418: Astrobiology Investigations Enabled by the NASA Mars 2020 Mission & Sample Return I

1
00:00:05,269 --> 00:00:03,350
good afternoon everyone uh i'm michael

2
00:00:07,269 --> 00:00:05,279
tuitt from the jet propulsion laboratory

3
00:00:09,750 --> 00:00:07,279
along with my co-convenience amy

4
00:00:12,950 --> 00:00:09,760
williams and emily cartarelli we welcome

5
00:00:14,910 --> 00:00:12,960
you here to this uh great session uh

6
00:00:17,349 --> 00:00:14,920
where we're gonna address some

7
00:00:20,630 --> 00:00:17,359
astrobiological investigations enabled

8
00:00:22,390 --> 00:00:20,640
by nasa mars 2020 mission and sample

9
00:00:24,390 --> 00:00:22,400
return

10
00:00:26,390 --> 00:00:24,400
a note to um

11
00:00:27,750 --> 00:00:26,400
our presenters you're going to get a one

12
00:00:29,029 --> 00:00:27,760
minute

13
00:00:31,990 --> 00:00:29,039

warning from

14
00:00:33,030 --> 00:00:32,000
emily i'll try to wrap it up as soon as

15
00:00:34,630 --> 00:00:33,040
you can

16
00:00:38,229 --> 00:00:34,640
we do have time for discussion at the

17
00:00:41,830 --> 00:00:38,239
end of the session uh in addition at uh

18
00:00:43,590 --> 00:00:41,840
when the session ends at 2 30

19
00:00:46,630 --> 00:00:43,600
eastern time

20
00:00:50,950 --> 00:00:46,640
there isn't a an online

21
00:00:53,110 --> 00:00:50,960
only session uh that we will host uh so

22
00:00:54,630 --> 00:00:53,120
when this wraps up if you can jump

23
00:00:56,549 --> 00:00:54,640
online there are a number of other

24
00:00:59,349 --> 00:00:56,559
really interesting talks so to get

25
00:01:01,510 --> 00:00:59,359
things started i'd like to introduce

26
00:01:12,550 --> 00:01:01,520
luther beagle

27
00:01:17,030 --> 00:01:14,870
everyone thanks for having me um this uh

28
00:01:18,950 --> 00:01:17,040
talk is basically the uh um discussion

29
00:01:20,950 --> 00:01:18,960
of what we've seen over the first year

30
00:01:23,429 --> 00:01:20,960
of uh on the martian surface using

31
00:01:25,590 --> 00:01:23,439
sherlock and watson as a search for

32
00:01:27,109 --> 00:01:25,600
potential biosignatures and to document

33
00:01:29,590 --> 00:01:27,119
samples a lot of what i'm going to talk

34
00:01:30,870 --> 00:01:29,600
about here is actually in press so we'll

35
00:01:32,630 --> 00:01:30,880
give you a little uh

36
00:01:34,149 --> 00:01:32,640
high level things of what what should be

37
00:01:36,390 --> 00:01:34,159
coming down the pike

38
00:01:38,870 --> 00:01:36,400

and how everything's going um this is

39
00:01:40,230 --> 00:01:38,880
sherlock and watson it is an arm mounted

40
00:01:42,389 --> 00:01:40,240
instrument it does laser raman

41
00:01:44,230 --> 00:01:42,399
spectroscopy along with

42
00:01:46,550 --> 00:01:44,240
fluorescent spectroscopy and microscopic

43
00:01:47,910 --> 00:01:46,560
imaging watson is a basically a reflate

44
00:01:49,190 --> 00:01:47,920
of the molle camera

45
00:01:50,069 --> 00:01:49,200
it does

46
00:01:53,350 --> 00:01:50,079
up to

47
00:01:55,109 --> 00:01:53,360
13 pixels per

48
00:01:56,069 --> 00:01:55,119
micros per pixel

49
00:01:57,990 --> 00:01:56,079
and

50
00:01:59,109 --> 00:01:58,000
does variable field focus so the image

51
00:02:00,550 --> 00:01:59,119
you saw on the previous page of the

52
00:02:03,350 --> 00:02:00,560
selfie we took with that particular

53
00:02:05,429 --> 00:02:03,360
camera uh sherlock itself has a what's

54
00:02:07,190 --> 00:02:05,439
called an aci autofocus and contextual

55
00:02:10,070 --> 00:02:07,200
imager it's a 10 micron per pixel

56
00:02:11,670 --> 00:02:10,080
grayscale imager um and that's what uh

57
00:02:14,070 --> 00:02:11,680
enables us to do this the ramadan

58
00:02:15,830 --> 00:02:14,080
spectroscopy on a particular point and

59
00:02:17,830 --> 00:02:15,840
map it up to a texture in in a

60
00:02:19,910 --> 00:02:17,840
particular sample

61
00:02:21,350 --> 00:02:19,920
uh sherlock stands for uh scanning

62
00:02:23,030 --> 00:02:21,360
habitable environments with raman and

63
00:02:24,790 --> 00:02:23,040

luminescence for organics and chemicals

64
00:02:26,550 --> 00:02:24,800
and yes it is the most contrived acronym

65
00:02:28,869 --> 00:02:26,560
on the mission uh with the possible

66
00:02:31,190 --> 00:02:28,879
exception of the watson camera which is

67
00:02:32,869 --> 00:02:31,200
uh weird appendage tapped to sherlock

68
00:02:34,470 --> 00:02:32,879
for operations and navigations but they

69
00:02:35,270 --> 00:02:34,480
wouldn't let us call it that so we went

70
00:02:37,589 --> 00:02:35,280
with

71
00:02:39,589 --> 00:02:37,599
wide wide angle topographic sensor for

72
00:02:40,790 --> 00:02:39,599
operations and navigation i mean it's a

73
00:02:43,350 --> 00:02:40,800
high resolution camera and the way

74
00:02:45,350 --> 00:02:43,360
sherlock works is uh we take uh we take

75
00:02:47,350 --> 00:02:45,360
images with watson uh we look at the we

76
00:02:49,270 --> 00:02:47,360
look at the textures we can take uh an

77
00:02:51,670 --> 00:02:49,280
image of the boulder and then we zoom in

78
00:02:53,509 --> 00:02:51,680
to a particular spot and then we take an

79
00:02:54,869 --> 00:02:53,519
aci image and the aci image is shown

80
00:02:57,830 --> 00:02:54,879
here on the on the

81
00:03:00,229 --> 00:02:57,840
the middle um this image is 12 by 16

82
00:03:02,149 --> 00:03:00,239
millimeters 10.1 microns per pixel it's

83
00:03:04,070 --> 00:03:02,159
a fixed focused imager and then we can

84
00:03:05,270 --> 00:03:04,080
scan a laser across a surface and what

85
00:03:07,190 --> 00:03:05,280
we do is we're looking for two different

86
00:03:09,190 --> 00:03:07,200
signatures one is raman and one is

87
00:03:11,430 --> 00:03:09,200
fluorescent spectroscopy so we can make

88
00:03:14,070 --> 00:03:11,440

these colored colorized maps like you

89
00:03:15,589 --> 00:03:14,080
see here uh from this uh from this

90
00:03:17,509 --> 00:03:15,599
this is a piece of

91
00:03:19,110 --> 00:03:17,519
fig tree so you can see where the

92
00:03:20,470 --> 00:03:19,120
mineralogy is from the ramadan and you

93
00:03:22,630 --> 00:03:20,480
can actually tell where the organics are

94
00:03:23,430 --> 00:03:22,640
from the fluorescence

95
00:03:26,390 --> 00:03:23,440
um

96
00:03:28,390 --> 00:03:26,400
uh sherlock is consistent consists of uh

97
00:03:31,750 --> 00:03:28,400
the aci imager uh we already talked

98
00:03:33,589 --> 00:03:31,760
about that a deep uv laser 248.6

99
00:03:35,030 --> 00:03:33,599
the watson camera on the right side the

100
00:03:38,390 --> 00:03:35,040
four optics the spectrometer and the

101
00:03:39,350 --> 00:03:38,400
context imager all on all on the side

102
00:03:41,990 --> 00:03:39,360
um

103
00:03:43,509 --> 00:03:42,000
basically the spectra's taken

104
00:03:45,670 --> 00:03:43,519
from each individual

105
00:03:47,350 --> 00:03:45,680
point on the surface we have an internal

106
00:03:48,630 --> 00:03:47,360
scanning mirror we move that scanning

107
00:03:50,550 --> 00:03:48,640
mirror across the surface and we can

108
00:03:51,830 --> 00:03:50,560
wrassle the laser across the surface and

109
00:03:54,550 --> 00:03:51,840
we take the raman and fluorescent

110
00:03:55,350 --> 00:03:54,560
spectra at the same time on the same ccd

111
00:03:57,270 --> 00:03:55,360
uh

112
00:03:58,470 --> 00:03:57,280
which is basically thermally controlled

113
00:04:02,149 --> 00:03:58,480

by a

114
00:04:03,350 --> 00:04:02,159
to how long we can actually operate on a

115
00:04:05,509 --> 00:04:03,360
surface which limits the number of

116
00:04:07,030 --> 00:04:05,519
points we can actually obtain

117
00:04:09,110 --> 00:04:07,040
so what is raman spectroscopy for those

118
00:04:10,949 --> 00:04:09,120
of you who don't know roman spectroscopy

119
