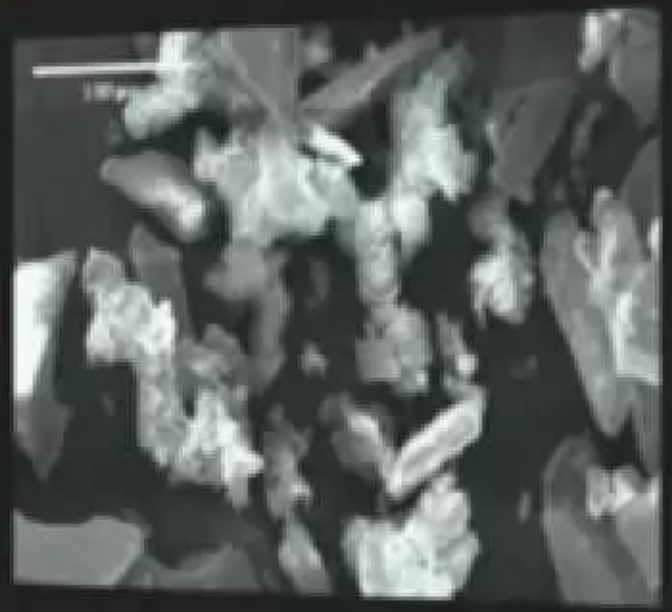

1
00:00:10,690 --> 00:00:09,459
fantastic thank you very much Lucy it

2
00:00:11,860 --> 00:00:10,700
wasn't until this morning that I

3
00:00:14,530 --> 00:00:11,870
realized there might be some

4
00:00:16,480 --> 00:00:14,540
expectations about how awesome this talk

5
00:00:18,249 --> 00:00:16,490
might be and that was a really

6
00:00:20,400 --> 00:00:18,259
terrifying thought so please take any

7
00:00:22,960 --> 00:00:20,410
expectations and kick them out the door

8
00:00:24,190 --> 00:00:22,970
I'm in that purgatory right now as a

9
00:00:25,780 --> 00:00:24,200
graduate student where I don't have a

10
00:00:27,729 --> 00:00:25,790
lot of results but I have awesome

11
00:00:29,260 --> 00:00:27,739
background to share with you if you were

12
00:00:31,030 --> 00:00:29,270
at fame lab last night then you know

13
00:00:33,729 --> 00:00:31,040

that my field site is in the Canadian

14
00:00:35,440 --> 00:00:33,739
High Arctic it's a place where elemental

15
00:00:37,720 --> 00:00:35,450
sulfur has been found on the surface of

16
00:00:40,630 --> 00:00:37,730
the ice and is considered as an analogue

17
00:00:42,880 --> 00:00:40,640
to Europa and I would also argue also as

18
00:00:44,260 --> 00:00:42,890
an analog to Mars I won't discuss that

19
00:00:46,569 --> 00:00:44,270
in this talk if you'd like to talk about

20
00:00:48,970 --> 00:00:46,579
it I can discuss those things later over

21
00:00:51,010 --> 00:00:48,980
a lot of beers this is where my field

22
00:00:52,870 --> 00:00:51,020
site is located so North America you can

23
00:00:55,360 --> 00:00:52,880
see Greenland there's Ella's Muir Island

24
00:00:56,860 --> 00:00:55,370
almost the top of the world I thought it

25
00:00:58,120 --> 00:00:56,870
was the highest land mass in the planet

26
00:00:59,139 --> 00:00:58,130
but there are two little islands of

27
00:01:02,139 --> 00:00:59,149
green line that go a little bit further

28
00:01:04,389 --> 00:01:02,149
north towards the North Pole but it's 81

29
00:01:06,069 --> 00:01:04,399
degrees north you can see here looking

30
00:01:08,350 --> 00:01:06,079
down from the Karman line at 100

31
00:01:10,599 --> 00:01:08,360
kilometers the structure of this

32
00:01:11,950 --> 00:01:10,609
north-south trending Valley there are

33
00:01:14,709 --> 00:01:11,960
mountains on the east and in the West

34
00:01:16,179 --> 00:01:14,719
where alpine glaciers are coming down

35
00:01:18,669 --> 00:01:16,189
out of the mountain system in forming

36
00:01:20,859 --> 00:01:18,679
this large coalescence glacier in the

37
00:01:22,870 --> 00:01:20,869
valley and it's on this glacier where

38
00:01:25,419 --> 00:01:22,880

these large deposits of elemental sulfur

39
00:01:27,819 --> 00:01:25,429
are found around these sulfide Springs

40
00:01:30,399 --> 00:01:27,829
and I'm sorry for not having a scale bar

41
00:01:32,739 --> 00:01:30,409
here but this is a rather large deposit

42
00:01:35,499 --> 00:01:32,749
of elemental sulfur seen in 2006

43
00:01:37,599 --> 00:01:35,509
observed that year by satellite through

44
00:01:40,179 --> 00:01:37,609
hyperspectral imaging and also seen in

45
00:01:42,190 --> 00:01:40,189
2007 in the same region so we can

46
00:01:45,099 --> 00:01:42,200
identify this sulfur on the surface from

47
00:01:47,109 --> 00:01:45,109
space with satellites this is a picture

48
00:01:49,419 --> 00:01:47,119
that looks kind of terrible now on this

