



1  
00:00:00,790 --> 00:00:07,320

[Music]

2  
00:00:11,959 --> 00:00:09,160

[Applause]

3  
00:00:12,949 --> 00:00:11,969

all right good afternoon everyone so

4  
00:00:15,379 --> 00:00:12,959

thank you very much for this opportunity

5  
00:00:17,390 --> 00:00:15,389

to get the talk so we're gonna

6  
00:00:19,159 --> 00:00:17,400

fast-forward a little bit in time about

7  
00:00:21,440 --> 00:00:19,169

a billion and a half years to the

8  
00:00:23,409 --> 00:00:21,450

Devonian and talk about the plant

9  
00:00:26,740 --> 00:00:23,419

revolution how the advent of roots

10  
00:00:29,630 --> 00:00:26,750

impacted global biogeochemical cycling

11  
00:00:32,569 --> 00:00:29,640

so kind of an important point here why

12  
00:00:34,310 --> 00:00:32,579

the Devonian why is it so unique so I

13  
00:00:37,220 --> 00:00:34,320

would argue that it's fraught with

14

00:00:39,979 --> 00:00:37,230

tremendous biological ecological and

15

00:00:42,110 --> 00:00:39,989

atmospheric change it hosted three

16

00:00:44,600 --> 00:00:42,120

pretty extraordinary events the first

17

00:00:46,850 --> 00:00:44,610

being as I mentioned the expansion and

18

00:00:50,330 --> 00:00:46,860

radiation of land plants so the advent

19

00:00:52,790 --> 00:00:50,340

of large root systems trees modern

20

00:00:56,180 --> 00:00:52,800

weathering soil formation processes and

21

00:00:57,860 --> 00:00:56,190

then modern nutrient cycling as well so

22

00:01:00,350 --> 00:00:57,870

there's also evidence of eutrophication

23

00:01:03,710 --> 00:01:00,360

and Devonian oceans on a global scale

24

00:01:06,109 --> 00:01:03,720

and then of course there's not one mass

25

00:01:08,450 --> 00:01:06,119

extinction in Devonian there's six so

26

00:01:11,630 --> 00:01:08,460

it's a very dynamic time in Earth's

27

00:01:14,690 --> 00:01:11,640

history so let's talk a little bit about

28

00:01:17,959 --> 00:01:14,700

the expansion and radiation of land

29

00:01:20,840 --> 00:01:17,969

plants so the figure on your left tiles

30

00:01:22,969 --> 00:01:20,850

a and B show what the Devonian probably

31

00:01:25,940 --> 00:01:22,979

looked like kind of early in the period

32

00:01:28,219 --> 00:01:25,950

so you have some land plants but they're

33

00:01:31,129 --> 00:01:28,229

basically relegated to areas immediately

34

00:01:33,980 --> 00:01:31,139

adjacent bodies of water you have no

35

00:01:36,819 --> 00:01:33,990

trees and the root systems were very

36

00:01:39,050 --> 00:01:36,829

very shallow so you fast forward towards

37

00:01:41,719 --> 00:01:39,060

the middle towards end of the Devonian

38

00:01:43,879 --> 00:01:41,729

in tiles C and D and you see a

39  
00:01:47,480 --> 00:01:43,889  
completely changed landscape so you now

40  
00:01:50,569 --> 00:01:47,490  
see land plants basically inhabiting

41  
00:01:52,099 --> 00:01:50,579  
continental interiors you see trees and

42  
00:01:54,199 --> 00:01:52,109  
then if you look at the figure here on

43  
00:01:56,480 --> 00:01:54,209  
the right you'll notice that as the

44  
00:01:59,510 --> 00:01:56,490  
Devonian progresses the root systems

45  
00:02:01,580 --> 00:01:59,520  
also become fairly extensive as well so

46  
00:02:04,269 --> 00:02:01,590  
we have large root systems more soil

47  
00:02:07,190 --> 00:02:04,279  
formation weathering that sort of thing

48  
00:02:10,160 --> 00:02:07,200  
so as I mentioned we have six mass

49  
00:02:11,449 --> 00:02:10,170  
extinctions in the Devonian you know

50  
00:02:13,280 --> 00:02:11,459  
some of which are much larger than

51  
00:02:16,400 --> 00:02:13,290  
others we have the end Devonian mass

52  
00:02:17,360 --> 00:02:16,410  