00:04:11,990 --> 00:04:10,959
is when you shoot a laser light out of

120
00:04:13,750 --> 00:04:12,000
sample

121
00:04:15,910 --> 00:04:13,760
three things can happen one is rally

122
00:04:17,909 --> 00:04:15,920
scattering uh that is when the light

123
00:04:20,390 --> 00:04:17,919
comes off and it's the same color as it

124
00:04:22,550 --> 00:04:20,400
hit so if i hit if i turn a red

125
00:04:23,749 --> 00:04:22,560
laser beam and on that wall back there

126
00:04:26,710 --> 00:04:23,759
you'll see the red that's raleigh

127
00:04:28,790 --> 00:04:26,720
scattering uh it is the most

128
00:04:31,030 --> 00:04:28,800
intense of the radiation that they can

129
00:04:33,270 --> 00:04:31,040
come across also you can get uh two

130
00:04:35,670 --> 00:04:33,280
different types of raman uh raman and uh

131
00:04:38,230 --> 00:04:35,680
stokes and anti-stokes uh scattering we

132
00:04:41,830 --> 00:04:38,240
only focus on the the stoke scattering i

133
00:04:44,469 --> 00:04:41,840
mean the rom the the excuse me the raman

134
00:04:47,510 --> 00:04:44,479
stoke scattering and then um that is uh

135
00:04:49,350 --> 00:04:47,520
collected by our optics uh in in there

136
00:04:51,189 --> 00:04:49,360
um and uh what it does is it gives a

137
00:04:52,950 --> 00:04:51,199
fingerprint of a particular mineral or a

138
00:04:54,390 --> 00:04:52,960

chemical um

139
00:04:56,629 --> 00:04:54,400
in this particular case this is from

140
00:04:58,710 --> 00:04:56,639
haley sapers papers from a few years ago

141
00:05:01,189 --> 00:04:58,720
we were looking at different types of

142
00:05:02,790 --> 00:05:01,199
nucleic acids and you can see the the

143
00:05:04,710 --> 00:05:02,800
difference in

144
00:05:07,029 --> 00:05:04,720
the raman signature from the nucleic

145
00:05:09,510 --> 00:05:07,039
acids that we looked at

146
00:05:11,029 --> 00:05:09,520
the raman does reveal molecular

147
00:05:14,390 --> 00:05:11,039
vibrations basically we're looking for

148
00:05:15,830 --> 00:05:14,400
ch stress cc stretches things like that

149
00:05:17,830 --> 00:05:15,840
um and then the fluorescence the

150
00:05:19,749 --> 00:05:17,840
fluorescence basically is resonant for

151
00:05:22,790 --> 00:05:19,759
organics at this particular wavelength

152
00:05:25,029 --> 00:05:22,800
um especially organics uh that are a

153
00:05:27,350 --> 00:05:25,039
polyaromatic hydrocarbon so uh what we

154
00:05:29,189 --> 00:05:27,360
do is we see a ton of these uh organics

155
00:05:30,390 --> 00:05:29,199
it's a very strong

156
00:05:32,790 --> 00:05:30,400
signature

157
00:05:34,790 --> 00:05:32,800
in fluorescence uh and

158
00:05:36,310 --> 00:05:34,800
we can we can detect very very small

159
00:05:38,310 --> 00:05:36,320
parts from

160
00:05:40,390 --> 00:05:38,320
very small concentrations over 100

161
00:05:42,070 --> 00:05:40,400
micron beam size

162
00:05:43,270 --> 00:05:42,080
um so the first thing we did when we

163
00:05:45,029 --> 00:05:43,280

landed on the surface was we looked at

164
00:05:46,710 --> 00:05:45,039
the cal target this is a paper that's

165
00:05:48,310 --> 00:05:46,720
been accepted for space science reviews

166
00:05:50,070 --> 00:05:48,320
it talks a lot about this

167
00:05:52,390 --> 00:05:50,080
and what this what the cal target is is

168
00:05:54,310 --> 00:05:52,400
kind of shows you exactly what we how we

169
00:05:55,510 --> 00:05:54,320
do it and how we function

170
00:05:57,590 --> 00:05:55,520
the cow target is made up of 10

171
00:05:59,189 --> 00:05:57,600
different samples we have the maze

172
00:06:00,950 --> 00:05:59,199
target that tells us how big the laser

173
00:06:02,150 --> 00:06:00,960
spot size is

174
00:06:03,749 --> 00:06:02,160
and you can see the dust that has

175
00:06:05,350 --> 00:06:03,759
accumulated on this over the course of

176
00:06:08,390 --> 00:06:05,360
two months

177
00:06:10,710 --> 00:06:08,400
it is a solvable maze and actually uh

178
00:06:12,629 --> 00:06:10,720
there's only one solution to it uh we

179
00:06:14,550 --> 00:06:12,639
sent a piece of mars back this is this

180
00:06:17,029 --> 00:06:14,560
piece of mars which is on loan from the

181
00:06:18,469 --> 00:06:17,039
natural history museum i have to return

182
00:06:21,270 --> 00:06:18,479
it someday

183
00:06:24,309 --> 00:06:21,280
but uh we'll worry about that um much

184
00:06:26,710 --> 00:06:24,319
much later um it is uh um uh the sau

185
00:06:28,070 --> 00:06:26,720
meteorite is sau uh zero zero eight it's

186
00:06:30,469 --> 00:06:28,080
a carbonaceous chondrite and we have

187
00:06:31,990 --> 00:06:30,479
nice uh samples of that and we've we've

188
00:06:34,150 --> 00:06:32,000

calibrated the laser and the

189
00:06:36,230 --> 00:06:34,160
spectrometer on this on the surface

190
00:06:37,909 --> 00:06:36,240
using that uh and then this uh we have a

191
00:06:39,909 --> 00:06:37,919
spacesuit materials four different types

192
00:06:41,909 --> 00:06:39,919
of spacesuit materials this one is uh a

193
00:06:43,749 --> 00:06:41,919
teflon and what you can see here is you

194
00:06:45,510 --> 00:06:43,759
can kind of see uh how the

195
00:06:47,590 --> 00:06:45,520
the concept works and

196
00:06:49,510 --> 00:06:47,600
and how big everything is the outer

197
00:06:52,790 --> 00:06:49,520
image there the color image is a watson

198
00:06:54,390 --> 00:06:52,800
image that we took for on uh sol 59 and

199
00:06:55,909 --> 00:06:54,400
the individual aci images or the

200
00:06:57,029 --> 00:06:55,919
grayscale ones that you can kind of see

201
00:07:00,469 --> 00:06:57,039
here and you can kind of see how

202
00:07:01,909 --> 00:07:00,479
everything works and how uh the the aci

203
00:07:04,469 --> 00:07:01,919
is kind of scattered with respect to

204
00:07:07,270 --> 00:07:04,479
things um when we took the spectra this

205
00:07:09,350 --> 00:07:07,280
is a specter of teflon from this

206
00:07:10,550 --> 00:07:09,360
spacesuit material and it matched up

207
00:07:12,629 --> 00:07:10,560
perfectly with what we thought it was

208
00:07:15,430 --> 00:07:12,639
going to be so as we landed on the

209
00:07:16,950 --> 00:07:15,440
surface nothing in the spectrometer got

210
00:07:18,309 --> 00:07:16,960
out of line which was really cool

211
00:07:19,350 --> 00:07:18,319
because everything's

212
00:07:21,589 --> 00:07:19,360
kind of uh

213
00:07:23,350 --> 00:07:21,599

done to about a micron precision scale

214
00:07:25,029 --> 00:07:23,360
inside the spectrometer this is the

215
00:07:27,029 --> 00:07:25,039
first abrasion target we did it's a

216
00:07:29,110 --> 00:07:27,039
target called guillaume

217
00:07:30,710 --> 00:07:29,120
and

218
00:07:32,870 --> 00:07:30,720
what we do on perseverance is we

219
00:07:34,070 --> 00:07:32,880
basically take uh all of the instruments

220
00:07:35,510 --> 00:07:34,080
and kind of look at the same target

221
00:07:36,950 --> 00:07:35,520
together and this is much more powerful

222
00:07:38,950 --> 00:07:36,960
this is looking at one thing

223
00:07:41,270 --> 00:07:38,960
individually and so here you can kind of

224
00:07:42,790 --> 00:07:41,280
see where the individual instruments uh

225
00:07:45,189 --> 00:07:42,800
took their individual scans and we kind

226
00:07:48,150 --> 00:07:45,199
of do overlap pixel is an elemental

227
00:07:49,430 --> 00:07:48,160
abundance uh analyzer it's a

228
00:07:54,869 --> 00:07:49,440
x-ray um

229
00:07:56,469 --> 00:07:54,879
elementals and it helps us uh understand

230
00:07:58,230 --> 00:07:56,479
things because sometimes aroma peaks

231
00:07:59,510 --> 00:07:58,240
have the same kind kanorama peaks so we

232
00:08:01,670 --> 00:07:59,520
can kind of differentiate things and

233
00:08:03,430 --> 00:08:01,680
they they take our data and then they

234
00:08:05,029 --> 00:08:03,440
