

$\delta^{18}\text{O}$ Unconformity Ridge Outcrop Cross Section



1
00:00:11,540 --> 00:00:09,180
okay welcome so today I'm going to be

2
00:00:14,160 --> 00:00:11,550
talking about stromatolites and

3
00:00:16,680 --> 00:00:14,170
traumatic shirts of the straw a pool

4
00:00:18,990 --> 00:00:16,690
formation which is 3.4 billion years old

5
00:00:21,960 --> 00:00:19,000
in the Paley archaean in Western

6
00:00:23,340 --> 00:00:21,970
Australia luckily I don't have to go

7
00:00:24,960 --> 00:00:23,350
over too much about what a stromatolite

8
00:00:30,000 --> 00:00:24,970
is because it seems like this crowd is

9
00:00:32,069 --> 00:00:30,010
pretty savvy about that so the first

10
00:00:34,229 --> 00:00:32,079
goal this project was what we're all

11
00:00:36,479 --> 00:00:34,239
trying to do basically detect and

12
00:00:38,369 --> 00:00:36,489
characterize paleo archaean habitats

13
00:00:41,189 --> 00:00:38,379

that we might be able to use for a proxy

14

00:00:44,430 --> 00:00:41,199

as other habitats on you know planetary

15

00:00:47,669 --> 00:00:44,440

systems the other goal was basically

16

00:00:50,399 --> 00:00:47,679

just to use Institute isotopic analysis

17

00:00:52,739 --> 00:00:50,409

of these shirts and courts to better

18

00:00:57,180 --> 00:00:52,749

piece together the petrographic story of

19

00:00:59,459 --> 00:00:57,190

these rocks so these are the three field

20

00:01:00,959 --> 00:00:59,469

areas that we used you're looking at the

21

00:01:04,770 --> 00:01:00,969

pill bark raid time again I think you've

22

00:01:08,040 --> 00:01:04,780

actually seen this map a couple of times

23

00:01:10,520 --> 00:01:08,050

today but we're in Western Australia so

24

00:01:12,929 --> 00:01:10,530

we are in the northwestern corner and

25

00:01:15,569 --> 00:01:12,939

the three sampling areas are

26

00:01:17,249 --> 00:01:15,579

unconformity Ridge and then there's a

27

00:01:20,670 --> 00:01:17,259

lot of data from the trendle locality

28

00:01:23,969 --> 00:01:20,680

and then camel creek a quick note about

29

00:01:26,700 --> 00:01:23,979

this the towbar kraton basically has all

30

00:01:29,459 --> 00:01:26,710

of these granitic complexes that are

31

00:01:31,350 --> 00:01:29,469

doming the sediments in the area and so

32

00:01:33,630 --> 00:01:31,360

the stroll a pool formation is this red

33

00:01:40,349 --> 00:01:33,640

formation that is basically wrapping

34

00:01:42,029 --> 00:01:40,359

around those domes within the area okay

35

00:01:43,529 --> 00:01:42,039

so here's a field shot of straw a pool

36

00:01:46,980 --> 00:01:43,539

formation we're looking directly down

37

00:01:49,289 --> 00:01:46,990

one of the underrated chert ridges the

38

00:01:51,179 --> 00:01:49,299

australia formation is bounded

39

00:01:56,010 --> 00:01:51,189

underneath by the couch aruna volcanics

40

00:01:57,630 --> 00:01:56,020

at around 34 26 million years old above

41

00:01:59,580 --> 00:01:57,640

the countryand volcanics we have an

42

00:02:02,910 --> 00:01:59,590

unconformity so there's some erosion and

43

00:02:04,830 --> 00:02:02,920

erosional period at that time and then

44

00:02:07,050 --> 00:02:04,840

basically at the base of the Strela pool

45

00:02:10,260 --> 00:02:07,060

we have these coarse clastic rocks and

46

00:02:12,210 --> 00:02:10,270

that grades upward into finer salissa

47

00:02:14,369 --> 00:02:12,220