extinction and the upper and lower

53  
00:02:19,399 --> 00:02:17,370  
kilowatts are events

54  
00:02:21,800 --> 00:02:19,409  
fairly large but what's important to

55  
00:02:22,100 --> 00:02:21,810  
note about all these mass extinctions is

56  
00:02:24,620 --> 00:02:22,110  
that the

57  
00:02:27,950 --> 00:02:24,630  
all characterized by one thing and

58  
00:02:33,440 --> 00:02:27,960  
that's marine anoxia whether it's global

59  
00:02:35,060 --> 00:02:33,450  
or localized they all have it so there

60  
00:02:38,060 --> 00:02:35,070  
have been some authors who have tried to

61  
00:02:40,310 --> 00:02:38,070  
link these events together and probably

62  
00:02:42,590 --> 00:02:40,320  
the most prominent which has been a

63  
00:02:44,990 --> 00:02:42,600

theory proposed by Al geo and sheckler

64

00:02:47,570 --> 00:02:45,000

in 1998 that basically said that this

65

00:02:50,930 --> 00:02:47,580

rapid radiation of land plants led to a

66

00:02:52,760 --> 00:02:50,940

drastic increase in soil weathering or

67

00:02:55,310 --> 00:02:52,770

soil development and weathering and then

68

00:02:58,100 --> 00:02:55,320

an unprecedented nutrient flux into the

69

00:02:59,990 --> 00:02:58,110

Devonian oceans and then this led to

70

00:03:02,540 --> 00:03:00,000

eutrophication eventually leading to

71

00:03:05,390 --> 00:03:02,550

anoxia and this widespread anoxia is

72

00:03:08,120 --> 00:03:05,400

what probably caused all of these marine

73

00:03:11,500 --> 00:03:08,130

mass extinctions so this is a great

74

00:03:13,910 --> 00:03:11,510

theory it has a few challenges however

75

00:03:15,710 --> 00:03:13,920

the first of which is that it's kind of

76

00:03:20,270 --> 00:03:15,720

a simplistic routes off routes on

77

00:03:23,150 --> 00:03:20,280

approach so we go from you know no roots

78

00:03:25,340 --> 00:03:23,160

to roots and a pulse of weathering in

79

00:03:27,410 --> 00:03:25,350

reality this probably happened in

80

00:03:29,900 --> 00:03:27,420

multiple smaller pulses at different

81

00:03:31,520 --> 00:03:29,910

times in different locations and then

82

00:03:34,550 --> 00:03:31,530

phosphorus is cited as a primary driver

83

00:03:37,640 --> 00:03:34,560

of this eutrophication but we don't have

84

00:03:41,390 --> 00:03:37,650

a constraint on how much phosphorus was

85

00:03:43,310 --> 00:03:41,400

exported and when and this is primarily

86

00:03:45,080 --> 00:03:43,320

due to the challenges in interpreting

87

00:03:48,920 --> 00:03:45,090

marine records for phosphorus in

88

00:03:52,490 --> 00:03:48,930

particular it's very difficult to get a

89

00:03:54,890 --> 00:03:52,500

handle on export from land using marine

90

00:03:58,400 --> 00:03:54,900

records so we need kind of a new way to

91

00:04:00,770 --> 00:03:58,410

look at this and we would argue that

92

00:04:04,100 --> 00:04:00,780

probably a really good way to do this is

93

00:04:06,520 --> 00:04:04,110

to look at lakes lakes offer a very

94

00:04:09,710 --> 00:04:06,530

unique high resolution record of

95

00:04:12,320 --> 00:04:09,720

sediment input and nutrient input so why

96

00:04:15,470 --> 00:04:12,330

not use these to try to get a handle on

97

00:04:17,150 --> 00:04:15,480

phosphorus transformations and then kind

98

00:04:20,360 --> 00:04:17,160

of get this information from different

99

00:04:22,159 --> 00:04:20,370

points in the Paleo earth and put them

100

00:04:24,800 --> 00:04:22,169

together to try and create a global

101  
00:04:26,600 --> 00:04:24,810  
model and see you know can we can we

102  
00:04:32,150 --> 00:04:26,610  
actually constrain the phosphorus

103  
00:04:33,589 --> 00:04:32,160  
release in time and amount so obviously

