"Deep" marine microfossils

2.52 Ga
Upper Gamohaan Fm.
Kaapvaal craton,
South Africa

1
00:00:10,640 --> 00:00:08,720
goodmornin last talk of the morning I'll

2
00:00:13,160 --> 00:00:10,650
try and keep it short and sweet it's

3
00:00:15,140 --> 00:00:13,170
good to be back at a grad calm seen

4
00:00:17,630 --> 00:00:15,150
bunch of old friends making some new

5
00:00:21,320 --> 00:00:17,640
friends even some new enemies Team

6
00:00:24,920 --> 00:00:21,330
Rocket for those of you who don't know

7
00:00:25,939 --> 00:00:24,930
they won trivia last night so yeah I'm

8
00:00:27,349 --> 00:00:25,949
going to be presenting some of my

9
00:00:29,000 --> 00:00:27,359
Master's work at the University of

10
00:00:31,849 --> 00:00:29,010
Cincinnati I'm transitioning now to a

11
00:00:34,880 --> 00:00:31,859
PhD at UCLA so talk a little bit about

12
00:00:36,620 --> 00:00:34,890
what I did and what I'm transitioning

13
00:00:41,209 --> 00:00:36,630

into and what I'd like to work on in the

14
00:00:43,369 --> 00:00:41,219
future solo vocab check for you we were

15
00:00:45,410 --> 00:00:43,379
all different disciplines here chemist

16
00:00:46,420 --> 00:00:45,420
physics biologist geologist so just to

17
00:00:48,350 --> 00:00:46,430
make sure we're all on the same page

18
00:00:49,700 --> 00:00:48,360
carbon isotopes I like that a couple

19
00:00:51,590 --> 00:00:49,710
people have talked about this before so

20
00:00:53,209 --> 00:00:51,600
some of this is a little bit review but

21
00:00:56,209 --> 00:00:53,219
it's basically a ratio of carbon-13 to

22
00:00:59,000 --> 00:00:56,219
carbon-12 and that's in Delta notation

23
00:01:03,219 --> 00:00:59,010
typically you can do it on perform this

24
00:01:09,100 --> 00:01:06,410
bio signature so and in this talk it's a

25
00:01:12,500 --> 00:01:09,110
mostly focus on evidence of past life

26
00:01:15,100 --> 00:01:12,510
precambrian is basically any strata that

27
00:01:17,300 --> 00:01:15,110
are older than 500 41 million years ago

28
00:01:19,340 --> 00:01:17,310
organics in the context that I am

29
00:01:21,620 --> 00:01:19,350
talking about them are mostly aromatic

30
00:01:23,660 --> 00:01:21,630
hydrocarbons that have been produced

31
00:01:25,999 --> 00:01:23,670
over billions of years in other words

32
00:01:28,100 --> 00:01:26,009
carriage in which I'll discuss in a

33
00:01:29,450 --> 00:01:28,110
minute and by metabolisms I'm

34
00:01:31,399 --> 00:01:29,460
specifically talking about microbial

35
00:01:33,410 --> 00:01:31,409
carbon fixation pathways so there's a

36
00:01:35,450 --> 00:01:33,420
lot of other microbial metabolism spoke

37
00:01:39,140 --> 00:01:35,460
them to focus explicitly on carbon here

38
00:01:40,670 --> 00:01:39,150

today so when we're measuring carbon

39
00:01:43,460 --> 00:01:40,680
isotopes an organic matter what you're

40
00:01:45,319 --> 00:01:43,470
looking at is our game air that's been

41
00:01:47,749 --> 00:01:45,329
produced over billions of years in the

42
00:01:50,810 --> 00:01:47,759
Precambrian mostly and it comes from

43
00:01:53,380 --> 00:01:50,820
originally from biopolymer so bio

44
00:01:56,660 --> 00:01:53,390
molecules that are made in microbes and

45
00:01:59,330 --> 00:01:56,670
basically when they die they get broken

46
00:02:02,770 --> 00:01:59,340
down through microbial degradation in

47
00:02:05,389 --> 00:02:02,780
the monomers and eventually into through

48
00:02:07,760 --> 00:02:05,399
polymerization condensation reactions

49
00:02:09,020 --> 00:02:07,770
turn into geo polymers which is

50
00:02:11,839 --> 00:02:09,030
basically a very high molecular weight

51
00:02:13,070 --> 00:02:11,849
