
AB
GRAD
CON23

1
00:00:14,629 --> 00:00:10,810
[Music]

2
00:00:15,770 --> 00:00:14,639
hi I'm Kimberly Sinclair I'm from the

3
00:00:17,330 --> 00:00:15,780
University of Washington department of

4
00:00:20,510 --> 00:00:17,340
Earth and space Sciences I'm working

5
00:00:21,890 --> 00:00:20,520
with David catling and Tim Elam I'm

6
00:00:23,689 --> 00:00:21,900
going to talk to you guys about this

7
00:00:25,370 --> 00:00:23,699
project the mineralogy of evaporites and

8
00:00:27,170 --> 00:00:25,380
sediments in the alkaline phosphate Rich

9
00:00:28,730 --> 00:00:27,180
Lakes of the Caribou Plateau which is

10
00:00:32,450 --> 00:00:28,740
work I've been doing with Sebastian Haas

11
00:00:33,830 --> 00:00:32,460
and is funded by the Simons Foundation

12
00:00:35,270 --> 00:00:33,840
okay so I want to give you a bit of

13
00:00:37,010 --> 00:00:35,280

background about the phosphorus problem

14
00:00:39,049 --> 00:00:37,020
in astrobiology because I know we're all

15
00:00:41,090 --> 00:00:39,059
coming from very different backgrounds

16
00:00:42,290 --> 00:00:41,100
uh there's a lot of biology talks this

17
00:00:44,450 --> 00:00:42,300
morning though so I'm sure a lot of you

18
00:00:46,690 --> 00:00:44,460
guys are caught up on this but uh so we

19
00:00:49,970 --> 00:00:46,700
all know DNA on the right hand side here

20
00:00:52,130 --> 00:00:49,980
has this sugar phosphate backbone and

21
00:00:53,869 --> 00:00:52,140
then you have your base pairs or if you

22
00:00:55,549 --> 00:00:53,879
zoom in closer you're seeing your

23
00:00:58,850 --> 00:00:55,559
phosphate group your sugar and your

24
00:01:00,889 --> 00:00:58,860
nuclear base here and in order to get

25
00:01:03,290 --> 00:01:00,899
this phosphate to incorporate into the

26
00:01:05,870 --> 00:01:03,300
nucleotide you need very high levels of

27
00:01:07,969 --> 00:01:05,880
phosphate and this has been shown by

28
00:01:10,310 --> 00:01:07,979
research done by powder at all in 2009

29
00:01:11,630 --> 00:01:10,320
so this question we want to ask is how

30
00:01:13,969 --> 00:01:11,640
much phosphorus is actually available

31
00:01:15,530 --> 00:01:13,979
for Prebiotic phosphorylation on early

32
00:01:16,789 --> 00:01:15,540
Earth

33
00:01:18,590 --> 00:01:16,799
um and even though we need these very

34
00:01:20,450 --> 00:01:18,600
high concentrations of phosphate up to

35
00:01:23,090 --> 00:01:20,460
one molar in Prebiotic phosphorylation

36
00:01:24,950 --> 00:01:23,100
experiments we only see very low

37
00:01:26,990 --> 00:01:24,960
concentrations of phosphate in the

38
00:01:29,090 --> 00:01:27,000

environment close to the micromolar

39
00:01:30,830 --> 00:01:29,100
level and that's because in natural

40
00:01:32,749 --> 00:01:30,840
Waters phosphate will combine with

41
00:01:35,330 --> 00:01:32,759
calcium and fall out of solution as an

42
00:01:38,090 --> 00:01:35,340
insoluble mineral known as appetite or

43
00:01:40,249 --> 00:01:38,100
calcium phosphate before reaching very

44
00:01:41,569 --> 00:01:40,259
high concentrations so there's a bit of

45
00:01:43,730 --> 00:01:41,579
a problem here and that's what we call

46
00:01:45,530 --> 00:01:43,740
the phosphorus problem

47
00:01:46,870 --> 00:01:45,540
we've proposed a solution to the

48
00:01:49,910 --> 00:01:46,880
phosphorus problem

49
00:01:52,069 --> 00:01:49,920
in a paper by toner catling in 2020 the

50
00:01:53,990 --> 00:01:52,079
hypothesis was stated that abundant

51
00:01:56,630 --> 00:01:54,000
carbonate leads to calcite formation

52
00:01:58,310 --> 00:01:56,640
calcite being calcium carbonate thus

53
00:02:00,889 --> 00:01:58,320
suppressing the calcium phosphate

54
00:02:02,510 --> 00:02:00,899
mineral formation and leaving phosphorus

55
00:02:03,469 --> 00:02:02,520
in solution to concentrate to higher

56
00:02:05,209 --> 00:02:03,479
levels

57
00:02:07,069 --> 00:02:05,219
so in order to test this Theory we

58
00:02:09,589 --> 00:02:07,079