classics and then finally into church

48

00:02:16,160 --> 00:02:14,379

and stromatolite éclairs towards the top

49

00:02:19,649 --> 00:02:16,170

and then it's capped again by this

50

00:02:22,119 --> 00:02:19,659

course clastic interval

51
00:02:25,180 --> 00:02:22,129
so going through those here's the basal

52
00:02:27,160 --> 00:02:25,190
conglomerate of the straw a pool you

53
00:02:31,149 --> 00:02:27,170
move up one and you're getting into a

54
00:02:34,390 --> 00:02:31,159
little bit finer sedimentary rocks sand

55
00:02:36,660 --> 00:02:34,400
stones and shirts up a little further

56
00:02:39,940 --> 00:02:36,670
and you're into the bedded shirts and

57
00:02:42,039 --> 00:02:39,950
then all of our favorites stromatolites

58
00:02:45,100 --> 00:02:42,049
is what you start to see after that on

59
00:02:46,720 --> 00:02:45,110
the Left we have stromatolites that are

60
00:02:48,280 --> 00:02:46,730
dolomitic stromatolite so there's

61
00:02:51,550 --> 00:02:48,290
actually some carbonaceous stromatolites

62
00:02:53,140 --> 00:02:51,560
preserved and you can see that parts of

63
00:02:54,910 --> 00:02:53,150

these stromatolites have been solicited

64

00:02:56,650 --> 00:02:54,920

so these there's these little salissa

65

00:02:58,539 --> 00:02:56,660

fiction fronts that come through and

66

00:02:59,979 --> 00:02:58,549

and just partially replace and some of

67

00:03:03,009 --> 00:02:59,989

you doing stromatolite research I'd love

68

00:03:05,440 --> 00:03:03,019

to ask about this later but and then

69

00:03:08,110 --> 00:03:05,450

anyway on the left or sorry on your

70

00:03:09,970 --> 00:03:08,120

right we have a completely solidified

71

00:03:14,039 --> 00:03:09,980

stromatolite which is what we more often

72

00:03:16,900 --> 00:03:14,049

see in the Cyrillic pool formation and

73

00:03:19,500 --> 00:03:16,910

then finally we have basically druzy

74

00:03:21,729 --> 00:03:19,510

coliform quartz veins that cut across

75

00:03:23,620 --> 00:03:21,739

the strongly pool formation and

76
00:03:27,789 --> 00:03:23,630
sometimes these breeches up towards the

77
00:03:30,009 --> 00:03:27,799
top so just a quick review on oxygen

78
00:03:33,099 --> 00:03:30,019
isotopes I know most of you know what's

79
00:03:34,780 --> 00:03:33,109
going on with this but we have a plot

80
00:03:38,140 --> 00:03:34,790
here showing temperature on the y-axis

81
00:03:39,490 --> 00:03:38,150
and Delta 18 on the x-axis and then

82
00:03:41,440 --> 00:03:39,500
these curves that you see are

83
00:03:45,940 --> 00:03:41,450
representing different values of water

84
00:03:47,800 --> 00:03:45,950
and so meteoric water tends to be light

85
00:03:51,789 --> 00:03:47,810
that's the evaporated water that we've

86
00:03:53,909 --> 00:03:51,799
talked about sea water tends to be at

87
00:03:56,909 --> 00:03:53,919
around 0 per mil that comprises the

88
00:03:59,979 --> 00:03:56,919

Vienna standard mean ocean water

89

00:04:02,020 --> 00:03:59,989

standard and then finally we have

90

00:04:03,430 --> 00:04:02,030

formation brians which are just

91

00:04:05,289 --> 00:04:03,440

basically base know Brian's that have

92

00:04:07,479 --> 00:04:05,299

undergone long interactions with rocks

93

00:04:11,530 --> 00:04:07,489

and have become ice topically heavier

94

00:04:13,990 --> 00:04:11,540

due to that and so you can see that this

95

00:04:16,210 --> 00:04:14,000