in saw you in soluble in organic

52
00:02:15,200 --> 00:02:13,080
solvents

53
00:02:19,730 --> 00:02:15,210
it makes up about ninety-five percent of

54
00:02:22,220 --> 00:02:19,740
organic matter well caveat is that this

55
00:02:24,350 --> 00:02:22,230
goes through a whole large range of

56
00:02:26,360 --> 00:02:24,360
history so it goes through diagenesis

57
00:02:28,700 --> 00:02:26,370
which is basically everything that

58
00:02:31,130 --> 00:02:28,710
happens prior to burial then it gets

59
00:02:34,250 --> 00:02:31,140
buried deep down and so as you go down

60
00:02:36,320 --> 00:02:34,260
in in the strata you're going up in

61
00:02:38,450 --> 00:02:36,330
temperature and pressure eventually

62
00:02:41,180 --> 00:02:38,460
leading the electrification and in some

63
00:02:45,560 --> 00:02:41,190

cases metamorphism which all these

64
00:02:48,050 --> 00:02:45,570
things can have to an extent an effect

65
00:02:50,180 --> 00:02:48,060
on the carbon isotope signature so how

66
00:02:51,590 --> 00:02:50,190
do we detect carriage inn in Precambrian

67
00:02:52,790 --> 00:02:51,600
rocks I like that someone else already

68
00:02:55,699 --> 00:02:52,800
went through ramen so I don't have to

69
00:02:58,490 --> 00:02:55,709
explain too much but basically this is

70
00:03:00,260 --> 00:02:58,500
your carriage and shift in your in your

71
00:03:02,030 --> 00:03:00,270
raman spectra so when you see this

72
00:03:03,410 --> 00:03:02,040
pop-up you have a pretty good feeling

73
00:03:06,620 --> 00:03:03,420
that you're looking at organic matter

74
00:03:08,180 --> 00:03:06,630
that was biologically produced so

75
00:03:09,890 --> 00:03:08,190
basically what Raman spectroscopy does

76
00:03:11,210 --> 00:03:09,900
is it allows you to measure this on the

77
00:03:13,400 --> 00:03:11,220
micron scale so you can measure this

78
00:03:14,420 --> 00:03:13,410
actually on individual microfossils so

79
00:03:16,640 --> 00:03:14,430
that's what we'll get into here in a

80
00:03:18,080 --> 00:03:16,650
second and you can do it institue in the

81
00:03:20,090 --> 00:03:18,090
thin section so you know that you have

82
00:03:21,410 --> 00:03:20,100
to extract anything you just throw a

83
00:03:22,910 --> 00:03:21,420
microscope slide underneath the

84
00:03:25,610 --> 00:03:22,920
underneath there and Zack with the laser

85
00:03:28,850 --> 00:03:25,620
and you know what you got also it's been

86
00:03:32,199 --> 00:03:28,860
shown bill shopping 2005 and others in a

87
00:03:36,800 --> 00:03:32,209
paper that was showing that you can

88
00:03:40,009 --> 00:03:36,810

quantitatively express the relative

89
00:03:41,930 --> 00:03:40,019
thermal maturity of of the kerogen so

90
00:03:43,250 --> 00:03:41,940
someone else showed raman earlier and

91
00:03:44,720 --> 00:03:43,260
said oh this is into geochemical

92
00:03:47,750 --> 00:03:44,730
immature and that's basically what he's

93
00:03:50,030 --> 00:03:47,760
referring to is comparing this sweet and

94
00:03:51,500 --> 00:03:50,040
so he uses what's called the r.i.p value

95
00:03:54,830 --> 00:03:51,510
so we did a little bit of that work in

96
00:03:57,680 --> 00:03:54,840
my masters and it's kind of

97
00:04:01,190 --> 00:03:57,690
counterintuitive low geochemical

98
00:04:03,530 --> 00:04:01,200
maturity is a high r.i.p value and this

99
00:04:08,840 --> 00:04:03,540
stuff down here is really cooked almost

100
00:04:10,070 --> 00:04:08,850
almost like graphite so carbon isotopes

101
00:04:11,750 --> 00:04:10,080
just a little bit more kind of

102
00:04:14,090 --> 00:04:11,760
background stuff I said you could do it

103
00:04:16,310 --> 00:04:14,100
