

MEASUREMENT CONVERSIONS

IF YOU KNOW MULTIPLY BY TO FIND

LENGTH

inches	2.540	centimeters
feet	30.480	centimeters
yards	0.914	meters
miles	1.609	kilometers
millimeters	0.039	inches
centimeters	0.393	inches
meters	3.280	feet
meters	1.093	yards
kilometers	0.621	miles

WEIGHT

ounces	28.350	grams
pounds	0.453	kilograms
grams	0.035	ounces
kilograms	2.204	pounds

VOLUME

fluid ounces	29.573	milliliters
pints	0.473	liters
quarts	0.946	liters
gallons (U.S.)	3.785	liters
milliliters	0.033	fluid ounces
liters	1.056	quarts
liters	0.264	gallons (U.S.)

TEMPERATURE

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times .555$$

$$^{\circ}\text{F} = (^{\circ}\text{C} \times 1.8) + 32$$

Inches	Decimals of foot	Milli-meters
1/16	.0052	1.5875
1/8	.0104	3.1750
3/16	.0156	4.7625
1/4	.0208	6.3500
5/16	.0260	7.9350
3/8	.0313	9.5250
1/2	.0417	12.700
5/8	.0521	15.875
3/4	.0625	19.050
7/8	.0729	22.225
1"	.0833	25.400
2"	.1667	50.800
3"	.2500	76.200
4"	.3333	101.60
5"	.4167	127.00
6"	.5000	152.40
7"	.5833	177.80
8"	.6667	203.20
9"	.7500	228.60
10"	.8333	254.00
11"	.9167	279.40
1 foot	1.0000	304.80

\$75 Reward

"Rite in the Rain"
ALL-WEATHER WRITING PAPER



If Found, please return to
Ben Weiss

Name

Address

Phone

Project

~~Caltech 170-25~~
~~Pasadena CA 91125~~
~~626-395-6187~~
~~Western Australia~~
MIT
EAPS Dept, Bldg 54-724
77 Massachusetts Ave
Cambridge, MA 02139

"Rite in the Rain" - a unique all-weather writing surface created to shed water and to enhance the written image. Makes it possible to write sharp, legible field data in any kind of weather.

a product of

J. L. DARLING CORPORATION
TACOMA, WA 98421-3696 USA

bpreiss@mit.edu

[illegible]

115° 55.599 E

→ waypoint MTNRY

Wed 6/27

Staying at Mt Narayan Station
with Mc Taggerts
Joe has GPS (coords)
waypoint QUARTS. (quarters)

Steve Mayers, Ben Weiss
Guscha Nurchin, Mark Harrison
Bob Pidgeon, Trevor Ireland
Munir Wumayan, Joe Kirschvink
Carolina Mc Taggart

Today's goals: to see Franke
etal locality and polymat
matrix supported boulder bed

Notes from pre-field trip meeting 8/25

T.M. Harrison: • Confirm H_2O on each
by meas. fract of O between 2 iron
+ water

- Determine terrestrial $\Delta^{14}\text{C}$ in order to assess age of the atmosphere

via ^{244}Pu -derived ^{136}Xe
(need zircon Kpu/u)
need 100 100-um old 4.4-4.3 Ga
Zircons

• Evidence for live terrestrial
 ^{146}Sm

$^{176}\text{W}/^{176}\text{Hf}$ investigations of
early continental crust cycling

• Chemistry of zircon melt
inclusions may yield atm-
crust-mantle fO_2

S J Meyers

dated 1046 zircon $\text{Pb}/\text{Pb}_{\text{geo}}$

2 def. nite pops

10% are 3.8-4.3 Ga

3-5% are 4.3 Ga

Sat. Phone # 0414 018855
(Vodafone)

Ultimate goal.

50,000, 100,000, 1x10⁶ 21x20⁶

read Nutman 2001 Proc. Am. Res.
Re 3.9 Ga detrital zircons

6/27

9.33a Sailer outcamp JAILCA way

26° 31.984 S

116° 18.726 E

on west side of GSWA map
(Williams + Myers)

trail into Mt Norrmyr on
~~left side~~ west side

170° 22.5' E LOC3

26° 30.16 S

locality 3 of 3rd Arch Field Guide
(M. Myers)

10:04
am turnoff to Mt Nanyer
(spot 29)

10:16
a turnoff off road over fence
(spot 30) (?)
Meeberrie Gneiss here

~~Waypoint MTNRY~~

→ ~~29~~ 26° 32.062 S
116° 19.362 E

Waypoint 30 ~~DELETED~~

2 photos of gneiss
possibly sheared granite

Bub:

Probably 2650 Ma granite

→ SHAR GRN. waypoint
26° 32.754 S
116° 22.093 E

Photo taken of Mt Nanyer
in background

10:45_{am} 26
BORE 1 Waypt

10:55a Waypoint TANKI
turn left

10:58 am left at waypoint
GATE 1

11:06 am left at corner
found emu egg
waypoint CORNER

Oups new fence! Path blocked!
~~back~~

11:36 a pushed down fence
and crossed
waypoint FENCEX

1:17 At Unit A
no Zircon dating done here

26° 30.273" S
116° 29.043" E

UNITA

S 26 30.274

E 116 24.023

Unit B quartzite
at Froude et al. locality
UNIT B

~~Sample Collected for Gollub lab -~~
Sample collected (not float)

127p Unit B conglomerate

ABCONG S 26° 30.282
E 116° 23.916

good amts of goethite
on grain boundary

(goeth comes off at 150°C)

Took picture in small camera of the famous
Unit B Conglomerate Site - in which you
can see the elongated pebbles. (Using
Marie's hammer for scale.

