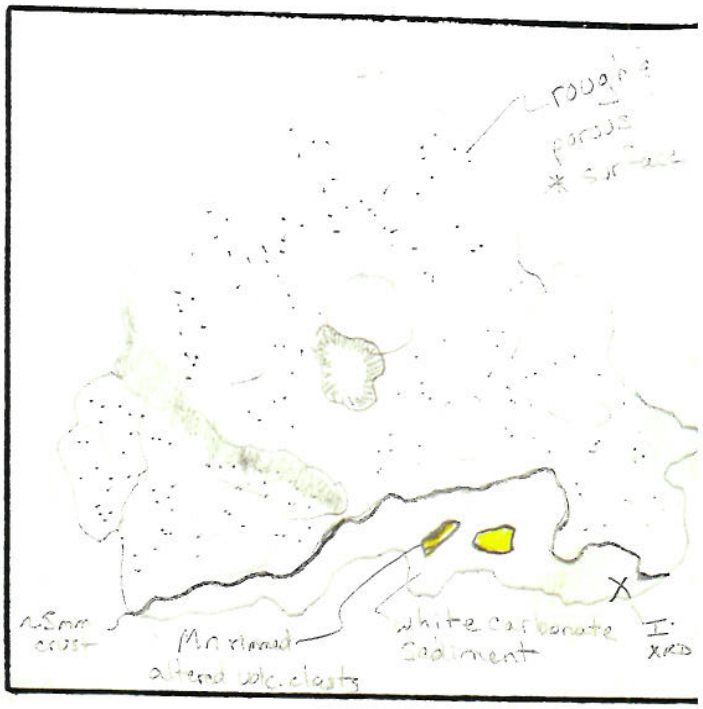
Substratum:

Rock type: Basalt?

Description: Thin Mn crust completely covering relatively unaltered compared to other rocks. This dredge 5 gray vesicular volcanic clast (12x5cm) w/ feldspar(?) & glass(?) phenocrysts. One side of Mn crust (not sure of top or bottom) is coated w/ white carbonate sediment (3.5mm thick). Incorporated in this carbonate are yellow altered volcanic clasts (1cm) w/ Mn rims.

Mineralogy (XRD):

I: carbonate & Mn:
II: volcanic clast:
III: phenocryst [illegible]