is basically representing church forming

96

00:04:18,879 --> 00:04:16,220

at equilibrium with these waters and so

97

00:04:21,129 --> 00:04:18,889

if you form a church at equilibrium at

98

00:04:23,650 --> 00:04:21,139

100 degrees Celsius with the water of

99

00:04:29,920 --> 00:04:23,660

say zero then you should get a value of

100

00:04:31,810 --> 00:04:29,930

about 21 22 per mil okay so precambrian

101
00:04:35,080 --> 00:04:31,820
shirts tend to be light

102
00:04:38,560 --> 00:04:35,090
over here in this 10 to 15 per mil which

103
00:04:42,130 --> 00:04:38,570
means that they're either warmer or that

104
00:04:46,870 --> 00:04:42,140
the oceans were basically isotopically

105
00:04:48,970 --> 00:04:46,880
negative vana Rizzo cherts format these

106
00:04:51,480 --> 00:04:48,980
higher isotopic values indicating

107
00:04:53,920 --> 00:04:51,490
probably cooler formation temperatures

108
00:04:55,990 --> 00:04:53,930
so the reason I bring this up is there's

109
00:04:58,180 --> 00:04:56,000
this long-standing debate basically

110
00:05:00,310 --> 00:04:58,190
about what this curve through time means

111
00:05:02,770 --> 00:05:00,320
so shirts in the past tend to be ice

112
00:05:08,290 --> 00:05:02,780
topically lighter and then through time

113
00:05:10,650 --> 00:05:08,300

they become heavier so scientists have

114

00:05:13,810 --> 00:05:10,660

offered basically three different

115

00:05:16,240 --> 00:05:13,820

mechanisms for this trend at the secular

116

00:05:18,760 --> 00:05:16,250

trend that we see through time it is

117

00:05:21,640 --> 00:05:18,770

either due to oceans being lighter in

118

00:05:24,520 --> 00:05:21,650

the past temperatures being warmer in

119

00:05:25,990 --> 00:05:24,530

the past or just the fact that all of

120

00:05:27,580 --> 00:05:26,000

these rocks over here have SAT around

121

00:05:28,930 --> 00:05:27,590

longer so it's more likely that they're

122

00:05:32,500 --> 00:05:28,940

altered and seeing some hydro

123

00:05:34,330 --> 00:05:32,510

hydrothermal activity basically the gray

124

00:05:37,390 --> 00:05:34,340

curve you see here is from oberon

125

00:05:39,610 --> 00:05:37,400

Chalcedon and this is what they propose

126

00:05:42,900 --> 00:05:39,620

as the least altered shirts because any

127

00:05:47,710 --> 00:05:42,910

post meteoric or hydrothermal alteration

128

00:05:50,140 --> 00:05:47,720

should lower those isotopic values so

129

00:05:51,820 --> 00:05:50,150

then we bring up some of our data and we

130

00:05:54,250 --> 00:05:51,830

see that we've got this one group of

131

00:05:56,950 --> 00:05:54,260

data from the trendle location that's

132

00:06:01,300 --> 00:05:56,960

significantly above that curve so what

133

00:06:03,580 --> 00:06:01,310

does that mean so then we start getting

134

00:06:05,530 --> 00:06:03,590

into the textures micro quartz is

135

00:06:08,830 --> 00:06:05,540

basically one of the earliest textures

136

00:06:10,360 --> 00:06:08,840

petrographic textures that I see then I

137

00:06:12,280 --> 00:06:10,370

see this mezzo quartz which is a

138

00:06:15,580 --> 00:06:12,290

slightly coarse inversion of micro

139

00:06:19,030 --> 00:06:15,590

chords then we move into mega quartz

140

00:06:23,200 --> 00:06:19,040

which is often found in veins and then

141

00:06:25,360 --> 00:06:23,210

just throughout the sample and then we

142