visited the most phosphorus-rich lake in

59
00:02:11,869 --> 00:02:09,599
the world this plot on the right hand

60
00:02:13,550 --> 00:02:11,879
side is from toner and catling 2020 you

61
00:02:15,350 --> 00:02:13,560
see a very high phosphorus

62
00:02:17,750 --> 00:02:15,360
concentrations in these lakes on the top

63
00:02:19,250 --> 00:02:17,760

right side which are good enough in last

64
00:02:21,410 --> 00:02:19,260
chance Lake and so that's where we

65
00:02:22,670 --> 00:02:21,420
wanted to visit to understand why you're

66
00:02:24,949 --> 00:02:22,680
getting these very high concentrations

67
00:02:26,869 --> 00:02:24,959
of phosphorus we can then apply our

68
00:02:28,670 --> 00:02:26,879
understanding of these Lakes to possible

69
00:02:31,670 --> 00:02:28,680
analog Lakes on Prebiotic Earth where

70
00:02:33,350 --> 00:02:31,680
origin of life could have happened

71
00:02:34,910 --> 00:02:33,360
so a little bit about these Lakes last

72
00:02:37,190 --> 00:02:34,920
chance and good enough Lakes are

73
00:02:38,510 --> 00:02:37,200
carbonate Rich alkaline soda lakes on

74
00:02:41,210 --> 00:02:38,520
the Caribou plateau in British Columbia

75
00:02:42,949 --> 00:02:41,220
Canada left hand side you see the map of

76
00:02:45,229 --> 00:02:42,959
British Columbia here in this green

77
00:02:47,210 --> 00:02:45,239
swath is the Caribou Plateau it's right

78
00:02:48,949 --> 00:02:47,220
East of those coastal mountains not too

79
00:02:50,509 --> 00:02:48,959
far north of Vancouver

80
00:02:52,250 --> 00:02:50,519
if you were to zoom in on Google Maps

81
00:02:55,630 --> 00:02:52,260
you would see the lakes here good enough

82
00:02:57,949 --> 00:02:55,640
Lake here and last chance Lake here

83
00:02:59,869 --> 00:02:57,959
they both have very high phosphate

84
00:03:02,509 --> 00:02:59,879
concentrations but particularly Last

85
00:03:04,190 --> 00:03:02,519
Chance Lake gets up to 37 millimolar of

86
00:03:06,410 --> 00:03:04,200
phosphorus which is very high in

87
00:03:07,729 --> 00:03:06,420
comparison to that micro molar level

88
00:03:08,809 --> 00:03:07,739

that we're usually seeing in natural

89
00:03:10,850 --> 00:03:08,819
Waters

90
00:03:13,250 --> 00:03:10,860
and this is an image of Last Chance Lake

91
00:03:14,449 --> 00:03:13,260
taken in November 2021 which is what it

92
00:03:16,070 --> 00:03:14,459
looks like from the ground level so

93
00:03:18,649 --> 00:03:16,080
you're seeing it form into these sort of

94
00:03:20,330 --> 00:03:18,659
brine pools

95
00:03:22,190 --> 00:03:20,340
so a little bit of context from these

96
00:03:24,350 --> 00:03:22,200
Lakes they're too small less than

97
00:03:26,750 --> 00:03:24,360
kilometer squared shallow closed Basin

98
00:03:29,390 --> 00:03:26,760
lakes with sodium carbonate sulfate

99
00:03:31,490 --> 00:03:29,400
chlorine brines these are typical major

100
00:03:32,630 --> 00:03:31,500
ions of soda Lakes developed on basaltic

101
00:03:35,149 --> 00:03:32,640
Rock

102
00:03:37,369 --> 00:03:35,159
they're sulfate potassium phosphate and

103
00:03:39,350 --> 00:03:37,379
magnesium are abundant whereas calcium

104
00:03:41,089 --> 00:03:39,360
iron silicon and dissolved inorganic

105
00:03:42,410 --> 00:03:41,099
nitrogen are present at very low

106
00:03:45,410 --> 00:03:42,420
concentrations

107
00:03:47,990 --> 00:03:45,420
uh the salinity reaches up to 462 grams

108
00:03:50,750 --> 00:03:48,000
per liter which is about 13 times

109
00:03:54,229 --> 00:03:50,760
seawater salinity so they're very salty

110
00:03:55,670 --> 00:03:54,239
and the pH ranges from 9.7 to 10.7 in

111
00:03:57,350 --> 00:03:55,680
both of these Lakes depending on the

112
00:03:59,869 --> 00:03:57,360
time of year and the location in The

113
00:04:02,570 --> 00:03:59,879

Lakes because they do get spring in fed

114
00:04:06,350 --> 00:04:02,580
from surrounding rivers and such

115
00:04:10,190 --> 00:04:07,970
