
AbSciCon
2017
MESA, ARIZONA

1
00:00:12,250 --> 00:00:06,150
you

2
00:00:17,680 --> 00:00:14,400
[Music]

3
00:00:20,679 --> 00:00:17,690
hi I'm Lindsey Williams I'm also from

4
00:00:22,210 --> 00:00:20,689
Michigan State University and I've also

5
00:00:23,650 --> 00:00:22,220
been working at the same system that

6
00:00:26,470 --> 00:00:23,660
Mary was just speaking about today

7
00:00:28,120 --> 00:00:26,480
chromo and I'm going to be talking to

8
00:00:30,820 --> 00:00:28,130
you today about some very preliminary

9
00:00:33,130 --> 00:00:30,830
work that is a bit of a stepping stone

10
00:00:35,410 --> 00:00:33,140
in order to look at seasonal and

11
00:00:41,320 --> 00:00:35,420
episodic microbial community dynamics

12
00:00:42,610 --> 00:00:41,330
within chromo so as Mary and a few

13
00:00:46,270 --> 00:00:42,620

others have pointed out throughout the

14
00:00:50,670 --> 00:00:46,280
day sir pandas ation is a very important

15
00:00:53,440 --> 00:00:50,680
process for creating chemosynthetic

16
00:00:58,270 --> 00:00:53,450
processes that microbes used to live and

17
00:00:59,950 --> 00:00:58,280
she also introduced our field site so

18
00:01:04,450 --> 00:00:59,960
I'm not going to touch on that very much

19
00:01:06,999 --> 00:01:04,460
right now but in terms of my analyses

20
00:01:11,320 --> 00:01:07,009
and what I'll be talking about today I

21
00:01:13,960 --> 00:01:11,330
am focusing on the qv1 one and the CSW

22
00:01:16,510 --> 00:01:13,970
one one wells that are located at these

23
00:01:19,899 --> 00:01:16,520
two different wall clusters that Mary

24
00:01:26,320 --> 00:01:19,909
mentioned and they are both the uncased

25
00:01:28,830 --> 00:01:26,330
wells so the chroma wells eight wells

26
00:01:31,660 --> 00:01:28,840
were drilled in 2011 with the purpose of

27
00:01:33,760 --> 00:01:31,670
monitoring the geochemistry the

28
00:01:36,219 --> 00:01:33,770
microbiology and the hydrogeology of the

29
00:01:39,010 --> 00:01:36,229
site and thus far some of the prior

30
00:01:41,200 --> 00:01:39,020
research has indicated that there's low

31
00:01:43,300 --> 00:01:41,210
microbial diversity and has also

32
00:01:45,310 --> 00:01:43,310
indicated certain substrates that can be

33
00:01:47,080 --> 00:01:45,320
used in successfully culture some of

34
00:01:49,330 --> 00:01:47,090
these organisms and it has also

35
00:01:52,569 --> 00:01:49,340
indicated organisms that primarily

36
00:01:57,190 --> 00:01:52,579
occupy the deep an toxic source waters

37
00:01:58,719 --> 00:01:57,200
as well as oxic in anoxic interfaces so

38
00:02:02,679 --> 00:01:58,729

the thing that I want to really focus on

39
00:02:04,330 --> 00:02:02,689
in terms of the site is looking at

40
00:02:06,639 --> 00:02:04,340
seasonal dynamics so we've all

41
00:02:09,340 --> 00:02:06,649
experienced seasons here on earth but we

42
00:02:12,069 --> 00:02:09,350
do also know that other planets and

43
00:02:15,819 --> 00:02:12,079
moons can be subject to seasonality if

44
00:02:18,580 --> 00:02:15,829
they are properly oriented and so if

45
00:02:21,280 --> 00:02:18,590
they are subject to seasons this is

46
00:02:23,020 --> 00:02:21,290
going to change conditions that any life

47
00:02:26,630 --> 00:02:23,030
that may live there is going to be

48
00:02:31,210 --> 00:02:29,720
and so we have indicated either evidence

49
00:02:36,320 --> 00:02:31,220
or potential evidence of

50
00:02:40,370 --> 00:02:36,330
serpentinization on different planets

51
00:02:42,500 --> 00:02:40,380
moons and so we've also noticed within

52
00:02:46,490 --> 00:02:42,510
our own serpentinization sites at chromo

53
00:02:48,740 --> 00:02:46,500
that certain microorganisms have

54
00:02:50,990 --> 00:02:48,750
numerous genes that allow them to

55
00:02:53,630 --> 00:02:51,000
basically use a variety of different