See took float sample
here with BIF conglomerate -
gneiss, chert

6

2:04 pm sampled ~~at~~ Unit B
(fine grained)

B CONZ

2:46 p UNITC Waypoint
Unit C

26° 30.575 S
116° 23.331 E

2:53 P Unit C conglomerate

26° 30.591 S
116° 23.304 E

^{up}
BOCBED waypoint

look a ^{float} sample of
BIF (conglomerate)

6

2:04 pm sampled ~~at~~ Unit B
(fine grained)

B CONZ

2:46 p UNITC Waypoint
Unit C

26° 30.575 S
116° 23.331 E

2:53 P Unit C conglomerate

26° 30.591 S
116° 23.304 E

^{up}
BOCBED waypoint

look a ^{float} sample of
BIF (conglomerate)

* marked on LP Road Atlas
(by me)

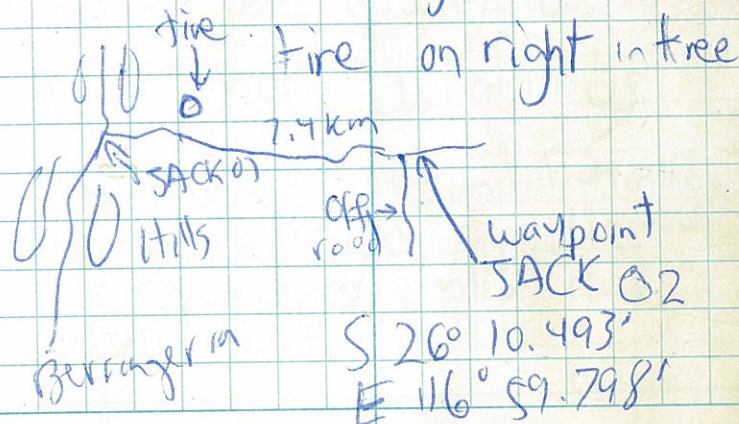
6/28 Mt Narryer Station
to the Jack Hills and
Mileura

Route:

Mt Narryer, turn on track
right before Buro, past
Mully Mully, Beringame

right on small track *
if miss track, retroglyphs on right
waypoint, - ~~84W~~ JACK 01

S 26° 09.44' E 117° 03.928'
7.4 km up this road to
the SH conglomerate



Some black chert pebbles
in ~~of~~ various orientations
— shows pebbles are not
broken up veins but
actually pebbles

Co/29 At Errowandoo Hill

BIF Unit "B"

took several photos
of BIF breccia and BIF folds

Bob thinks BIF breccia is
primary and not secondary

6/29/01
Oriented Hand Samples

Eranondoo Hill area, Jack
Hills, W. A.

EHJH-1 is a "breccia" in the ~3.0 byr
BIF in the same sequence.

No clue as to stratigraphic up/down

Samples EHJH 1 → 3 are from
the BIFs in the sequence. ? 3 byr?

Beddings might be overturned

6/29/01

CW Suncompass

Mag

dip

Sun

Time

Lighting
EHJH-1 346° 40° 216 11:13
Bedding ~~320°~~ 240° 70° NW 328 11:22
Lightning around sample → use S/C
S 26° 10.138'
E 116° 59.547'

Lightning
EHJH-2 320° 54° 222 11:35
bedding 240° 80° NW 320 11:38
This is a nicely folded BIF sample
S 26° 10.144'
E 116° 59.544'

Lightning
EHJH-3 303° 12° 225 11:51
Bedding 240° 80° NW
1 m SE of EHJH-2

EHJH-4

Flint chert from near BIF

~~If wide and~~

Sample EHJH-5 is from the
metacarbonate + quartzite clasts
the same unit with the old Erans
unit ASC. This is the locality
that Steve Molzsis lead us to as
a spot with chromite and Fuchsite
in host rock being mined locally.

EHJH-6 is from the upper type
locality on Eransodoo hill which
yielded Haslem Zircon.

EHJH-7 is from the lower type
locality, about 4-5m down hill from #6
There is a rare picture of Joe
on the small camera standing on the
locality with the sample.
Most samples have 1 or 2 pictures

6/29/01

	Mag	Dip	Sun	Time
EHJH-5	92°	96°	58°	14:53
Bedding	(60°) (70°)	93°	81	14:56

No lightning

S 26° 16.107'
E 116° 59.366'

EHJH-6	278	18	227	15:23
Bedding	45°	115° o.v.		

No Lightning here

at upper type locality
see earlier for GPS
(waypoint ERAWON)

EHJH-7	015° 58°	129	15:49
Bedding:	058° 121° o.v.	083	16:03

Waypoint 34

S 26° 11.164

E 116° 56.998

6/30/01

34

~~33~~

Started at waypoint ~~30~~, west
of turnoff ~~to~~ to Erawondoo
Hill on tire road

Climbed north over BIF

Chert on other side
waypoint C1

S 26° 10.925

E 116° 56.860

Orthoquartzite, followed by
granite (?)

qtz conglomerate like type locality
but more weathered with
pebbles weathering at angle
pointing up

Waypoint C2
banded chert! adj to sheared/
pelitic unit, ultramafic
S 26 10.435,
E 116 56.562

West Jack Hills Cherts

For Magrely/ossini(?) Sturmer

Based on Bob Pigeon's map,

WJH-2 is on the Northern side
of the Jack Hills, good view of the
Flat Plane to the North

Point C4

S 26° 10.233

E 116° 56.444

6/30/01

Mag
~~SW~~

Dip

Son

Time

WJH-1

254

41

270

12:33

Bedding

250

93_{or}

dip to the NW (is up)

GPS waypoint C2 on previous page.

WJH-2

291 $^{\circ}$ 14 $^{\circ}$

244

13:21

Bedding

244 $^{\circ}$ 94 $^{\circ}$ NW

Another, more coarsely crystalline
chert with bands

Waypoint C3

S 26° 10.338'

E 116° 56.517'

This chert is separated from
previous chert by ~~pelitic schist~~
ultramafic

Classic-type glz pebble
conglomerate with graded
bedding! Suggests that
the ~~50'~~ belt is an antiform
younging to the South

W5H CON ~~X~~ waypoint

S 26° 10.680'

E 116° 56.717'

Trevor's Photos

1 West end of JH

2-4 Erawondoo

5-6 East of Erawondoo

Eastern end of belt

East end looking down axis
to west

Today's pit in E of Mt Hale

Several shots of Mt Hale

7/1/01 Flight over the Sack
Hills!