so we wanted to go and visit these Lakes

116
00:04:12,050 --> 00:04:10,200
over different seasons in order to

117
00:04:13,970 --> 00:04:12,060
understand how the mineralogy of

118
00:04:16,069 --> 00:04:13,980
different precipitates and evaporites as

119
00:04:17,270 --> 00:04:16,079
well as precipitates in the sediments

120
00:04:20,210 --> 00:04:17,280
change

121
00:04:21,469 --> 00:04:20,220
so we went in winter summer and fall and

122
00:04:24,950 --> 00:04:21,479
you can see the corresponding pictures

123
00:04:27,530 --> 00:04:24,960
here in Winter 2021 you see these brine

124
00:04:30,469 --> 00:04:27,540
pools starting to freeze over

125
00:04:32,210 --> 00:04:30,479
um and summer 22 to 2022 it enters this

126
00:04:34,070 --> 00:04:32,220
ephemeral Lake stage where it has enough

127
00:04:35,210 --> 00:04:34,080
water that it actually covers the entire

128
00:04:37,909 --> 00:04:35,220
surface

129
00:04:39,950 --> 00:04:37,919
and then in Autumn 2022 these brine

130
00:04:41,749 --> 00:04:39,960
pools are drying out into Salt Flats and

131
00:04:45,110 --> 00:04:41,759
so there's basically no water left in

132
00:04:46,550 --> 00:04:45,120
this system at all it's just salt

133
00:04:47,930 --> 00:04:46,560
so we wanted to collect lots of

134
00:04:49,249 --> 00:04:47,940
different evaporites which are these

135
00:04:51,950 --> 00:04:49,259
salts that are forming around the lake

136
00:04:54,770 --> 00:04:51,960
shore as well as precipitates within the

137
00:04:58,010 --> 00:04:54,780
lake these are different fun examples of

138
00:04:59,689 --> 00:04:58,020

evaporites we collected so in our winter

139
00:05:02,810 --> 00:04:59,699
trip you get a lot of these salts

140
00:05:05,570 --> 00:05:02,820
forming on rocks Around the Lake Shores

141
00:05:07,189 --> 00:05:05,580
around the brine pools in June this is

142
00:05:08,810 --> 00:05:07,199
an example of a precipitate that formed

143
00:05:10,310 --> 00:05:08,820
and fell to the bottom of the lake and

144
00:05:11,090 --> 00:05:10,320
so you can pick it up from under the

145
00:05:14,090 --> 00:05:11,100
water

146
00:05:17,450 --> 00:05:14,100
it's a lot of salt mixed in with mud and

147
00:05:20,390 --> 00:05:17,460
clay and then in September when it's in

148
00:05:21,950 --> 00:05:20,400
that salt crust phase you can dig into

149
00:05:23,270 --> 00:05:21,960
the salt crust and take this out and

150
00:05:24,350 --> 00:05:23,280
that's what the cross section looks like

151
00:05:26,450 --> 00:05:24,360
so you're getting these very white

152
00:05:29,090 --> 00:05:26,460
opaque salts on the top that middle

153
00:05:30,830 --> 00:05:29,100
layer of translucent Neutron salt in the

154
00:05:33,590 --> 00:05:30,840
middle and then a layer of algae right

155
00:05:37,370 --> 00:05:35,930
we also wanted to collect sediments from

156
00:05:38,810 --> 00:05:37,380
the lake bottom and so these are

157
00:05:42,110 --> 00:05:38,820
pictures of us collecting different

158
00:05:43,730 --> 00:05:42,120
sediment samples with sediment cores we

159
00:05:46,249 --> 00:05:43,740
did it both around the lake shore as

160
00:05:47,689 --> 00:05:46,259
well as at the lake bottom and then the

161
00:05:50,150 --> 00:05:47,699
center picture you see is us taking

162
00:05:51,890 --> 00:05:50,160
those sudden cores and chopping off

163
00:05:53,749 --> 00:05:51,900

different depths in order to see how the

164
00:05:56,510 --> 00:05:53,759
mineralogy changes with depth in the

165
00:06:01,070 --> 00:05:58,909
so we did a mineralogy analysis with

166
00:06:02,990 --> 00:06:01,080
x-ray diffraction we used a Brooker d8

167
00:06:04,969 --> 00:06:03,000
powder x-ray diffractometer with a

168
00:06:07,430 --> 00:06:04,979
copper anode microfocus x-ray source

169
00:06:08,689 --> 00:06:07,440
which is the Micro Focus x-ray source is

170
00:06:10,070 --> 00:06:08,699
really useful when you have very small

171
00:06:12,890 --> 00:06:10,080