56
00:02:55,070 --> 00:02:53,640
substrates and this can indicate that

57
00:02:56,570 --> 00:02:55,080
they might need to be able to use those

58
00:02:58,750 --> 00:02:56,580
different substrates because something

59
00:03:01,430 --> 00:02:58,760
about the environment is changing and

60
00:03:05,540 --> 00:03:01,440
basically requiring that they use

61
00:03:07,340 --> 00:03:05,550
different things in order to live so the

62
00:03:10,220 --> 00:03:07,350
things i wanted to address here were

63
00:03:13,220 --> 00:03:10,230

what factors affect microbial abundance

64
00:03:14,660 --> 00:03:13,230
overall based on all the samples that

65
00:03:17,570 --> 00:03:14,670
we've taken throughout the time there at

66
00:03:20,270 --> 00:03:17,580
site our patterns of cycling seen in

67
00:03:23,120 --> 00:03:20,280
microorganisms cell abundance and other

68
00:03:25,580 --> 00:03:23,130
geochemical parameters and do different

69
00:03:27,260 --> 00:03:25,590
factors play a larger role in microbial

70
00:03:30,140 --> 00:03:27,270
abundance in different environmental

71
00:03:37,340 --> 00:03:30,150
conditions and so to begin to look at

72
00:03:39,170 --> 00:03:37,350
this there we go

73
00:03:42,860 --> 00:03:39,180
I wanted to analyze some data that we

74
00:03:45,410 --> 00:03:42,870
had on the water table so this is data

75
00:03:47,210 --> 00:03:45,420
that we've collected starting in 2014

76
00:03:49,970 --> 00:03:47,220
and it stands through to the summer of

77
00:03:52,040 --> 00:03:49,980
2016 we had in-situ pressure and

78
00:03:53,540 --> 00:03:52,050
temperature transducers installed in

79
00:03:56,720 --> 00:03:53,550
these walls and they basically take

80
00:04:01,070 --> 00:03:56,730
hourly samples of water table elevation

81
00:04:03,050 --> 00:04:01,080
and temperature and so other than times

82
00:04:05,240 --> 00:04:03,060
that we were there and pumping which you

83
00:04:09,610 --> 00:04:05,250
can see the drawdown in the water table

84
00:04:14,000 --> 00:04:09,620
there does seem to be some evidence of

85
00:04:17,750 --> 00:04:14,010
cycling probably due to drought increase

86
00:04:19,970 --> 00:04:17,760
or decrease rain in the area these are

87
00:04:26,030 --> 00:04:19,980
two different plots the one on the left

88
00:04:28,490 --> 00:04:26,040

here this x axis is time and then up

89
00:04:31,130 --> 00:04:28,500
here we can see cell abundance in 10 to

90
00:04:33,140 --> 00:04:31,140
the 5 cells per mil and below here is

91
00:04:36,200 --> 00:04:33,150
the depth of the water table in meters

92
00:04:38,360 --> 00:04:36,210
and so at sea SW 1 1 the water table

93
00:04:39,930 --> 00:04:38,370
seems to be relatively stable but we do

94
00:04:41,790 --> 00:04:39,940
see

95
00:04:43,620 --> 00:04:41,800
visual evidence right off the bat that

96
00:04:46,680 --> 00:04:43,630
there does appear to be some cycling in

97
00:04:49,650 --> 00:04:46,690
the cell abundance and over here

98
00:04:51,240 --> 00:04:49,660
again I have the x-axis as time and I

99
00:04:53,250 --> 00:04:51,250
want to put all the geochemical and

100
00:04:55,680 --> 00:04:53,260
other parameters that we measure for on

101
00:04:58,800 --> 00:04:55,690
the same graph so some of the units are

102
00:05:02,160 --> 00:04:58,810
weird but you can see what units each of

103
00:05:04,830 --> 00:05:02,170
these are in but essentially what we see

104
00:05:08,070 --> 00:05:04,840
is that we're seeing some cyclic nature

105
00:05:12,420 --> 00:05:08,080
with ORP dissolved inorganic carbon

106
00:05:14,780 --> 00:05:12,430
dissolved methane and sulfate these are

107
00:05:17,820 --> 00:05:14,790
the same exact plots with the same axes

108
00:05:20,580 --> 00:05:17,830
and generally the same parameters here

109
00:05:22,860 --> 00:05:20,590
for QV 1:1 and we can see here that