they analyze our from our data what

235
00:08:07,350 --> 00:08:05,039
they're looking at because it is a

236
00:08:08,710 --> 00:08:07,360
discrete point pixel also is a 100

237
00:08:10,070 --> 00:08:08,720
micron scale

238
00:08:12,150 --> 00:08:10,080

spectrometer

239
00:08:14,150 --> 00:08:12,160
so what we can do is we can look over we

240
00:08:16,469 --> 00:08:14,160
can look over the rock we scan the rock

241
00:08:17,670 --> 00:08:16,479
with uh and we add supercam in there we

242
00:08:19,029 --> 00:08:17,680
can identify the fact that this

243
00:08:21,350 --> 00:08:19,039
particular sample

244
00:08:23,589 --> 00:08:21,360
at guillaume uh was made was a mafic com

245
00:08:25,749 --> 00:08:23,599
composition uh had plenty of salts in it

246
00:08:27,430 --> 00:08:25,759
sodium chloride from pixel and then we

247
00:08:29,670 --> 00:08:27,440
saw the calcium sulfate

248
00:08:32,149 --> 00:08:29,680
there was a lot of iron oxides and we

249
00:08:33,909 --> 00:08:32,159
saw silicates including plagioclase and

250
00:08:36,230 --> 00:08:33,919
peroxine and

251
00:08:38,230 --> 00:08:36,240
the mineral appetite in this particular

252
00:08:40,310 --> 00:08:38,240
sample

253
00:08:43,909 --> 00:08:40,320
we've done this is a kind of what we do

254
00:08:45,670 --> 00:08:43,919
with uh sherlock data data set um uh we

255
00:08:47,430 --> 00:08:45,680
basically scan the laser and then we

256
00:08:49,590 --> 00:08:47,440
look at different hots points hot points

257
00:08:52,630 --> 00:08:49,600
along the surface so uh what you see

258
00:08:54,470 --> 00:08:52,640
here is uh you see the scan of of where

259
00:08:57,190 --> 00:08:54,480
where sherlock went in and the bottom

260
00:09:00,310 --> 00:08:57,200
scans are where the the 960 the 10 20

261
00:09:01,910 --> 00:09:00,320
and the 1110 ramen feature is strongest

262
00:09:04,070 --> 00:09:01,920
um so now then we can go back in and we

263
00:09:05,670 --> 00:09:04,080

map that out with um with with the

264
00:09:06,949 --> 00:09:05,680
textures to really understand what

265
00:09:08,710 --> 00:09:06,959
happened to the rock and where the rock

266
00:09:11,990 --> 00:09:08,720
has come from

267
00:09:14,550 --> 00:09:12,000
um uh we've identified uh possible uh

268
00:09:15,990 --> 00:09:14,560
phosphate sulfate peaks uh and and we

269
00:09:17,829 --> 00:09:16,000
can actually map those two things out

270
00:09:19,509 --> 00:09:17,839
where they fit in the um

271
00:09:21,350 --> 00:09:19,519
in the um um

272
00:09:24,150 --> 00:09:21,360
the light tone versus the dark tone

273
00:09:26,949 --> 00:09:24,160
regions of this of the sample

274
00:09:29,190 --> 00:09:26,959
um uh this is one of those survey scans

275
00:09:31,350 --> 00:09:29,200
we've done uh basically we do a 100

276
00:09:32,470 --> 00:09:31,360
micron laser spot and we scan it across

277
00:09:34,550 --> 00:09:32,480
the surface

278
00:09:35,750 --> 00:09:34,560
sometimes we we change the number of

279
00:09:36,710 --> 00:09:35,760
points depending on what we're looking

280
00:09:38,710 --> 00:09:36,720
for

281
00:09:39,829 --> 00:09:38,720
and here we found a bunch of calcium

282
00:09:41,750 --> 00:09:39,839
sulfate

283
00:09:44,630 --> 00:09:41,760
and calcium phosphate

284
00:09:46,790 --> 00:09:44,640
differentiable inside the rock itself

285
00:09:48,949 --> 00:09:46,800
and those those samples actually do

286
00:09:50,470 --> 00:09:48,959
correlate to textures on the rock and

287
00:09:52,150 --> 00:09:50,480
you can kind of see how the rock formed

288
00:09:53,750 --> 00:09:52,160

and this gives us a little bit more

289
00:09:56,389 --> 00:09:53,760
information of everything

290
00:09:58,949 --> 00:09:56,399
is going on the blue square here is uh

291
00:10:00,310 --> 00:09:58,959
six millimeters per side for uh for

292
00:10:02,310 --> 00:10:00,320
reference

293
00:10:05,110 --> 00:10:02,320
um this is a

294
00:10:07,590 --> 00:10:05,120
a slide that uh sannenda sharma showed

295
00:10:10,949 --> 00:10:07,600
in her talk on monday um basically this

296
00:10:12,870 --> 00:10:10,959
is the um uh uh a sample called guard uh

297
00:10:15,030 --> 00:10:12,880
where we see carbonates we see olivines

298
00:10:17,990 --> 00:10:15,040
and we see kind of uh carbonates and

299
00:10:20,230 --> 00:10:18,000
olivine in the same exact spot we also

300
00:10:22,630 --> 00:10:20,240
found this particular spot this is part

301
00:10:25,590 --> 00:10:22,640
of eva's paper that's in review

302
00:10:26,870 --> 00:10:25,600
right now where you can actually map out

303
00:10:30,069 --> 00:10:26,880
within the

304
00:10:32,069 --> 00:10:30,079
rock you can actually map where the

305
00:10:33,269 --> 00:10:32,079
organic material is and you can kind of

306
00:10:35,430 --> 00:10:33,279
see that it correlates to this

307
00:10:37,030 --> 00:10:35,440
particular feature and we can go back in

308
00:10:38,870 --> 00:10:37,040
and determine what mineralogy that

309
00:10:41,110 --> 00:10:38,880
particular feature has especially if

310
00:10:43,430 --> 00:10:41,120
we've got the pixel overlays as well so

311
00:10:44,829 --> 00:10:43,440
this was uh this was pretty exciting

312
00:10:50,710 --> 00:10:44,839
for

313
00:10:52,630 --> 00:10:50,720

we uh drove to the delta front um this

314
00:10:53,750 --> 00:10:52,640
is uh alfalfa and this is the abrasion

315
00:10:55,509 --> 00:10:53,760
on

316
00:10:57,269 --> 00:10:55,519
that we did and basically the textures

317
00:10:59,990 --> 00:10:57,279
and minerals of this particular abrasion

318
00:11:01,910 --> 00:11:00,000
patch did support the igneous volcanic

319
00:11:04,790 --> 00:11:01,920
origin for the crater floor rocks which

320
00:11:06,230 --> 00:11:04,800
is uh currently in review as well um uh

321
00:11:07,990 --> 00:11:06,240
and hopefully that paper will be uh

322
00:11:10,870 --> 00:11:08,000
published soon

323
00:11:13,990 --> 00:11:10,880
um so so far we've collected uh eight

324
00:11:15,829 --> 00:11:14,000
cores we've done uh what is it um uh ten

325
00:11:17,590 --> 00:11:15,839
different abrasion patches uh each

326
00:11:19,509 --> 00:11:17,600
individual abrasion patch is we've

327
00:11:20,630 --> 00:11:19,519
learned something new on um getting

328
00:11:22,470 --> 00:11:20,640
below the

329
00:11:24,710 --> 00:11:22,480
the weathering layer outside that with

330
00:11:26,389 --> 00:11:24,720
all the the dust and everything in there

331
00:11:27,829 --> 00:11:26,399
has been really fascinating to see the

332
00:11:30,470 --> 00:11:27,839
rocks with the rocks actually look like

333
00:11:32,550 --> 00:11:30,480
not covered uh with dust and and

334
00:11:34,310 --> 00:11:32,560
and um things that have been uh evolved

335
00:11:35,910 --> 00:11:34,320
over the course of uh you know three

336
00:11:37,829 --> 00:11:35,920
billion years the material has been on

337
00:11:39,670 --> 00:11:37,839
the surface

338
00:11:42,069 --> 00:11:39,680

um thanks for listening this is a

339
00:11:43,670 --> 00:11:42,079
partial list of everybody who has been

340
00:11:45,590 --> 00:11:43,680
part of this including the engineers who

341
00:11:48,710 --> 00:11:45,600
help build it the current science team

342
00:11:50,550 --> 00:11:48,720
members uh um and we um uh we really

343
00:11:54,069 --> 00:11:50,560
really do thank you for your uh

344
00:11:54,079 --> 00:12:02,470
attention

345
00:12:06,470 --> 00:12:04,790
thanks so much luther um so we do

346
00:12:07,829 --> 00:12:06,480
actually have a few minutes for

347
00:12:10,310 --> 00:12:07,839
questions

348
00:12:13,670 --> 00:12:10,320
if any are out there and we can also

349
00:12:15,509 --> 00:12:13,680
monitor our chat for our online hybrid

350
00:12:17,190 --> 00:12:15,519
participants

351
00:12:19,430 --> 00:12:17,200