quantities of powder that you're trying

172
00:06:14,810 --> 00:06:12,900
to analyze and a plotus 100K large area

173
00:06:16,310 --> 00:06:14,820
2D detector is really helpful when you

174
00:06:19,430 --> 00:06:16,320
want to increase the resolution of your

175
00:06:22,430 --> 00:06:20,689
um just a quick note about sample

176
00:06:24,050 --> 00:06:22,440
preparation we tried to isolate the

177
00:06:25,850 --> 00:06:24,060
mineral phases visually as much as we

178
00:06:28,670 --> 00:06:25,860
could from our samples in order to

179
00:06:30,950 --> 00:06:28,680
simplify the pattern matching uh grind

180
00:06:32,270 --> 00:06:30,960
it up really fine you want to have good

181
00:06:34,309 --> 00:06:32,280
particle statistics for x-ray

182
00:06:38,210 --> 00:06:34,319
diffraction and then dropping it onto a

183
00:06:39,710 --> 00:06:38,220
silica zero background sample holder to

184
00:06:42,110 --> 00:06:39,720
try and get that flat homogeneous

185
00:06:43,490 --> 00:06:42,120
surface that's so important

186
00:06:46,370 --> 00:06:43,500
and then for those of you who haven't

187
00:06:48,710 --> 00:06:46,380
seen xrd Data before this is sort of

188
00:06:50,510 --> 00:06:48,720

what it looks like uh you've got your

189
00:06:53,450 --> 00:06:50,520
two Theta on the x-axis intensity and

190
00:06:55,670 --> 00:06:53,460
the y-axis and your observed pattern is

191
00:06:58,550 --> 00:06:55,680
in blue this is using a software called

192
00:07:00,350 --> 00:06:58,560
gsas2 which is an open source code for

193
00:07:02,930 --> 00:07:00,360
xrd analysis

194
00:07:05,110 --> 00:07:02,940
and then you're trying to match database

195
00:07:07,969 --> 00:07:05,120
database patterns of different minerals

196
00:07:10,430 --> 00:07:07,979
to this observed pattern and so the

197
00:07:11,689 --> 00:07:10,440
calculated one pattern that's a

198
00:07:13,490 --> 00:07:11,699
conglomeration of all the different

199
00:07:15,050 --> 00:07:13,500
mineral phases we've identified as shown

200
00:07:17,450 --> 00:07:15,060
in green overlaid on top of that

201
00:07:18,950 --> 00:07:17,460
observed pattern

202
00:07:21,650 --> 00:07:18,960
um so this is an example of one

203
00:07:24,890 --> 00:07:21,660
evaporite and one sediment from these

204
00:07:26,809 --> 00:07:24,900
Lakes uh going through on this evaporite

205
00:07:29,390 --> 00:07:26,819
here we've identified multiple different

206
00:07:30,830 --> 00:07:29,400
sodium carbonate phases so there's a lot

207
00:07:32,809 --> 00:07:30,840
of thermom nitrite which is sodium

208
00:07:34,990 --> 00:07:32,819
carbonate with one water molecule at the

209
00:07:37,430 --> 00:07:35,000
60 weight percent level

210
00:07:39,529 --> 00:07:37,440
and then for reference in this sample

211
00:07:41,689 --> 00:07:39,539
here the thermonitrite is this blue and

212
00:07:44,150 --> 00:07:41,699
so each mineral you're supposed to you

213
00:07:46,670 --> 00:07:44,160

expect to see different Peaks and

214
00:07:48,110 --> 00:07:46,680
um the two Theta range and so we're just

215
00:07:50,029 --> 00:07:48,120
matching those Peaks

216
00:07:51,890 --> 00:07:50,039
we're also seeing Toronto which is

217
00:07:54,650 --> 00:07:51,900
another sodium carbonate as well as the

218
00:07:56,749 --> 00:07:54,660
nardite sodium sulfate halide sodium

219
00:07:58,850 --> 00:07:56,759
chloride brookite which is a sodium

220
00:08:00,890 --> 00:07:58,860
carbonate sulfate and acolyte sodium

221
00:08:02,570 --> 00:08:00,900
bicarbonate so these mineral phases are

222
00:08:04,809 --> 00:08:02,580
all very common and these evaporates

223
00:08:07,670 --> 00:08:04,819
we're finding across these Lakes

224
00:08:10,550 --> 00:08:07,680
while in the sediment we're seeing a lot

225
00:08:13,370 --> 00:08:10,560
of feldspars like albeitgeite as well as

226
00:08:16,430 --> 00:08:13,380
an orthoclase and a northite and other

227
00:08:18,529 --> 00:08:16,440
samples around the 70 to 20 to 30