110
00:05:24,750 --> 00:05:22,870
there's a little bit more variability

111
00:05:27,390 --> 00:05:24,760
within the water table we're still

112
00:05:29,040 --> 00:05:27,400
seeing some of that cyclic nature and

113
00:05:33,570 --> 00:05:29,050

our cell abundance and we're also seeing

114
00:05:36,120 --> 00:05:33,580
a cyclic nature in ORP dissolved methane

115
00:05:39,260 --> 00:05:36,130
and dissolved inorganic carbon so these

116
00:05:44,400 --> 00:05:39,270
are all promising in terms of looking at

117
00:05:45,930 --> 00:05:44,410
seasonal effects so what I wanted to do

118
00:05:49,080 --> 00:05:45,940
with some of this data was try to figure

119
00:05:51,240 --> 00:05:49,090
out what things are most important in

120
00:05:55,410 --> 00:05:51,250
predicting what the cell abundances so

121
00:05:57,330 --> 00:05:55,420
to quickly look at this what I wanted to

122
00:06:01,110 --> 00:05:57,340
do was create multiple linear regression

123
00:06:04,140 --> 00:06:01,120
models using the data that we have we do

124
00:06:05,910 --> 00:06:04,150
have some gaps that were in our data set

125
00:06:08,550 --> 00:06:05,920
as we weren't always able to sample for

126
00:06:11,570 --> 00:06:08,560
everything so what I did to start was

127
00:06:14,160 --> 00:06:11,580
compile all my data and essentially

128
00:06:16,560 --> 00:06:14,170
simulate my missing time points using

129
00:06:19,100 --> 00:06:16,570
Markov chain Monte Carlo permutations

130
00:06:22,970 --> 00:06:19,110
which is a method that has been used

131
00:06:25,710 --> 00:06:22,980
successfully in other biological

132
00:06:27,860 --> 00:06:25,720
applications the next thing that I did

133
00:06:31,560 --> 00:06:27,870
was set up multiple linear regressions

134
00:06:34,560 --> 00:06:31,570
setting my cell a buttons as my Y value

135
00:06:36,510 --> 00:06:34,570
and then essentially comparing it to a

136
00:06:39,060 --> 00:06:36,520
variety of different X values that would

137
00:06:41,250 --> 00:06:39,070
be my different geochemical parameters

138
00:06:44,100 --> 00:06:41,260

and so essentially what I would end up

139
00:06:47,010 --> 00:06:44,110
with is my cell abundance with an

140
00:06:48,630 --> 00:06:47,020
intercept and then plus each of those

141
00:06:50,760 --> 00:06:48,640
different geochemical parameters and

142
00:06:52,410 --> 00:06:50,770
initially I started out with every

143
00:06:53,970 --> 00:06:52,420
single variable and then

144
00:06:56,610 --> 00:06:53,980
manually remove them in a stepwise

145
00:07:01,500 --> 00:06:56,620
manner to obtain a model that had

146
00:07:05,550 --> 00:07:01,510
significant coefficients overall so I

147
00:07:08,460 --> 00:07:05,560
started with a full model to use all the

148
00:07:11,550 --> 00:07:08,470
time points that we have and for c SW 1

149
00:07:13,980 --> 00:07:11,560
1 and QV 1 1 these are the parameters

150
00:07:16,110 --> 00:07:13,990
that were deemed significant in the

151
00:07:19,890 --> 00:07:16,120
model and you can see the adjusted

152
00:07:21,750 --> 00:07:19,900
r-squared down here and the check marks

153
00:07:24,750 --> 00:07:21,760
that are displayed next to some of these

154
00:07:28,410 --> 00:07:24,760
parameters are there ones that were

155
00:07:30,630 --> 00:07:28,420
indicated as or had a clearly visual

156
00:07:33,690 --> 00:07:30,640
cyclical nature in some of those plots

157
00:07:35,370 --> 00:07:33,700
that I showed you earlier so following

158
00:07:37,680 --> 00:07:35,380
this what I really wanted to look at is

159
00:07:40,740 --> 00:07:37,690
seasonality so I need to determine how I

160
00:07:44,250 --> 00:07:40,750
was going to separate my seasons we do

161
00:07:46,320 --> 00:07:44,260
know that the lower lake county which is

162
00:07:49,590 --> 00:07:46,330