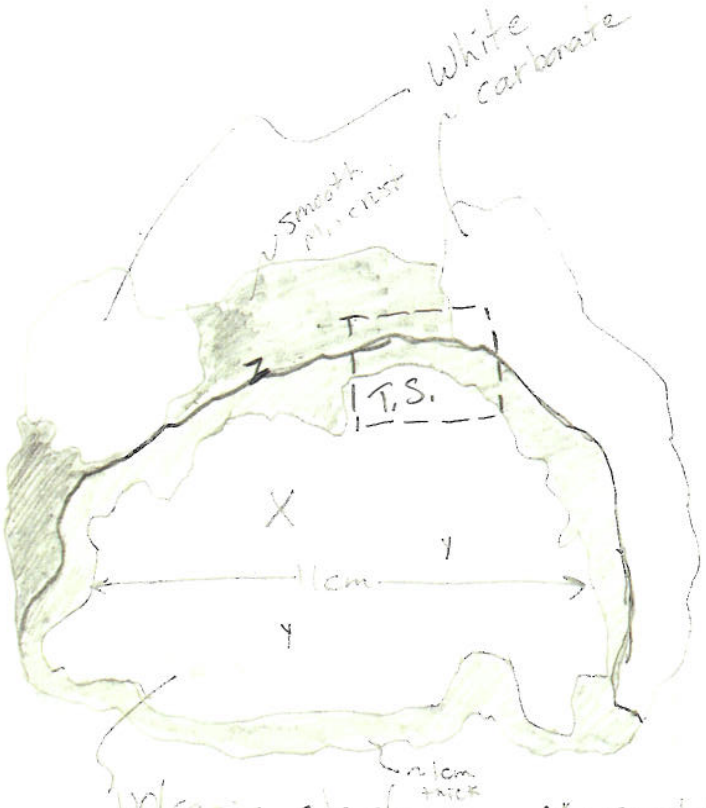


* This is probably the bottom - I couldn't tell until I cut it

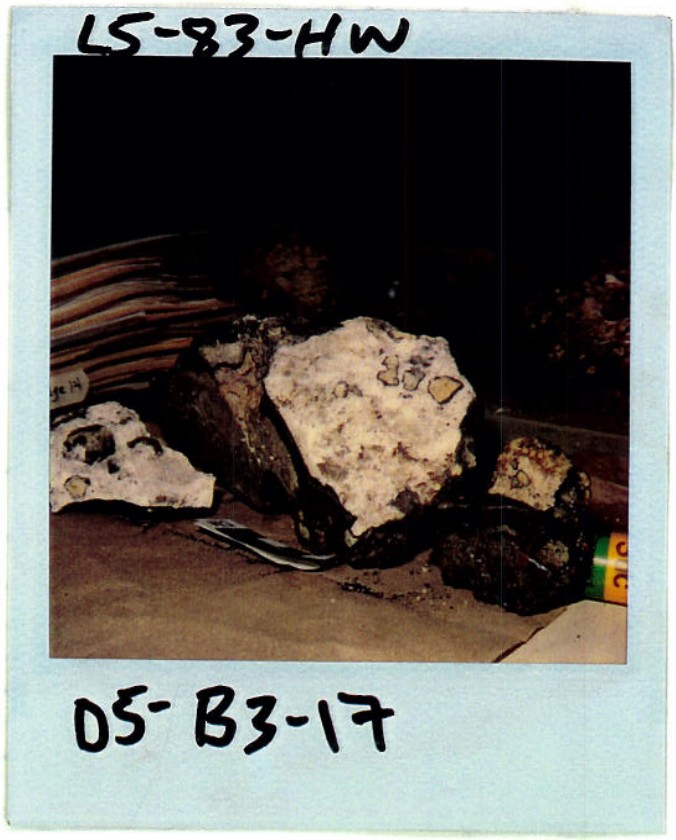
Analyses and subsamples:

OVER →

analysis:	analyst:
XRD:	C. Daniel
DS-B3-17-I: Carbonate & Mn	
II: volc. clast	
III phenocryst	
IV: bulk Mn (0-1cm)	
Doubly Polished T.S. to Mann Pet.	
Pt group (12/86)	Floyd Brown



Volcanic clast cross section



X : sampled for XRD (wide) # II

Y : sampled phenocrysts for XRD → # II

Z : sampled Mn crust for XRD → # IV

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-12

Location: Mesker Ridge

Size: 11X11X5cm Weight: 463g

Mn crust thickness:

Total: min: 1cm max: 2.5cm ave: 2.5cm

Inner crust: min: ____ max: ____ ave: ____

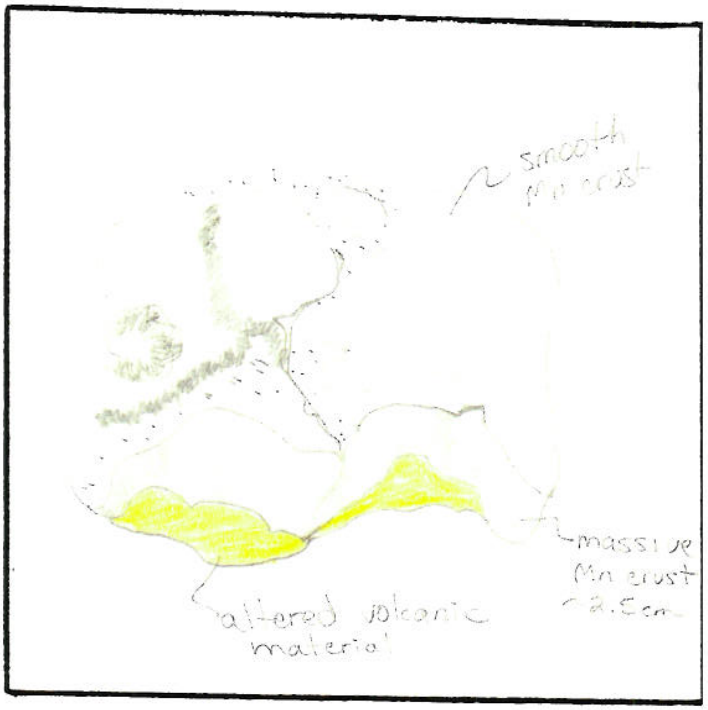
Outer crust: min: ____ max: ____ ave: ____