104  
00:04:35,870 --> 00:04:33,599  
there would have been tremendous

105  
00:04:37,700 --> 00:04:35,880  
transformations within lakes

106  
00:04:40,850 --> 00:04:37,710  
for other nutrients as well including

107  
00:04:42,950 --> 00:04:40,860  
nitrogen carbon so you know we're gonna

108  
00:04:45,310 --> 00:04:42,960  
look at that as well but we'd

109  
00:04:47,900 --> 00:04:45,320  
essentially agree with algae Oh in that

110  
00:04:50,060 --> 00:04:47,910  
this mobilization from phosphorus was

111  
00:04:53,570 --> 00:04:50,070  
caused by or mobilization from land

112  
00:04:55,790 --> 00:04:53,580  
plants cause some phosphorus to dump

113  
00:04:59,680 --> 00:04:55,800

into the oceans and eventually resulted

114

00:05:02,360 --> 00:04:59,690

in these biota crises in the Devonian so

115

00:05:06,050 --> 00:05:02,370

basically the first couple steps that we

116

00:05:10,010 --> 00:05:06,060

took was to look at some sample sites in

117

00:05:12,500 --> 00:05:10,020

the Acadian basin so the first of which

118

00:05:14,810 --> 00:05:12,510

was sand side by Sentai bay in northern

119

00:05:17,480 --> 00:05:14,820

scotland and the second of which was

120

00:05:20,900 --> 00:05:17,490

ella island in greenland so these are

121

00:05:22,730 --> 00:05:20,910

pretty good sites because they are they

122

00:05:24,380 --> 00:05:22,740

are geographically geographically

123

00:05:27,620 --> 00:05:24,390

separated however they share a common

124

00:05:29,450 --> 00:05:27,630

formation in that they are both formed

125

00:05:33,710 --> 00:05:29,460

in the vicinity of the Caledonian

126  
00:05:35,930 --> 00:05:33,720  
mountains so we've got some similarities

127  
00:05:39,440 --> 00:05:35,940  
but we've also got enough separation to

128  
00:05:41,060 --> 00:05:39,450  
hopefully tell us a good story so just

129  
00:05:44,260 --> 00:05:41,070  
to give you some kind of Paleo

130  
00:05:47,240 --> 00:05:44,270  
Geographic framework here so the two

131  
00:05:49,610 --> 00:05:47,250  
sites labeled Greenland and then orkney

132  
00:05:51,830 --> 00:05:49,620  
shetland basically the same as our

133  
00:05:53,740 --> 00:05:51,840  
northern scotland site you can see that

134  
00:05:57,950 --> 00:05:53,750  
they're very close to the paleo earth

135  
00:06:01,610 --> 00:05:57,960  
they're both located on your America so

136  
00:06:03,680 --> 00:06:01,620  
a little more information on both of

137  
00:06:05,240 --> 00:06:03,690  
those sites as I mentioned form under

138  
00:06:07,550 --> 00:06:05,250

similar conditions both extensional

139

00:06:10,370 --> 00:06:07,560

basins formed from the uplift of the

140

00:06:13,160 --> 00:06:10,380

Caledonian mountains there Tim poorly

141

00:06:17,150 --> 00:06:13,170

similar the Scotland sites are from the

142

00:06:18,860 --> 00:06:17,160

late I feel Ian and the Greenland sites

143

00:06:20,690 --> 00:06:18,870

are from kind of the early to mid kvetch

144

00:06:23,990 --> 00:06:20,700

end so they're very close together

145

00:06:25,550 --> 00:06:24,000

geologically speaking the Scotland site

146

00:06:27,140 --> 00:06:25,560

is significant because it's coincident

147

00:06:29,180 --> 00:06:27,150

with the appearance of the first art gap

148

00:06:32,330 --> 00:06:29,190

Terrace trees and the Greenland site

149

00:06:34,520 --> 00:06:32,340

also contains preserved stems of small

150

00:06:38,510 --> 00:06:34,530

Bardia which is basically a cousin of

151  
00:06:40,640 --> 00:06:38,520  
our cube Terrace so let's get into the

152  
00:06:42,230 --> 00:06:40,650  
some of the results some of our initial

153  
00:06:46,790 --> 00:06:42,240  
results which should be presented before