Photos taken by Steve

#215 Hale

216 Oblique Hale

217 Eastern Belt

218 Western Belt

219

220

221

222

223

224-229 Erawondoo

232-233 Mt Hale road

2pm drove into Mt Hale
region of Sack Hills

Took sample of float
breccia in glz vein matrix
adjacent to in-place breccia
~~MH~~ MHJA-1 outcrop

Saw took GPS coords

this breccia is probably
from "A's" unit from
Pidgeon's large map

(Quartz-mica schist)
waypoint BEN ~~CLG~~-CLG
S 26° 01.819' E 117° 17.755'

Hiked to ridge of ~~the~~
quartzite conglomerate
More altered / silicified than
Erawandoo till so we
didn't sample

Waypoint 40
S 26° 3.073'
E 117° 17.310'

Mojzsis collected conglom.
with ~~of~~ watermelon-sized
clasts in gully below

7/4 In North Shaw
North Pole Dome
Trip led by R. Buick

North Pole turn off east of
Shaw River
Locality #1

No. 6 chert in N. Pole
Dome = Shelley Pool chert

& almost all cherts are
sedimentary (shallow water)
and undated (no zircons)

Felsic volcanic unit is 3460 Ma
"anomalous" GSWA SHRIMP date 3300 Ma
Intrusives give 3460 Ma

Today: No. 1 (lowermost)
and No. 4 cherts

At Auramuk et al 1983
locality Buick: look most
like fossils compared to
anything else

Auramuk et al. locality A?

- locality missing!
- Basalts nearby are 2.6 Ga
Follescoe Group which
flowed over Warramunga
Grp (not recognized in '83)

FG wraps around hill
containing Auramuk locality

FG has large amygdalae
(WB doesn't)
WB heavily hydroxyl altered

- Auramuk fossils are brown
not black like WB-kerosen
that has been to prehnite
pump.

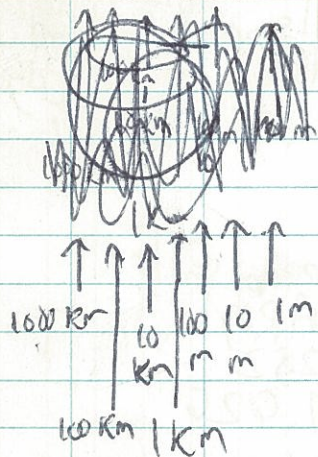
Follescoe Group basalt
way point AWARD
S 21° 4.252'
E 119° 24.626'

Locality # 2 Stromatolites

Waypoint STROMA

AMG 0753626 Easting

7666376 Northing



AMG meaning

banded cherts here are heavily weathered and resiltified
hem, goethite everywhere

Locality #2 11:03 am

Now down to No. 1 chert

Units dipping to East at 35°

Pillared Mg-basalt w/ hyaloblastite
prehnite facies in some places
low Mg have pumpellyite
a few drill cores

not retrogressive meta!

surface weathering down to 100 m

radial and tangential faults
separating 10-50 m blocks

frequent km-displacement
faults

No. 1 chert is most complex
chert in Pibara. Only found
in North Pole Dome

Blue unit on VK ²⁰⁰⁰ map

60m-thick with large
variations in thickness,
(disappears some places)

lies on pillow basalt
with amygdules + acelli

2 sedimentary cycles within it
possibly separated by
unconformity

Here we are at top of 1st cycle
facies:

Sandy

muddy

— banded chert with microcarbonate
sulfate —> stromatolites

only
carbonate

evaporative gnosum

at Walter et al stromatolites
are completely gone

heavily weathered
possibly biogenic

(N. Pole adamellite)
Intrusive granitoid 2468 ± 12 My

cross cutting dikes: > 3460 Ma

Coonterunah group: < 3515 Ma

Archean wave ripples
(See got photo)

STROMATOLITES

graded
wave-rippled chert
precursor: partly tuffaceous & carbonate
gypsum which grew during early diagenesis

Barite replacing evaporite

tidal channel facies
intermittently under water

Photo taken of stromatolite
^{Damical}
World's oldest fossils??

large scale flexures w/
superimposed small scale text
with superimposed mm-scale
flexures
4th order 100 μ m flexing

4 orders of layering
~~several~~ mm, several mm, 1 mm
20 or 50 μ m white + dark
Some dark layers have kerogen
Buck has found no microfossils
here or elsewhere

original organism
has diam less than

width of thinnest bed (15mm)

Basalts syngenetically altered
by hydrothermal alteration

lost silica, barium,
Silica went to inter-pillow
areas and replaced
all original sedimentary
materials

gypsum $\rightarrow$ barite

basalts all re-altered except
for ilmenite and a little
pyroxene

carbonate microinclusions +
pyrite + kerogen in chert may be
original

so magnetite may be preserved

~~Wamp~~ Photographed core
Core DDH3 somewhere
else in the shed
(taken nearby)

Locality #4 Barite mine
2:50 pm

Hike through a 15-m
stratigraphic column

middle - top of 1st cycle

mostly bedded sulfates ^(barite)
~~(gypsum)~~
which replaced gypsum?

- 3460 Mg felsic dyke at base
dacitic
concordant zircons

- Veined barite (white)
- 10-20% ~~SS~~ ³⁴⁷?
in veined chert

transsecting stratigraphy

Several photos.