Surface texture: Smooth

Internal structure: ____

layered: ____
laminated: ____
massive: ✓
porous: ____
dendritic: ____
other: ____

Mineralogy (XRD): ____



Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining

Substratum:

Rock type: volc. breccia (mostly Mn)

Description: Thick Mn crust with a small amount of unconsolidated volcanic material attached to the bottom.

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-19

Location: Necker Ridge

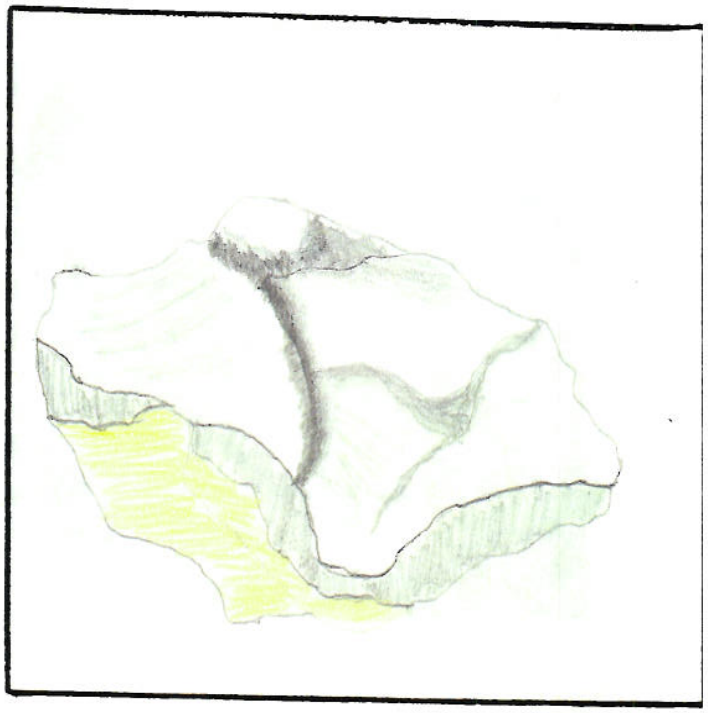
Size: 13x10x7cm Weight: 656 g

Mn crust thickness:

Total: min: 1cm max: 2cm ave: 2cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:



Surface texture: Smooth

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Brown phosphorite coating
Fe oxide staining on crust & breccia

Substratum:

Rock type: vol's breccia

Description: Mn crust wrapped around one (?) highly altered volcanic clast (3x6cm) - yellow & gray w/tan sediment coating. Along top of clast (between crust & clast) is hard, pink, well-indurated phosphorite? vein? One small pocket of white carbonate material in crust