154  
00:06:48,560 --> 00:06:46,800  
from Scotland basically show a fairly

155  
00:06:49,610 --> 00:06:48,570  
large phosphorus pulse and you can see

156  
00:06:52,670 --> 00:06:49,620  
highlighted in the orange

157  
00:06:54,290 --> 00:06:52,680  
area right around the time that we would

158  
00:06:55,280 --> 00:06:54,300  
expect to see the first Archaeopteryx

159  
00:06:57,020 --> 00:06:55,290  
trees

160  
00:06:59,960 --> 00:06:57,030  
so this graph basically shows

161  
00:07:01,610 --> 00:06:59,970  
phosphorous normalized to some to

162  
00:07:03,920 --> 00:07:01,620  
Regina's elements to kind of weed out

163  
00:07:06,439 --> 00:07:03,930

the effects of sediment focusing and

164

00:07:08,900 --> 00:07:06,449

things like that but basically what we

165

00:07:12,500 --> 00:07:08,910

see is a large nutrient pulse coincident

166

00:07:15,439 --> 00:07:12,510

with the appearance of Archaeopteryx so

167

00:07:18,560 --> 00:07:15,449

that's great so can we reproduce that

168

00:07:22,100 --> 00:07:18,570

somewhere else and the answer is yes we

169

00:07:23,870 --> 00:07:22,110

can so these are our results from Elle

170

00:07:26,270 --> 00:07:23,880

Island Greenland basically the same

171

00:07:29,330 --> 00:07:26,280

analyses so phosphorus or relative well

172

00:07:33,140 --> 00:07:29,340

as some original elements and we see the

173

00:07:35,120 --> 00:07:33,150

exact same pulse of phosphorus across

174

00:07:38,350 --> 00:07:35,130

all these graphs here highlighted in the

175

00:07:44,360 --> 00:07:38,360

gray so again we have a nutrient pulse

176

00:07:48,230 --> 00:07:44,370

similar to the pulse in Scotland and so

177

00:07:49,730 --> 00:07:48,240

you know is this a coincidence and you

178

00:07:52,010 --> 00:07:49,740

know I would like to think that it's not

179

00:07:54,800 --> 00:07:52,020

a coincidence we have two similar but

180

00:07:56,300 --> 00:07:54,810

geographically separated Lakes the

181

00:07:59,570 --> 00:07:56,310

nutrient pulses are similar in magnitude

182

00:08:00,920 --> 00:07:59,580

in nature the timing is similar and

183

00:08:05,529 --> 00:08:00,930

they're coincident with the appearance

184

00:08:07,850 --> 00:08:05,539

of the first trees so you know this is

185

00:08:10,190 --> 00:08:07,860

pretty exciting but of course it doesn't

186

00:08:12,440 --> 00:08:10,200

tell a global tale because again we're

187

00:08:14,420 --> 00:08:12,450

or in your America we haven't looked at

188

00:08:16,070 --> 00:08:14,430

anything I've gone Gondwana yet so

189

00:08:18,980 --> 00:08:16,080

that's kind of the the next step and

190

00:08:21,879 --> 00:08:18,990

what we're working on currently so we've

191

00:08:24,500 --> 00:08:21,889

kind of focused our studies on the

192

00:08:27,140 --> 00:08:24,510

aphelion kvetch in the question

193

00:08:28,520 --> 00:08:27,150

sequences or nearly custom sequences to

194

00:08:30,879 --> 00:08:28,530

see if we can find some more of these

195

00:08:34,640 --> 00:08:30,889

results in other places particularly

196

00:08:36,680 --> 00:08:34,650

Gondwana or paleo China we're currently

197

00:08:39,199 --> 00:08:36,690

analyzing another sequence from

198

00:08:43,040 --> 00:08:39,209

Greenland which is a flooville sequence

199

00:08:47,930 --> 00:08:43,050

again from the kvetching hopefully gonna

200

00:08:50,060 --> 00:08:47,940

give us some similar results but ideally

201  
00:08:52,790 --> 00:08:50,070  
we'd like to have samples from all over

202  
00:08:54,260 --> 00:08:52,800  
the paleo earth we don't have me from

203  
00:08:56,570 --> 00:08:54,270  
paleo China at the moment we don't have

204  
00:08:59,210 --> 00:08:56,580  