00:06:28,000 --> 00:06:25,370

have cavity megachords cavity megachords

143

00:06:30,550 --> 00:06:28,010

is this euhedral quartz that's growing

144

00:06:35,530 --> 00:06:30,560

into cavities and voids like a geode in

145

00:06:37,690 --> 00:06:35,540

a way then there's detrital courts and

146

00:06:39,190 --> 00:06:37,700

sandstone cements and for any of you who

147

00:06:41,710 --> 00:06:39,200

have looked in a petrographic microscope

148

00:06:43,450 --> 00:06:41,720

I just want to mention this is a thickly

149

00:06:45,899 --> 00:06:43,460

cut section so that's why you're seeing

150

00:06:48,850 --> 00:06:45,909

high interference colors in courts

151
00:06:51,179 --> 00:06:48,860
and then finally we see Chow said me

152
00:06:57,369 --> 00:06:51,189
which is basically these banded

153
00:06:59,379 --> 00:06:57,379
radiating courts okay so that basically

154
00:07:02,139 --> 00:06:59,389
brings me to these two different groups

155
00:07:04,659 --> 00:07:02,149
that we see we see an earlier or sorry

156
00:07:06,579 --> 00:07:04,669
we see a lower Delta eight teen group

157
00:07:08,499 --> 00:07:06,589
and a higher deltoid teen group and the

158
00:07:11,529 --> 00:07:08,509
question was what is this higher Delta

159
00:07:13,389 --> 00:07:11,539
18 group and so with Sims basically

160
00:07:15,699 --> 00:07:13,399
going in we see that we really break

161
00:07:19,659 --> 00:07:15,709
this rule from robear in Chalcedon with

162
00:07:21,819 --> 00:07:19,669
this higher deltoid teen group basically

163
00:07:25,509 --> 00:07:21,829

that higher deltoid teen group is found

164

00:07:27,639 --> 00:07:25,519

in kept in this cavity mega courts and

165

00:07:29,229 --> 00:07:27,649

then basically all of these coarser

166

00:07:32,469 --> 00:07:29,239

textures which is telling us something

167

00:07:36,100 --> 00:07:32,479

Petra graphically and then finally these

168

00:07:38,169 --> 00:07:36,110

lower groups are found in these Petra

169

00:07:43,239 --> 00:07:38,179

graphically earlier textures and finer

170

00:07:45,549 --> 00:07:43,249

groups so moving into this a little bit

171

00:07:49,480 --> 00:07:45,559

out here you can see the groups that are

172

00:07:52,239 --> 00:07:49,490

basically this is that drusy cavity

173

00:07:54,669 --> 00:07:52,249

quartz I talked about earlier and then

174

00:07:56,199 --> 00:07:54,679

if we look at that with an SEM into one

175

00:07:57,850 --> 00:07:56,209

of the voids then you can see the sort

176
00:08:00,339 --> 00:07:57,860
of geode like texture I was describing

177
00:08:03,909 --> 00:08:00,349
and then further if I look at that with

178
00:08:06,249 --> 00:08:03,919
cl which is cathode a luminescence you

179
00:08:09,609 --> 00:08:06,259
see this really incredible zone texture

180
00:08:12,069 --> 00:08:09,619
in these and these in my mind are

181
00:08:16,179 --> 00:08:12,079
clearly late they're clearly growing in

182
00:08:19,029 --> 00:08:16,189
and coming in later so one of the

183
00:08:22,059 --> 00:08:19,039
questions we had was is this late druzo

184
00:08:27,069 --> 00:08:22,069
cavity megachords also present at depth

185
00:08:29,829 --> 00:08:27,079
and so we checked into the so we sampled

186
00:08:31,029 --> 00:08:29,839
from the court we sampled a core that

187
00:08:32,920 --> 00:08:31,039
was drilled through the stroller pool

188
00:08:35,679 --> 00:08:32,930

formation the Strela pool is in yellow