*rock fell apart when cut

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

LS-83-HW

DS-83-19

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: D5-83-20

Location: Neckar

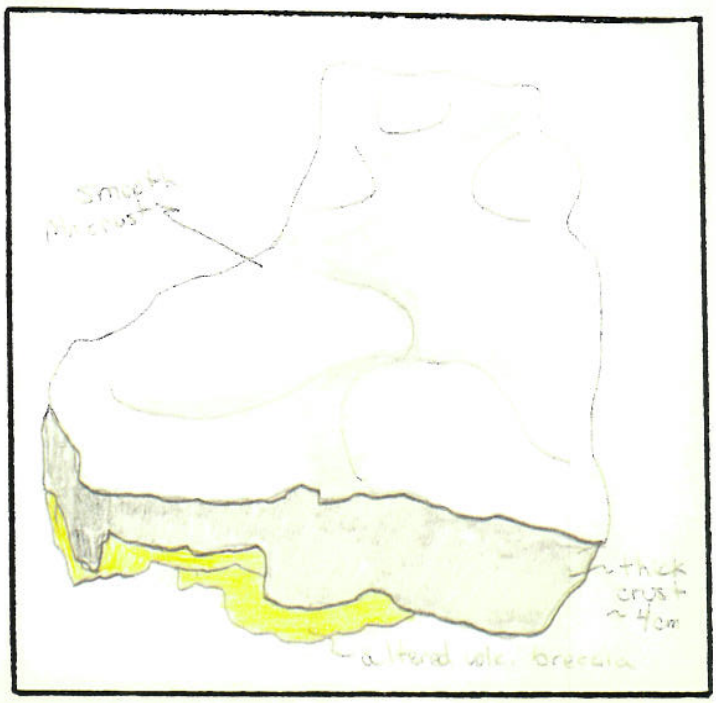
Size: 9x12x4cm Weight: 1.1 kg

Mn crust thickness:

Total: min: 2 max: 4 ave: 2.5cm

Inner crust: min: max: ave: .8cm

Outer crust: min: max: ave: 1.8cm



Surface texture: Smooth

Internal structure:

layered: ✓ ~2

laminated:

massive: ✓

porous:

dendritic:

other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

yellow altered volcaniclastics

Fe oxide staining in crust & breccia

Substratum: not much ~.5-2cm thick

Rock type: volc. breccia

Description: Smooth to porous (in crevices) Mn crust wrapping around one side to bottom & interfingering breccia. Mn crust on bottom is porous

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-21

Location: Necker Ridge

Size: 15x7x5cm Weight: 510g

Mn crust thickness:

Total: min: 2cm max: 5cm ave: 3cm

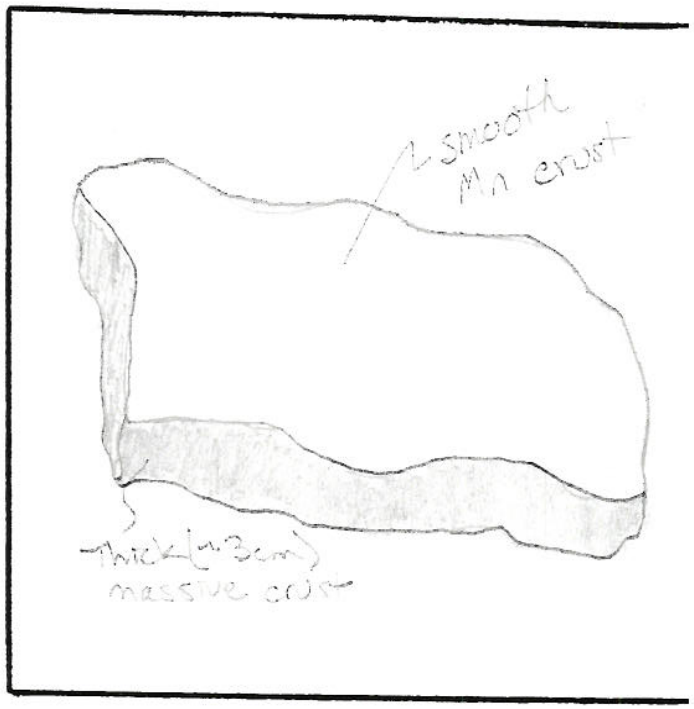
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide stain

Substratum:

Rock type: Mn crust

Description: Thick massive Mn crust - no real substratum. Very small amount (~2mm thick) of altered volcanics

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-23

Location: Necker Ridge

Size: 16x12x5cm Weight: 501g.