in carbon and in organics so carbonate

104
00:04:19,000 --> 00:04:16,320
or organic carbon here's the pretty

105
00:04:20,900 --> 00:04:19,010
equation for all your math people and

106
00:04:23,300 --> 00:04:20,910
then you what you can do is you can

107
00:04:24,950 --> 00:04:23,310
measure in the inorganic source and the

108
00:04:26,270 --> 00:04:24,960
organic source take the difference and

109
00:04:27,050 --> 00:04:26,280
that basically gives you the total

110
00:04:29,780 --> 00:04:27,060
metabolic

111
00:04:31,640 --> 00:04:29,790
for the biomass and so that's basically

112
00:04:33,740 --> 00:04:31,650
what's mainly used when you are

113
00:04:36,290 --> 00:04:33,750

inferring microbial carbon fixation

114
00:04:38,450 --> 00:04:36,300
pathways in the Precambrian is you're

115
00:04:41,510 --> 00:04:38,460
using this difference from the organic

116
00:04:44,330 --> 00:04:41,520
source to the inorganic source the catch

117
00:04:46,040 --> 00:04:44,340
is is that various metabolic pathways of

118
00:04:48,890 --> 00:04:46,050
microorganisms fraction eight carbon

119
00:04:50,810 --> 00:04:48,900
isotopes differently and to a different

120
00:04:53,720 --> 00:04:50,820
extents so that's what's shown on this

121
00:04:56,510 --> 00:04:53,730
plot here adapted from Manfred should

122
00:05:00,400 --> 00:04:56,520
Lasky in 2001 and circle at all in 2005

123
00:05:02,870 --> 00:05:00,410
so what this basically shows is average

124
00:05:06,379 --> 00:05:02,880
compositions for the inorganic species

125
00:05:08,900 --> 00:05:06,389
in the black so you have a marine carbon

126
00:05:11,060 --> 00:05:08,910
a bicarbonate atmospheric co2 develop

127
00:05:14,060 --> 00:05:11,070
co2 all roughly between zero and

128
00:05:16,969 --> 00:05:14,070
negative 10 so what carbon and carbon

129
00:05:21,770 --> 00:05:16,979
isotope terms that's relatively heavy as

130
00:05:24,110 --> 00:05:21,780
opposed to these microbial fixation

131
00:05:27,200 --> 00:05:24,120
pathways which fraction eight carbon to

132
00:05:31,370 --> 00:05:27,210
a much greater extent so anywhere from

133
00:05:34,340 --> 00:05:31,380
negative ten to negative 35 for most

134
00:05:35,840 --> 00:05:34,350
cyanobacteria photosynthetic organisms

135
00:05:38,990 --> 00:05:35,850
and when you get down into

136
00:05:41,630 --> 00:05:39,000
methanogenesis and especially methane a

137
00:05:46,580 --> 00:05:41,640
trophy so methane cycling can really

138
00:05:48,560 --> 00:05:46,590

deplete carbon isotopes quite a ways so

139
00:05:52,310 --> 00:05:48,570
when we look at this in the geologic

140
00:05:54,350 --> 00:05:52,320
record this difference between the

141
00:05:56,270 --> 00:05:54,360
organic species in the inorganic species

142
00:06:00,110 --> 00:05:56,280
is notable all the way back three and a

143
00:06:01,490 --> 00:06:00,120
half billion years potentially even 23.8

144
00:06:03,950 --> 00:06:01,500
so some of you might be familiar with

145
00:06:07,190 --> 00:06:03,960
the issue I met a sedimentary sweet so

146
00:06:09,200 --> 00:06:07,200
this is showing the organic carbon

147
00:06:11,360 --> 00:06:09,210
measured the range of it and this is

148
00:06:13,490 --> 00:06:11,370
showing carbon isotopes that have been

149
00:06:15,140 --> 00:06:13,500
altered by metamorphism so the

150
00:06:17,180 --> 00:06:15,150
metamorphism tends to drive things

151
00:06:18,320 --> 00:06:17,190
towards more heavy values and you'll

152
00:06:23,540 --> 00:06:18,330
notice actually that the carbonate

153
00:06:26,090 --> 00:06:23,550
values are depleted as well these long

154
00:06:28,760 --> 00:06:26,100
bars here what they represent our iron