→ hill from below

→ barite veins across gully
next to bedded barite

McCulloch got initial

$^{87}\text{Sr}/^{86}\text{Sr}$

published EPSL 1996 +

Don De Paolo Nature News and
Views

His argument
required that there was no
continental crust and
that the barite's Sr
represented primitive mantle

bedded barite - evaporite
vein barite - remobilized

positive δS in the
bedded barites may
be evidence for biology?

But atmospheric non-mass
dependent + thermochemical
fractionation

July 4 Trip led by R Buckle

Locality #5 Marble Bar
Chert + Apex Chert at
Chingaman Creek

Warawpuna Group may not
correlate with units here

3 km walk up Chingaman Creek

Famous Schopf + Packer 1987
microfossil locality

9:07 am Bonnie Packer, Schopf's
PhD student on Fortescue
and Archean microfossils

Schopf
Collected 11 samples at Apex chert
took a photo, coords from geo map

waypoint SCHOPF

AMG 0779958 (East)
7655854 (North)

Fragmental dark grains within
clear chert SCHOPF waypoint

over next 6 years described
microfossils

"chert sandstone/arenite"

Flamboyant and seplate morphology
locality:

Laminated, silicified turf
+ silty and sandy

Schopf took other samples
but could not
replicate lithology or microfossils

Neither could Buick

Buick: need more than GPS
must have detailed stratigraphy
locate sample to within 1 cm

Last year: Schopf and mappers
tried to relocate sample locality

with Packer's photo

Actual locality up the bank
(~~South~~ ~~West~~ South bank)

Martin Brazier resampled it
and looked at type material
lower greenschist facies
Waypoint SCHOPTZ
taken at actual Schopf
locality

*Secondary chert dikes
occurs as multiple episodes
of silica infiltration into faults

sometimes fault breccia included
can look like sedimentary
clasts which have been
multiply brecciated and silicified

paper in review at Nature by
Brazier

Fossils in one of oldest clasts
photo taken at actual Schopf locality
with Joe in background

Schopf's response: clasts are
fall-in material into fault

grey chert dike not a sandstone

Harrison and Mojzsis found $-33 \text{ } ^{13}\text{C}$
in bulk samples but no carbon
in "microfossils"

Brazier: all filaments are non-
biogenic; kaolinite plates and
iron-oxide around silica on fractures
many more morphologies than
Schopf described

2nd Schopf locality at Shelley
Pool: ~~these~~ pieces of silica
in silica, not fossils (Buck)

many of Apev fossils have

branches (branching only
common to advanced
cyanobacteria)

Brazier: Septation is actually
pseudo-septation from gaps
between adjacent crystals
and fill-in with oxides

→ takes us with no Archean
fossils in Pilbara

Unconvincing Barberton
fossils

2.5 Ga pretty clear
microfossils from Transvaal Group
(Schopf)

3.45 N. Pole and Barberton
stromatolites

took photo of Schopf +
Packer chert dike

Waypoint SCHOP2

AMG 0780002
7655836

Waypoint SCHOP3

AMG 0779973
7655775

→ "Schopf + Packer" samples
I sampled cherts at
SCHOP2 and SCHOP3
waypoints

"MB Chert" sample:
discordant bedding at
SCHOP3 (red, black and
white banded cherts at
hill top)
Photo taken of outcrop

Deines, Galimov studied
 $\delta^{13}\text{C}$ of eclogitic diamonds
-30‰!
3 Ga subducted organic matter
peridotite diamonds -6‰

Turner 1970 - no $^{40}\text{Ar}/^{37}\text{Ar}$ plateau
in lunar materials due to
solar insolation heating

Locality #6 Marble Bar Chert

MRBLBAR

waypoint

S 21° 11.275'

E 119° 42.626°

Origin could be:

- hydrothermal origin
- replacement of carbonate
-

Go to Jasper Hill to collect oriented samples

red bands = hematite
mostly original white bands

black bands mostly dikes

~~Massive~~

Conglomerate of red chert clasts in grey silica matrix (in dyke)
clasts cm-m in size

Joe photographed Marble
Bar chert and breccia

How about conglomerate
test to constrain dyke
temp and to see whether
MB cherts contain primary
remenance?

Val's homophone 514-631-8385

7/9 Sampling Apex Basalt
at Chigaman Creek

Schoft microfossil locality

Ben, Tanja, Dave^E, Joe^K, Bob
Pidgeon, Troy Hudson,
Ryan Reifersuz

Sampling Apex Basalt
across creek from Schoof
chert dike

Bedded surfaces with black Mn
oxide crust

CCS Chinaman Creek
Schoof locality

higher # go down the section

stratigraphic distance -

orientation of the bedding $\rightarrow 138^\circ$

bedding dip $\rightarrow$ almost 90 (100 about)

No sun for sun compass

Way point 011
S $21^\circ 10.581'$
E $119^\circ 41.854$

Dave sighted to a tree downstream
Strike 085

Actual GPS bearing 088-089

Sample # Mag Dip

CCS-1	152°	16°
- 1 m		
CCS-2	046°	12°
- 30 cm		
CCS-3	098°	14°
- 1 m		
CCS-4	098°	15°
- same strat. unit		
CCS-5	062°	21°

Tues 7/10/01

East Shelley Belt

Tanya Busak	Joe Kirschunk
Troy Hudson	Ben Weiss
Ryan Peterson	Bob Ridgeman
Dave Evans	

Going To Lowe Stromatolites
west of Shelley Pool
→ Departed Marble Bar 8:45 am
Turned off on to first road
west of Shaw River, coming
from Marble Bar
(Waypoint STRELT)

Turned right at ^{road} split to
Shelley Gorge

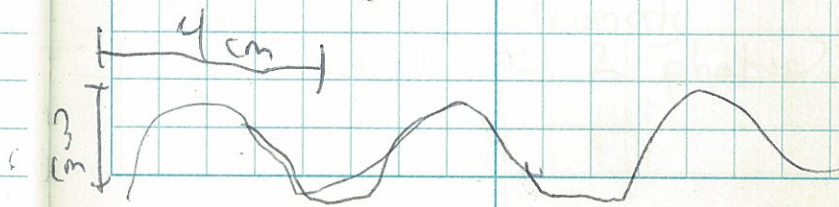
Crossed Shelley River

liban Turn left at small track
waypoint TURN2
AMG 709023 7662614
Easting Northing

Locality found by Tanja and
Ben Possible biogenic
Stromatolite
waypoint LOWE3
S $21^{\circ} 8.077'$
E $119^{\circ} 0.370'$

Another locality with
Obvious egg-carton
Stromatolites

Parallel laminae



Waypoint LOWE6
chert

See sampled carbonate
that appears to be relic.