228
00:08:19,969 --> 00:08:18,539
percent range

229
00:08:21,589 --> 00:08:19,979
um a secondary phase we're seeing a lot

230
00:08:23,930 --> 00:08:21,599
of in the sediments is Dolomite which is

231
00:08:25,070 --> 00:08:23,940
that calcium magnesium carbonate and

232
00:08:27,110 --> 00:08:25,080
that's very important I'll come back to

233
00:08:29,270 --> 00:08:27,120
that in a moment we're also seeing a lot

234
00:08:30,950 --> 00:08:29,280
of minor phases like quartz and

235
00:08:32,269 --> 00:08:30,960
vesuvianite and other things like that

236
00:08:34,909 --> 00:08:32,279
that are just present in the natural

237
00:08:36,409 --> 00:08:34,919
soil in the area

238
00:08:37,610 --> 00:08:36,419

so then you do this a bunch more times

239
00:08:39,829 --> 00:08:37,620
because you're a graduate student and

240
00:08:41,690 --> 00:08:39,839
you do a lot of Labor and you take a lot

241
00:08:43,670 --> 00:08:41,700
of samples

242
00:08:46,850 --> 00:08:43,680
and this comes together into the

243
00:08:48,949 --> 00:08:46,860
complete xrd results from the study so

244
00:08:50,509 --> 00:08:48,959
I've divided this into results for last

245
00:08:52,370 --> 00:08:50,519
chance Lake as well as good enough Lake

246
00:08:54,110 --> 00:08:52,380
and then in each respective like the

247
00:08:55,730 --> 00:08:54,120
sediments and the salts the salts being

248
00:08:57,530 --> 00:08:55,740
the evaporites around the lake shore as

249
00:08:59,210 --> 00:08:57,540
well as the precipitates and the lake

250
00:09:00,350 --> 00:08:59,220
on the left hand side we have all the

251
00:09:01,430 --> 00:09:00,360
different mineral phases we've

252
00:09:04,250 --> 00:09:01,440
identified

253
00:09:07,190 --> 00:09:04,260
so in the sediments the main phases of

254
00:09:09,170 --> 00:09:07,200
Interest were these feldspars both

255
00:09:12,650 --> 00:09:09,180
plagioclase feldspar as well as Alkali

256
00:09:14,990 --> 00:09:12,660
or k-feldspars as well as Dolomite those

257
00:09:16,250 --> 00:09:15,000
calcium carbonates is and Mica the clay

258
00:09:17,930 --> 00:09:16,260
minerals

259
00:09:19,610 --> 00:09:17,940
we're also seeing some thermonitrite

260
00:09:21,530 --> 00:09:19,620
that sodium carbonate and the good

261
00:09:23,509 --> 00:09:21,540
enough Lake sediments but not in the

262
00:09:26,090 --> 00:09:23,519
last chance Lake sediments

263
00:09:28,130 --> 00:09:26,100

and then the main mineral phases we're

264
00:09:29,570 --> 00:09:28,140
seeing in the evaporates or the salts

265
00:09:31,490 --> 00:09:29,580
are those sodium carbonates both

266
00:09:34,910 --> 00:09:31,500
thermonitrite and Trona as well as

267
00:09:38,150 --> 00:09:34,920
burkite that sodium carbonate sulfate

268
00:09:39,829 --> 00:09:38,160
a quick word about hydrated minerals we

269
00:09:41,449 --> 00:09:39,839
only detected thermonitrite which is

270
00:09:43,130 --> 00:09:41,459
sodium carbonate with one water molecule

271
00:09:46,430 --> 00:09:43,140
in the xod patterns after sample

272
00:09:48,530 --> 00:09:46,440
preparation however previous studies of

273
00:09:51,050 --> 00:09:48,540
this area have identified Neutron salts

274
00:09:53,630 --> 00:09:51,060
as the predominant phase Natron is just

275
00:09:55,370 --> 00:09:53,640
sodium carbonate with 10 water molecules

276
00:09:57,410 --> 00:09:55,380
um and so if the relative humidity is

277
00:10:00,350 --> 00:09:57,420
below 60 percent at zero degrees Celsius

278
00:10:01,970 --> 00:10:00,360
or 70 percent at room temperature then

279
00:10:03,350 --> 00:10:01,980
Natron will lose its water and turn into

280
00:10:04,850 --> 00:10:03,360
therminatrite and so we're just

281
00:10:07,310 --> 00:10:04,860
anticipating that's what happened in our

282
00:10:09,110 --> 00:10:07,320
samples here since the relative humidity

283
00:10:11,329 --> 00:10:09,120
in indoor environments is around 50

284
00:10:12,590 --> 00:10:11,339