155
00:06:31,700 --> 00:06:28,770
ion microprobe measurements in appetite

156
00:06:33,290 --> 00:06:31,710
grains which show that the graphite in

157
00:06:37,159 --> 00:06:33,300
there has actually been preserved

158
00:06:40,430 --> 00:06:37,169
differently than it has elsewhere in the

159
00:06:41,050 --> 00:06:40,440
rock so there is some some suggestions

160
00:06:43,700 --> 00:06:41,060
that

161
00:06:45,560 --> 00:06:43,710
carbon isotopes and carriage in might be

162
00:06:48,320 --> 00:06:45,570
preferentially preserved in certain

163
00:06:49,940 --> 00:06:48,330

minerals we've seen that in albeit and

164
00:06:53,210 --> 00:06:49,950
it appears to be so in courts as opposed

165
00:06:55,400 --> 00:06:53,220
to something like a carbonate one thing

166
00:06:57,170 --> 00:06:55,410
to note was just talking about how

167
00:06:58,610 --> 00:06:57,180
methane cycling can really deplete these

168
00:07:00,110 --> 00:06:58,620
carbon isotopes that's what's thought to

169
00:07:02,600 --> 00:07:00,120
have occurred here at the Fortescue

170
00:07:06,260 --> 00:07:02,610
corrosion excursion 2.7 billion years

171
00:07:09,860 --> 00:07:06,270
ago when you saw a large may possibly

172
00:07:12,380 --> 00:07:09,870
evolutionarily advancement of methane

173
00:07:14,870 --> 00:07:12,390
cycling metabolisms I think that's a

174
00:07:18,350 --> 00:07:14,880
pretty cool thing so looking into

175
00:07:20,330 --> 00:07:18,360
archaean one thing I work on is

176
00:07:22,760 --> 00:07:20,340
microfossils so we tie a carriage inn

177
00:07:24,980 --> 00:07:22,770
and carbon isotopes to microfossils to

178
00:07:27,350 --> 00:07:24,990
try and better understand very early

179
00:07:30,140 --> 00:07:27,360
evolution of life these are all the

180
00:07:32,120 --> 00:07:30,150
known microfossil occurrences in the

181
00:07:34,700 --> 00:07:32,130
archaean record so it's a few dozen so

182
00:07:37,100 --> 00:07:34,710
anything you find nowadays is a huge

183
00:07:39,860 --> 00:07:37,110
contribution to this so most of these

184
00:07:42,050 --> 00:07:39,870
things are relatively small less than 50

185
00:07:44,480 --> 00:07:42,060
microns but there have been more

186
00:07:46,100 --> 00:07:44,490
recently found some of these larger

187
00:07:47,420 --> 00:07:46,110
Lloyd things which are exceptionally

188
00:07:49,520 --> 00:07:47,430

large for the Precambrian and

189
00:07:53,470 --> 00:07:49,530
particularly the archaean record where

190
00:07:55,520 --> 00:07:53,480
they get up to 300 microns in diameter

191
00:07:59,360 --> 00:07:55,530
the heck are those things is a good

192
00:08:01,250 --> 00:07:59,370
question so here's just another way of

193
00:08:03,860 --> 00:08:01,260
portraying that this is just some images

194
00:08:06,470 --> 00:08:03,870
collected some from chef at all 2007 and

195
00:08:08,750 --> 00:08:06,480
some of these new extra large

196
00:08:12,080 --> 00:08:08,760
Lloyd's discovered by sujit ani at all

197
00:08:15,830 --> 00:08:12,090
in 2010 and jabot at all in 2010 2010

198
00:08:18,820 --> 00:08:15,840
was a good year so we mostly filaments

199
00:08:22,390 --> 00:08:18,830
small Lloyd's some of these kind of

200
00:08:24,980 --> 00:08:22,400
bacillus shaped things and and really

201
00:08:26,690 --> 00:08:24,990
they're so simple the morphologies are

202
00:08:29,120 --> 00:08:26,700
so simple that you have a very hard time

203
00:08:30,890 --> 00:08:29,130
tying it back to a modern microorganism

204
00:08:33,110 --> 00:08:30,900
saying yeah that's what it is oh that

205
00:08:35,600 --> 00:08:33,120
filament oh yeah it's a sulfur oxidizing

206
00:08:40,040 --> 00:08:35,610