Waypoint LOWE5

S 21° 8.330'
E 119° 0.440'

Waypoint LOWE6

S 21° 8.228'
E 119° 0.417'

Black chert breccia
(See photographed)

July 11, 2001

At core shed in N. Pok
① Took sample from DDH ~~NP4~~
depth: 186.5 cm

All of these samples from
Apex Basalt

~~1~~

silica breccia for microfossils

② Second Sample
depth 134.75 m

Hyaloclastite sample
Fairly unweathered

DDH MP4 core

③ Basalt flow non-hyaloclastite
depth 138.26 m

④ Basalt flow with possible pyrite
depth 165.17 m

⑤ Basalt
depth 171.13 m

⑥ Black chert
depth 190-75m

Black, a place to sample
Marble Bar chert that
is outside protected area
is Jasper Hill

Waypoint JASPRH

AMG 0782981
7652654

Surfide

NSS 2

Bick 1

Bick 2

Bick 3

Bick 4

McNaughton
McNaughton

GPS coords for North Shaw Localities

- ① Pidgeon a: Duffer Dacite
S 21° ~~24.3~~ 23.6', E 119° 36.3'
- ② Pidgeon b, U/Pb NSS
S 21° ~~26.9~~ 28.2', E 119° ~~35.6~~ 34.87'
- ③ Bickle ~~WV~~, Pb/Pb NSS
S 21° ~~28.1~~ 24.8', E 119° ~~31.9~~ 28.8'
- ④ Bickle, Pb/Pb NSS
S 21° ~~28.6~~ 25.6', E 119° 28.6/29.3'
- ⑤ Bickle, Pb/Pb NSS
S 21° 23.3', E 117° 23.2'
- ⑥ Bickle
S 21° 24.4', E 119° 21.4'
- ⑦ McNaughton 88? Ar/Ar
S 21° 28', E 119° 22.4'

SITE 1

Waypoint NSSI-A

S 21° 26,093'

E 119° 31,217'

Sampling North Shaw Suite
in creekbed NW of
Black Range Dike

Low rolling granite hills
Reddened on top, but
scraped clean near creek

Granites appear foliated

Strike of foliation 275°
DIP of foliation $70-90^{\circ}$
At NSSI-G

Took 2 photos of
foliation and pegmatites
Pegmatites abundant

McNaught

8 McNaughton⁸⁸? U/Pb
S 21° 27.4' E 119° 22.4'

July 12

Took samples from North
Shaw Suite

We were careful to take
the 7 cores more than a
couple dike widths away
from pegmatites

Also took another sample
with both host granite and
pegmatite "NSS1 / Pegmatite"

Waypoint at nice dike test?

S 21° 25.704

E 119° 30.276

3 generations of rock

(2 dikes)

a little weathered

SITE 2

River bed (Cooliya Creek)
South bank of creek
Cooliya Creek Tonalite

Same foliation orientation

Way point NSS2

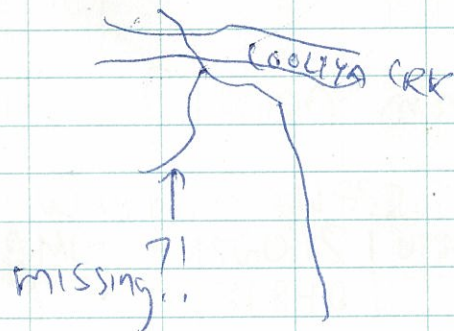
AMG 075604S | UTM S 21° 23.848'
7631840 | E 119° 28.181'

NSS2-A to F (6 samples)

Biotite appears chloritized
Sphene?

~~NSS~~

SITE 3
(Track to SW is missing
completely, so we turned
around)



NSS3 A to G

Foliated granite (Codiya Creek
Tonalite)

Probably at Bickle locality (3)
(see several pages earlier)

Waypoint NSS3
S 21° 25.343'
E 119° 29.115'

SITE 3. is foliated weakly
(E-W foliation)
biotites visible

little chloritization

On a diorite dike to south,
Dave discovered Aboriginal
petroglyphs!!

Sexual figures (shaks) with
erectans

Joe took several photos

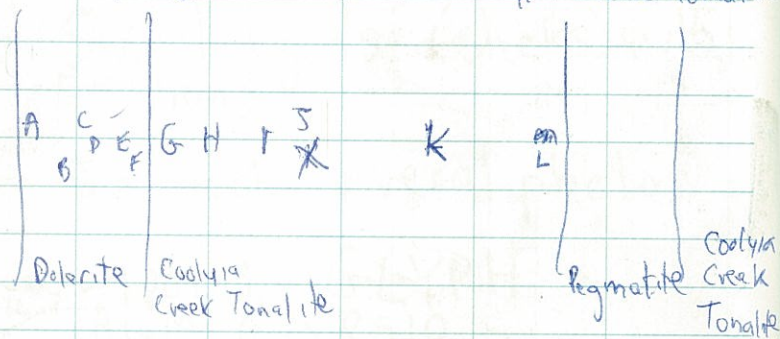
waypoint GLYPH
AGM 0758910
7628447

Took waypoint at another
Eoolyig Creek Tonalite outcrop
SHAW? AMG 0759117
7628370