49
00:01:51,879 --> 00:01:49,429
screen that I just took a few weeks ago

50
00:01:53,980 --> 00:01:51,889
at my field site again you can see this

51
00:01:56,169 --> 00:01:53,990
large icing here where there's yellow

52
00:01:58,209 --> 00:01:56,179
elemental sulfur on the surface of the

53
00:02:00,789 --> 00:01:58,219
glacier to give you a little scale this

54
00:02:02,169 --> 00:02:00,799
is me standing beside it I'll go back so

55
00:02:03,399 --> 00:02:02,179
i'll be standing up in the corner up

56
00:02:04,659 --> 00:02:03,409
here it's basically like the same

57
00:02:06,999 --> 00:02:04,669
structure standing right there and a

58
00:02:08,589 --> 00:02:07,009
little dot so you can see me standing

59
00:02:10,120 --> 00:02:08,599
beside some of this yellow software

60
00:02:12,280 --> 00:02:10,130
where it comes off the side of the

61
00:02:14,949 --> 00:02:12,290
glacier fills a small marine and goes

62
00:02:17,199 --> 00:02:14,959
down through a valley here's another

63
00:02:19,450 --> 00:02:17,209

look from helicopter when we were flying

64
00:02:21,070 --> 00:02:19,460
in and looking down there's a

65
00:02:23,980 --> 00:02:21,080
circular spot up on top of it kind of

66
00:02:25,420 --> 00:02:23,990
like a lip side that's we called the

67
00:02:28,000 --> 00:02:25,430
blister this year we've never seen that

68
00:02:29,800 --> 00:02:28,010
form before except for this year on the

69
00:02:32,740 --> 00:02:29,810
glacier we don't know why it formed yet

70
00:02:34,870 --> 00:02:32,750
our current hypothesis is that these

71
00:02:37,660 --> 00:02:34,880
things form kind of like lava tubes in

72
00:02:40,180 --> 00:02:37,670
the wintertime form large icings under

73
00:02:42,130 --> 00:02:40,190
the snow deposit elemental sulfur under

74
00:02:43,690 --> 00:02:42,140
the snow and once the snow melts in the

75
00:02:45,730 --> 00:02:43,700
summer we then see all this elemental

76
00:02:47,590 --> 00:02:45,740
sulfur and it's still being formed

77
00:02:49,540 --> 00:02:47,600
because as you might know from last

78
00:02:52,240 --> 00:02:49,550
night there was a blow out of the one

79
00:02:53,770 --> 00:02:52,250
crevasse near me while I was there we

80
00:02:55,720 --> 00:02:53,780
went back and investigated that region

81
00:02:58,120 --> 00:02:55,730
we watched it over the next few days and

82
00:02:59,920 --> 00:02:58,130
saw sulfur forming on top of that fresh

83
00:03:02,200 --> 00:02:59,930
snow and so I have samples of that

84
00:03:04,180 --> 00:03:02,210
sulfur now to work with as well one

85
00:03:05,560 --> 00:03:04,190
thing for anyone who understands the

86
00:03:07,690 --> 00:03:05,570
environmental concentrations of hydrogen

87
00:03:10,480 --> 00:03:07,700
sulfide you will note that this is a

88
00:03:12,640 --> 00:03:10,490

really high value that's the highest

89
00:03:14,740 --> 00:03:12,650
amount of sulfide or hydrogen sulfide

90
00:03:16,600 --> 00:03:14,750
found in any cold spring in North

91
00:03:18,310 --> 00:03:16,610
America to my knowledge I've never heard

92
00:03:20,020 --> 00:03:18,320
of anyone finding any more than that and

93
00:03:21,580 --> 00:03:20,030
so when you're standing there it smells

94
00:03:23,710 --> 00:03:21,590
just like being in Yellowstone it smells

95
00:03:25,630 --> 00:03:23,720
like hydrogen sulfide and the question

96
00:03:27,160 --> 00:03:25,640
originally about this field site is

97