me from Russia but we do have some from

205  
00:09:00,530 --> 00:08:59,220  
West Falklands Bolivia some more from

206  
00:09:03,080 --> 00:09:00,540  
Orkney

207  
00:09:05,570 --> 00:09:03,090  
and possibly have access to some in New

208  
00:09:07,460 --> 00:09:05,580  
York and Pennsylvania so there's

209  
00:09:11,840 --> 00:09:07,470  
potential to have some a pretty good

210  
00:09:14,840 --> 00:09:11,850  
data set here so just to kind of wrap

211  
00:09:18,200 --> 00:09:14,850  
everything up here by looking at lakes

212  
00:09:20,300 --> 00:09:18,210  
we think that we could possibly answer

213  
00:09:23,960 --> 00:09:20,310

this long-standing scientific question

214

00:09:27,320 --> 00:09:23,970

and ultimately better understand the

215

00:09:29,090 --> 00:09:27,330

evolution of our own biosphere and then

216

00:09:31,250 --> 00:09:29,100

obviously in the spirit of the

217

00:09:33,590 --> 00:09:31,260

conference if we can understand our own

218

00:09:35,480 --> 00:09:33,600

planet you know that gives us a much

219

00:09:39,830 --> 00:09:35,490

greater chance of understanding other

220

00:09:47,870 --> 00:09:39,840

planets so with that if we have time for

221

00:09:49,640 --> 00:09:47,880

questions yeah I didn't quite understand

222

00:09:52,160 --> 00:09:49,650

the reasoning that you have plants

223

00:09:53,840 --> 00:09:52,170

develop roots and then these roots what

224

00:09:55,970 --> 00:09:53,850

do they do they crack the rocks and that

225

00:09:58,310 --> 00:09:55,980

makes this phosphorus pulse possible

226

00:10:00,860 --> 00:09:58,320

that's I mean that's essentially yeah so

227

00:10:02,350 --> 00:10:00,870

but but that's we I would think that's

228

00:10:04,250 --> 00:10:02,360

weird because these roots are presumably

229

00:10:06,080 --> 00:10:04,260

phosphorus is a valuable thing to them

230

00:10:09,440 --> 00:10:06,090

so why would they really produce it for

231

00:10:11,180 --> 00:10:09,450

other things yes yes so they basically

232

00:10:13,880 --> 00:10:11,190

mobilize this phosphorus from the

233

00:10:16,430 --> 00:10:13,890

mineral apatite and they don't use all

234

00:10:18,200 --> 00:10:16,440

of it so what they don't use essentially

235

00:10:19,310 --> 00:10:18,210

gets washed through runoff why would

236

00:10:21,590 --> 00:10:19,320

they mobilize something that they don't

237

00:10:22,400 --> 00:10:21,600

use well they do use it they just don't

238

00:10:24,680 --> 00:10:22,410

use all of it

239

00:10:26,960 --> 00:10:24,690

so that's kind of the key so once they

240

00:10:35,330 --> 00:10:26,970

have fewer roots then it's a great

241

00:10:39,170 --> 00:10:35,340

question sort of in that line is there

242

00:10:41,510 --> 00:10:39,180

any do you have any sort of a way to

243

00:10:44,180 --> 00:10:41,520

think about if you're talking more about

244

00:10:45,860 --> 00:10:44,190

like again mobilization of stuff that

245

00:10:47,720 --> 00:10:45,870

never goes into the biomass or you're

246

00:10:48,920 --> 00:10:47,730

suddenly making all this biomass and it

247

00:10:50,450 --> 00:10:48,930

starts rotting and all the stuff that

248

00:10:52,130 --> 00:10:50,460

it's rotting goes downstream and

249

00:10:54,740 --> 00:10:52,140

everything like is there a way to try to

250

00:10:56,720 --> 00:10:54,750

tell if there's if you're more talk

251

00:10:58,430 --> 00:10:56,730

about material it didn't wind up in life

252

00:11:00,680 --> 00:10:58,440

on the land or stuff that or it sort of

253

00:11:03,350 --> 00:11:00,690

increase in land biomass that then

254

00:11:05,390 --> 00:11:03,360

washes away yeah no that's that's a

255