we have just a few minutes here before

352
00:12:21,350 --> 00:12:19,440
the next presentation so if anyone wants

353
00:12:38,069 --> 00:12:21,360
to give luther a hard time this is your

354
00:12:50,829 --> 00:12:38,710
i

355
00:12:53,350 --> 00:12:50,839
to analyze

356
00:12:56,870 --> 00:12:53,360
uh cortier

357
00:12:58,710 --> 00:12:56,880
you you can actually go online and get

358
00:13:00,790 --> 00:12:58,720
all the images from uh both the watson

359
00:13:02,949 --> 00:13:00,800
and aci image all of the images all the

360
00:13:04,870 --> 00:13:02,959
raw images go immediately up uh to the

361
00:13:06,550 --> 00:13:04,880
web as soon as we download them but

362
00:13:08,629 --> 00:13:06,560
cordier has this really cool feature

363
00:13:11,190 --> 00:13:08,639

that we call the polar bear um and it

364
00:13:13,990 --> 00:13:11,200
was uh um just a neat sample to look at

365
00:13:15,509 --> 00:13:14,000
um over christmas and uh it's uh it's

366
00:13:17,190 --> 00:13:15,519
got some it's got some really neat

367
00:13:22,230 --> 00:13:17,200
secrets in it that we're um hopefully

368
00:13:25,590 --> 00:13:23,829
yes

369
00:13:27,910 --> 00:13:25,600
can you go to the microphone behind you

370
00:13:35,269 --> 00:13:27,920
there so that the folks online can also

371
00:13:39,990 --> 00:13:37,910
hello i'm santiago gularza and my

372
00:13:41,990 --> 00:13:40,000
question is what is the biggest

373
00:13:43,670 --> 00:13:42,000
challenge you have faced

374
00:13:46,230 --> 00:13:43,680
um the biggest challenge we have on the

375
00:13:47,910 --> 00:13:46,240
rover as with anything is there's 430

376
00:13:49,750 --> 00:13:47,920
people on the science team approximately

377
00:13:51,829 --> 00:13:49,760
with engineers and it's getting

378
00:13:53,430 --> 00:13:51,839
everybody to agree it's been a really

379
00:13:56,230 --> 00:13:53,440
cool process so far and the teams really

380
00:13:57,750 --> 00:13:56,240
come together there's not a lot of

381
00:14:00,389 --> 00:13:57,760
there's there's some debate but it's a

382
00:14:02,470 --> 00:14:00,399
healthy debate but getting everybody um

383
00:14:05,189 --> 00:14:02,480
focused on the same thing is is a real

384
00:14:06,629 --> 00:14:05,199
challenge plus we uh we like to be used

385
00:14:08,069 --> 00:14:06,639
all the time but there is there are

386
00:14:09,670 --> 00:14:08,079
limitations we have certain number of

387
00:14:12,550 --> 00:14:09,680
laser pulses we can use over the course

388
00:14:14,470 --> 00:14:12,560

of the mission um there are uh energy

389
00:14:16,310 --> 00:14:14,480
requirements that the the rover needs to

390
00:14:18,230 --> 00:14:16,320
do the rover needs to be in a state of

391
00:14:20,389 --> 00:14:18,240
charge and next next saw so that we can

392
00:14:22,310 --> 00:14:20,399
you know it does limit our ability to do

393
00:14:23,670 --> 00:14:22,320
things but with anything there's only

394
00:14:25,350 --> 00:14:23,680
when you have rare resources you've got

395
00:14:27,670 --> 00:14:25,360
to make a good trade space

396
00:14:28,790 --> 00:14:27,680
and it's uh that sometimes becomes a

397
00:14:30,629 --> 00:14:28,800
little um

398
00:14:32,389 --> 00:14:30,639
a little stressful trying to choose

399
00:14:34,389 --> 00:14:32,399
whether we're gonna scan for an hour or

400
00:14:35,910 --> 00:14:34,399
scan for two hours or

401
00:14:37,910 --> 00:14:35,920
do something like that or use pixel

402
00:14:40,310 --> 00:14:37,920
before us or after us and those things

403
00:14:41,910 --> 00:14:40,320
all have to be worked out

404
00:14:44,629 --> 00:14:41,920
but the the science team has been really

405
00:14:47,030 --> 00:14:44,639
good especially in covet um it's

406
00:14:48,710 --> 00:14:47,040
there you go i did i did i did talk fast

407
00:14:50,310 --> 00:14:48,720
didn't i um the science team has come

408
00:14:51,430 --> 00:14:50,320
together pretty pretty well given the

409
00:14:53,590 --> 00:14:51,440
fact that we've all been remote the

410
00:14:54,790 --> 00:14:53,600
whole time and it's the first time i've

411
00:14:56,550 --> 00:14:54,800
seen a lot of people that worked on the

412
00:15:00,069 --> 00:14:56,560
mission as at this conference and it's

413
00:15:07,750 --> 00:15:00,079

been it's been nice to see people

414
00:15:10,710 --> 00:15:09,750
so i'm happy to introduce our second

415
00:15:12,949 --> 00:15:10,720
speaker

416
00:15:15,110 --> 00:15:12,959
emily cartarelli is going to speak about

417
00:15:17,509 --> 00:15:15,120
assessing organic preservation and the

418
00:15:19,430 --> 00:15:17,519
implications for potential biosignatures

419
00:15:26,550 --> 00:15:19,440
in the bastied member of the seita

420
00:15:30,949 --> 00:15:28,870
thank you amy and thank you luther for a

421
00:15:33,189 --> 00:15:30,959
great introduction to sherlock as well

422
00:15:34,389 --> 00:15:33,199
as to some of the wonderful abrasion

423
00:15:38,470 --> 00:15:34,399
patches that we've looked at with

424
00:15:42,870 --> 00:15:41,030
so the primary mars 2020 mission

425
00:15:44,230 --> 00:15:42,880
objectives center on characterizing the

426
00:15:46,230 --> 00:15:44,240
geology

427
00:15:47,749 --> 00:15:46,240
of jezreel and the surrounding area and

428
00:15:49,990 --> 00:15:47,759
understanding

429
00:15:52,150 --> 00:15:50,000
uh the processes of formation as well as

430
00:15:54,949 --> 00:15:52,160
alteration within these rocks the

431
00:15:57,990 --> 00:15:54,959
astrobiology relevant goals for this

432
00:16:00,230 --> 00:15:58,000
area include assessing habitability of

433
00:16:02,470 --> 00:16:00,240
the environment of these these ancient

434
00:16:04,069 --> 00:16:02,480
areas as well as seeking evidence for

435
00:16:05,110 --> 00:16:04,079
signs of past life

436
00:16:06,310 --> 00:16:05,120
and

437
00:16:08,389 --> 00:16:06,320
in seeking

438
00:16:11,030 --> 00:16:08,399

signs for past life then selecting

439
00:16:13,350 --> 00:16:11,040
sampling locations that

440
00:16:15,749 --> 00:16:13,360
we can we can choose

441
00:16:18,470 --> 00:16:15,759
to move forward with uh

442
00:16:20,470 --> 00:16:18,480
with sampling that have a high

443
00:16:21,829 --> 00:16:20,480
biosignature preservation potential as

444
00:16:23,670 --> 00:16:21,839
luther mentioned it could be hard

445
00:16:27,430 --> 00:16:23,680
sometimes on a team of 400 people to

446
00:16:28,949 --> 00:16:27,440
decide where to sample so identifying

447
00:16:31,430 --> 00:16:28,959
areas where

448
00:16:34,389 --> 00:16:31,440
we have high biosignature preservation

449
00:16:36,150 --> 00:16:34,399
potential is quite important and

450
00:16:37,910 --> 00:16:36,160
as the session suggests this is all a

451
00:16:39,910 --> 00:16:37,920
part of

452
00:16:41,749 --> 00:16:39,920
our three-phase plan

453
00:16:43,269 --> 00:16:41,759
to bring the samples not only collect

454
00:16:45,189 --> 00:16:43,279
the samples but to eventually bring them

455
00:16:46,710 --> 00:16:45,199
back to earth as part of mars sample

456
00:16:48,230 --> 00:16:46,720
return

457
00:16:51,030 --> 00:16:48,240
so

458
00:16:52,629 --> 00:16:51,040
in jezreel and around jezreel uh

459
00:16:54,389 --> 00:16:52,639
we see we

460
00:16:56,790 --> 00:16:54,399
were fortunate enough as katie mentioned

461
00:16:58,949 --> 00:16:56,800
on tuesday to land at the

462
00:17:01,590 --> 00:16:58,959
contact of uh

463
00:17:03,430 --> 00:17:01,600

two major uh mineralogy so the olivine

464
00:17:04,390 --> 00:17:03,440
bearing unit which is in bright red as

465
00:17:08,549 --> 00:17:04,400
well as

466
00:17:12,309 --> 00:17:08,559
uh the calcium bearing pyroxene unit and

467
00:17:13,590 --> 00:17:12,319
since landing we traverse around uh

468
00:17:15,429 --> 00:17:13,600
sure if you can see

469
00:17:19,429 --> 00:17:15,439