SITE 4 Baked Contact Test
Dolerite Dike, Coolyia Creek
Tonalite, Pegmatite Dike

Waypoint NSS4
S 21° 25.7' 31"
E 119° 30.1' 95"

NSS4 A, B, C, D, E, F
taken from dolerite dike
NSS4 G → L from Coolyia Creek Tonalite



Rocks, some weathered red

Site is flat-lying exposures
next to dry creek bed

Mag Dp Sun Time

NSS4-A

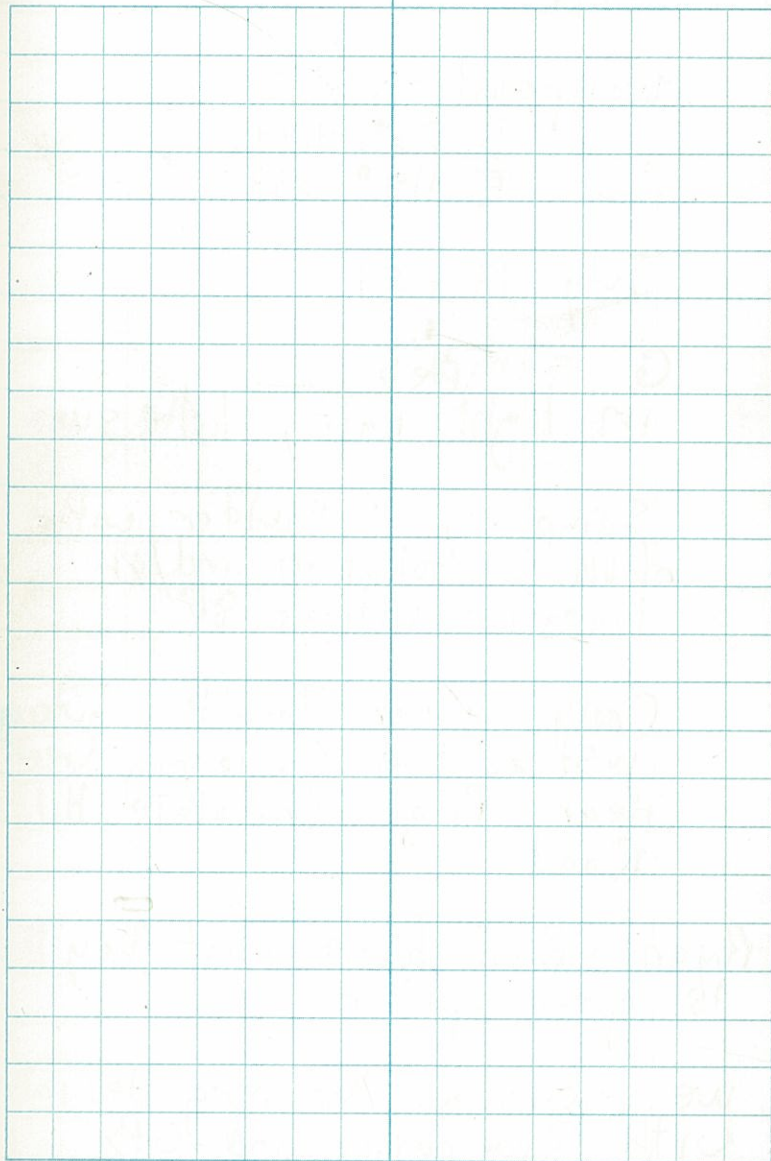
We took a number of photos
of sample localities

Ausk, Roadhouse
9176-6988

SITE 5

Waypoint ~~NS55~~

hand samples



SITE 6

Waypoint NSSG

S 21° 41492 °

E 119° 38437 °

July 13, 2001

6 samples
in light rain, little sun

Sampling a boulder with
obvious foliation and/or
lineation (strike 80°)

Coolyia Creek Tonalite, outcropping
just east of Cooglegang Creek
near Pilga-Chocolate Hill
Road

Ryan + Bob found what they think
is green epidote

we measured the mag deviation
with 3 compasses and GPS
answer: 70

(this deviation agrees with map)

SITE 7

NSSS 7 waypoint

S $21^{\circ} 23.055'$ E $119^{\circ} 22.152'$

Coolyia Creek Tonalite outcropping
at edge of Coaglegong Creek

Foliated but fresh outcrops
with a few tiny dikelets.

Mostly dike-free

Rock full of fractures

7 samples NSS 7-A to G

See back a photo of the
outcrop with me for scale

Foliation strikes at 49°

July 15 Raining!

After staying at Astley
Roadhouse encountered
a 20-30 m thick ruddcut
through red shales, cherts,
and occasional bit

"Chert" dikes about 1-2
cm thick cut section
vertically, some with
1-2 cm clasts (breccia
test!)

Also a 30° angle fault
which folds sediments
beautifully ~~into~~ by 90°
(fold test?)

Actually in Karijini National
Park.

Paleomagnetics (old) visible

See photo'd section with
Tajia for scale
(with dikes)

I photo'd fold / fault
with Rik-in-Rain for scale

Waypoint HAM1
S 22° 24.769'
E 118° 41.054'

→ Next road cut: less ferruginous
shales just before Munjina
Gorge

→ Munjina Gorge
Massive BIF, but
heavily oxidized to goethite
lamina 1-2 mm thick
with sparkly crystals

Troy found some shale with
wave ripples $\lambda \sim 4\text{cm}$

leached = Fe-poor

Waypoint HAM 2
S 22° E 27.599'
E 118° 42.279'

→ laterite : oxic zone underlined
by leached zone
(bottom zone not visible)

→ Munjina Gorge lookout
photo of group at overlook

→ BIF roadcut
I picked up a rock off
cliff face to reveal a
lizard on BIF face
we took photo

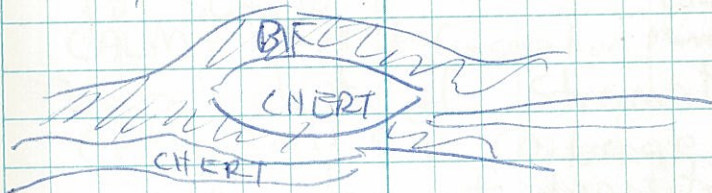
2-m high termite mound

→ Visitors Center

→ Fortescue Falls

→ Hancock Gorge
Worked down through BIF
many ripple marks → Shallow
marine

pods of chert(?) surrounded
by layers of BIF



Are Pods an alteration product?