percent so you can see this pot on the

285
00:10:14,930 --> 00:10:12,600
right hand side from Hanes at all

286
00:10:17,030 --> 00:10:14,940
showing Natron here turning into

287
00:10:18,350 --> 00:10:17,040
thermonitrite when you've decreased

288
00:10:20,470 --> 00:10:18,360

relative humidity and increased

289
00:10:23,269 --> 00:10:20,480
temperature

290
00:10:25,310 --> 00:10:23,279
so in summary we found that the

291
00:10:27,110 --> 00:10:25,320
evaporite so the salts are dominated by

292
00:10:28,490 --> 00:10:27,120
sodium carbonates sodium carbonate

293
00:10:30,230 --> 00:10:28,500
sulfate and sodium chloride

294
00:10:32,870 --> 00:10:30,240
demonstrating the predominance of that

295
00:10:34,550 --> 00:10:32,880
sodium ion in The Lakes whereas the

296
00:10:36,230 --> 00:10:34,560
sediments are dominated by carbonates

297
00:10:38,990 --> 00:10:36,240
both Dolomite and acry as well as

298
00:10:42,530 --> 00:10:39,000
feldspars plagioclase and kfeldspar

299
00:10:45,050 --> 00:10:42,540
quartz peroxine and Clay minerals

300
00:10:46,910 --> 00:10:45,060
however the big takeaway was we found no

301
00:10:48,829 --> 00:10:46,920
calcium phosphate which is that appetite

302
00:10:51,170 --> 00:10:48,839
I talked about earlier in any of the

303
00:10:53,389 --> 00:10:51,180
samples and this was confirmed by icpms

304
00:10:54,530 --> 00:10:53,399
data showing very low abundance of

305
00:10:56,810 --> 00:10:54,540
phosphorus and all of the different

306
00:10:58,490 --> 00:10:56,820
samples we've taken so it's not just an

307
00:11:00,769 --> 00:10:58,500
xrd fluke it's also backed up by

308
00:11:02,269 --> 00:11:00,779
Elemental abundances

309
00:11:04,490 --> 00:11:02,279
um these results are consistent with the

310
00:11:06,110 --> 00:11:04,500
hypothesis that calcium carbonates

311
00:11:09,290 --> 00:11:06,120
precipitate early in the mineralization

312
00:11:11,150 --> 00:11:09,300
sequence of these Lakes thus decreasing

313
00:11:13,310 --> 00:11:11,160

the dissolved calcium concentrations and

314
00:11:14,990 --> 00:11:13,320
allowing phosphate to accumulate to high

315
00:11:17,269 --> 00:11:15,000
concentrations instead of precipitating

316
00:11:19,430 --> 00:11:17,279
out as appetite which is that calcium

317
00:11:23,150 --> 00:11:19,440
phosphate

318
00:11:24,829 --> 00:11:23,160
concentrations in solution and that's

319
00:11:26,810 --> 00:11:24,839
great for that Prebiotic phosphorylation

320
00:11:29,269 --> 00:11:26,820
that you need very high phosphate

321
00:11:32,449 --> 00:11:29,279
concentrations to get that incorporation

322
00:11:33,710 --> 00:11:32,459
into your nucleotides and the potential

323
00:11:36,889 --> 00:11:33,720
origin of life so these could be really

324
00:11:39,230 --> 00:11:36,899
good environments for analogs for hidean

325
00:11:47,290 --> 00:11:39,240
Earth Lakes where life started

326
00:11:54,350 --> 00:11:49,610
thanks Kimberly we have plenty of time

327
00:11:58,610 --> 00:11:56,690
I have a quick one for you yeah

328
00:12:03,889 --> 00:11:58,620
um do you know how good enough Lake was

329
00:12:03,899 --> 00:12:07,550
question and when they

330
00:12:07,560 --> 00:12:10,850
win like yeast

331
00:12:14,030 --> 00:12:12,230
I was just curious because when we were

332
00:12:16,630 --> 00:12:14,040
in Australia there was a lot of strange

333
00:12:19,310 --> 00:12:16,640
Lake names out there like dead kangaroo

334
00:12:21,410 --> 00:12:19,320
uh Peaks Piggery and we didn't really

335
00:12:23,569 --> 00:12:21,420
understand like the history of them but

336
00:12:25,610 --> 00:12:23,579
yeah anyway there were a lot of jokes in

337
00:12:28,210 --> 00:12:25,620
the field uh about oh it's our last

338
00:12:39,889 --> 00:12:28,220

chance to get our last chance sample and

339
00:12:45,650 --> 00:12:43,069
hi I'm Ellie from CU Boulder and I was

340
00:12:47,750 --> 00:12:45,660
wondering if the so I know you said your

341
00:12:51,050 --> 00:12:47,760
