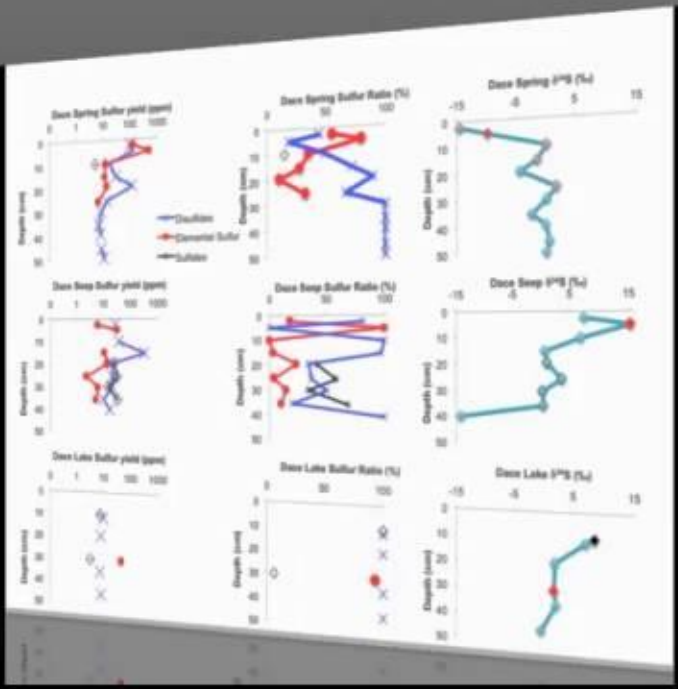
Dace Spring Sulfur yield (ppm)
Dace Spring Sulfur Ratio (%)
Dace Spring δ34S (‰)
Dace Seep Sulfur yield (ppm)
Dace Seep Sulfur Ratio (%)
Dace Seep δ34S (‰)
Dace Lake Sulfur yield (ppm)
Dace Lake Sulfur Ratio (%)
Dace Lake δ34S (‰)
Depth (cm)
Disulfides
Elemental Sulfur
Sulfates

1
00:00:16,110 --> 00:00:09,870
it holds it all started with this

2
00:00:21,750 --> 00:00:16,120
microbe that was found on the border of

3
00:00:25,380 --> 00:00:21,760
a dry lake bed in a spring and you see

4
00:00:28,680 --> 00:00:25,390
their little dots inside that microbes

5
00:00:31,350 --> 00:00:28,690
are sulfur granules and it turned out

6
00:00:34,889 --> 00:00:31,360
that this microbe is a sulphur oxidizer

7
00:00:40,140 --> 00:00:34,899
and that was quite interesting because

8
00:00:46,200 --> 00:00:40,150
it lived in a spring on the side of a

9
00:00:48,750 --> 00:00:46,210
dry lake bed and that Lake is a wet in

10
00:00:53,850 --> 00:00:48,760
the spring after winter when you have

11
00:00:56,310 --> 00:00:53,860
ice falling and lots of snow melting in

12
00:00:58,290 --> 00:00:56,320
the spring you have some water in the

13
00:01:01,620 --> 00:00:58,300

lake but on the side of the leg you have

14
00:01:05,280 --> 00:01:01,630
two springs that are mythos to meet the

15
00:01:08,580 --> 00:01:05,290
thermal so room temperature like our

16
00:01:11,310 --> 00:01:08,590
swimming pool temperature and you have

17
00:01:16,320 --> 00:01:11,320
those microbes living there they are

18
00:01:20,420 --> 00:01:16,330
white they also free oxidizers they are

19
00:01:23,640 --> 00:01:20,430
a photic so they do not need sunlight to

20
00:01:27,180 --> 00:01:23,650
survive and actually they do not like

21
00:01:30,030 --> 00:01:27,190
oxygen that much they can tolerate it in

22
00:01:34,170 --> 00:01:30,040
small concentrations but they would

23
00:01:36,899 --> 00:01:34,180
rather be in areas with small

24
00:01:38,190 --> 00:01:36,909
concentration of dissolved oxygen and

25
00:01:42,179 --> 00:01:38,200
the thing that's very interesting is

26
00:01:44,340 --> 00:01:42,189
that this is an open-air area the

27
00:01:46,370 --> 00:01:44,350
sunlight going there so that's why it

28
00:01:48,920 --> 00:01:46,380
was interesting to see those microbes

29
00:01:51,630 --> 00:01:48,930
there and where they actually come from

30
00:01:56,490 --> 00:01:51,640
where we actually find them more often

31
00:01:59,999 --> 00:01:56,500
is in caves on the ground in little

32
00:02:08,940 --> 00:02:00,009
forts or just water flowing on the

33
00:02:12,869 --> 00:02:08,950
grounds and yeah here the geologic

34
00:02:15,600 --> 00:02:12,879
setting of the area it's in Oregon and

35
00:02:19,440 --> 00:02:15,610
it's a volcanic area you have volcanoes

36
00:02:28,640 --> 00:02:22,500
but it's still a volcanic region there

37
00:02:32,759 --> 00:02:28,650
is that huge Valley with lots of lakes

38
00:02:36,290 --> 00:02:32,769

and the water is running off from those

39
00:02:41,930 --> 00:02:36,300
Springs from those hydrothermal Springs

40
00:02:47,220 --> 00:02:41,940
towards the center of the valley and and

41
00:02:50,520 --> 00:02:47,230
this is where I took samples so this is

42
00:02:53,009 --> 00:02:50,530
what the the dry lake bed look like you

43
00:02:57,330 --> 00:02:53,019
have vegetation on the side of the lake

44
00:03:02,180 --> 00:02:57,340
bed you have the springs on the side and

45
00:03:05,670 --> 00:03:02,190
you have two Springs next to each other

46
00:03:09,270 --> 00:03:05,680
this one is the spring where we found

47
00:03:12,900 --> 00:03:09,280
the microbe and this one we did not find

48
00:03:15,449 --> 00:03:12,910
any microbes but that spring goes on the

49
00:03:17,160 --> 00:03:15,459
ground most of the time so it doesn't

50
00:03:20,100 --> 00:03:17,170
mean that the microbes are not day I

51
00:03:23,069 --> 00:03:20,110
just we don't see them and so the point

52
00:03:25,410 --> 00:03:23,079
was to take some pores take the core

53
00:03:27,660 --> 00:03:25,420
samples so like you could see here it's

54
00:03:32,210 --> 00:03:27,670
about a metre tall but when you actually

55
00:03:35,580 --> 00:03:32,220
get the sample it's half a meter long

56
00:03:39,360 --> 00:03:35,590
and so we took samples along the flow

57
00:03:42,599 --> 00:03:39,370
path of that spring and along the one

58
00:03:49,319 --> 00:03:42,609
that is just a few hundred meters away

59
00:03:55,020 --> 00:03:49,329
from each other we looked at the sulfur

60
00:03:58,770 --> 00:03:55,030
compounds in those samples to look and

61
00:04:02,190 --> 00:03:58,780
we look at the isotopic values as well

62
00:04:04,020 --> 00:04:02,200
of those samples and the point is to

63
00:04:06,089 --> 00:04:04,030

find if there is something interesting

64
00:04:08,460 --> 00:04:06,099
happening at the location where those

65
00:04:11,640 --> 00:04:08,470
microbes actually thriving even though

66
00:04:13,680 --> 00:04:11,650
it's not their optimal living condition

67
00:04:15,780 --> 00:04:13,690
living area they're still there and they

68
00:04:17,069 --> 00:04:15,790
are still very happy to be there and so

69
00:04:23,040 --> 00:04:17,079
we wanted to know if there was something

70
00:04:25,140 --> 00:04:23,050
interesting about that area and the

71
00:04:27,719 --> 00:04:25,150
short message is it is interesting the

72
00:04:31,110 --> 00:04:27,729
problem is that all of those areas are

73
00:04:33,090 --> 00:04:31,120
all different from each others so even

74
00:04:36,000 --> 00:04:33,100
along one spring it

75
00:04:39,930 --> 00:04:36,010
point of the flow path is different and

76
00:04:43,380 --> 00:04:39,940
so here like take a deep breath but we

77
00:04:45,390 --> 00:04:43,390
have circular concentrations and so

78
00:04:48,650 --> 00:04:45,400
that's such a concentration this one is

79
00:04:51,360 --> 00:04:48,660
exactly the same but in a different view

80
00:04:55,500 --> 00:04:51,370
here the surfer concentrations are based

81
00:04:58,650 --> 00:04:55,510
on the amount of sample I had so it's

82
00:05:02,280 --> 00:04:58,660
the true concentration here it's a

83
00:05:05,910 --> 00:05:02,290
conscious concentration relative only to

84
00:05:07,890 --> 00:05:05,920
the sulphur compound so one hundred

85
00:05:10,380 --> 00:05:07,900
percent is a hundred percent of sulfur

86
00:05:15,330 --> 00:05:10,390
so overall if you take all those points

87
00:05:17,820 --> 00:05:15,340
and you add them at one depth you would

88
00:05:20,090 --> 00:05:17,830

get a hundred percent it just is the sum

89
00:05:22,790 --> 00:05:20,100
one hundred percent is the sum of

90
00:05:26,280 --> 00:05:22,800
sulfide element of surfer and sulfates

91
00:05:27,960 --> 00:05:26,290
and it's just a different view to see if

92
00:05:33,090 --> 00:05:27,970
we could see something because most of

93
00:05:36,090 --> 00:05:33,100
the data we got is just all those degree

94
00:05:40,170 --> 00:05:36,100
line going everywhere and it's kind of

95
00:05:44,180 --> 00:05:40,180
hard to see anything happening then we

96
00:05:45,990 --> 00:05:44,190
had we looked at the sulfur isotopes

97
00:05:48,530 --> 00:05:46,000
just to see if there was something

98
00:05:52,380 --> 00:05:48,540
interesting usually you have

99
00:05:55,740 --> 00:05:52,390
fractionation so having the microbes

100
00:05:58,110 --> 00:05:55,750
preferring light isotopes usually you

101
00:06:01,190 --> 00:05:58,120
have that phosphate reduction and you

102
00:06:05,220 --> 00:06:01,200
don't see that much for surfer oxidation

103
00:06:08,880 --> 00:06:05,230
so we are looking if there is surveyed

104
00:06:10,380 --> 00:06:08,890
reduction or anything we did assume they

105
00:06:13,710 --> 00:06:10,390
would be sulphate and they would be

106
00:06:17,400 --> 00:06:13,720
surveyed reduction but actually there

107
00:06:19,830 --> 00:06:17,410
was really really not a lot of sulfate

108
00:06:22,500 --> 00:06:19,840
in any of the samples and so if you look

109
00:06:26,130 --> 00:06:22,510
to add the true concentrations so here

110
00:06:28,380 --> 00:06:26,140
you have so the spring that doesn't have

111
00:06:33,030 --> 00:06:28,390
a lot that doesn't have the microbes and

112
00:06:38,400 --> 00:06:33,040
here is the spring another the second

113
00:06:42,060 --> 00:06:38,410

area and then the dry lake bed those

114
00:06:45,930 --> 00:06:42,070
concentrations are very low compared to

115
00:06:47,040 --> 00:06:45,940
my ring settings I mean marine settings

116
00:06:50,659 --> 00:06:47,050
are

117
00:06:54,240 --> 00:06:50,669
sometimes persons or at least per meal

118
00:06:57,749 --> 00:06:54,250
not ppm so there is a hundred or a

119
00:07:02,010 --> 00:06:57,759
thousand difference in order of

120
00:07:05,070 --> 00:07:02,020
magnitude so that was actually

121
00:07:07,320 --> 00:07:05,080
interesting that the dry lake bed so on

122
00:07:11,390 --> 00:07:07,330
the photo where you see me take the

123
00:07:16,469 --> 00:07:11,400
sample and it's all very very light

124
00:07:19,409 --> 00:07:16,479
colored and very bright there was

125
00:07:21,240 --> 00:07:19,419
absolutely nothing I mean it's just very

126
00:07:23,640 --> 00:07:21,250
and so that's kind of a little bit

127
00:07:26,640 --> 00:07:23,650
depressing because it's actually where

128
00:07:30,390 --> 00:07:26,650
you would that would be the end zone for

129
00:07:35,459 --> 00:07:30,400
preservation potential and it actually

130
00:07:37,290 --> 00:07:35,469
doesn't preserve anything much which

131
00:07:40,230 --> 00:07:37,300
shows that you know if you go on Mars

132
00:07:42,839 --> 00:07:40,240
and if you did have a cave of some place

133
00:07:45,600 --> 00:07:42,849
on the side of maybe that that big belly

134
00:07:48,300 --> 00:07:45,610
on Mars and that you'd have some seep

135
00:07:50,100 --> 00:07:48,310
coming and bringing with it those

136
00:07:51,809 --> 00:07:50,110
microbes that live on the ground in that

137
00:07:55,110 --> 00:07:51,819
cave in that lava tube whatever you want

138
00:07:57,959 --> 00:07:55,120

and bring them there you know your Rover

139
00:08:02,189 --> 00:07:57,969
really has to be at the right spot to

140
00:08:05,839 --> 00:08:02,199
see I mean at least those microbes and

141
00:08:10,050 --> 00:08:05,849
so because a few hundred meters away

142
00:08:13,860 --> 00:08:10,060
might be you might miss it and not

143
00:08:19,339 --> 00:08:13,870
release it this this one here is the one

144
00:08:22,110 --> 00:08:19,349
way we actually see the microbes and as

145
00:08:24,240 --> 00:08:22,120
it's just everything is a little bit is

146
00:08:29,010 --> 00:08:24,250
different here we have another sulfate

147
00:08:34,040 --> 00:08:29,020
that we don't have much here it's going

148
00:08:37,350 --> 00:08:34,050
to take a lot more thinking about why

149
00:08:39,750 --> 00:08:37,360
this is and what exactly is going on

150
00:08:44,340 --> 00:08:39,760
everywhere but it's actually very

151
00:08:48,139 --> 00:08:44,350
interesting just when I Gosar I mean

152
00:08:52,650 --> 00:08:48,149
fresh results to see that all those

153
00:08:54,590 --> 00:08:52,660
isotopic profiles and even the

154
00:09:00,800 --> 00:08:54,600
concentration profiles are all different

155
00:09:09,600 --> 00:09:03,650
one thing that is interesting is the

156
00:09:14,490 --> 00:09:09,610
width of the isotopic range it's not

157
00:09:18,660 --> 00:09:14,500
that big like in for Marion settings but

158
00:09:20,490 --> 00:09:18,670
it's still pretty pretty wide and there

159
00:09:24,270 --> 00:09:20,500
is definitely something different

160
00:09:26,730 --> 00:09:24,280
between the spring that actually has the

161
00:09:30,600 --> 00:09:26,740
microbes and the other one that's next

162
00:09:34,560 --> 00:09:30,610
to it this one is much broader whereas

163
00:09:44,160 --> 00:09:34,570

yeah this one has a narrower range of

164
00:09:49,590 --> 00:09:44,170
values so we have to do some statistics

165
00:09:57,420 --> 00:09:49,600
on that one thing here is actually the

166
00:10:03,870 --> 00:09:57,430
fractionation pattern not that

167
00:10:05,700 --> 00:10:03,880
interesting right now I'll have to you

168
00:10:08,580 --> 00:10:05,710
know I'd have to study that a lot more

169
00:10:10,800 --> 00:10:08,590
but something that is actually visible

170
00:10:14,790 --> 00:10:10,810
is that there is here we do see a

171
00:10:18,120 --> 00:10:14,800
pattern with the fractionation of the

172
00:10:20,280 --> 00:10:18,130
self so it's sulfate compared to a

173
00:10:22,470 --> 00:10:20,290
sulfide or element or sulfur compared to

174
00:10:24,120 --> 00:10:22,480
certified and so that would be looking

175
00:10:26,220 --> 00:10:24,130
at the sulfate reduction whereas this

176
00:10:29,840 --> 00:10:26,230
one would look at the sulfur oxidation

177
00:10:35,310 --> 00:10:29,850
and so there is definitely a pattern

178
00:10:37,610 --> 00:10:35,320
having all that it is fractionated the

179
00:10:40,230 --> 00:10:37,620
fractionation is kind of different

180
00:10:44,910 --> 00:10:40,240
between the two there's something I

181
00:10:49,980 --> 00:10:44,920
forgot to mention here on them on the

182
00:10:52,380 --> 00:10:49,990
big profiles is that I change the color

183
00:10:57,660 --> 00:10:52,390
here of some of the data points to show

184
00:11:04,200 --> 00:10:57,670
which of the species of the surface

185
00:11:07,980 --> 00:11:04,210
species is dominating the the actual

186
00:11:11,070 --> 00:11:07,990
isotopic value so here as I said those

187
00:11:13,290 --> 00:11:11,080
ones are not the raw data about the

188
00:11:15,600 --> 00:11:13,300

survivor to observe certify stops

189
00:11:18,110 --> 00:11:15,610
something like that so here it's

190
00:11:20,790 --> 00:11:18,120
actually the the concentration

191
00:11:24,470 --> 00:11:20,800
multiplied by D isotopic value and that

192
00:11:28,110 --> 00:11:24,480
gives you a whole average for that depth

193
00:11:30,810 --> 00:11:28,120
and and so you can see that at some

194
00:11:34,230 --> 00:11:30,820
depth you have the elemental sulfur that

195
00:11:37,280 --> 00:11:34,240
is actually dominating the the isotopic

196
00:11:41,569 --> 00:11:37,290
value and so and here on the first cake

197
00:11:44,009 --> 00:11:41,579
you have sulfate dominating the whole

198
00:11:48,180 --> 00:11:44,019
isotopic value but most of the time it's

199
00:11:50,340 --> 00:11:48,190
the disulfides but always to keep in

200
00:11:52,620 --> 00:11:50,350
mind it's always small concentrations

201
00:12:00,180 --> 00:11:52,630
never something in the order of

202
00:12:07,650 --> 00:12:00,190
magnitude of the ocean so that's what

203
00:12:09,960 --> 00:12:07,660
I'm going to present today thank you

204
00:12:24,639 --> 00:12:09,970
very much do we have any questions for

205
00:12:29,749 --> 00:12:27,199
so I was wondering you said that there's

206
00:12:31,369 --> 00:12:29,759
some that grow like out in the open he's

207
00:12:34,609 --> 00:12:31,379
opposed to sunlight and air and then

208
00:12:37,280 --> 00:12:34,619
some that grow in the cave and they're

209
00:12:39,590 --> 00:12:37,290
probably the same genus has anybody done

210
00:12:41,900 --> 00:12:39,600
any like species or subspecies genomic

211
00:12:44,329 --> 00:12:41,910
information on them to see what the

212
00:12:46,819 --> 00:12:44,339
differences might actually be and why

213
00:12:48,710 --> 00:12:46,829

some of them will grow in the presence

214
00:12:53,269 --> 00:12:48,720
of sunlight and on the lake beds but

215
00:12:58,069 --> 00:12:53,279
then others stay in the cave so they

216
00:13:00,049 --> 00:12:58,079
have cultured the one in the cave those

217
00:13:01,759 --> 00:13:00,059
ones we haven't tried to curse them at

218
00:13:04,429 --> 00:13:01,769
all we haven't even looked at anything

219
00:13:07,369 --> 00:13:04,439
we just you know looked at the some of

220
00:13:15,829 --> 00:13:07,379
the DNA and matched to see whether would

221
00:13:18,559 --> 00:13:15,839
the closest relative to why I'm I think

222
00:13:20,179 --> 00:13:18,569
it's just a tolerance thing if you've

223
00:13:25,280 --> 00:13:20,189
got enough food and you don't care about

224
00:13:28,100 --> 00:13:25,290
the sunlight you can be there I mean

225
00:13:30,470 --> 00:13:28,110
they can do it very well and the one

226
00:13:35,629 --> 00:13:30,480
thing is there's a lot of grass in the

227
00:13:38,329 --> 00:13:35,639
summer so for at least for the oxygen

228
00:13:41,329 --> 00:13:38,339
it's possible that the decomposition of

229
00:13:43,669 --> 00:13:41,339
that grass even during the summer or in

230
00:13:46,369 --> 00:13:43,679
the winter will decrease the amount of

231
00:13:51,559 --> 00:13:46,379
oxygen in the water and will at least

232
00:13:59,239 --> 00:13:51,569
make them in in a zone that is almost an

233
00:14:00,499 --> 00:13:59,249
anoxic anyone else if not we are now