189

00:08:39,309 --> 00:08:35,689

and then the drill core traces in blue

190

00:08:41,879 --> 00:08:39,319

here and then basically we found that

191

00:08:44,980 --> 00:08:41,889

the outcrop Trent or we found the earth

192

00:08:47,499 --> 00:08:44,990

we sampled a transect at the outcrop

193

00:08:50,530 --> 00:08:47,509

above the drill core and then we sampled

194

00:08:53,590 --> 00:08:50,540

the drill core at depth and then we

195

00:08:56,590 --> 00:08:53,600

compared them and basically we found

196

00:08:58,420 --> 00:08:56,600

that we have sand stones and

197

00:08:59,140 --> 00:08:58,430

conglomerates of base once again then

198

00:09:04,180 --> 00:08:59,150

moving up into the

199

00:09:06,100 --> 00:09:04,190

is bedded shirts this is all ice topic

200

00:09:08,890 --> 00:09:06,110

lighter because it's volcanic courts and

201
00:09:11,440 --> 00:09:08,900
so this is the actual detrital grains of

202
00:09:15,070 --> 00:09:11,450
quartz and then we saw this step up

203
00:09:16,600 --> 00:09:15,080
whoops and we saw this step up right at

204
00:09:18,610 --> 00:09:16,610
the BET right at the boundary between

205
00:09:21,820 --> 00:09:18,620
shirts and sandstones and glamour 'it's

206
00:09:24,100 --> 00:09:21,830
in both the samples at depth and on the

207
00:09:26,170 --> 00:09:24,110
surface but you'll notice over here the

208
00:09:30,520 --> 00:09:26,180
delta 18 does not get up to that 30 per

209
00:09:32,620 --> 00:09:30,530
mil that you saw earlier okay so here's

210
00:09:34,510 --> 00:09:32,630
some of the enca to work we did we found

211
00:09:40,690 --> 00:09:34,520
that the micro court cements we're right

212
00:09:42,370 --> 00:09:40,700
around 14 per mil and then that the

213
00:09:47,080 --> 00:09:42,380

dreidel quartz was right around this

214

00:09:49,330 --> 00:09:47,090

kind of 10 to 11 12 per mil this is an

215

00:09:51,790 --> 00:09:49,340

example of that there's the 14 per mil

216

00:09:57,880 --> 00:09:51,800

courts in the cements and then the trial

217

00:10:00,910 --> 00:09:57,890

court's is right around 12 so what we

218

00:10:02,740 --> 00:10:00,920

found based on all of this is that we

219

00:10:05,860 --> 00:10:02,750

have these Petra graphically early

220

00:10:07,510 --> 00:10:05,870

textures that define this lower group so

221

00:10:09,580 --> 00:10:07,520

these are the sandstones this peak ends

222

00:10:10,990 --> 00:10:09,590

up being basically sandstone right here

223

00:10:13,600 --> 00:10:11,000

that 14 per mil that I showed you

224

00:10:16,600 --> 00:10:13,610

earlier and then these end up being

225

00:10:18,780 --> 00:10:16,610

those Petra graphically early micro

226

00:10:23,080 --> 00:10:18,790

courts from the trundle locality

227

00:10:24,400 --> 00:10:23,090

straddle it exert and so that's so once

228

00:10:26,950 --> 00:10:24,410

again we can see that these early

229

00:10:31,530 --> 00:10:26,960

textures tend to be within that that

230

00:10:36,280 --> 00:10:31,540

range of precambrian turrets that we see

231

00:10:43,090 --> 00:10:36,290

and then finally the later textures tend

232

00:10:44,950 --> 00:10:43,100

to be in that 22 to 30 per mil range so

233

00:10:46,450 --> 00:10:44,960

what we conclude from this is that we

234

00:10:48,520 --> 00:10:46,460

think this there's an early salissa

235

00:10:50,530 --> 00:10:48,530