why our site is located is subject to

163
00:07:52,320 --> 00:07:49,600

flooding in the winter and then some

164
00:07:53,910 --> 00:07:52,330
drought in the summer so I appeared from

165
00:07:56,040 --> 00:07:53,920
these graphs and this data that from

166
00:07:57,900 --> 00:07:56,050
November through to March there seems to

167
00:08:00,990 --> 00:07:57,910
be significantly more precipitation in

168
00:08:04,740 --> 00:08:01,000
the system and that from April to

169
00:08:06,930 --> 00:08:04,750
October it's in a drought stage so I

170
00:08:12,920 --> 00:08:06,940
chose a wet and a dry season

171
00:08:19,140 --> 00:08:15,600
model basically to create these wet and

172
00:08:21,600 --> 00:08:19,150
dry models in doing multiple linear

173
00:08:23,130 --> 00:08:21,610
regression and so these were my

174
00:08:26,760 --> 00:08:23,140
parameters that came up as being

175
00:08:30,720 --> 00:08:26,770
significant for csw one one for the wet

176
00:08:32,400 --> 00:08:30,730
and the dry season and Valerie which has

177
00:08:34,350 --> 00:08:32,410
the star next to it was a parameter that

178
00:08:36,000 --> 00:08:34,360
was not initially in that full model

179
00:08:39,510 --> 00:08:36,010
when I used all the time points that

180
00:08:42,840 --> 00:08:39,520
indicates that Valerie may be important

181
00:08:45,990 --> 00:08:42,850
in the wet season I did the same thing

182
00:08:47,820 --> 00:08:46,000
with the QV one one Wells and again here

183
00:08:50,100 --> 00:08:47,830
you can see that the depth to the water

184
00:08:52,320 --> 00:08:50,110
table and then specific conductance in

185
00:08:54,920 --> 00:08:52,330
both the wet and dry season seem to be

186
00:08:57,180 --> 00:08:54,930
parameters that are maybe more important

187
00:09:01,310 --> 00:08:57,190
within these different seasons as

188
00:09:05,970 --> 00:09:01,320

compared to overall with my full model

189
00:09:08,490 --> 00:09:05,980
so some conclusions from this initial

190
00:09:10,560 --> 00:09:08,500
is that it does appear that unique

191
00:09:12,300 --> 00:09:10,570
parameters that are different from what

192
00:09:14,370 --> 00:09:12,310
the overall model that seems to predict

193
00:09:15,780 --> 00:09:14,380
cell abundance were found to

194
00:09:19,259 --> 00:09:15,790
significantly contribute to cell

195
00:09:21,569 --> 00:09:19,269
abundance so that does seem to indicate

196
00:09:23,699 --> 00:09:21,579
that seasonal effects on the system

197
00:09:26,759 --> 00:09:23,709
could be playing a significant role in

198
00:09:32,490 --> 00:09:26,769
microbial cell abundance and so in order

199
00:09:36,689 --> 00:09:32,500
to further investigate this I'm going to

200
00:09:38,939 --> 00:09:36,699
be incorporating 16s rRNA data in order

201
00:09:42,060 --> 00:09:38,949
to provide more robust results as well

202
00:09:44,100 --> 00:09:42,070
as indicate effects on dominant species

203
00:09:46,379 --> 00:09:44,110
in the system and then do further

204
00:09:48,540 --> 00:09:46,389
regression and clustering and other

205
00:09:52,139 --> 00:09:48,550
analyses in order to better visualize

206
00:09:54,720 --> 00:09:52,149
any trends that we see here in terms of

207
00:09:56,220 --> 00:09:54,730
implications understanding how microbial

208
00:09:58,680 --> 00:09:56,230
communities respond to changing

209
00:10:02,340 --> 00:09:58,690
environmental conditions is important in

210
00:10:04,740 --> 00:10:02,350
order to understand what taxa might be

211
00:10:08,430 --> 00:10:04,750
more prominent in a specific condition

212
00:10:10,410 --> 00:10:08,440
and so based on this if we're visiting

213
00:10:13,410 --> 00:10:10,420

an astro biological site that seems to

214
00:10:15,210 --> 00:10:13,420
be suitable that this kind of knowledge

215
00:10:16,920 --> 00:10:15,220
could be important for indicating