→ Hancock Gorge
Hiked down through BIF
many ripple marks → Shallow
marine

Pods of chert(?) surrounded
by layers of BIF



Are Pods an alteration product?

July 17, 2001

Hamelin Pool (Telegraph Stn.)

Brian Rose at CALM in
Denham is responsible for
managing Shark Bay
Stromatolites - permission
to sample

CALM = Dept of Conservation Management
Magistrate of Stromatolites!
(lithified Ca-carbonate)

→ give time of deposition

→ Photo: of group in quarrying
quarry (bivalve shells mostly
~ 0.5 cm, also gastropods)

quarried for building materials

shells provide Ca carb for
Hamelin Pool Stromatolites

Shells of Cardiid (Cockle
(*Fragum eragatum*) deposited

6000 yr ago

Walking along beach, E. of pier. Took 3 photos of lithified shells and possible microbial materials in tidal area near water.

→ Took sample of ^{poorly} lithified material

Waypoint HAMØ1

S 26° 24.056'

E 114° 09.585'

→ Took photo sign commemorating dead stromatolites

rate of deposition 1 cm per
10-100 cm

→ Took photo on boardwalk of red-capped dead Stromatolites and black ooze

(more recent mats?)

Waypoint HAML 02

S 26° 24.120' E 114° 09.491'

- 2 Close-up photos of red-capped ~~pho~~ stromats (20¢ piece for scale)
- 1 more photo of Bent Tanja looking over pier at stromats

Waypoint HAML 03

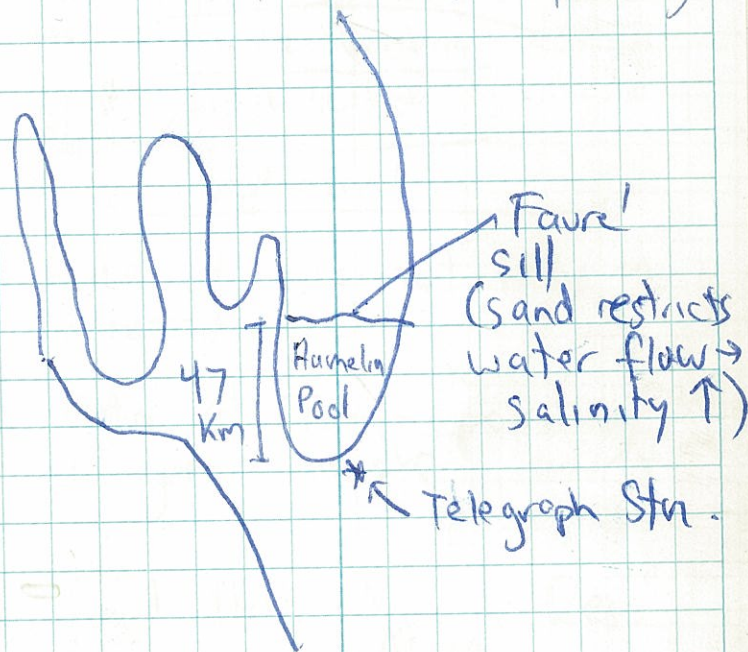
S 26° 24.106'

E 114° 09.448'

- 3 Photo of our shadows on water surface with stromats submerged using polarized
- Photo without shadows
- Close-up photo
- Photo of submerged stromat with black muck, green

Crud, and red crud
(taken into sun with
polarizing filter)

→ Photo of wagon ruts
in the black gack
(ruts from 60+ years ago)



Waypoint HAML04

S 26° 24.185'

E 114° 09.493'

→ Photo of excised, submerged
mat pustulose,
ridged surface H₂O

green cyanos

purple bacteria

black sulfide

Sediment

→ Photo of stromatolite on
stromatolite

→ Photo of Tanja pointing
to green mud

Richard Hall, Marine Res.
Officer CALM
99481208

Staying at Denham Seaside
Caravan Park

7/18 Waypoint HAMLØS

Green muck mat and a few
dead stromatolites

Tidal flat

Tanja took sample of muck mat

Ryan (Jesus) waded out 20m:
more muck mat out there

→ Then back to Hamelin Pool

Joe and Ryan wading out in
swimming area west of boardwalk
to photograph underwater stromats
to test Awaruk's claim that
they are tilted north toward
the average annual posn. of the
sun

Time 12:54 Ryan photographing
Not really oriented toward sun

295° is strike of ridges
dip is horizontal
Photo of ridges + ruffles
on the strata (#12-13)
wagon ridges?

Last 10 pictures taken from
a location ~20 m west of
first 20 pix. (all pictures
after pic of Tanja)

SECOND FIELD SEASON

Aug 2, 2004

Ben W, San Kees Blom
Barbara Thuss, Isaac Hilborn

Shaw granite outcrop w/ biotite granodiorite
Picture 14 foliated granite
with sills

Picture 15 another outcrop
of same foliated

Picture 16 close up of
granite foliation face showing
Using Australian Dollar for scale

UTM 0759948
7629282

WAYPOINT SHAW11

Picture 18 leucogranite sill (?)
here showing foliation
(aligned black x'tals)

Picture 19 rock showing
foliation defined by corne

SHAW 12

Ag Sr dike

striking 30° W of N

0756919

7632726

Pictures (9-21)

Pic 21 shows flow banding
(probably primary igneous since
sq. xstals are equant and not
deformed)

~~What~~

INT 01 → Intersection

to turn off to und. Shaw
suite.