traverse the bot traverse around the

470
00:17:22,069 --> 00:17:19,439
bottom of this uh part here and the red

471
00:17:24,549 --> 00:17:22,079
colored unit is the olivine bearing unit

472
00:17:26,230 --> 00:17:24,559
that we now refer to as sata and i'm

473
00:17:28,390 --> 00:17:26,240
going to be talking about that further

474
00:17:29,590 --> 00:17:28,400
and we're i was particularly interested

475
00:17:33,750 --> 00:17:29,600
in

476
00:17:36,549 --> 00:17:33,760
because as you might notice

477
00:17:38,070 --> 00:17:36,559
the olivine bearing unit also co-occurs

478
00:17:40,310 --> 00:17:38,080
with a

479
00:17:42,710 --> 00:17:40,320
strong carbonate signature as well as a

480
00:17:45,430 --> 00:17:42,720
signature for uh

481
00:17:46,549 --> 00:17:45,440
alteration minerals

482
00:17:49,909 --> 00:17:46,559
and

483
00:17:51,750 --> 00:17:49,919
where i'll be talking about today so

484
00:17:55,029 --> 00:17:51,760
that was the starting location of our

485
00:17:56,710 --> 00:17:55,039
landing site as in on the right side and

486
00:18:00,230 --> 00:17:56,720
the blue marker

487
00:18:05,430 --> 00:18:00,240
is where we currently are so this is uh

488
00:18:07,750 --> 00:18:05,440

the first 250 saws 270 stalls or so

489
00:18:09,830 --> 00:18:07,760
so the olivine bearing unit is of

490
00:18:12,150 --> 00:18:09,840
particular interest because

491
00:18:15,430 --> 00:18:14,390
there are thought there are hypotheses

492
00:18:17,510 --> 00:18:15,440
that the

493
00:18:18,789 --> 00:18:17,520
reason why the carbonate bearing unit uh

494
00:18:20,470 --> 00:18:18,799
so closely

495
00:18:22,630 --> 00:18:20,480
is associated with the olivine bearing

496
00:18:24,150 --> 00:18:22,640
unit is because the olivine bearing unit

497
00:18:26,150 --> 00:18:24,160
has undergone aqueous alteration

498
00:18:27,590 --> 00:18:26,160
producing the magnesium-rich carbonate

499
00:18:29,590 --> 00:18:27,600
which may be

500
00:18:31,750 --> 00:18:29,600
capable of preserving astrobiological

501
00:18:34,630 --> 00:18:31,760
signs of ancient life

502
00:18:37,110 --> 00:18:34,640
and on earth uh

503
00:18:39,029 --> 00:18:37,120
we see magnesium carbonate also known as

504
00:18:42,150 --> 00:18:39,039
magnesite um

505
00:18:44,710 --> 00:18:42,160
intruding an ultramafic protolith in

506
00:18:47,190 --> 00:18:44,720
australia and within the sample

507
00:18:49,190 --> 00:18:47,200
so the blue is magnesium

508
00:18:51,669 --> 00:18:49,200
uh we've been able to observe

509
00:18:53,750 --> 00:18:51,679
halite overlying the magnesite and then

510
00:18:57,350 --> 00:18:53,760
on the halite

511
00:18:58,390 --> 00:18:57,360
you can see there are some purple oops

512
00:19:01,430 --> 00:18:58,400
some

513
00:19:03,990 --> 00:19:01,440

red is

514
00:19:05,909 --> 00:19:04,000
carbon and you can see they are round

515
00:19:07,830 --> 00:19:05,919
rounded and there are sort of three

516
00:19:09,430 --> 00:19:07,840
rounded shapes there as well as a

517
00:19:12,150 --> 00:19:09,440
potential dendritic structure to the

518
00:19:14,230 --> 00:19:12,160
left when we zoom in

519
00:19:15,590 --> 00:19:14,240
this might be a sign of life that

520
00:19:18,070 --> 00:19:15,600
perhaps

521
00:19:21,510 --> 00:19:18,080
might expect to see in a

522
00:19:23,350 --> 00:19:21,520
preserved in a carbonate

523
00:19:25,590 --> 00:19:23,360
so within this talk i'll talk about i'll

524
00:19:27,750 --> 00:19:25,600
build on what luther mentioned in terms

525
00:19:29,990 --> 00:19:27,760
of the power of multi-instrument

526
00:19:32,150 --> 00:19:30,000
detections and how

527
00:19:33,990 --> 00:19:32,160
by applying multiple instruments to a

528
00:19:35,990 --> 00:19:34,000
single target we can gain insights into

529
00:19:39,029 --> 00:19:36,000
the the provenance of the samples as

530
00:19:41,669 --> 00:19:39,039
well as the its ulceration history and

531
00:19:43,750 --> 00:19:41,679
potential preservation within this unit

532
00:19:45,590 --> 00:19:43,760
also talk about micron scale mineral

533
00:19:47,510 --> 00:19:45,600
mapping within the stage of formation

534
00:19:49,110 --> 00:19:47,520
and localized organic detections that

535
00:19:51,430 --> 00:19:49,120
have been made so far

536
00:19:53,029 --> 00:19:51,440
and talk about implications of finding

537
00:19:54,630 --> 00:19:53,039
carbonated olivine

538
00:19:58,710 --> 00:19:54,640

as a potential

539
00:19:59,750 --> 00:19:58,720
place to preserve biosignatures

540
00:20:01,350 --> 00:19:59,760
so

541
00:20:04,470 --> 00:20:01,360
as luther mentioned i'll be talking

542
00:20:06,549 --> 00:20:04,480
about results from sherlock

543
00:20:08,230 --> 00:20:06,559
which is capable of detecting mineral

544
00:20:11,830 --> 00:20:08,240
which is capable of simultaneously

545
00:20:14,870 --> 00:20:11,840
detecting minerals and organics in a

546
00:20:19,830 --> 00:20:14,880
micro textural context with dpv ramen

547
00:20:21,590 --> 00:20:19,840
and native fluorescence at 100 microns

548
00:20:24,549 --> 00:20:21,600
or so

549
00:20:26,549 --> 00:20:24,559
and sherlock as well as pixel are the

550
00:20:28,310 --> 00:20:26,559
two instruments on the arm that are

551
00:20:31,590 --> 00:20:28,320
capable of proximity science that i'll

552
00:20:34,549 --> 00:20:31,600
be talking about today however

553
00:20:36,870 --> 00:20:34,559
insights from the mass base arm

554
00:20:39,270 --> 00:20:36,880
or sorry the mass the mast including

555
00:20:40,230 --> 00:20:39,280
mass kmz and supercam have also helped

556
00:20:43,669 --> 00:20:40,240
inform

557
00:20:47,510 --> 00:20:45,430
so from the orbital scale we see the

558
00:20:49,190 --> 00:20:47,520
sata formation in dark green and we see

559
00:20:51,029 --> 00:20:49,200
it contacting the moss formation which

560
00:20:53,830 --> 00:20:51,039
lisa will be talking about later

561
00:20:55,590 --> 00:20:53,840
and it's astrobiological uh preservation

562
00:20:58,870 --> 00:20:55,600
potential and

563
00:21:00,710 --> 00:20:58,880

the basteed outcrop and brock outcrop uh

564
00:21:04,390 --> 00:21:00,720
are where the two abrasions were taken

565
00:21:08,390 --> 00:21:05,830
and when we first arrived at these

566
00:21:10,630 --> 00:21:08,400
outcrops we still weren't certain if

567
00:21:12,149 --> 00:21:10,640
these rocks were igneous or sedimentary

568
00:21:15,270 --> 00:21:12,159
given their layered structure in both

569
00:21:16,710 --> 00:21:15,280
the brock and best seed outcrops however

570
00:21:18,630 --> 00:21:16,720
once we were able to abrade these

571
00:21:20,870 --> 00:21:18,640
surfaces we saw that there was a

572
00:21:24,789 --> 00:21:20,880
crystalline texture indicating that

573
00:21:26,549 --> 00:21:24,799
these these rocks were igneous in nature

574
00:21:28,630 --> 00:21:26,559
and

575
00:21:31,029 --> 00:21:28,640
from the abrasion patch we're able to

576
00:21:33,669 --> 00:21:31,039
take different size scans as well as

577
00:21:36,070 --> 00:21:33,679
scans that are capable of

578
00:21:39,110 --> 00:21:36,080
analyzing different areas with different

579
00:21:42,230 --> 00:21:39,120
numbers of pulses per point so the white

580
00:21:44,390 --> 00:21:42,240
square in the center is the five by five

581
00:21:46,630 --> 00:21:44,400
millimeter area that uh

582
00:21:50,870 --> 00:21:46,640
analyze with the survey scan that

583
00:21:52,950 --> 00:21:50,880
that completes uh 1296 points and does

584
00:21:55,830 --> 00:21:52,960
15 pulses per point and then

585
00:21:57,830 --> 00:21:55,840
looking for areas of fluorescence and

586
00:21:59,029 --> 00:21:57,840
then from there we can select detailed

587
00:22:01,830 --> 00:21:59,039
scans

588
00:22:05,110 --> 00:22:01,840

the blue area is a larger area where we

589