sediments are pledged all my Micah and

342
00:12:52,730 --> 00:12:51,060
feldspar dominated I was curious if you

343
00:12:54,650 --> 00:12:52,740
would think that the similar pattern

344
00:12:56,090 --> 00:12:54,660
that you saw here would happen even if

345
00:12:58,069 --> 00:12:56,100
your soda Lake was hosted by a different

346
00:13:00,290 --> 00:12:58,079
type of like set like Base Rock

347
00:13:01,910 --> 00:13:00,300
essentially like if we change instead of

348
00:13:03,110 --> 00:13:01,920
balsaltic or things like that like do

349
00:13:04,490 --> 00:13:03,120
you feel like the same pattern would

350
00:13:05,870 --> 00:13:04,500
hold in terms of the precipitation of

351
00:13:07,190 --> 00:13:05,880
the evaporites

352
00:13:09,050 --> 00:13:07,200
yeah

353
00:13:10,790 --> 00:13:09,060
um these Lakes are very dependent on the

354
00:13:12,530 --> 00:13:10,800
host mineralogy and so you wouldn't

355
00:13:14,210 --> 00:13:12,540
expect to see the same

356
00:13:15,949 --> 00:13:14,220
um aqueous chemistry and a different

357
00:13:17,750 --> 00:13:15,959
host environment and that's one of the

358
00:13:19,850 --> 00:13:17,760
reasons why these uh this environment is

359
00:13:22,430 --> 00:13:19,860
so interesting is because of that uh

360
00:13:24,949 --> 00:13:22,440
plagioclase bass Rock causing

361
00:13:26,629 --> 00:13:24,959
um this very specific aqueous chemistry

362
00:13:28,910 --> 00:13:26,639
um so even just like what is it 100

363
00:13:31,850 --> 00:13:28,920

miles nearby is an incredibly

364
00:13:34,190 --> 00:13:31,860
sulfate-rich Lake that people study for

365
00:13:43,550 --> 00:13:34,200
different reasons so slight change in

366
00:13:47,449 --> 00:13:45,949
a really interesting talk uh I have kind

367
00:13:49,850 --> 00:13:47,459
of two questions

368
00:13:52,550 --> 00:13:49,860
um you mentioned that you collected

369
00:13:53,690 --> 00:13:52,560
samples seasonally ended sediment by

370
00:13:55,129 --> 00:13:53,700
death measurements do you see any

371
00:13:57,170 --> 00:13:55,139
variability

372
00:13:59,810 --> 00:13:57,180
um in your mineralization based on like

373
00:14:01,069 --> 00:13:59,820
seasons and was that reflected any depth

374
00:14:04,069 --> 00:14:01,079
transect

375
00:14:06,949 --> 00:14:04,079
yes we hoped we would see more variation

376
00:14:09,650 --> 00:14:06,959
but we didn't uh the only variation you

377
00:14:11,509 --> 00:14:09,660
really saw was that you could say and

378
00:14:13,370 --> 00:14:11,519
maybe this isn't even a statistically

379
00:14:15,230 --> 00:14:13,380
like significant conclusion is that you

380
00:14:17,810 --> 00:14:15,240
might see more Dolomite at the top of

381
00:14:19,490 --> 00:14:17,820
the sediment core so like right in the

382
00:14:20,990 --> 00:14:19,500
interaction Zone with the water you're

383
00:14:22,850 --> 00:14:21,000
getting less Dolomite at depth which

384
00:14:24,889 --> 00:14:22,860
makes sense for calcium carbonate

385
00:14:26,269 --> 00:14:24,899
precipitating out of solution whereas at

386
00:14:28,190 --> 00:14:26,279
depth in the sediment cores you're

387
00:14:30,530 --> 00:14:28,200
getting more of those feldspars which is

388
00:14:41,110 --> 00:14:30,540

just the host Rock but not as much in

389
00:14:41,120 --> 00:14:44,990
two slides back

390
00:14:50,350 --> 00:14:47,750
yeah so like you have data for I think

391
00:14:53,389 --> 00:14:50,360
uh necklite

392
00:14:55,430 --> 00:14:53,399
and third nine diet which has

393
00:14:58,370 --> 00:14:55,440
uncertainty higher than the data so is

394
00:14:59,870 --> 00:14:58,380
it normal or how can you explain this

395
00:15:01,970 --> 00:14:59,880
sorry could you say the last part again

396
00:15:03,829 --> 00:15:01,980
so the uncertainty in the data is higher

397
00:15:05,870 --> 00:15:03,839
than the the value so can you explain

398
00:15:08,329 --> 00:15:05,880
this yes because a lot of these samples