bacteria no doubt about it so we need to

207
00:08:43,460 --> 00:08:40,050
find other methods of finding evidence

208
00:08:45,380 --> 00:08:43,470
to explain basically the paleo ecology

209
00:08:47,770 --> 00:08:45,390
of these of these fossils and one way

210
00:08:51,710 --> 00:08:47,780
you can do that is with carbon isotopes

211
00:08:53,639 --> 00:08:51,720
so some of my work at UC in Cincinnati I

212
00:08:57,569 --> 00:08:53,649
was also working in the

213
00:09:00,150 --> 00:08:57,579

a cat Val kraton from South Africa the

214
00:09:02,249 --> 00:09:00,160
2.5 two billion year old upper gamma han

215
00:09:08,280 --> 00:09:02,259
formation which is part of that can bail

216
00:09:09,929 --> 00:09:08,290
Ram Campbell ran super group and it's

217
00:09:12,389 --> 00:09:09,939
basically the distal portion of that of

218
00:09:14,340 --> 00:09:12,399
that carbonate platform and so what we

219
00:09:15,660 --> 00:09:14,350
found where we found these pretty large

220
00:09:18,299 --> 00:09:15,670
things you scale bars here are 50

221
00:09:21,720 --> 00:09:18,309
microns so they're relatively large but

222
00:09:25,619 --> 00:09:21,730
on average 100 25 microns in diameter

223
00:09:27,660 --> 00:09:25,629
all the way up to like 265 and so when

224
00:09:29,009 --> 00:09:27,670
we view them transverse to the bedding

225
00:09:31,650 --> 00:09:29,019
plane you can see that they're actually

226
00:09:33,350 --> 00:09:31,660
preserved and somewhat show kind of

227
00:09:35,639 --> 00:09:33,360
almost a resistance to compaction

228
00:09:37,160 --> 00:09:35,649
between individual layers of sediment

229
00:09:39,989 --> 00:09:37,170
which was a pretty interesting

230
00:09:41,999 --> 00:09:39,999
taphonomic feature when you basically

231
00:09:43,769 --> 00:09:42,009
slice along one of these layers you're

232
00:09:45,629 --> 00:09:43,779
looking at it from the top down and you

233
00:09:47,850 --> 00:09:45,639
get a much better idea of how spherical

234
00:09:51,989 --> 00:09:47,860
this thing is my adviser always like to

235
00:09:53,939 --> 00:09:51,999
say it's like a like a beach ball so it

236
00:09:56,069 --> 00:09:53,949
wasn't like it used to be this big large

237
00:09:57,749 --> 00:09:56,079
sphere but it's gotten all the the

238
00:09:59,639 --> 00:09:57,759

pressure out of it and it's flattened

239
00:10:01,049 --> 00:09:59,649
and you can move it around you can twist

240
00:10:02,489 --> 00:10:01,059
it fold it and that those are the kind

241
00:10:05,879 --> 00:10:02,499
of things that we think are happening

242
00:10:07,230 --> 00:10:05,889
here also when you're viewing them in

243
00:10:09,059 --> 00:10:07,240
these bedding planes you can see some of

244
00:10:10,860 --> 00:10:09,069
these filamentous microfossils so

245
00:10:12,929 --> 00:10:10,870
something we started to speculate about

246
00:10:15,499 --> 00:10:12,939
was whether we might be seeing two

247
00:10:18,689 --> 00:10:15,509
different communities one a benthic

248
00:10:21,030 --> 00:10:18,699
chemosynthetic 1 and 1a planktonic

249
00:10:22,650 --> 00:10:21,040
photosynthetic one but based on

250
00:10:23,879 --> 00:10:22,660
morphology you can't say that alone so

251
00:10:26,009 --> 00:10:23,889
what you need to do is you need to plug

252
00:10:28,259 --> 00:10:26,019
into carbon isotopes and thankfully

253
00:10:30,660 --> 00:10:28,269
nowadays Sims has become a very useful

254
00:10:32,579 --> 00:10:30,670
technique for doing this so we can use

255
00:10:33,809 --> 00:10:32,589
raman to measure the carriage in on a

256
00:10:35,790 --> 00:10:33,819
micron scale of an individual

257