00:11:06,920 --> 00:11:05,400

great question um yeah I don't I don't

256

00:11:09,740 --> 00:11:06,930

really know how you could necessarily

257

00:11:10,880 --> 00:11:09,750

tease out the differences there but but

258

00:11:12,540 --> 00:11:10,890

yeah that's I mean that's not they're

259

00:11:20,519 --> 00:11:12,550

not familiar with theirs

260

00:11:21,990 --> 00:11:20,529

or anything hi I'm Bethany Teeling so I

261

00:11:23,910 --> 00:11:22,000

also work on the Silurian and Devonian

262

00:11:25,889 --> 00:11:23,920

which is great so I was excited to see

263

00:11:29,190 --> 00:11:25,899

this talk I was wondering if you guys

264

00:11:32,069 --> 00:11:29,200

had just like considered the fact that

265

00:11:34,410 --> 00:11:32,079

you're very close to this this why I

266

00:11:36,120 --> 00:11:34,420

call it the Pangaea like early pangaeian

267

00:11:37,410 --> 00:11:36,130

collisional zone so you're very very

268

00:11:39,600 --> 00:11:37,420

close to all your samples are gonna be

269

00:11:42,600 --> 00:11:39,610

very close to that are you concerned at

270

00:11:44,490 --> 00:11:42,610

all about the different kinds of fluxes

271

00:11:45,810 --> 00:11:44,500

that you might get being so close to

272

00:11:47,460 --> 00:11:45,820

these uplifts and that you're

273

00:11:49,230 --> 00:11:47,470

necessarily going to get more weathering

274

00:11:51,090 --> 00:11:49,240

being closer to those uplifted areas

275

00:11:55,860 --> 00:11:51,100

yeah so that I mean that's that's

276

00:11:58,800 --> 00:11:55,870

definitely consideration as well so when

277

00:12:00,120 --> 00:11:58,810

we try to conduct other analyses and

278

00:12:02,550 --> 00:12:00,130

kind of normalize phosphorous to other

279

00:12:04,800 --> 00:12:02,560

elements that's kind of the kind of try

280

00:12:08,600 --> 00:12:04,810

to eliminate sediment focusing if we can

281

00:12:12,000 --> 00:12:08,610

but that is for sure a potential issue

282

00:12:14,180 --> 00:12:12,010

with respect to like also just how close

283

00:12:17,550 --> 00:12:14,190

these lakes are to the mountains and

284

00:12:19,260 --> 00:12:17,560

potential you know just things like you

285

00:12:20,970 --> 00:12:19,270

know it's rock slides things like that

286

00:12:23,030 --> 00:12:20,980

exposing fresh surfaces it's exposing

287

00:12:29,190 --> 00:12:23,040

more appetite so that's definitely

288

00:12:32,160 --> 00:12:29,200

definitely consideration I have a very

289

00:12:34,889 --> 00:12:32,170

naive question on your graph towards the

290

00:12:38,010 --> 00:12:34,899

end you also have a second phosphorus

291

00:12:39,840 --> 00:12:38,020

peak yeah yeah okay so that correspond

292

00:12:41,400 --> 00:12:39,850

to anything interesting so you're

293

00:12:45,680 --> 00:12:41,410

talking about this one down here yeah

294

00:12:47,850 --> 00:12:45,690

yeah so I I don't have any particular

295

00:12:48,720 --> 00:12:47,860

analysis on that particular peak but

296

00:12:50,490 --> 00:12:48,730

yeah for sure

297

00:12:53,010 --> 00:12:50,500

I mean you can see that's a that is a

298

00:12:55,050 --> 00:12:53,020

definite signal it's at the end of our

299

00:12:56,220 --> 00:12:55,060

dataset so that's kind of why I didn't

300

00:12:59,150 --> 00:12:56,230

really mention it cuz we can't really

301

00:13:01,920 --> 00:12:59,160

can't really say too much about it but

302

00:13:05,100 --> 00:13:01,930

we have definitely some plans to go back

303

00:13:06,960 --> 00:13:05,110

and resample some of these because these

304

00:13:08,130 --> 00:13:06,970

samples right here I did not collect so

305

00:13:11,670 --> 00:13:08,140

these were actually collected by dr.