399
00:15:09,710 --> 00:15:08,339
only have these minor phases and a

400
00:15:11,150 --> 00:15:09,720
couple of the samples

401
00:15:12,530 --> 00:15:11,160
um and so there's just not very good

402
00:15:13,610 --> 00:15:12,540
counting statistics we're talking about

403
00:15:15,710 --> 00:15:13,620
maybe

404
00:15:18,590 --> 00:15:15,720
three out of 100 samples or something

405
00:15:21,470 --> 00:15:18,600
that have these minor phases

406
00:15:23,870 --> 00:15:21,480
um so yeah

407
00:15:26,750 --> 00:15:23,880
a Taylor plattner at Georgia Institute

408
00:15:29,750 --> 00:15:26,760
of Technology this was really cool I had

409
00:15:32,150 --> 00:15:29,760
no idea that these Lakes were so high in

410
00:15:34,250 --> 00:15:32,160
phosphate um I know a couple people that

411
00:15:36,769 --> 00:15:34,260
are have studied like last chance Lake

412
00:15:37,430 --> 00:15:36,779
and then the basket Lakes

413
00:15:39,650 --> 00:15:37,440

um

414
00:15:41,389 --> 00:15:39,660
I was curious

415
00:15:42,290 --> 00:15:41,399
um because you're saying at the end you

416
00:15:44,870 --> 00:15:42,300
know

417
00:15:47,389 --> 00:15:44,880
interesting in terms of like the origin

418
00:15:48,889 --> 00:15:47,399
of Life have you thought about actually

419
00:15:50,810 --> 00:15:48,899
I have a couple questions

420
00:15:53,990 --> 00:15:50,820
um have you thought about

421
00:15:57,470 --> 00:15:54,000
like looking at what maybe preserved in

422
00:15:59,810 --> 00:15:57,480
in these salts or and I also have a

423
00:16:02,449 --> 00:15:59,820
question on I know you did xrd do you

424
00:16:02,990 --> 00:16:02,459
plan on doing any other analyzes

425
00:16:06,290 --> 00:16:03,000
um

426
00:16:07,910 --> 00:16:06,300
with your samples yeah so I guess your

427
00:16:10,550 --> 00:16:07,920
first question about if we're studying

428
00:16:13,090 --> 00:16:10,560
uh the present Life in The Lakes

429
00:16:17,750 --> 00:16:13,100
yeah

430
00:16:18,769 --> 00:16:17,760
um out of my macroscopic scale when you

431
00:16:20,689 --> 00:16:18,779
go there it's really interesting because

432
00:16:22,730 --> 00:16:20,699
you see all these brine flies that are

433
00:16:24,230 --> 00:16:22,740
just encrusted in the salt

434
00:16:25,610 --> 00:16:24,240
um which is kind of it's kind of freaky

435
00:16:28,250 --> 00:16:25,620
because in the summer you're like

436
00:16:29,990 --> 00:16:28,260
encompassed by flies and then in the

437
00:16:31,430 --> 00:16:30,000
winter it's like a fly cemetery and

438
00:16:33,050 --> 00:16:31,440

there's just a bunch of dead flies on

439
00:16:35,930 --> 00:16:33,060
the ground but

440
00:16:39,470 --> 00:16:35,940
um in a more astrobiology sense

441
00:16:41,810 --> 00:16:39,480
um there are other uh teams um at I

442
00:16:44,389 --> 00:16:41,820
think it's

443
00:16:46,550 --> 00:16:44,399
shoot University in Canada who are

444
00:16:49,129 --> 00:16:46,560
studying the current microbiology in the

445
00:16:51,410 --> 00:16:49,139
ice because there are living microbes in

446
00:16:52,670 --> 00:16:51,420
the ice in the winter and so we're not

447
00:16:54,710 --> 00:16:52,680
necessarily doing that work but there

448
00:16:59,569 --> 00:16:54,720
are colleagues who are

449
00:17:04,669 --> 00:17:02,509
yes okay so uh my section of the work

450
00:17:06,289 --> 00:17:04,679
was a lot about the mineralogy of the

451
00:17:07,730 --> 00:17:06,299
sediments and the evaporites but my

452
00:17:09,590 --> 00:17:07,740
colleague Sebastian hosted a lot more of

453
00:17:12,530 --> 00:17:09,600
the water chemistry

454
00:17:13,850 --> 00:17:12,540
um and so we're submitting a paper now

455
00:17:16,669 --> 00:17:13,860
and hopefully you'll be able to read

456
00:17:21,900 --> 00:17:16,679
that and hear all about his work as well

457
00:17:24,599 --> 00:17:23,400
[Music]

458
00:17:32,330 --> 00:17:24,609
[Applause]

459
00:17:35,320 --> 00:17:32,340
[Music]