00:10:37,860 --> 00:10:35,800
microfossil and then pair that with

258
00:10:39,780 --> 00:10:37,870
carbon isotope evidence of an individual

259
00:10:41,299 --> 00:10:39,790
microfossil this has been done pretty

260
00:10:44,009 --> 00:10:41,309
extensively over the last few years

261
00:10:46,199 --> 00:10:44,019
willeford at all in 2013 published this

262
00:10:48,809 --> 00:10:46,209
lovely paper and so what you can see

263
00:10:50,129 --> 00:10:48,819

basically is they noted to microfossils

264
00:10:51,179 --> 00:10:50,139
with different morphologies and they

265
00:10:53,069 --> 00:10:51,189
wanted to say okay do they have a

266
00:10:55,169 --> 00:10:53,079
similar carbon carbon isotope signature

267
00:10:57,539 --> 00:10:55,179
so when they measured them they notice

268
00:10:59,850 --> 00:10:57,549
that these ones are roughly negative 29

269
00:11:01,139 --> 00:10:59,860
these ones are roughly negative 22 so

270
00:11:03,900 --> 00:11:01,149
this suggests that there was a slightly

271
00:11:06,630 --> 00:11:03,910
different carbon fixation pathway that

272
00:11:08,370 --> 00:11:06,640
existed within these things

273
00:11:09,750 --> 00:11:08,380
and so that's what we're looking to find

274
00:11:10,710 --> 00:11:09,760
out we did both carbon isotope

275
00:11:12,330 --> 00:11:10,720
measurements on these things we

276
00:11:13,860 --> 00:11:12,340
extracted the carriage and put it in a

277
00:11:15,780 --> 00:11:13,870
mass spec and we've got about negative

278
00:11:18,150 --> 00:11:15,790
35 so if you remember that chart earlier

279
00:11:20,940 --> 00:11:18,160
that's kind of at the tail end for

280
00:11:23,090 --> 00:11:20,950
photosynthesis it's a very extreme

281
00:11:25,290 --> 00:11:23,100
depletion for purely photosynthetic

282
00:11:28,140 --> 00:11:25,300
which are more typically around negative

283
00:11:31,110 --> 00:11:28,150
25 so the question then is do we have

284
00:11:32,730 --> 00:11:31,120
two populations a photosynthetic one and

285
00:11:36,180 --> 00:11:32,740
an Tibet and a benthic chemosynthetic

286
00:11:37,440 --> 00:11:36,190
one so we'll be going to university of

287
00:11:39,390 --> 00:11:37,450
wisconsin-madison to work with john

288
00:11:41,970 --> 00:11:39,400

valley and do some some sims analyses on

289
00:11:43,320 --> 00:11:41,980
these things wouldn't be right if I

290
00:11:47,670 --> 00:11:43,330
didn't come to astrobiology conference

291
00:11:50,040 --> 00:11:47,680
and didn't talk about Mars so a lot of

292
00:11:52,680 --> 00:11:50,050
this research does have implications

293
00:11:55,770 --> 00:11:52,690
going forward particularly for sample

294
00:11:57,630 --> 00:11:55,780
return I think but curiosity has already

295
00:11:59,310 --> 00:11:57,640
detected some organic compounds which is

296
00:12:00,930 --> 00:11:59,320
great because that wasn't even its

297
00:12:02,610 --> 00:12:00,940
primary mission so it's just stumbling

298
00:12:04,320 --> 00:12:02,620
upon these things and now we have March

299
00:12:06,830 --> 00:12:04,330
2020 which is much more directed at

300
00:12:10,880 --> 00:12:06,840
searching for organics and signs of life

301
00:12:13,170 --> 00:12:10,890
and sample return is something that I

302
00:12:15,720 --> 00:12:13,180
think a lot of us very much hope to be a

303
00:12:16,740 --> 00:12:15,730
part of it be really really neat to get

304
00:12:23,190 --> 00:12:16,750
them back and throw the kitchen sink

305
00:12:26,160 --> 00:12:23,200
atom here and so I think that what we're

306
00:12:27,660 --> 00:12:26,170
trying to do now is use ramen in the

307
00:12:30,390 --> 00:12:27,670
deep UV which is this Sherlock

308