216
00:10:18,990 --> 00:10:16,930
geochemical parameters that might be

217
00:10:20,730 --> 00:10:19,000
more important to test for metabolic

218
00:10:23,759 --> 00:10:20,740
functions that could be occurring and

219
00:10:27,000 --> 00:10:23,769
also inform on culturing methods that

220
00:10:29,550 --> 00:10:27,010
might be more successful I would like to

221
00:10:32,819 --> 00:10:29,560
thank the strength lab group as well as

222
00:10:34,680 --> 00:10:32,829
nai RPL for funding this work and our

223
00:10:41,140 --> 00:10:34,690
collaborator collaborators for all of

224
00:10:45,740 --> 00:10:43,430
we have about three minutes for

225
00:10:57,150 --> 00:10:45,750
questions so come up to the mic if you

226
00:11:01,620 --> 00:10:59,610
do you get the same in analyzing your

227
00:11:04,170 --> 00:11:01,630
seasonal patterns have you tried using

228
00:11:06,180 --> 00:11:04,180
actual climate data for those time

229
00:11:11,820 --> 00:11:06,190
periods as opposed to annual and monthly

230
00:11:14,190 --> 00:11:11,830
averages so I have looked into that part

231
00:11:16,260 --> 00:11:14,200
of the issue

232
00:11:18,720 --> 00:11:16,270
well not issue but I guess I didn't

233
00:11:20,790 --> 00:11:18,730
really get the time to go back through

234
00:11:23,970 --> 00:11:20,800
some of the weather data and actually

235
00:11:25,410 --> 00:11:23,980
pull temperature precipitation data from

236
00:11:27,330 --> 00:11:25,420
the exact date so that we were there

237
00:11:29,010 --> 00:11:27,340
sampling so that would actually be a

238
00:11:31,350 --> 00:11:29,020

really good thing to incorporate as I

239
00:11:33,690 --> 00:11:31,360
continue with this there's been some

240
00:11:37,020 --> 00:11:33,700
pretty variable years in the past five

241
00:11:39,480 --> 00:11:37,030
so yeah you might intercept results yeah

242
00:11:48,300 --> 00:11:39,490
which could potentially help binary it

243
00:11:50,280 --> 00:11:48,310
down any more questions yeah this is

244
00:11:51,900 --> 00:11:50,290
Dave DeMaria maybe you've said this but

245
00:11:53,880 --> 00:11:51,910
it seems to me that the depth of the

246
00:11:55,950 --> 00:11:53,890
water and the well and also the just the

247
00:11:58,350 --> 00:11:55,960
chemistry of the surface the upper part

248
00:12:00,600 --> 00:11:58,360
of the well that's really what would be

249
00:12:03,780 --> 00:12:00,610
responding to seasons and maybe what

250
00:12:06,000 --> 00:12:03,790
really drives the the results that you

251
00:12:09,510 --> 00:12:06,010
see and I presume you did that but I

252
00:12:10,980 --> 00:12:09,520
just don't remember and looking at that

253
00:12:13,290 --> 00:12:10,990
well like during the winter you'd have

254
00:12:14,580 --> 00:12:13,300
more fresh water coming in right well

255
00:12:17,460 --> 00:12:14,590
would be higher and that would affect

256
00:12:19,470 --> 00:12:17,470
this gradient going down the well so I

257
00:12:23,790 --> 00:12:19,480
presume you made those connections but I

258
00:12:25,770 --> 00:12:23,800
just so all the samples essentially both

259
00:12:28,500 --> 00:12:25,780
the microbiology as well as any of the

260
00:12:31,710 --> 00:12:28,510
geochemistry samples for my purposes

261
00:12:34,830 --> 00:12:31,720
were all taken from a water pump from

262
00:12:36,570 --> 00:12:34,840
the very bottom of the wells so even

263
00:12:38,940 --> 00:12:36,580

though there is more water coming into

264
00:12:41,040 --> 00:12:38,950
system during the winter there would

265
00:12:43,050 --> 00:12:41,050
probably be a lag but essentially we'd

266
00:12:44,850 --> 00:12:43,060
probably see the influence of that

267
00:12:46,710 --> 00:12:44,860
meteor water coming down through the

268
00:12:51,720 --> 00:12:46,720
surface affecting those communities