306

00:13:13,949 --> 00:13:11,680

Marshall in Southampton so we've kind of

307

00:13:15,329 --> 00:13:13,959

used his data set and then analyzed his

308

00:13:17,610 --> 00:13:15,339

samples so he allowed me to sub sample

309

00:13:19,019 --> 00:13:17,620

his catalogue but ideally I would like

310

00:13:23,689 --> 00:13:19,029

to go back and I would like to get some

311

00:13:28,650 --> 00:13:26,790

hi Heather Graham kind of on the same

312

00:13:30,210 --> 00:13:28,660

line of questioning thinking

313

00:13:32,129 --> 00:13:30,220

mechanistically about where this

314

00:13:33,989 --> 00:13:32,139

phosphorus is coming from are there any

315

00:13:35,910 --> 00:13:33,999

good biomarkers or have you looked for

316

00:13:37,619 --> 00:13:35,920

any organic evidence that might tell you

317

00:13:41,040 --> 00:13:37,629

a little bit about root exudates that

318

00:13:44,790 --> 00:13:41,050

that help mobilize this material yeah so

319

00:13:46,889 --> 00:13:44,800

um we haven't necessarily looked at root

320

00:13:48,869 --> 00:13:46,899

exudates particularly but as far as

321

00:13:51,449 --> 00:13:48,879

biomarkers go you know we're basically

322

00:13:53,220 --> 00:13:51,459

using pollen assemblages to kind of to

323

00:13:56,189 --> 00:13:53,230

tell us like what what was present

324

00:13:59,389 --> 00:13:56,199

during the period so you know we have in

325

00:14:02,670 --> 00:13:59,399

the case of Scotland we have you know

326

00:14:05,309 --> 00:14:02,680

evidence of some of the early trees and

327

00:14:08,369 --> 00:14:05,319

whatnot in in Greenland we actually have

328

00:14:09,749 --> 00:14:08,379

stems from fall Bardia so we're

329

00:14:11,429 --> 00:14:09,759

definitely looking at biomarkers and

330

00:14:13,249 --> 00:14:11,439

that is probably one of the weaker

331

00:14:16,499 --> 00:14:13,259

points of our study at the moment and

332

00:14:19,499 --> 00:14:16,509

one of the criticisms on our NSF

333

00:14:21,960 --> 00:14:19,509

proposal so yeah we are for sure

334

00:14:23,549 --> 00:14:21,970

trying to so a cool thing that you might

335

00:14:24,869 --> 00:14:23,559

want to look at at the bottom of this

336

00:14:26,819 --> 00:14:24,879

where you're seeing that other peak

337

00:14:28,110 --> 00:14:26,829

since you're doing pulmonology is maybe

338

00:14:29,879 --> 00:14:28,120

think about looking at your fungal

339

00:14:35,100 --> 00:14:29,889

spores too since that's gonna have a lot

340

00:14:37,799 --> 00:14:35,110

of weathering okay yeah thank you hi I'm

341

00:14:40,259 --> 00:14:37,809

Michael do you have a sense of you know

342

00:14:42,269 --> 00:14:40,269

what time is represented by your pulse

343

00:14:44,100 --> 00:14:42,279

there and what the you know how how long

344

00:14:46,290 --> 00:14:44,110

your lake may have persisted

345

00:14:50,369 --> 00:14:46,300

yeah and that's in another weakness of

346

00:14:53,220 --> 00:14:50,379

our study is we do not have a very good

347

00:14:56,280 --> 00:14:53,230

constraint on these ages so I can tell

348

00:14:58,439 --> 00:14:56,290

you that this is probably you know over

349

00:15:00,090 --> 00:14:58,449

the course of you know maybe a couple

350

00:15:02,939 --> 00:15:00,100

million years and and that's probably

351

00:15:04,559 --> 00:15:02,949

about as best as I can do and hopefully

352

00:15:07,139 --> 00:15:04,569

we can constrain a little bit better

353

00:15:09,150 --> 00:15:07,149

before you know if we can get this to

354

00:15:12,470 --> 00:15:09,160

publication the millions years that's a

355

00:15:15,480 --> 00:15:12,480

pretty long live Lake yeah for sure