00:03:29,470 --> 00:03:27,170
where where is all this software coming

98
00:03:31,750 --> 00:03:29,480
from on the lab there is a geological

99
00:03:33,280 --> 00:03:31,760
map of the valley so you can see the

100
00:03:34,420 --> 00:03:33,290
general structure of the glacier I have

101
00:03:36,520 --> 00:03:34,430
a yellow circle showing where the

102
00:03:39,130 --> 00:03:36,530
springs are located there are only

103
00:03:41,680 --> 00:03:39,140
really two large software sources in

104
00:03:43,510 --> 00:03:41,690
this region geologically most of the

105
00:03:45,940 --> 00:03:43,520
rock around the valley is carbonate rock

106
00:03:49,240 --> 00:03:45,950
there's some lime stones from plastics

107
00:03:52,060 --> 00:03:49,250
and some small intervening shales shell

108
00:03:54,910 --> 00:03:52,070
has sulfur in usually but not nearly

109
00:03:57,040 --> 00:03:54,920
enough software to form the masses of

110
00:03:59,290 --> 00:03:57,050
software we found every summer in the

111
00:04:02,920 --> 00:03:59,300
Arctic here by the way this was first in

112
00:04:04,450 --> 00:04:02,930
1988 first observed on foot in 1999 so

113
00:04:08,350 --> 00:04:04,460

he things been happening every summer

114
00:04:10,030 --> 00:04:08,360
for almost 30 years so anyway there's

115
00:04:11,530 --> 00:04:10,040
two regions in the area these two

116
00:04:13,720 --> 00:04:11,540
geological units in the area that have

117
00:04:16,479 --> 00:04:13,730
sulfur in and high concentrations are

118
00:04:19,060 --> 00:04:16,489
both anhydrate layers that contain a lot

119
00:04:21,130 --> 00:04:19,070
of calcium sulfate and so one is the

120
00:04:23,620 --> 00:04:21,140
Mount Bailey formation it outcrops

121
00:04:25,870 --> 00:04:23,630
nearby about 19 kilometers away but

122
00:04:28,000 --> 00:04:25,880
stratigraphically so in the layers of

123
00:04:30,460 --> 00:04:28,010
the rock record it should pinch out and

124
00:04:32,620 --> 00:04:30,470
end long before it gets the 19

125
00:04:33,040 --> 00:04:32,630
kilometers to my valley the only other

126
00:04:34,570 --> 00:04:33,050
call

127
00:04:36,700 --> 00:04:34,580
pretend the one that we think is really

128
00:04:38,680 --> 00:04:36,710
the source of all this sulfur in the

129
00:04:41,469 --> 00:04:38,690
form of sulfate is the auto few word

130
00:04:43,899 --> 00:04:41,479
formation outcrops 21 kilometers away

131
00:04:46,119 --> 00:04:43,909
but is extensive in the region there is

132
00:04:48,100 --> 00:04:46,129
dire ISM that occurs with auto fuel

133
00:04:50,499 --> 00:04:48,110
formation that's where for in this case

134
00:04:52,779 --> 00:04:50,509
like a salt would move up through the

135
00:04:53,740 --> 00:04:52,789
rock and form large tubes basically

136
00:04:56,499 --> 00:04:53,750
because it's lighter than the rock

137
00:04:58,089 --> 00:04:56,509
around it and so it moves up but those

138
00:05:00,730 --> 00:04:58,099

those die appears in the region are all

139
00:05:02,770 --> 00:05:00,740
ten kilometers wide and cause a lot of

140
00:05:04,629 --> 00:05:02,780
structural variation geologically we

141
00:05:06,249 --> 00:05:04,639
think we would see here in this region

142
00:05:08,379 --> 00:05:06,259
if that was happening so we think the

143
00:05:10,659 --> 00:05:08,389
fluids might have to travel a kilometer

144
00:05:13,059 --> 00:05:10,669
and a half into the subsurface to

145
00:05:15,070 --> 00:05:13,069
circulate around to take sulfate out and

146
00:05:17,619 --> 00:05:15,080
bring that sulfate that's sulfur source

147
00:05:19,180 --> 00:05:17,629
back to the surface but if there is

148
00:05:21,999 --> 00:05:19,190
sulfate then we have to figure out how

149
00:05:24,399 --> 00:05:22,009
we get from sulfate to saw find that h2s

150
00:05:26,950 --> 00:05:24,409
I told you about well sulfate can be

151
00:05:28,990 --> 00:05:26,960
reduced to sulfide in two ways through

152
00:05:31,659 --> 00:05:29,000
thermochemical sulfate reduction through

153
00:05:33,670 --> 00:05:31,669
biological sulfate reduction in this

154
00:05:36,189 --> 00:05:33,680
region the permafrost is about 500

155
00:05:38,170 --> 00:05:36,199
meters thick the geotherm or the change

156
00:05:40,200 --> 00:05:38,180
in temperature going down to the rocks

157
00:05:42,939 --> 00:05:40,210
it's about 22 degrees Celsius per

158
00:05:45,490 --> 00:05:42,949
kilometer which means that it would take

159
00:05:47,350 --> 00:05:45,500
about seven kilometers into the

160
00:05:49,330 --> 00:05:47,360
subsurface for thermochemical sulfate

161
00:05:51,100 --> 00:05:49,340
reduction to happen for anyone who

162
00:05:53,320 --> 00:05:51,110
understands geophysics that's way too

163
00:05:54,909 --> 00:05:53,330

deep at that point the rocks are pushing

164
00:05:57,459 --> 00:05:54,919
too hard for water to get into the

165
00:05:59,830 --> 00:05:57,469
subsurface so we think is going on is

166
00:06:02,080 --> 00:05:59,840
biological sulfate reduction it makes

167
00:06:04,059 --> 00:06:02,090
sense as a pathway and it also is

168
00:06:05,649 --> 00:06:04,069
supported by isotopic data I'm glad

169
00:06:07,300 --> 00:06:05,659
Bradley gave you an introduction the

170
00:06:10,510 --> 00:06:07,310
isotopes and what Delta means I don't

171
00:06:13,420 --> 00:06:10,520
have to explain this for Delta s this is

172
00:06:17,230 --> 00:06:13,430
Delta 34 software it's measuring the 34

173
00:06:18,760 --> 00:06:17,240
software versus 32 sulphur in this

174
00:06:21,580 --> 00:06:18,770
figure you can see at the auto floor dan

175
00:06:23,709 --> 00:06:21,590
hydrate again is our culprit gypsum

176
00:06:26,290 --> 00:06:23,719
precipitate gypsum is calcium sulfate

177
00:06:27,610 --> 00:06:26,300
dihydrate so it's remnants off eight in

178
00:06:29,890 --> 00:06:27,620
the spring water that's coming out and

179
00:06:33,430 --> 00:06:29,900
forming precipitates on the surface

180
00:06:35,800 --> 00:06:33,440
appears to be enriched in 34 sulfur

181
00:06:37,990 --> 00:06:35,810
whereas the sulfide and the software

182
00:06:41,379 --> 00:06:38,000
coming out themselves are much lower or

183
00:06:43,420 --> 00:06:41,389
depleted in 34 sulfur suggesting that

184
00:06:46,810 --> 00:06:43,430
microbes are taking this anhydride and

185
00:06:47,110 --> 00:06:46,820
are reducing the sulfate so that this is

186
00:06:51,580 --> 00:06:47,120
lie

187
00:06:53,530 --> 00:06:51,590
and this is heavy and this is supported

188
00:06:55,480 --> 00:06:53,540

by another feature in the region that I

189
00:06:57,189 --> 00:06:55,490
haven't talked about a lot to anyone

190
00:06:59,560 --> 00:06:57,199
here at the conference yet that we've

191
00:07:02,500 --> 00:06:59,570
called paleo pipes some people in the

192
00:07:04,330 --> 00:07:02,510
audience who do paleo work won't like me

193
00:07:06,990 --> 00:07:04,340
using this word to describe these things

194
00:07:09,939 --> 00:07:07,000
in this case these pipes are at most

195
00:07:12,520 --> 00:07:09,949
7,500 years old so not millions or

196
00:07:14,680 --> 00:07:12,530
billions but these are alterations

197
00:07:16,930 --> 00:07:14,690
features we found in the region near the

198
00:07:19,600 --> 00:07:16,940
toe of the glacier that appeared to

199
00:07:22,029 --> 00:07:19,610
possibly be passed pipes where fluids

200
00:07:24,070 --> 00:07:22,039
had flowed up through the subsurface and

201
00:07:26,080 --> 00:07:24,080
contacted the glacier and when the

202
00:07:28,210 --> 00:07:26,090
glacier moved away these pipes were left

203
00:07:29,590 --> 00:07:28,220
sitting out in the environment and so

204
00:07:31,600 --> 00:07:29,600
when we see these structures there's the

205
00:07:33,790 --> 00:07:31,610
carbonate rock out around that carbon

206
00:07:36,129 --> 00:07:33,800
troc starts to mix with gypsum and we

207
00:07:38,469 --> 00:07:36,139
see iron oxide iron oxy hydroxides

208
00:07:40,480 --> 00:07:38,479
around and that red rim you might see

209
00:07:43,029 --> 00:07:40,490
around the feature in the top left there

210
00:07:44,950 --> 00:07:43,039
in the center it's a lot of gypsum some

211
00:07:47,020 --> 00:07:44,960
elemental sulfur and some sulfide grains

212
00:07:49,300 --> 00:07:47,030
so it fits the model that we proposed

213
00:07:51,640 --> 00:07:49,310

for how this is actually forming and

214
00:07:54,520 --> 00:07:51,650
that supports the overall model of the

215
00:07:56,050 --> 00:07:54,530
system so meltwater is coming off the

216
00:07:58,510 --> 00:07:56,060
Blazers nearby these alpine glaciers

217
00:08:00,909 --> 00:07:58,520
other coalescence glaciers it's going

218
00:08:03,159 --> 00:08:00,919
into the subsurface potentially taking

219
00:08:05,350 --> 00:08:03,169
some of this Permian shale you see here

220
00:08:07,900 --> 00:08:05,360
taking some organic carbon out of that

221
00:08:09,750 --> 00:08:07,910
and using that to metabolize the sulfate

222
00:08:12,940 --> 00:08:09,760
down below in the salt the subsurface

223
00:08:14,320 --> 00:08:12,950
driving microbial sulfate reduction and

224
00:08:16,210 --> 00:08:14,330
so where my part of the research now

225
00:08:18,520 --> 00:08:16,220
comes in is really looking at what

226
00:08:20,950 --> 00:08:18,530
happens on the surface where there is

227
00:08:23,320 --> 00:08:20,960
this oxidation of hydrogen sulphide to

228
00:08:24,969 --> 00:08:23,330
form that yellow elemental sulfur you've

229
00:08:26,890 --> 00:08:24,979
seen in these pictures on the ice you

230
00:08:29,469 --> 00:08:26,900
can see it there in the left in 2006 a

231
00:08:33,010 --> 00:08:29,479
picture from 2007 the yellow sulfur on

232
00:08:34,420 --> 00:08:33,020
the ice when we're considering whether

233
00:08:36,310 --> 00:08:34,430
or not microorganisms could be

234
00:08:39,399 --> 00:08:36,320
responsible for some of that oxidation

235
00:08:41,320 --> 00:08:39,409
of hydrogen sulphide to solve for my

236
00:08:44,050 --> 00:08:41,330
past lab mate Catherine right who's been

237
00:08:47,949 --> 00:08:44,060
to AB grad con before before moving on

238
00:08:50,380 --> 00:08:47,959

did some work just think genomics of a

239
00:08:52,600 --> 00:08:50,390
spring deposit studying at bf not oneida

240
00:08:54,610 --> 00:08:52,610
one the far left there is right at the

241
00:08:57,699 --> 00:08:54,620
spring source and as you move right

242
00:08:59,350 --> 00:08:57,709
along this scale it's going further and

243
00:09:00,050 --> 00:08:59,360
further away from the spring so trying

244
00:09:02,270 --> 00:09:00,060
to see what organ

245
00:09:04,130 --> 00:09:02,280
isms are present and what she found is

246
00:09:06,740 --> 00:09:04,140
that these two organisms burkholderia

247
00:09:08,180 --> 00:09:06,750
and ralstonia appear to be present in

248
00:09:10,100 --> 00:09:08,190
the fluids where they emerged from the

249
00:09:12,400 --> 00:09:10,110
glacier potentially being involved in

250
00:09:14,450 --> 00:09:12,410
that sulfate reduction in the subsurface

251
00:09:17,030 --> 00:09:14,460
what's interesting is that this other

252
00:09:19,100 --> 00:09:17,040
organism flavobacterium appears to

253
00:09:21,680 --> 00:09:19,110
dominate that surface that veneer of

254
00:09:23,450 --> 00:09:21,690
sulphur that's all over this area and

255
00:09:26,720 --> 00:09:23,460
tens of square kilometers across my

256
00:09:28,970 --> 00:09:26,730
field site in the past and the lab

257
00:09:30,890 --> 00:09:28,980
dobnik Gleason who was was in our lab

258
00:09:32,860 --> 00:09:30,900
for a while was doing a lot of gradient

259
00:09:36,170 --> 00:09:32,870
tube culture studies that I continued on

260
00:09:37,880 --> 00:09:36,180
taking gradients of sulfide in the

261
00:09:40,250 --> 00:09:37,890
bottom of a plug and a culture to

262
00:09:42,320 --> 00:09:40,260
allowing oxygen to diffuse in and the

263
00:09:44,300 --> 00:09:42,330

two will mix forming a gradient of

264
00:09:46,610 --> 00:09:44,310
sulfide and oxygen to allow these

265
00:09:48,440 --> 00:09:46,620
organisms to grow and what we found is

266
00:09:50,750 --> 00:09:48,450
not only can they form large blooms of

267
00:09:52,970 --> 00:09:50,760
elemental sulfur in the center of these

268
00:09:55,220 --> 00:09:52,980
tubes compared to controls but that the

269
00:09:57,230 --> 00:09:55,230
structure of some of the filaments and

270
00:09:59,420 --> 00:09:57,240
sheets and other things that are formed

271
00:10:01,130 --> 00:09:59,430
are really intriguing eventually really

272
00:10:03,710 --> 00:10:01,140
useful bio minerals for studying these

273
00:10:06,350 --> 00:10:03,720
processes if they're occurring in the

274
00:10:10,100 --> 00:10:06,360
field I have on this figure on the left

275
00:10:12,800 --> 00:10:10,110
is a general eh pH diagram it's studying

276
00:10:14,840 --> 00:10:12,810
the the potential energy being shifted

277
00:10:17,630 --> 00:10:14,850
to the environment and the acidity of

278
00:10:20,510 --> 00:10:17,640
the environment given parameters from my

279
00:10:23,270 --> 00:10:20,520
field site and if you look the general

280
00:10:26,030 --> 00:10:23,280
region of the spring water is coming out

281
00:10:28,220 --> 00:10:26,040
shouldn't be forming that sulfur rambla

282
00:10:29,330 --> 00:10:28,230
up to the top the elemental sulfur it

283
00:10:31,940 --> 00:10:29,340
should all be going straight from

284
00:10:33,740 --> 00:10:31,950
sulphide up to gypsum in my field site

285
00:10:35,810 --> 00:10:33,750
so we think not only are organisms

286
00:10:37,070 --> 00:10:35,820
involved in this process but they're

287
00:10:39,290 --> 00:10:37,080
doing something to stabilize the

288
00:10:41,420 --> 00:10:39,300

elemental sulfur at the surface once

289
00:10:43,580 --> 00:10:41,430
that snow melts in its present it really

290
00:10:46,190 --> 00:10:43,590
should be oxidized further to sulfate

291
00:10:47,810 --> 00:10:46,200
and we don't know exactly why yet so in

292
00:10:49,070 --> 00:10:47,820
my work I'll be working to try to figure

293
00:10:51,290 --> 00:10:49,080
out if there's various forms of

294
00:10:53,210 --> 00:10:51,300
morphology things I can look at doing

295
00:10:55,370 --> 00:10:53,220
some chemistry to but try to pick out

296
00:10:57,860 --> 00:10:55,380
polysulfides which is a mixture of

297
00:10:59,060 --> 00:10:57,870
elemental sulfur and one sulfide that

298
00:11:00,860 --> 00:10:59,070
are mixed together and are usually

299
00:11:04,310 --> 00:11:00,870
produced by microorganisms that oxidize

300
00:11:06,080 --> 00:11:04,320
hydrogen sulfide or sulfide and also

301
00:11:07,280 --> 00:11:06,090
organics are present in the spring

302
00:11:09,200 --> 00:11:07,290
fluids and so it's worth looking into

303
00:11:12,020 --> 00:11:09,210
whether or not there's organics around

304
00:11:13,120 --> 00:11:12,030
the software that we see this is an sem

305
00:11:15,370 --> 00:11:13,130
image that i have on the right

306
00:11:17,140 --> 00:11:15,380
here of that paleo pipe feature i took

307
00:11:19,150 --> 00:11:17,150
some material from it looked at it under

308
00:11:20,710 --> 00:11:19,160
the electron microscope and although

309
00:11:22,810 --> 00:11:20,720
their structures much smaller than my

310
00:11:24,820 --> 00:11:22,820
saw and my gradient tube culture there

311
00:11:27,100 --> 00:11:24,830
on the left you can still see this long

312
00:11:29,020 --> 00:11:27,110
spindly filamentous structure that was

313
00:11:30,700 --> 00:11:29,030

formed by microorganisms my samples I

314
00:11:31,960 --> 00:11:30,710
don't have a lot of time to jump through

315
00:11:33,880 --> 00:11:31,970
the rest of this stuff when I show you

316
00:11:35,860 --> 00:11:33,890
real quick but I'm also doing a lot of

317
00:11:39,400 --> 00:11:35,870
x-ray spectroscopy x-ray fluorescence

318
00:11:40,780 --> 00:11:39,410
studies of the samples I have this is an

319
00:11:43,030 --> 00:11:40,790
image on the right of an x-ray

320
00:11:45,580 --> 00:11:43,040
fluorescence map conducted at 2500

321
00:11:48,880 --> 00:11:45,590
electron volts of my sample every atom

322
00:11:51,760 --> 00:11:48,890
absorbs x-ray energy at a certain energy

323
00:11:53,620 --> 00:11:51,770
out of certain energy and so I can go in

324
00:11:54,940 --> 00:11:53,630
and use that to look at my samples and

325
00:11:56,920 --> 00:11:54,950
figure out what kind of sulfur is

326
00:11:59,020 --> 00:11:56,930
present in my samples I'm going to skip

327
00:12:00,850 --> 00:11:59,030
through a couple of these real quick one

328
00:12:03,010 --> 00:12:00,860
interesting thing I found are these

329
00:12:04,840 --> 00:12:03,020
things i'm calling sulfur turds in my

330
00:12:06,190 --> 00:12:04,850
sample you can see it there on the left

331
00:12:08,560 --> 00:12:06,200
and some images here on the right that

332
00:12:11,500 --> 00:12:08,570
are pure elemental sulfur inside of this

333
00:12:13,420 --> 00:12:11,510
sample but that appear to be surrounded

334
00:12:15,370 --> 00:12:13,430
by what looks like an organosulfur

335
00:12:17,140 --> 00:12:15,380
through xbase matroska p and you can

336
00:12:19,120 --> 00:12:17,150
kind of see here that this spot 12 map

337
00:12:20,260 --> 00:12:19,130
at the top is elemental sulfur and down

338
00:12:22,900 --> 00:12:20,270

here is the stuff that could be

339
00:12:24,640 --> 00:12:22,910
organosulfur surrounding it and so with

340
00:12:26,920 --> 00:12:24,650
that I'd like to show my collaborators

341
00:12:28,150 --> 00:12:26,930
Steve grasby is my main field

342
00:12:30,190 --> 00:12:28,160
collaborate is the guy sleeping on the

343
00:12:31,750 --> 00:12:30,200
ice right there and I'll acknowledge

344
00:12:34,150 --> 00:12:31,760
them as well Alexis Templeton's my

345
00:12:35,320 --> 00:12:34,160
adviser she's fantastic and John sphere

346
00:12:37,420 --> 00:12:35,330
and Christian Betty are doing a lot of

347
00:12:39,490 --> 00:12:37,430
the genomics work metagenomics and RNA

348
00:12:41,410 --> 00:12:39,500
work on all the samples that we have and

349
00:12:48,760 --> 00:12:41,420
again Steve grasby is just the man in

350
00:13:03,170 --> 00:13:00,890
questions anyone so your field site is

351
00:13:05,120 --> 00:13:03,180
obviously a cold environment and I'm

352
00:13:07,070 --> 00:13:05,130
guessing that you go there in the summer

353
00:13:08,930 --> 00:13:07,080
hmm i'm wondering if these

354
00:13:11,750 --> 00:13:08,940
microorganisms that are suffering the

355
00:13:14,870 --> 00:13:11,760
sec that they're cycling the sulfur if

356
00:13:17,420 --> 00:13:14,880
their fries tolerant and if when it gets

357
00:13:19,730 --> 00:13:17,430
cold are they just do they just go into

358
00:13:20,930 --> 00:13:19,740
hibernation or can they still grow is

359
00:13:22,730 --> 00:13:20,940
there still i actually haven't studied

360
00:13:23,840 --> 00:13:22,740
that and since i presented earlier than

361
00:13:25,640 --> 00:13:23,850
this week about doing some freeze

362
00:13:26,840 --> 00:13:25,650
tolerance stuff if you carry it maybe

363
00:13:29,240 --> 00:13:26,850

work with a little looking into but i

364
00:13:30,950 --> 00:13:29,250
actually don't know we have them in

365
00:13:32,210 --> 00:13:30,960
really cold cultures and so they're fine

366
00:13:34,850 --> 00:13:32,220
but as far as what their freeze

367
00:13:37,070 --> 00:13:34,860
tolerance level is in sub-zero I'm not

368
00:13:39,170 --> 00:13:37,080
really certain they're easy to bring

369
00:13:40,430 --> 00:13:39,180
back once they're frozen though so it

370
00:13:42,400 --> 00:13:40,440
should be okay to freeze them lower

371
00:13:44,720 --> 00:13:42,410
maybe I should do a study with that too

372
00:13:47,720 --> 00:13:44,730
got time for one more question if anyone

373
00:13:49,850 --> 00:13:47,730
has one no well I have a question please

374
00:13:51,530 --> 00:13:49,860
and I would like to know these or these

375
00:13:53,390 --> 00:13:51,540
groups of organisms you're seeing and

376
00:13:55,850 --> 00:13:53,400
we're seeing single species domination

377
00:13:57,800 --> 00:13:55,860
or genera it's definitely general we

378
00:13:59,330 --> 00:13:57,810
think so the flavor bacterium we've been

379
00:14:01,280 --> 00:13:59,340
trying to work and splitting out like

380
00:14:03,020 --> 00:14:01,290
which flavor bacteria they are and we

381
00:14:04,550 --> 00:14:03,030
have one specific one that Katherine's

382
00:14:06,620 --> 00:14:04,560
been working on a lot to try what she

383
00:14:09,580 --> 00:14:06,630
was working on a lot that she thinks was

384
00:14:11,480 --> 00:14:09,590
the primary culprit for this process so