fiction front possibly hydrothermal

236

00:10:53,770 --> 00:10:50,540

that comes through and forms these low

237

00:11:00,550 --> 00:10:53,780

delta 18 microcrystalline and earlier

238

00:11:03,310 --> 00:11:00,560

textures in the courts we think that

239

00:11:06,340 --> 00:11:03,320

late diagenesis or some sort of warm

240

00:11:11,170 --> 00:11:06,350

heavy delta 18 fluid probably forms this

241

00:11:13,070 --> 00:11:11,180

drusy cavity megachords and this is a

242

00:11:15,170 --> 00:11:13,080

little difficult to constrain we're not

243

00:11:17,150 --> 00:11:15,180

the exact timing of this just that it's

244

00:11:25,490 --> 00:11:17,160

late it's Petra graphically late to the

245

00:11:29,540 --> 00:11:25,500

story drill core samples tend to be very

246

00:11:31,940 --> 00:11:29,550

similar to the samples at depth

247

00:11:33,650 --> 00:11:31,950

indicating that at least in this area we

248

00:11:35,720 --> 00:11:33,660

didn't have that presence of drusy

249

00:11:38,060 --> 00:11:35,730

cavity megachords we didn't have that

250

00:11:41,570 --> 00:11:38,070

high delta 18 group for one reason or

251
00:11:43,040 --> 00:11:41,580
another in that sampling area and then

252
00:11:44,600 --> 00:11:43,050
finally what we've concluded from this

253
00:11:47,000 --> 00:11:44,610
is at least within the Strela pool

254
00:11:49,040 --> 00:11:47,010
information shirts are probably not a

255
00:11:52,160 --> 00:11:49,050
viable proxy for either the temperature

256
00:11:53,960 --> 00:11:52,170
of paleo archaean sea water or the Delta

257
00:11:55,730 --> 00:11:53,970
18 at paley are key in sea water and

258
00:12:12,120 --> 00:11:55,740
with that I'll take any questions that

259
00:12:23,760 --> 00:12:19,920
oh sure you're in my blind spot thank

260
00:12:27,570 --> 00:12:23,770
you not knowing anything about the feel

261
00:12:32,120 --> 00:12:27,580
I have a stupid question is there any

262
00:12:36,210 --> 00:12:32,130
evidence about the you're experiencing a

263
00:12:39,350 --> 00:12:36,220

critical global warming in the history

264

00:12:42,510 --> 00:12:39,360

of the earth it's I know Easter 11 but I

265

00:12:45,900 --> 00:12:42,520

I think what we found is actually that

266

00:12:47,730 --> 00:12:45,910

but most of this is probably due in my

267

00:12:50,520 --> 00:12:47,740

mind to hydrothermal activity if I were

268

00:12:53,130 --> 00:12:50,530

to give a single answer to why I think

269

00:12:55,200 --> 00:12:53,140

the trend that there's the secular trend

270

00:12:56,700 --> 00:12:55,210

in church through time it could be that

271

00:12:59,250 --> 00:12:56,710

there's just increased hydrothermal

272

00:13:01,530 --> 00:12:59,260

activity throughout the Precambrian and

273

00:13:04,380 --> 00:13:01,540

that you know your charts are forming at

274

00:13:06,210 --> 00:13:04,390

this sea water you know sea water

275

00:13:07,740 --> 00:13:06,220

sediment inter interface at the base of

276

00:13:11,340 --> 00:13:07,750

the sea floor and that's where those

277

00:13:12,720 --> 00:13:11,350

circulation cells would be and so it's a

278

00:13:14,160 --> 00:13:12,730

potential that this whole trend that

279

00:13:16,020 --> 00:13:14,170

we're reading into and trying to figure

280

00:13:18,240 --> 00:13:16,030

out ambient sea water temperatures we're

281

00:13:20,180 --> 00:13:18,250

really just were just reading that the