00:12:34,200 --> 00:12:30,400
instrument which will be on 2020 and we

309
00:12:36,750 --> 00:12:34,210
want to look at organics in things our

310
00:12:38,100 --> 00:12:36,760
known biological organic matter and if

311
00:12:41,190 --> 00:12:38,110
we can see what those look like in the

312
00:12:43,170 --> 00:12:41,200
deep UV on earth then if we if we see

313
00:12:44,550 --> 00:12:43,180

that on Mars with Sherlock then we'll

314
00:12:48,750 --> 00:12:44,560
have a good idea of what samples we want

315
00:12:54,690 --> 00:12:48,760
to snag up and cash for later and who

316
00:12:56,850 --> 00:12:54,700
knows what the Europeans are doing so

317
00:12:59,910 --> 00:12:56,860
yeah fine life's in organics is

318
00:13:02,760 --> 00:12:59,920
difficult there's other ways that you

319
00:13:05,070 --> 00:13:02,770
can produce organic matter that is

320
00:13:07,650 --> 00:13:05,080
carriage and like and depleted in carbon

321
00:13:09,870 --> 00:13:07,660
isotopes right so just those two things

322
00:13:11,100 --> 00:13:09,880
alone you can't say biologically for

323
00:13:15,390 --> 00:13:11,110
sure you really have to take a holistic

324
00:13:17,730 --> 00:13:15,400
approach and that's going to take a lot

325
00:13:20,500 --> 00:13:17,740
more research one thing I'd like to do

326
00:13:23,020 --> 00:13:20,510
my PhD is look at these different forms

327
00:13:24,070 --> 00:13:23,030
of organic matter and try and see if

328
00:13:25,600 --> 00:13:24,080
there are some characteristic

329
00:13:27,610 --> 00:13:25,610
differences in them that we might be

330
00:13:28,960 --> 00:13:27,620
able to discern the biogenesis V of any

331
00:13:32,650 --> 00:13:28,970
organic matter we detect on Mars which

332
00:13:34,210 --> 00:13:32,660
be awesome so how do we determine a

333
00:13:35,530 --> 00:13:34,220
biotic first biological synthesis of

334
00:13:37,180 --> 00:13:35,540
organics that's the big question I think

335
00:13:40,450 --> 00:13:37,190
right now in terms of in terms of this

336
00:13:42,490 --> 00:13:40,460
so with that I'd like to acknowledge my

337
00:13:45,520 --> 00:13:42,500
advisor my community a thesis committee

338
00:13:47,380 --> 00:13:45,530

my funding sources and absolutely the a

339
00:14:04,120 --> 00:13:47,390
grad con organizers great job guys

340
00:14:06,070 --> 00:14:04,130
appreciate questions for Jeff if you're

341
00:14:08,890 --> 00:14:06,080
looking at your sedimentary samples from

342
00:14:10,840 --> 00:14:08,900
2.5 billion years ago how prevalent are

343
00:14:12,490 --> 00:14:10,850
these features in them do you have to

344
00:14:14,470 --> 00:14:12,500
look really hard or just slice it open

345
00:14:19,660 --> 00:14:14,480
and they're pretty abundant in their own

346
00:14:21,910 --> 00:14:19,670
there so I features I think your talk

347
00:14:24,580 --> 00:14:21,920
about the microfossils yeah exactly okay

348
00:14:30,120 --> 00:14:24,590
so searching for microfossils is a very

349
00:14:32,350 --> 00:14:30,130
painstaking a thing to do it is so

350
00:14:34,780 --> 00:14:32,360
sometimes you'll go through 300 thin

351
00:14:37,090 --> 00:14:34,790
sections and not see a thing sometimes

352
00:14:39,490 --> 00:14:37,100
you'll pop one in there and it's just

353
00:14:42,970 --> 00:14:39,500
filled so in this case they were pretty

354
00:14:46,150 --> 00:14:42,980
isolated we probably went through 20 or

355
00:14:50,050 --> 00:14:46,160
30 thin sections maybe 20 and found may

356
00:14:51,940 --> 00:14:50,060
be 100 150 micro souls so and most of

357
00:14:53,680 --> 00:14:51,950
them aren't that well preserved they

358
00:14:56,080 --> 00:14:53,690