Mn crust thickness:

Total: min: 1.5cm max: 2.5cm ave: 2.5cm

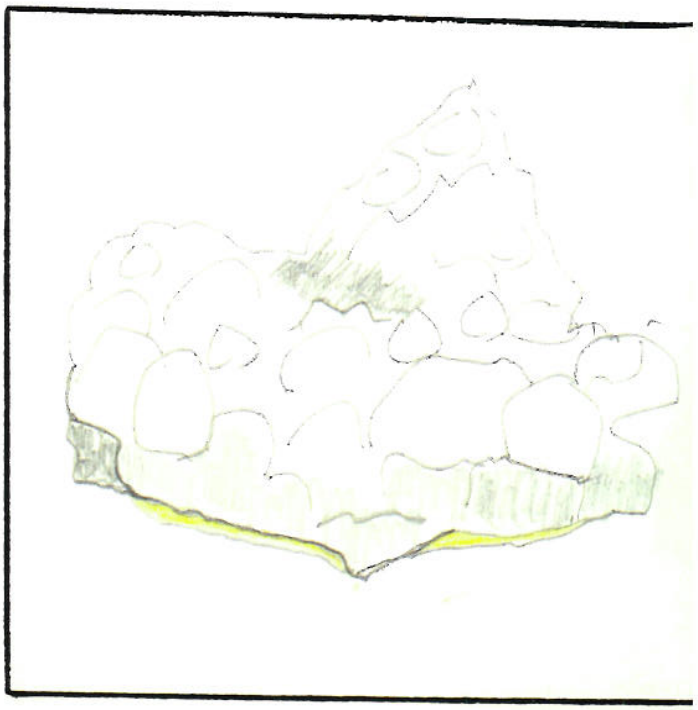
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: botryoidal-granular

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide stain

Substratum:

Rock type: Mn crust

Description: Botryoidal Mn crust wraps around bottom on one side - thicker on this end (~5cm). Thin (~2mm) yellow altered volcanic material

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Pt group (12/86)	Floyd Brown

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-24

Location: Necker Ridge

Size: 14X10X5cm Weight: 568 g

Mn crust thickness:

Total: min: 3cm max: 4.5cm ave: 3cm

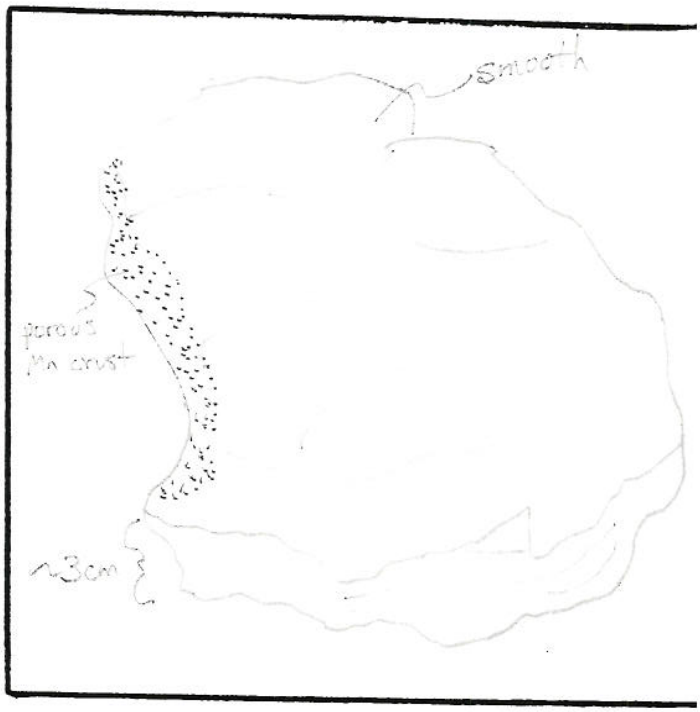
Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth
porous on one side which wraps around underneath