SHAW 13

at last!

outcrop of

North Shaw Tonalite

Next to a Black Range

Full of hornblende type dike

Pict 22 N Shaw Tonalite
at SHAW 12 with Black
Range Dike in background

SHAW 13 0754764
7636369

(Near)
SHAW 14 @ contact between
North Shaw Tonalite and
greenstones
(see Picture 24)
(in stream bed)

Shaw 15 → Shaw + white
calcareous mud alteration

Shaw 16 → good Shaw tonalite
outcrop. Rocks
crisscross w/ fractures & siliceous
replacement.

GPS: 0756018 21.3495°S
7637154 119.46861°E

unfoliated w/ hornblende
well shielded from lightning.

North Shaw Tonalite
(Ag Sns)

8/4/04

SAMPLE	MAW	DIP	SUN	TIME
			(83)	(9:54)

NSS1B2-1	305	25	188	16:40
----------	-----	----	-----	-------

NSS1B2-2	275 278	65	163	16:54
	275 263 281	66	(53)	(9:55)

3	286	65	186	16:59
	270		(74)	(9:52)
	298			8/4/04

SKIPPED 4 - BLACK MOVED DURING
DRILLING

NSS1B2-5*	269	77	96	9:47
	288	79		
	275			9:45
6*	249	65	31	8/4/04
	254			
7*	206	49	63	9:46

CCW Compass !!

8/4

Day 2 Field Season 2
8/4/04

Second drilling site S(AW2B)

S 21.3443° E 119.46819°

UTM: 07SS5974 7637163

North Shaw Tonalite

outcrop on stream
just downstream from IB2

* Took sun compass readings
from NSS1B2 4, 5, 6, 7, & 8
which we were unable to get
on 8/3 because sun set.

Also remeasured Mag + Dip for
8/3 cores / yesterday's compass

SAMPLE MAG DIP ^{SUN} ~~MAG~~ ~~DIP~~ TIME

NSS1B2-4

NSS1B2-4* 79 7 217 9:50

NSS1B2-8* 91 7 229 9:48

NSS1B2-9

block sample
for U/P5

(SPG #)

Pictures #

Sample

~~28~~ 35

35

36

~~38~~ 39

40

41

42

43

45

46-49

2B1-1

2B1-2

2B1-3

2B1-4

2B1-5

2B1-6

2B1-7

2B1-8

2B1-9 to 8

SAMPLE

MAG

DIP

SUN

8/4/04
TIME

NSS2B1-1

281

15

59

9:57

NSS2B1-2

100

0

242

10:03

-3

281

69

64

10:16

~~-5~~

327

46

114

10:29

~~-4~~

286

64

83

11:03

-6

304

60

92

10:36

-7

244

30

34

10:43

-8

257

32

57

11:09

Took block sample
N552B1-9 for U/Pb

Sat phone TBJK 0147164513

+61-1471-64513

Alex

or

0891761023

0891761195

Police

0891761005

② ①

WAYPOINT

SHAW

NSS 2B2

075598

SHAW 2B2

7037846

Day 2 Site 2

S 21° 20' 35.8"

E 119° 28' 02.8"

This 2B2 site actually was composed of ^{four} ~~three~~ subsites
these all have waypoints

- SHAW 2B2 1-5 : Cores 1-5
- SHAW 2B2 6-8 : Cores 6-8
(both in [↑] creek bed)

- SHAW 2B2 Hill : Cores 9-14
(on edge of hill up from creek)

- SHAW 2B2 CON : Cores 15-17
(foliated granite in stream bed
near a greenstone enclave - THIS
BLOCK MIGHT NOT BE IN PLACE)

SAMPLE MAG DIP SUN TIME

NSS 2B2-1 019 27 242 14:16

-2 003 35 27 14:20

-3 044 51 255 13:31

-4 036 44 263 14:31

-5 031 49 262 14:41

-6 SKIPPED - BROKEN ^{core}

Very
weathered

↪ easier
to cut

& more
friable

- also
purple

must/day

-7 002 47 232 14:44

-8A 336 35 206 14:48

-8B 055 54 285 14:51

-9A → orientation/in place

New outcrop,
not in stream bed
~~At~~ to possibility of
lightning strikes

Monter	str/dip	Sum	Time
→ -9	42/57	—	—
-10	79/51	—	—
~11	45/59	—	—
~12	41/55	—	—
-13	31/67	—	—
-14	42/69	—	—
- 17 17	49/55	288	15:38
- 15 15	294/26	186	15:53:30
-16	238 24	120	16:00

NSS

2 B3 → Greenstones
down the creek
from the granites
of the N. Shaw suite

Way point SHAW 2B3

Talga Talga Subgroup

755720

→ 7637663

Awmbe

"Carbonate altered basalt,
metamorphosed"

Monitor

	<u>Stk/Dip</u>	<u>Sun</u>	<u>Time</u>
NSS 2B3 -3	213/27	100	16:48:30
-5	223/39	110	16:51
-4	208/24	96	16:52
-4	250/30 ~135		16:53:30
-2	248/32 ~135		16:55
-6	256/16	144	16:55:40
-7	268/11	156	16:56

Day 3

Ben, Isaac, Tanja & Jan Kees
drove out to Coolyia Creek
where it goes through
the greenstone - Coolyia Creek
Tonalite contact

This is a beautiful room nearly
continuous section that is
visible on our aerial photos

We took a lot of waypoints
on the track out here
No drilling today - out of time

Day 4

Began drilling Coolyia Creek
tonalite section

W. AUSTRALIA

2001/2004



"Return to the Rain"

ALL WEATHER
FIELD BOOK

No. 350

W. AUSTRALIA 2001/2004