don't look that good so I put up the

359
00:14:57,580 --> 00:14:56,090
ones that look nice so we can all do you

360
00:14:59,380 --> 00:14:57,590
know how that compares to like more

361
00:15:01,180 --> 00:14:59,390
recent millions of your old Michael

362
00:15:02,830 --> 00:15:01,190
microfossils just trying to get an idea

363
00:15:07,870 --> 00:15:02,840

of abundance from back then compared to

364
00:15:10,180 --> 00:15:07,880
modern day in terms of abundance um well

365
00:15:11,920 --> 00:15:10,190
I think you have a lot more life well

366
00:15:13,510 --> 00:15:11,930
yes actually wonder if it's easy if you

367
00:15:14,590 --> 00:15:13,520
see the smaller the earth so there's

368
00:15:18,100 --> 00:15:14,600
more likelihood that you're going to

369
00:15:19,660 --> 00:15:18,110
have microfossils preserved but really

370
00:15:22,590 --> 00:15:19,670
what it comes down to is the

371
00:15:25,000 --> 00:15:22,600
preservation ille processes so

372
00:15:27,160 --> 00:15:25,010
microfossils in the Precambrian are

373
00:15:29,800 --> 00:15:27,170
really only preserved when you have

374
00:15:32,920 --> 00:15:29,810
early silica replacement and you have

375
00:15:34,170 --> 00:15:32,930
this trip formation that basically it

376
00:15:36,189 --> 00:15:34,180
traps every

377
00:15:37,569 --> 00:15:36,199
before the carbonate grains can grow

378
00:15:39,430 --> 00:15:37,579
large enough to break everything apart

379
00:15:41,350 --> 00:15:39,440
so you really need early diagenetic

380
00:15:43,480 --> 00:15:41,360
silica replacement to preserve

381
00:15:45,249 --> 00:15:43,490
microfossils which was much more common

382
00:15:47,170 --> 00:15:45,259
in the Precambrian when the oceans were

383
00:15:49,329 --> 00:15:47,180
super saturated with silica but now you

384
00:15:51,220 --> 00:15:49,339
have organisms in the oceans and the

385
00:15:54,579 --> 00:15:51,230
waters that are secreting silica taking

386
00:15:57,460 --> 00:15:54,589
it out so it just it's just not it's

387
00:16:07,030 --> 00:15:57,470
just not a prevalent process nowadays

388
00:16:08,319 --> 00:16:07,040

okay thank you yeah actually have a

389
00:16:12,430 --> 00:16:08,329
simple preparation question I'm

390
00:16:15,460 --> 00:16:12,440
wondering the prep your samples for an

391
00:16:18,790 --> 00:16:15,470
epic analysis and ramen can you utilize

392
00:16:20,170 --> 00:16:18,800
the same thin section or can you talk a

393
00:16:23,350 --> 00:16:20,180
little bit about that in terms of the

394
00:16:25,509 --> 00:16:23,360
sim preparation and ramen okay ramen is

395
00:16:27,930 --> 00:16:25,519
a lot easier than sims that's for dang

396
00:16:31,629 --> 00:16:27,940
sure i will learn that the hard way

397
00:16:33,460 --> 00:16:31,639
ramen is non-destructive so it's you can

398
00:16:35,230 --> 00:16:33,470
zap it and it won't do anything to it

399
00:16:36,790 --> 00:16:35,240
unless you zapped it with a deep UV

400
00:16:38,530 --> 00:16:36,800
laser that's some of the problems that

401
00:16:42,069 --> 00:16:38,540
are having with Sherlock is that it can

402
00:16:43,660 --> 00:16:42,079
alter the sample but in the visible

403
00:16:45,879 --> 00:16:43,670
wavelengths we were using it doesn't

404
00:16:47,470 --> 00:16:45,889
alter the sample at all so you can hit

405
00:16:49,449 --> 00:16:47,480
it with ramen but once you hit it with

406
00:16:50,590 --> 00:16:49,459
the sims it's ablating it so you're

407
00:16:54,250 --> 00:16:50,600
gonna you're going to lose some material

408
00:16:59,710 --> 00:16:54,260
there you can use the same themes in

409
00:17:01,389 --> 00:16:59,720
same thin section yeah okay let's think