Internal structure:

layered:
laminated: ✓
massive: ✓
porous:
dendritic:
other:



Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide stain

Substratum:

Rock type: Mn crust

Description: Thin (~1 mm) yellow sediment (altered ash) crust. Also small amount of white carbonate sediment

Mineralogy (XRD):

Analyses and subsamples:

analysis:	analyst:
Subsampled forams	Paula Quinterno

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: ? D5-83-25 Location: Necker Ridge

Size: 15x11x4cm Weight: 547g

Mn crust thickness:

Total: min: 2cm max: 3cm ave: 2.5cm

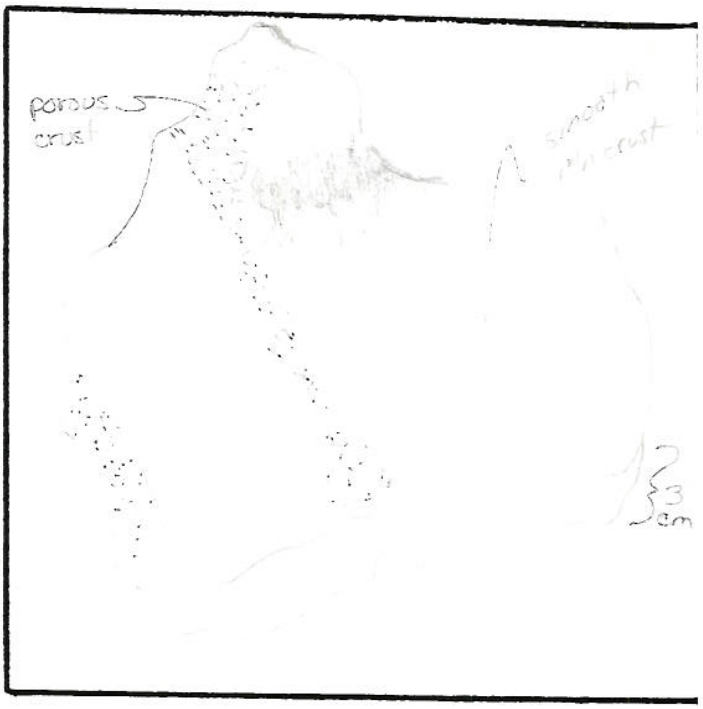
Inner crust: min: ____ max: ____ ave: ____

Outer crust: min: ____ max: ____ ave: ____

Surface texture: Smooth

Internal structure: ____

layered: ____
laminated: ____
massive: ✓
porous: ✓ on one side
dendritic: ____
other: ____



Mineralogy (XRD): ____

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide stain

Substratum: no real substratum

Rock type: volc. breccia

Description: Thick massive Mn crust coated on cotton (?) yellow, altered volcanic fragments (~2mm thick) one broken up gray, altered, volcanic clast (3x5cm)

Mineralogy (XRD): ____

Analyses and subsamples:

analysis:	analyst:
whole rx. given to:	Dan G. Font Jr.
for flotation separation	Salt Lake City, Utah

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D S-83-26

Location: Necker Ridge

Size: 11X8X5cm Weight: [illegible]

Mn crust thickness:

Total: min: 3cm max: 5cm ave: 4.5cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Smooth

Internal structure:

layered:
laminated: ✓?
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe [illegible]
thin [illegible] phosphorite? or sediment coating

Substratum:

Rock type: Mn crust

Description: [illegible]
[illegible] coating
[illegible] material

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D 5-83-27

Location: Necker Ridge

Size: 11x9x7cm Weight: 400g

Mn crust thickness:

Total: min: 7mm max: 1.5cm ave: 1cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:

Surface texture: Botryoidal - smooth

Internal structure:

layered:
laminated:
massive: /
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide stain in crust

Substratum:

Rock type: Volcaniclastic breccia

Description: Relatively thinner Mn crust than rest of 43 rocks. Yellow sub-rounded (distinct edges) altered volcanic clasts (.5-5cm) in a Mn matrix

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-B4

Location: Necker Ridge

* Size: 22x14x9cm Weight: 3.674Kg

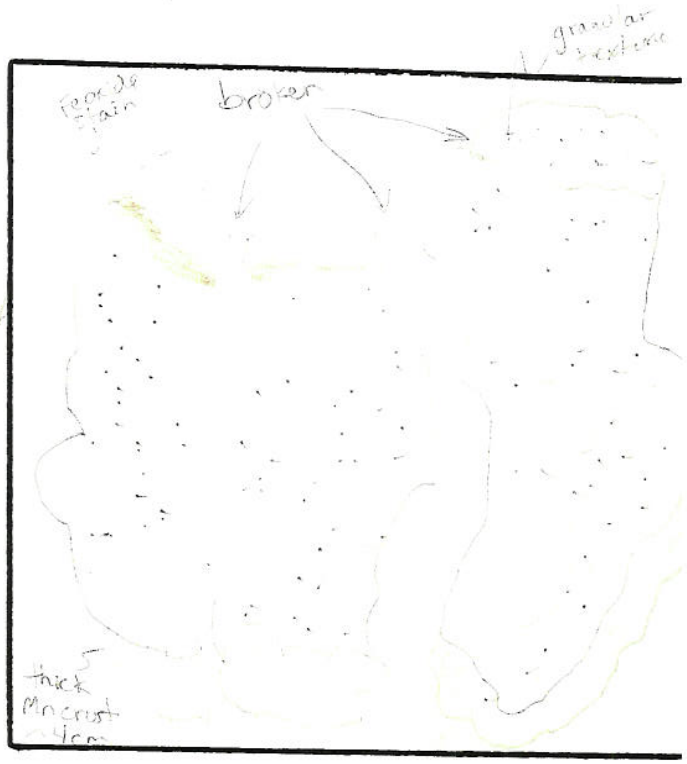
Broken in 4 pieces: 18x12x7cm; 17x7x6cm; 5x4x3cm

Mn crust thickness:

Total: min: 1cm max: 4cm ave: 3cm

Inner crust: min: max: ave:

Outer crust: min: max: ave:



Surface texture: Granular, slightly botryoidal

Internal structure:

layered:
laminated:
massive: ✓
porous:
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Heavy red orange Fe oxide stain

Substratum:

Rock type: Volc. breccia

Description: Thick, massive Mn crust, yellow, orange, gray, altered volcanic clasts (no real definite boundaries) Bottom surface is rough & uneven w/ porous Mn covering ~half of the bottom.

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst:

Sample Description

Cruise I.D: L5-83-HW

Sample I.D: Sta: 8 D5-B5

Location: Necker Ridge

Size: 27X23X6cm Weight: 2.672 Kg

Mn crust thickness:

Total: min: 2.5cm max: [illegible] ave: [illegible]

Inner crust: min: 7mm max: 10mm ave: 7mm

Outer crust: min: 1.5cm max: 1.5cm ave: [illegible]

Surface texture: Small granular [illegible]

Internal structure:

layered: ✓
laminated:
massive: ✓
porous: ✓ on one side
dendritic:
other:

Mineralogy (XRD):

Associated alteration, phosphorite, or hydrothermal deposits:

Fe oxide staining of crust & breccia

Substratum:

Rock type: Volcaniclastic breccia

Description: Thick, layered, massive Mn crust [illegible] thin coating of porous Mn on bottom (of that side). Yellow-orange altered volcanic material w/a few gray broken up volcanic clasts (3-5cm) - all [illegible]

Mineralogy (XRD):

Analyses and subsamples:

analysis:

analyst: