

1
00:00:11,330 --> 00:00:08,419
i also want to start off with thinking

2
00:00:13,249 --> 00:00:11,340
the conference organizers are FG and

3
00:00:16,609 --> 00:00:13,259
I've got Colin Fame lab they're all

4
00:00:19,460 --> 00:00:16,619
blast I have learned a ton I'm probably

5
00:00:22,429 --> 00:00:19,470
the only one here who hasn't started

6
00:00:24,019 --> 00:00:22,439
graduate school yet but I'm probably not

7
00:00:29,179 --> 00:00:24,029
the only one who had a typo on their

8
00:00:30,800 --> 00:00:29,189
abstract so my abstract on the top it

9
00:00:32,269 --> 00:00:30,810
says University of Cincinnati that's

10
00:00:35,410 --> 00:00:32,279
where I'll be starting at the end of

11
00:00:39,530 --> 00:00:35,420
august and I'll be working with kira and

12
00:00:41,389 --> 00:00:39,540
also her advisor and each aya this work

13
00:00:45,560 --> 00:00:41,399

was done while i was a postback at

14

00:00:48,889 --> 00:00:45,570

university of oregon with my advisor

15

00:00:50,690 --> 00:00:48,899

then now my mentor Greg metallic and my

16

00:00:54,319 --> 00:00:50,700

awesome colleague undergrad Brooklyn

17

00:00:56,510 --> 00:00:54,329

goes who did great great petrographic

18

00:00:59,360 --> 00:00:56,520

work and a lot of Petra logical work on

19

00:01:02,510 --> 00:00:59,370

this study I'm just presenting most of

20

00:01:04,789 --> 00:01:02,520

the stable isotope stuff and so I did a

21

00:01:06,109 --> 00:01:04,799

kind of a small part of it but but I'm

22

00:01:08,270 --> 00:01:06,119

really grateful for a lot of her work

23

00:01:10,969 --> 00:01:08,280

the other one is that said implications

24

00:01:14,600 --> 00:01:10,979

but no I'm saying consequences so a

25

00:01:17,240 --> 00:01:14,610

little bit different okay for those who

26

00:01:21,710 --> 00:01:17,250

don't know snowball earth is or what it

27

00:01:22,969 --> 00:01:21,720

is and that's none of you right okay so

28

00:01:23,780 --> 00:01:22,979

we're down in South Australia here and

29

00:01:27,670 --> 00:01:23,790

this is where we're looking at were

30

00:01:31,270 --> 00:01:27,680

rocks the snout the snowball earth was a

31

00:01:34,460 --> 00:01:31,280

there's been a couple of them supposedly

32

00:01:36,469 --> 00:01:34,470

we're looking at the last and supposedly

33

00:01:38,630 --> 00:01:36,479

the greatest worldwide glaciation event

34

00:01:41,929 --> 00:01:38,640

somewhat proposed that it hard capped

35

00:01:45,649 --> 00:01:41,939

all the way to the equator on both the

36

00:01:47,830 --> 00:01:45,659

continents and the oceans and we're here

37

00:01:51,200 --> 00:01:47,840

to tell a little bit different story

38

00:01:55,100 --> 00:01:51,210

you've also heard it be termed the Marin

39

00:01:57,530 --> 00:01:55,110

Owen glaciation that's from the nearby

40

00:02:00,260 --> 00:01:57,540

Moreno rocks and those overlap with the

41

00:02:02,090 --> 00:02:00,270

ediacaran so we think that the Latin

42

00:02:04,340 --> 00:02:02,100

glaciation fits better fungal Latin

43

00:02:06,319 --> 00:02:04,350

formation which which coincides with the

44

00:02:10,639 --> 00:02:06,329

end of the cryogenic you can see those

45

00:02:12,790 --> 00:02:10,649

lineup and preceding the ediacaran and

46

00:02:15,520 --> 00:02:12,800

then the following Cambrian

47

00:02:18,630 --> 00:02:15,530

so here we are at the renilla siltstone

48

00:02:20,530 --> 00:02:18,640

South Australia looking at outcrop

49

00:02:22,240 --> 00:02:20,540

unfortunately I didn't get a good field

50

00:02:24,790 --> 00:02:22,250

work but a Greg brought back some

51
00:02:27,670 --> 00:02:24,800
awesome samples these a bit previously

52
00:02:32,110 --> 00:02:27,680
been interpreted as a submarine methane

53
00:02:34,030 --> 00:02:32,120
seeps and they were deposited within a

54
00:02:35,710 --> 00:02:34,040
paleo latitude of 12 degrees equator

55
00:02:37,360 --> 00:02:35,720
actually let me go back real quick I

56
00:02:39,940 --> 00:02:37,370
want to point out the Flinders range up

57
00:02:42,040 --> 00:02:39,950
here this was a deposit in a higher

58
00:02:43,720 --> 00:02:42,050
paleo latitude but it has really really

59
00:02:45,730 --> 00:02:43,730
good glacial evidence got dynamic tape

60
00:02:47,170 --> 00:02:45,740
dynamic tights taillights things like

61
00:02:50,170 --> 00:02:47,180
that that really indicates strong

62
00:02:52,020 --> 00:02:50,180
glacial evidence so we're reanalyzing

63
00:02:54,190 --> 00:02:52,030

these outcrops to see what they say

64

00:02:56,590 --> 00:02:54,200

basically we're arguing is it a

65

00:03:00,790 --> 00:02:56,600

submarine seep or is it a sub burial

66

00:03:03,970 --> 00:03:00,800

soil based on the oxygen isotopes that

67

00:03:05,500 --> 00:03:03,980

we obtained so there's a couple stark

68

00:03:08,020 --> 00:03:05,510

differences between the two when you're

69

00:03:10,930 --> 00:03:08,030

looking at them paleo Sol's have a

70

00:03:12,700 --> 00:03:10,940

really indicative red color nodules are

71

00:03:16,330 --> 00:03:12,710

usually of a regular shape they're not a

72

00:03:17,440 --> 00:03:16,340

nice a nice circular form and they have

73

00:03:20,140 --> 00:03:17,450

a little bit different composition

74

00:03:22,420 --> 00:03:20,150

compared to you can see them a methane

75

00:03:25,090 --> 00:03:22,430

seep type outcrop here which has a great

76
00:03:26,710 --> 00:03:25,100
color smooth rounded nodules and clay

77
00:03:29,650 --> 00:03:26,720
host rock so a little bit different

78
00:03:35,110 --> 00:03:29,660
there for all my strap people there's

79
00:03:37,720 --> 00:03:35,120
your strike home so this is what Greg

80
00:03:39,699 --> 00:03:37,730
brought back as a sketch and Brooklyn

81
00:03:42,040 --> 00:03:39,709
had to put into computer program to make

82
00:03:44,140 --> 00:03:42,050
it look nice and pretty like that so you

83
00:03:47,500 --> 00:03:44,150
can see here these are some of these in

84
00:03:50,890 --> 00:03:47,510
straddle deformation where it really

85
00:03:53,770 --> 00:03:50,900
developed soil which I'm going to tell

86
00:03:56,260 --> 00:03:53,780
you their soil you can see it's really a

87
00:03:57,790 --> 00:03:56,270
long gate shape and and that's a little

88
00:03:59,740 --> 00:03:57,800

bit different to than what you'd see in

89
00:04:02,170 --> 00:03:59,750
a methane seep methane seeps are usually

90
00:04:04,750 --> 00:04:02,180
more tubular so straight down I'm kind

91
00:04:05,970 --> 00:04:04,760
of like that and these kind of come in

92
00:04:10,270 --> 00:04:05,980
at a little bit of an angle like this

93
00:04:13,660 --> 00:04:10,280
which is more indicative of a sub aerial

94
00:04:16,270 --> 00:04:13,670
environment where these caps hands that

95
00:04:18,729 --> 00:04:16,280
are coming in and filling in or are are

96
00:04:20,500 --> 00:04:18,739
from a fluvial glacial type outwash so

97
00:04:22,810 --> 00:04:20,510
you can see these large sand wedges and

98
00:04:24,330 --> 00:04:22,820
large nodules the bigger it gets the

99
00:04:25,920 --> 00:04:24,340
more nodules you get

100
00:04:28,590 --> 00:04:25,930
on the larger the duration of

101
00:04:30,560 --> 00:04:28,600
development before something happens so

102
00:04:33,719 --> 00:04:30,570
this is a better kind of a

103
00:04:36,810 --> 00:04:33,729
representation of that so you can see

104
00:04:39,210 --> 00:04:36,820
when it starts off there's nice planar

105
00:04:40,830 --> 00:04:39,220
bedding and as you get more developed

106
00:04:44,370 --> 00:04:40,840
you see this nodules start to develop in

107
00:04:45,900 --> 00:04:44,380
place it's what replaces means and you

108
00:04:47,370 --> 00:04:45,910
can see house development gets more and

109
00:04:49,170 --> 00:04:47,380
more they kind of you can see these

110
00:04:50,909 --> 00:04:49,180
structures come about don't worry about

111
00:04:52,710 --> 00:04:50,919
the names those come from some crazy

112
00:04:54,990 --> 00:04:52,720
Aboriginal language and there's about

113
00:04:57,780 --> 00:04:55,000

four or five different paleosol

114

00:05:00,750 --> 00:04:57,790

classification types so I wouldn't worry

115

00:05:03,330 --> 00:05:00,760

too much about those now here's the

116

00:05:05,640 --> 00:05:03,340

nitty-gritty I don't have any complex

117

00:05:07,710 --> 00:05:05,650

mathematical models or any crazy

118

00:05:11,700 --> 00:05:07,720

instrumentation if you want to come see

119

00:05:13,500 --> 00:05:11,710

my my mass spec you can come up me after

120

00:05:16,529 --> 00:05:13,510

i'll give you a really sweet instruction

121

00:05:19,129 --> 00:05:16,539

manual so here here's what we're looking

122

00:05:23,240 --> 00:05:19,139

at the stable isotopes we collected

123

00:05:26,550 --> 00:05:23,250

compared to a previous study of that

124

00:05:29,310 --> 00:05:26,560

Mike Kennedy at all in 2008 now the

125

00:05:30,750 --> 00:05:29,320

sedimentary carbonate is a is from an

126

00:05:33,379 --> 00:05:30,760

unknown stratigraphic level but we can

127

00:05:38,340 --> 00:05:33,389

see that it's definitely depleted in

128

00:05:41,760 --> 00:05:38,350

delta 18 oxygen so for methane seeps you

129

00:05:43,770 --> 00:05:41,770

get you usually get this really nice

130

00:05:47,550 --> 00:05:43,780

vertical cross plot that's associated

131

00:05:50,159 --> 00:05:47,560

right around zero that comes from a

132

00:05:52,409 --> 00:05:50,169

couple of things usually it's because

133

00:05:54,240 --> 00:05:52,419

these are marine so this is taken from a

134

00:05:55,950 --> 00:05:54,250

miocene methane seep but it's really

135

00:05:58,110 --> 00:05:55,960

well documented so this is what we're

136

00:06:01,440 --> 00:05:58,120

basing our basing it off of and they had

137

00:06:03,120 --> 00:06:01,450

good good isotope values so we like to

138

00:06:05,100 --> 00:06:03,130

look at this and kind of compare the two

139

00:06:06,870 --> 00:06:05,110

you can obviously see the stark

140

00:06:09,930 --> 00:06:06,880

difference in that between this nice

141

00:06:12,089 --> 00:06:09,940

linear covariance right here that lines

142

00:06:14,460 --> 00:06:12,099

up with more recent soils well document

143

00:06:16,950 --> 00:06:14,470

in their isotopes as well and they show

144

00:06:20,909 --> 00:06:16,960

this nice vertical cross plot I'll come

145

00:06:23,550 --> 00:06:20,919

back to this in a second so the the

146

00:06:27,839 --> 00:06:23,560

implications of these or let me explain

147

00:06:30,029 --> 00:06:27,849

them first I guess is you could see that

148

00:06:33,149 --> 00:06:30,039

correlation between the two right and

149

00:06:35,310 --> 00:06:33,159

that covariance is really unique to a

150

00:06:38,150 --> 00:06:35,320

sub aerial environment what happens

151

00:06:41,390 --> 00:06:38,160

there is that evaporative and by law

152

00:06:44,660 --> 00:06:41,400

processes select for massive both

153

00:06:47,530 --> 00:06:44,670

isotopes and carbon dioxide so that

154

00:06:50,630 --> 00:06:47,540

doesn't usually happen when you're in a

155

00:06:53,510 --> 00:06:50,640

marine environment where the oxygen

156

00:06:54,710 --> 00:06:53,520

content is dominated by the water and so

157

00:06:56,720 --> 00:06:54,720

when you when you're looking at this

158

00:06:58,670 --> 00:06:56,730

that's what you're seeing the oxygen

159

00:07:02,060 --> 00:06:58,680

content is totally indicated by the

160

00:07:05,240 --> 00:07:02,070

water right here and the variation of

161

00:07:08,570 --> 00:07:05,250

variation in the carbon is from with

162

00:07:12,310 --> 00:07:08,580

Anna Genesis so you can get a depleted

163

00:07:14,510 --> 00:07:12,320

carbonate in that in that form or from

164

00:07:16,430 --> 00:07:14,520

just from the methane seeps themselves

165

00:07:18,230 --> 00:07:16,440

creating the methane this is really

166

00:07:20,570 --> 00:07:18,240

similar to what you're going to see it's

167

00:07:21,560 --> 00:07:20,580

a really weird term but that's basically

168

00:07:25,420 --> 00:07:21,570

saying is similar to what you're going

169

00:07:29,240 --> 00:07:25,430

to see in a wetland environment and that

170

00:07:31,460 --> 00:07:29,250

covariance right there as far as we know

171

00:07:32,930 --> 00:07:31,470

is not present in any marine rocks or

172

00:07:35,480 --> 00:07:32,940

sediment so it's very indicative of a

173

00:07:37,280 --> 00:07:35,490

sub burial environment this is a kind of

174

00:07:38,840 --> 00:07:37,290

hypothetical reconstruction we're

175

00:07:42,320 --> 00:07:38,850

looking at maybe coastal plains

176

00:07:44,780 --> 00:07:42,330

intertidal flats yet still a very cold

177

00:07:49,100 --> 00:07:44,790

and arid environment so it's not to say

178

00:07:50,780 --> 00:07:49,110

that during this supposed to snowball

179

00:07:53,570 --> 00:07:50,790

earth that we were in a temperate

180

00:07:55,250 --> 00:07:53,580

tropics no we were actually in a really

181

00:07:56,840 --> 00:07:55,260

frigid environment looks something more

182

00:08:00,260 --> 00:07:56,850

like the soils of Antarctica it really

183

00:08:03,230 --> 00:08:00,270

is what it looked like so cold but we

184

00:08:04,610 --> 00:08:03,240

don't think they are glaciated so this

185

00:08:07,010 --> 00:08:04,620

was definitely frigid looking something

186

00:08:08,870 --> 00:08:07,020

like this it's called caught pattern

187

00:08:11,300 --> 00:08:08,880

ground is what they most people call it

188

00:08:12,560 --> 00:08:11,310

this is a from a dry Valley and

189

00:08:13,760 --> 00:08:12,570

Antarctica and that's similar to the

190

00:08:17,210 --> 00:08:13,770

type of environment we're looking like

191

00:08:19,970 --> 00:08:17,220

looking at and where the where the cap

192

00:08:23,630 --> 00:08:19,980

stands are coming in and and filled from

193

00:08:24,710 --> 00:08:23,640

from this glacial outwash in ice wedges

194

00:08:27,800 --> 00:08:24,720

there are there another type of a

195

00:08:30,730 --> 00:08:27,810

similar form but I but they form

196

00:08:33,700 --> 00:08:30,740

horizontal layers within within these uh

197

00:08:36,680 --> 00:08:33,710

within the elongate area whereas a

198

00:08:38,839 --> 00:08:36,690

whereas cap sands that come in and sand

199

00:08:42,409 --> 00:08:38,849

wedges that come in and they fill almost

200

00:08:46,640 --> 00:08:42,419

vertically or kind of in a awkward kind

201
00:08:49,310 --> 00:08:46,650
of fashion irregular fashion say so

202
00:08:50,810 --> 00:08:49,320
these have no glacial till lights as far

203
00:08:52,370 --> 00:08:50,820
as we can see there's no methane seeps

204
00:08:55,550 --> 00:08:52,380
or extensive marine

205
00:08:57,380 --> 00:08:55,560
posited so this is what this was we're

206
00:08:58,910 --> 00:08:57,390
not the first ones to say this this was

207
00:09:01,520 --> 00:08:58,920
a previously interpreted a long time ago

208
00:09:03,980 --> 00:09:01,530
and we basically agree with the previous

209
00:09:07,190 --> 00:09:03,990
interpretation the other thing is that

210
00:09:10,670 --> 00:09:07,200
it doesn't appear that this deglaciation

211
00:09:13,670 --> 00:09:10,680
happened immediately really fast as has

212
00:09:15,680 --> 00:09:13,680
been previously supposed proposed when

213
00:09:18,400 --> 00:09:15,690

you had large amounts of methane going

214

00:09:20,600 --> 00:09:18,410

into the atmosphere to turn back and

215

00:09:23,570 --> 00:09:20,610

rebuttal this this snowball earth event

216

00:09:25,120 --> 00:09:23,580

it actually seems that the ediacaran was

217

00:09:30,110 --> 00:09:25,130

rather cold too and it took some time to

218

00:09:34,550 --> 00:09:30,120

gather some rather usually geologically

219

00:09:35,990 --> 00:09:34,560

speaking pretty normal now let's get to

220

00:09:39,980 --> 00:09:36,000

the astrobiology what does this mean for

221

00:09:42,230 --> 00:09:39,990

life and things like that so this this

222

00:09:43,880 --> 00:09:42,240

glaciation which still was probably one

223

00:09:47,150 --> 00:09:43,890

of the greatest glaciation events the

224

00:09:49,730 --> 00:09:47,160

earth has ever seen it preceded the

225

00:09:52,820 --> 00:09:49,740

Ediacaran and the following Cambrian

226

00:09:55,460 --> 00:09:52,830

explosion two big big biological events

227

00:09:58,210 --> 00:09:55,470

in Earth's history so we know we know

228

00:10:02,420 --> 00:09:58,220

this would probably play a huge role in

229

00:10:05,390 --> 00:10:02,430

how that that preceded but how would

230

00:10:08,210 --> 00:10:05,400

photosynthetic life survive in an

231

00:10:09,920 --> 00:10:08,220

environment where you had the oceans

232

00:10:11,990 --> 00:10:09,930

hard cap all the way to eke waiters and

233

00:10:14,240 --> 00:10:12,000

how would rebound from that it's almost

234

00:10:16,340 --> 00:10:14,250

like a the opposite of Venus where it's

235

00:10:18,950 --> 00:10:16,350

a runaway ice house effect instead of a

236

00:10:21,260 --> 00:10:18,960

runaway greenhouse effect there's been a

237

00:10:24,410 --> 00:10:21,270

couple of things proposed sloshball

238

00:10:26,630 --> 00:10:24,420

earth model thin ice model and Chris

239

00:10:29,420 --> 00:10:26,640

McKay is famous for that one or well

240

00:10:31,940 --> 00:10:29,430

known for that one and those those are

241

00:10:34,520 --> 00:10:31,950

both definitely plausible to but in our

242

00:10:36,980 --> 00:10:34,530

eyes it seems that there was probably

243

00:10:39,140 --> 00:10:36,990

more likely an equatorial ocean which

244

00:10:42,410 --> 00:10:39,150

climate models have also agreed with so

245

00:10:44,270 --> 00:10:42,420

that that's basically the simplest

246

00:10:46,040 --> 00:10:44,280

interpretation that we can come to with

247

00:10:48,410 --> 00:10:46,050

the data we've obtained the good thing

248

00:10:51,940 --> 00:10:48,420

is life did survive and responded well

249

00:10:56,030 --> 00:10:51,950

thank goodness we can all be here okay

250

00:10:57,940 --> 00:10:56,040

so this is what it you could see some

251
00:11:01,280 --> 00:10:57,950
maybe previous interpretations thinking

252
00:11:04,929 --> 00:11:01,290
snowball earth looked like this is what

253
00:11:12,079 --> 00:11:06,829
or maybe a little something more like

254
00:11:27,889 --> 00:11:12,089
this so i'll leave you with that let me

255
00:11:30,829 --> 00:11:27,899
know if you have any questions thanks hi

256
00:11:32,720 --> 00:11:30,839
I was wondering if you could use water

257
00:11:38,780 --> 00:11:32,730
carbonate oxygen isotope fractionation

258
00:11:42,049 --> 00:11:38,790
to estimate the temperatures water say

259
00:11:46,009 --> 00:11:42,059
it again water carbonate oxygen isotope

260
00:11:47,679 --> 00:11:46,019
fractionation to determine there's a to

261
00:11:50,569 --> 00:11:47,689
determine what the temperature Oh

262
00:11:53,210 --> 00:11:50,579
temperature yeah that step that's

263
00:11:56,720 --> 00:11:53,220

definitely possible it was a part of our

264

00:11:58,609 --> 00:11:56,730

study but it could definitely be done as

265

00:12:00,079 --> 00:11:58,619

far as I know there's no reason it

266

00:12:02,359 --> 00:12:00,089

couldn't be as long as you can get a

267

00:12:05,480 --> 00:12:02,369

representative outcrop and a good sample

268

00:12:08,150 --> 00:12:05,490

that could I could tell you that I'm not

269

00:12:09,949 --> 00:12:08,160

sure I haven't I mean there may be

270

00:12:12,799 --> 00:12:09,959

studies already out there indicating

271

00:12:14,090 --> 00:12:12,809

temperatures but when you when you're

272

00:12:15,559 --> 00:12:14,100

trying to apply that on a global scale

273

00:12:17,199 --> 00:12:15,569

it makes it a little bit tough you know

274

00:12:20,239 --> 00:12:17,209

what I mean you have to have a lot of

275

00:12:22,669 --> 00:12:20,249

decently supportive evidence and

276

00:12:29,199 --> 00:12:22,679

evidence the lines up but but it's

277

00:12:32,179 --> 00:12:29,209

definitely any more questions all right

278

00:12:34,730 --> 00:12:32,189

yeah so looking at your the Delta 0 vs

279

00:12:37,009 --> 00:12:34,740

Delta C figure all those other data

280

00:12:42,079 --> 00:12:37,019

points are the same rocks in the same

281

00:12:43,840 --> 00:12:42,089

region these yeah or so Arizona okay so

282

00:12:46,429 --> 00:12:43,850

yeah you can see some of these are a

283

00:12:48,650 --> 00:12:46,439

quaternary so there look actually really

284

00:12:53,360 --> 00:12:48,660

young yeah but but they still have that

285

00:12:55,999 --> 00:12:53,370

stable isotope covariance there these

286

00:12:59,239 --> 00:12:56,009

were taken so the red ones were the ones

287

00:13:03,169 --> 00:12:59,249

that I studied in particular and in the

288

00:13:04,730 --> 00:13:03,179

Kennedy paper he actually has some some

289

00:13:06,230 --> 00:13:04,740

carbonate values to that actually lined

290

00:13:07,309 --> 00:13:06,240

up a lot better with this one I'm not

291

00:13:11,419 --> 00:13:07,319

sure why we didn't include them in the

292

00:13:12,619 --> 00:13:11,429

figure but yeah they were taken from a

293

00:13:16,340 --> 00:13:12,629

lot different places and what this

294

00:13:18,260 --> 00:13:16,350

basically indicates is the more the more

295

00:13:20,030 --> 00:13:18,270

you're paleosol gets developed the

296

00:13:21,890 --> 00:13:20,040

the more depreciating and covariance

297

00:13:23,720 --> 00:13:21,900

you're going to develop right so I guess

298

00:13:25,730 --> 00:13:23,730

what I'm curious about then is whether

299

00:13:27,500 --> 00:13:25,740

or not these rocks and other rocks of

300

00:13:28,760 --> 00:13:27,510

the same age and similar rocks have been

301

00:13:32,150 --> 00:13:28,770

studied anywhere else on the planet

302

00:13:35,360 --> 00:13:32,160

besides just this one region to find out

303

00:13:39,920 --> 00:13:35,370

if these are paleosols similarly well as

304

00:13:42,110 --> 00:13:39,930

far as I know these are parasols I

305

00:13:43,690 --> 00:13:42,120

always tell people a lot of people study

306

00:13:47,360 --> 00:13:43,700

marine science for a lot of good reasons

307

00:13:51,740 --> 00:13:47,370

not a lot of people study paleosols also

308

00:13:53,150 --> 00:13:51,750

for a lot of good reasons so they're not

309

00:13:54,320 --> 00:13:53,160

well preserved in the rock record you

310

00:13:55,520 --> 00:13:54,330

know you mean so you have to be really

311

00:13:59,000 --> 00:13:55,530

careful when you find any weight and

312

00:14:00,890 --> 00:13:59,010

when you interpret them and if there was

313

00:14:03,410 --> 00:14:00,900

only a thin section you know 12 degrees

314

00:14:05,960 --> 00:14:03,420

15 degrees paleo latitude where there

315

00:14:08,330 --> 00:14:05,970

was actually paleosols there everything

316

00:14:10,700 --> 00:14:08,340

else was covered by glaciers so if you

317

00:14:12,590 --> 00:14:10,710

could find more more evidence from that

318

00:14:14,570 --> 00:14:12,600

time near produce a great time period

319

00:14:17,210 --> 00:14:14,580

and find more paleosols anything and

320

00:14:21,470 --> 00:14:17,220

corroborate that then absolutely it's