00:22:07,029 --> 00:22:05,120
completed a 100 analysis points and 500

590
00:22:09,510 --> 00:22:07,039
pulses per point and

591
00:22:11,350 --> 00:22:09,520
the benefit of using a greater number of

592
00:22:12,710 --> 00:22:11,360
pulses per point is that you could be

593
00:22:14,630 --> 00:22:12,720
more you can potentially be more

594
00:22:16,789 --> 00:22:14,640
confident in your mineral identification

595
00:22:17,590 --> 00:22:16,799
from the raman spectra that you get

596
00:22:27,190 --> 00:22:17,600
and

597
00:22:30,230 --> 00:22:27,200
where we completed a hundred pulses per

598
00:22:34,149 --> 00:22:30,950
so

599
00:22:35,270 --> 00:22:34,159
additional instruments as luther

600
00:22:38,230 --> 00:22:35,280
mentioned

601
00:22:40,470 --> 00:22:38,240
at for example with pixel so in

602
00:22:43,190 --> 00:22:40,480
the dorm abrasion patch

603
00:22:44,870 --> 00:22:43,200
we very well co-located the area that we

604
00:22:46,070 --> 00:22:44,880
analyzed with sherlock as well as the

605
00:22:48,470 --> 00:22:46,080
pixel

606
00:22:49,510 --> 00:22:48,480
which provided uh

607
00:22:51,510 --> 00:22:49,520
additional

608
00:22:52,870 --> 00:22:51,520
information into the provenance of the

609
00:22:54,789 --> 00:22:52,880
sample to see the elemental

610
00:22:57,029 --> 00:22:54,799
distributions of

611
00:22:59,270 --> 00:22:57,039
magnesium and silica as well as calcium

612
00:23:01,669 --> 00:22:59,280
and silica we're able to identify that

613
00:23:03,669 --> 00:23:01,679

this is a cumulative texture and that

614
00:23:06,070 --> 00:23:03,679
this purple olivine grain here was

615
00:23:06,789 --> 00:23:06,080
invaded by a pyroxene however we also

616
00:23:09,029 --> 00:23:06,799
see

617
00:23:12,710 --> 00:23:09,039
uh

618
00:23:14,149 --> 00:23:12,720
sulfate and carbonate and

619
00:23:17,110 --> 00:23:14,159
feldspar within the cracks here

620
00:23:20,630 --> 00:23:17,120
indicating that aqueous alteration

621
00:23:23,270 --> 00:23:20,640
has occurred within the sample

622
00:23:25,510 --> 00:23:23,280
so moving back to the other abrasion

623
00:23:27,669 --> 00:23:25,520
patch that i mentioned guard

624
00:23:31,990 --> 00:23:27,679
this was an abrasion patch in which we

625
00:23:34,630 --> 00:23:32,000
had a survey scan as well as

626
00:23:36,789 --> 00:23:34,640
two of the blue scans which are our hdr

627
00:23:39,029 --> 00:23:36,799
scans that have 500 pulses per point so

628
00:23:40,870 --> 00:23:39,039
we're able to

629
00:23:42,789 --> 00:23:40,880
get improved mineral detection as well

630
00:23:45,269 --> 00:23:42,799
as these detailed scans so we're really

631
00:23:47,909 --> 00:23:45,279
able to look at the mineralogy as well

632
00:23:51,190 --> 00:23:47,919
as the distribution of organics across

633
00:23:54,870 --> 00:23:53,750
so within the hdr scan we're able to

634
00:23:57,510 --> 00:23:54,880
determine

635
00:24:00,230 --> 00:23:57,520
the location where we saw carbonate as

636
00:24:02,549 --> 00:24:00,240
well as olivine signatures and this was

637
00:24:04,789 --> 00:24:02,559
pretty exciting

638
00:24:07,909 --> 00:24:04,799

because this was the first

639
00:24:09,830 --> 00:24:07,919
this was the first evidence of uh

640
00:24:11,029 --> 00:24:09,840
the localization that we're able to see

641
00:24:13,350 --> 00:24:11,039
from orbit

642
00:24:15,190 --> 00:24:13,360
in an abrasion patch so here we see the

643
00:24:17,029 --> 00:24:15,200
distribution of olivine which tends to

644
00:24:18,870 --> 00:24:17,039
occur on the darker colored euhedral

645
00:24:20,470 --> 00:24:18,880
greens and

646
00:24:22,549 --> 00:24:20,480
carbonate either co-occurring with the

647
00:24:23,750 --> 00:24:22,559
olivine or around it

648
00:24:26,230 --> 00:24:23,760
and

649
00:24:28,149 --> 00:24:26,240
so we see this really nice co-location

650
00:24:30,789 --> 00:24:28,159
within this area

651
00:24:35,350 --> 00:24:33,029
moving to the detailed scans when we

652
00:24:38,310 --> 00:24:35,360
look at the carbonate on so this again

653
00:24:40,070 --> 00:24:38,320
is a seven by seven millimeter uh area

654
00:24:42,549 --> 00:24:40,080
when we move down to a one by one

655
00:24:46,230 --> 00:24:42,559
millimeter area we're able to see that

656
00:24:48,390 --> 00:24:46,240
the carbonates here tend to occur on the

657
00:24:51,990 --> 00:24:48,400
light toned areas

658
00:24:53,990 --> 00:24:52,000
within the the image presented

659
00:24:55,590 --> 00:24:54,000
and

660
00:24:58,230 --> 00:24:55,600
looking at the

661
00:25:00,630 --> 00:24:58,240
the raman spectra we see the presence of

662
00:25:01,590 --> 00:25:00,640
olivine which is this first blue peak

663
00:25:04,870 --> 00:25:01,600

and

664
00:25:06,789 --> 00:25:04,880
see the presence of we see the peak

665
00:25:09,350 --> 00:25:06,799
being well fit by magnesite which is our

666
00:25:11,830 --> 00:25:09,360
magnesium carbonate so we're seeing the

667
00:25:14,870 --> 00:25:11,840
magnesium carbonate signatures adjacent

668
00:25:17,510 --> 00:25:14,880
to these olivine grain boundaries and in

669
00:25:19,510 --> 00:25:17,520
this bottom uh bottom sample we're also

670
00:25:21,990 --> 00:25:19,520
seeing this hump here

671
00:25:24,070 --> 00:25:22,000
which may be indicative of uh amorphous

672
00:25:25,750 --> 00:25:24,080
silicate

673
00:25:26,789 --> 00:25:25,760
presence as well

674
00:25:28,870 --> 00:25:26,799
and

675
00:25:30,470 --> 00:25:28,880
when we look at the fluorescence

676
00:25:32,630 --> 00:25:30,480
features

677
00:25:38,070 --> 00:25:32,640
and look at areas where we see strong

678
00:25:40,390 --> 00:25:39,110
range

679
00:25:41,510 --> 00:25:40,400
we see that

680
00:25:43,350 --> 00:25:41,520
in the

681
00:25:45,990 --> 00:25:43,360
middle scan and the bottom scan that

682
00:25:48,630 --> 00:25:46,000
this area seems to co-locate with this

683
00:25:50,630 --> 00:25:48,640
uh depression feature that is adjacent

684
00:25:51,830 --> 00:25:50,640
to this light-colored uh potential

685
00:25:55,350 --> 00:25:51,840
carbonate

686
00:25:56,950 --> 00:25:55,360
region and then a similar trend with the

687
00:25:59,590 --> 00:25:56,960
the bottom one but we do see that the

688
00:26:00,789 --> 00:25:59,600

fluorescence is very strongly localized

689
00:26:02,470 --> 00:26:00,799
with uh

690
00:26:04,870 --> 00:26:02,480
potential silicate and carbonate

691
00:26:05,909 --> 00:26:04,880
signatures at these grain boundaries

692
00:26:11,510 --> 00:26:05,919
and

693
00:26:14,149 --> 00:26:11,520
this uh this position this for

694
00:26:16,070 --> 00:26:14,159
this 340 nanometer feature may be

695
00:26:20,230 --> 00:26:16,080
consistent with uh

696
00:26:22,870 --> 00:26:20,240
double ring aromatic aromatics

697
00:26:25,190 --> 00:26:22,880
so some key takeaways from what we found

698
00:26:27,990 --> 00:26:25,200
so far is

699
00:26:29,350 --> 00:26:28,000
uh this mineral suite enables

700
00:26:31,590 --> 00:26:29,360
simultaneous mineralogical and

701
00:26:33,510 --> 00:26:31,600
compositional measurements across scales

702
00:26:37,029 --> 00:26:33,520
from the outcrop scale down to the

703
00:26:39,190 --> 00:26:37,039
millimeter submicrons or micron scale

704
00:26:41,990 --> 00:26:39,200
and we observed these in-situ

705
00:26:44,149 --> 00:26:42,000
associations of carbonates

706
00:26:46,070 --> 00:26:44,159
potentially derived from ultramafic

707
00:26:48,549 --> 00:26:46,080
aqueous alteration

708
00:26:51,350 --> 00:26:48,559
with the organics and we see that these

709
00:26:52,789 --> 00:26:51,360
organics are very localized features

710
00:26:54,789 --> 00:26:52,799
concentrated at the edge of grain

711
00:26:57,190 --> 00:26:54,799
boundaries for the targets that have

712
00:26:59,269 --> 00:26:57,200
been analyzed within this formation

713
00:27:02,149 --> 00:26:59,279

and we also observed that the carbonated

714
00:27:04,710 --> 00:27:02,159
olivine within the sata formation

715
00:27:07,750 --> 00:27:04,720
may be a potential biosignature

716
00:27:09,110 --> 00:27:07,760
preserving environment for jezreel

717
00:27:11,190 --> 00:27:09,120
and with that

718
00:27:13,350 --> 00:27:11,200
i'd like to highlight some ongoing work

719
00:27:15,750 --> 00:27:13,360
so we'll continue to constrain the

720
00:27:18,789 --> 00:27:15,760
distribution and speciation of

721
00:27:21,110 --> 00:27:18,799
uh carbon within this mission and even

722
00:27:23,909 --> 00:27:21,120
if uh

723
00:27:26,070 --> 00:27:23,919
the synthesis of the organics is

724
00:27:28,149 --> 00:27:26,080
uh abiotic due to

725
00:27:29,350 --> 00:27:28,159
aqueous alteration rock water

726
00:27:31,990 --> 00:27:29,360
interactions

727
00:27:33,590 --> 00:27:32,000
uh knowing where and what type it is is

728
00:27:35,029 --> 00:27:33,600
still important for understanding the

729
00:27:36,070 --> 00:27:35,039
carbon on mars

730
00:27:38,950 --> 00:27:36,080
and

731
00:27:41,269 --> 00:27:38,960
as lisa will pick up with she will will

732
00:27:43,669 --> 00:27:41,279
be doing unit based comparisons as well

733
00:27:45,990 --> 00:27:43,679
to see what we find between

734
00:27:47,669 --> 00:27:46,000
between different units

735
00:27:49,669 --> 00:27:47,679
and with that i'd like to thank the

736
00:27:51,909 --> 00:27:49,679
sherlock team uh none of this would have

737
00:27:52,950 --> 00:27:51,919
been possible without them and take any

738
00:27:59,190 --> 00:27:52,960

questions

739
00:28:04,549 --> 00:28:01,110
thanks thanks so much emily so we do

740
00:28:07,029 --> 00:28:04,559
have a couple of minutes for questions

741
00:28:08,710 --> 00:28:07,039
i'd like to remind you we have two

742
00:28:10,710 --> 00:28:08,720
at least two microphones available if

743
00:28:13,590 --> 00:28:10,720
you want to bring that up and then

744
00:28:15,350 --> 00:28:13,600
anyone online feel free to

745
00:28:23,750 --> 00:28:15,360
post your questions in the chat and we

746
00:28:26,870 --> 00:28:26,149
so i can i can kick it off and give you

747
00:28:29,350 --> 00:28:26,880
the

748
00:28:30,549 --> 00:28:29,360
most wishy-washy uh question because i

749
00:28:33,430 --> 00:28:30,559
don't know that any of us have the

750
00:28:35,350 --> 00:28:33,440
answer um but as you pointed out you

751
00:28:37,269 --> 00:28:35,360
know we landed in the crater floor and

752
00:28:40,470 --> 00:28:37,279
we weren't sure if we were looking at

753
00:28:42,789 --> 00:28:40,480
sediments or igneous rock at that point

754
00:28:44,870 --> 00:28:42,799
do you have a sense for

755
00:28:47,190 --> 00:28:44,880
or could you predict

756
00:28:50,549 --> 00:28:47,200
do you think that if we get into a

757
00:28:53,590 --> 00:28:50,559
really organic rich location in the

758
00:28:55,269 --> 00:28:53,600
delta i mean is is sherlock just going

759
00:28:57,110 --> 00:28:55,279
to light up i mean is this just is it

760
00:28:58,630 --> 00:28:57,120
going to be super obvious

761
00:29:00,149 --> 00:28:58,640
right from the start like look at all

762
00:29:02,230 --> 00:29:00,159
these organics here are we going to

763
00:29:04,310 --> 00:29:02,240

really have to pick through the data in

764
00:29:07,269 --> 00:29:04,320
order to find those organic

765
00:29:08,630 --> 00:29:07,279
signatures in the delta

766
00:29:11,590 --> 00:29:08,640
well i think that really depends on the

767
00:29:13,269 --> 00:29:11,600
type of scans that we start with

768
00:29:15,669 --> 00:29:13,279
however most times we start with a

769
00:29:17,350 --> 00:29:15,679
survey scan which is

770
00:29:19,830 --> 00:29:17,360
fewer pulses per point so that's 15

771
00:29:21,029 --> 00:29:19,840
pulses per point over a

772
00:29:23,029 --> 00:29:21,039
and

773
00:29:25,029 --> 00:29:23,039
the the spots are

774
00:29:27,110 --> 00:29:25,039
as closely uh

775
00:29:28,710 --> 00:29:27,120
positioned as as we can get them and so

776
00:29:32,470 --> 00:29:28,720
we're able to cover

777
00:29:33,990 --> 00:29:32,480
a medium sized area but quite thoroughly

778
00:29:35,669 --> 00:29:34,000
and

779
00:29:38,230 --> 00:29:35,679
just

780
00:29:39,590 --> 00:29:38,240
then we can then we can move from uh so

781
00:29:41,830 --> 00:29:39,600
if we see fluorescence with the 15

782
00:29:44,950 --> 00:29:41,840
pulses per point then sherlock is

783
00:29:46,230 --> 00:29:44,960
actually capable of uh then refocusing

784
00:29:48,230 --> 00:29:46,240
to the areas where it sees the

785
00:29:50,310 --> 00:29:48,240
fluorescence and then taking additional

786
00:29:53,430 --> 00:29:50,320
scans with higher numbers of pulses per

787
00:29:55,909 --> 00:29:53,440
point after that fabulous i'm really

788
00:30:03,590 --> 00:29:55,919

looking forward to it it'll be great

789
00:30:08,149 --> 00:30:06,230
all right wonderful so our next speaker

790
00:30:11,669 --> 00:30:08,159
is lisa mayhew who is going to be

791
00:30:21,190 --> 00:30:11,679
presenting uh sharing their screen

792
00:30:26,710 --> 00:30:24,310
if only was that mysterious

793
00:30:30,389 --> 00:30:28,630
can you see my slide

794
00:30:33,830 --> 00:30:30,399
yes and you are

795
00:30:36,549 --> 00:30:33,840
not in presentation mode yet

796
00:30:37,430 --> 00:30:36,559
okay i see you so perfect

797
00:30:38,470 --> 00:30:37,440
great

798
00:30:40,230 --> 00:30:38,480
oh

799
00:30:42,389 --> 00:30:40,240
yep just switch to the other swap

800
00:30:43,590 --> 00:30:42,399
displays and you'll be set

801
00:30:45,029 --> 00:30:43,600
there you go

802
00:30:46,230 --> 00:30:45,039
does that

803
00:30:48,950 --> 00:30:46,240
look okay

804
00:30:52,710 --> 00:30:48,960
five by five

805
00:30:55,430 --> 00:30:53,590
okay

806
00:30:57,110 --> 00:30:55,440
um thank you all so much for having me

807
00:30:59,430 --> 00:30:57,120
i'm really sorry that i can't be there

808
00:31:01,430 --> 00:30:59,440
in person with you all um

809
00:31:03,830 --> 00:31:01,440
but regardless today i'm

810
00:31:05,669 --> 00:31:03,840
um looking forward to sharing with you

811
00:31:07,430 --> 00:31:05,679
um some work we've been doing

812
00:31:09,110 --> 00:31:07,440
investigating the astrobiological

813
00:31:10,230 --> 00:31:09,120

potential of

814
00:31:12,470 --> 00:31:10,240
um

815
00:31:14,230 --> 00:31:12,480
what i'm going to call rubion-like rocks

816
00:31:16,789 --> 00:31:14,240
that we have found on the jezreel crater

817
00:31:18,630 --> 00:31:16,799
floor during the first

818
00:31:20,070 --> 00:31:18,640
year of the mission our first year of

819
00:31:22,549 --> 00:31:20,080
exploration

820
00:31:24,149 --> 00:31:22,559
um and i'm showing this image this is um

821
00:31:26,630 --> 00:31:24,159
the rubion rock itself with the

822
00:31:29,509 --> 00:31:26,640
guillaume abrasion patch

823
00:31:32,149 --> 00:31:29,519
and um what we notice here

824
00:31:34,870 --> 00:31:32,159
and hopefully you all notice too is um

825
00:31:37,350 --> 00:31:34,880
reddish coloration that was perhaps iron

826
00:31:38,470 --> 00:31:37,360
staining pits and holes and white

827
00:31:40,870 --> 00:31:38,480
patches

828
00:31:43,269 --> 00:31:40,880
all characteristics that suggest that

829
00:31:44,630 --> 00:31:43,279
this rock underwent alteration and in

830
00:31:47,509 --> 00:31:44,640
fact when we attempted to sample this

831
00:31:50,149 --> 00:31:47,519
this was our first sampling attempt

832
00:31:51,909 --> 00:31:50,159
we were unable to get a sample in a tube

833
00:31:53,750 --> 00:31:51,919
and that was also suggestive of

834
00:31:55,350 --> 00:31:53,760
extensive alteration

835
00:31:57,190 --> 00:31:55,360
and made this

836
00:31:58,950 --> 00:31:57,200
feel even more astrobiologically

837
00:32:00,710 --> 00:31:58,960
compelling

838
00:32:02,630 --> 00:32:00,720

in order to

839
00:32:05,190 --> 00:32:02,640
get a sample that would give us the

840
00:32:07,190 --> 00:32:05,200
secondary mineral record of multiple

841
00:32:09,509 --> 00:32:07,200
habitable aqueous environments that we

842
00:32:11,590 --> 00:32:09,519
think this rock could potentially

843
00:32:13,269 --> 00:32:11,600
represent but it presents the challenge

844
00:32:15,669 --> 00:32:13,279
because um

845
00:32:19,990 --> 00:32:15,679
these types of rocks um you know are

846
00:32:23,110 --> 00:32:20,000
must are less resistant and competent

847
00:32:25,269 --> 00:32:23,120
um and so we were interested in the in

848
00:32:27,590 --> 00:32:25,279
um sampling a water rock system that can

849
00:32:30,870 --> 00:32:27,600
support habitable environments

850
00:32:32,950 --> 00:32:30,880
for lots of reasons but this sums it up

851
00:32:33,830 --> 00:32:32,960
nicely this is a national academies of

852
00:32:36,230 --> 00:32:33,840
science

853
00:32:38,710 --> 00:32:36,240
recent publication in 2019 a consensus

854
00:32:40,950 --> 00:32:38,720
report that found that understanding

855
00:32:42,470 --> 00:32:40,960
chemosynthetic subsurface environments

856
00:32:44,710 --> 00:32:42,480
and saline fluids

857
00:32:46,789 --> 00:32:44,720
um as potential habitats have

858
00:32:49,269 --> 00:32:46,799
implications for astrobiology

859
00:32:51,350 --> 00:32:49,279
and as a result of that they recommended

860
00:32:52,789 --> 00:32:51,360
that nasa emissions should dedicate

861
00:32:54,230 --> 00:32:52,799
focus to exploring subsurface

862
00:32:56,470 --> 00:32:54,240
habitability

863
00:32:58,630 --> 00:32:56,480

um and all of this stems from what we've

864
00:32:59,750 --> 00:32:58,640
learned in the last especially five to

865
00:33:03,269 --> 00:32:59,760
ten years

866
00:33:05,590 --> 00:33:03,279
about um life and organics in uh watered

867
00:33:07,590 --> 00:33:05,600
altered igneous rocks

868
00:33:09,990 --> 00:33:07,600
so um

869
00:33:11,430 --> 00:33:10,000
um as i mentioned there's been a lot of

870
00:33:12,870 --> 00:33:11,440
new research coming out in the last five

871
00:33:14,789 --> 00:33:12,880
to 10 years

872
00:33:16,630 --> 00:33:14,799
indicating that these altered igneous

873
00:33:18,789 --> 00:33:16,640
rocks on earth can facilitate production

874
00:33:21,669 --> 00:33:18,799
of abiotically and biotically derived

875
00:33:23,909 --> 00:33:21,679
organic material

876
00:33:26,710 --> 00:33:23,919
a variety of multicarbon and complex

877
00:33:28,389 --> 00:33:26,720
carbon molecules have been detected in

878
00:33:30,389 --> 00:33:28,399
these rocks

879
00:33:32,230 --> 00:33:30,399
and the presence of functionalized

880
00:33:33,269 --> 00:33:32,240
molecules means that these rocks can

881
00:33:35,029 --> 00:33:33,279
produce

882
00:33:37,269 --> 00:33:35,039
molecules that are biologically

883
00:33:39,509 --> 00:33:37,279
biotically interesting

884
00:33:42,070 --> 00:33:39,519
in that that they can sustain microbes

885
00:33:44,549 --> 00:33:42,080
as food and abiotically interesting um

886
00:33:47,190 --> 00:33:44,559
with relevance to prebiotic synthesis

887
00:33:49,990 --> 00:33:47,200
processes and the origin of life

888
00:33:51,750 --> 00:33:50,000

and they um and these different organic

889
00:33:54,549 --> 00:33:51,760
materials have been detected amongst a

890
00:33:57,509 --> 00:33:54,559
variety of mineral assemblages and this

891
00:33:59,430 --> 00:33:57,519
figure from sforna adele 2018

892
00:34:01,750 --> 00:33:59,440
is illustrating that where we see

893
00:34:04,310 --> 00:34:01,760
clays and iron oxides um and

894
00:34:06,710 --> 00:34:04,320
phosilicates um along with some primary

895
00:34:09,109 --> 00:34:06,720
igneous phases like olivine

896
00:34:10,869 --> 00:34:09,119
in close association with condensed

897
00:34:12,629 --> 00:34:10,879
carbonaceous matter

898
00:34:14,869 --> 00:34:12,639
and i'll particularly just call up

899
00:34:17,030 --> 00:34:14,879
olivine and serpentine as some of those

900
00:34:18,829 --> 00:34:17,040
mineral assemblages that are interesting

901
00:34:21,270 --> 00:34:18,839
here

902
00:34:23,589 --> 00:34:21,280
um and

903
00:34:25,190 --> 00:34:23,599
diverse not only do we know that we can

904
00:34:27,430 --> 00:34:25,200
find organic material in these water

905
00:34:30,310 --> 00:34:27,440
altered igneous rocks we actually know

906
00:34:33,030 --> 00:34:30,320
that these um lithologies on earth can

907
00:34:34,550 --> 00:34:33,040
host rich microbial ecosystems

908
00:34:37,030 --> 00:34:34,560
and these um

909
00:34:39,349 --> 00:34:37,040
ecosystems on earth are widespread they

910
00:34:41,750 --> 00:34:39,359
occur in diverse lithologies and they

911
00:34:45,190 --> 00:34:41,760
vary with lithology and setting

912
00:34:48,069 --> 00:34:45,200
and the microbes that we find in these

913
00:34:49,270 --> 00:34:48,079

um rock hosted systems are powered by

914
00:34:51,669 --> 00:34:49,280
the energy

915
00:34:54,069 --> 00:34:51,679
held in these rocks and so this figure

916
00:34:55,589 --> 00:34:54,079
here from suzuki at all 2020 shows that

917
00:34:58,550 --> 00:34:55,599
we can image

918
00:35:00,710 --> 00:34:58,560
um the presence of life in rocks and its

919
00:35:03,750 --> 00:35:00,720
association with different mineral

920
00:35:05,190 --> 00:35:03,760
phases the cells in green here on the

921
00:35:07,990 --> 00:35:05,200
right hand side of each one of these

922
00:35:09,829 --> 00:35:08,000
paired images are being lit up by a dna

923
00:35:11,910 --> 00:35:09,839
staining dye

924
00:35:13,829 --> 00:35:11,920
and are showing the co-localization of

925
00:35:19,829 --> 00:35:13,839
the cells at the interface between

926
00:35:25,190 --> 00:35:23,190
and um again we can actually visualize

927
00:35:26,950 --> 00:35:25,200
cells in the subsurface of water altered

928
00:35:30,310 --> 00:35:26,960
igneous rocks this is another example

929
00:35:32,870 --> 00:35:30,320
here from the templeton l 2021 paper of

930
00:35:35,109 --> 00:35:32,880
cells um at about 120 meters depth in

931
00:35:39,109 --> 00:35:35,119
the iman ophiolite

932
00:35:40,310 --> 00:35:39,119
and beyond um actually imaging um

933
00:35:44,310 --> 00:35:40,320
cells

934
00:35:46,069 --> 00:35:44,320
signatures

935
00:35:48,069 --> 00:35:46,079
including um

936
00:35:49,510 --> 00:35:48,079
component cellular components like

937
00:35:51,589 --> 00:35:49,520
membrane lipids

938
00:35:54,310 --> 00:35:51,599

um leodel 2020 found the presence of

939
00:35:55,430 --> 00:35:54,320
both archaeal and bacterial lipids

940
00:35:57,109 --> 00:35:55,440
in

941
00:35:59,589 --> 00:35:57,119
deep and old

942
00:36:01,349 --> 00:35:59,599
up to 100 million year old basalts in

943
00:36:03,589 --> 00:36:01,359
the ocean crust

944
00:36:05,750 --> 00:36:03,599
we can also see see things like bio

945
00:36:08,470 --> 00:36:05,760
biologically derived organic material

946
00:36:12,069 --> 00:36:08,480
and structures that can be identified

947
00:36:14,390 --> 00:36:12,079
using techniques such as raman

948
00:36:15,910 --> 00:36:14,400
and we um

949
00:36:17,910 --> 00:36:15,920
see these altered igneous rocks as

950
00:36:20,390 --> 00:36:17,920
ubiquitous habitats on earth so where we

951
00:36:22,630 --> 00:36:20,400
see igneous rocks in contact with water

952
00:36:25,589 --> 00:36:22,640
and terrestrial locations such as the

953
00:36:27,829 --> 00:36:25,599
oman ophelite and also submarine systems

954
00:36:30,950 --> 00:36:27,839
like the basaltic or predatic ocean

955
00:36:33,270 --> 00:36:30,960
crust these are fully realized microbial

956
00:36:34,870 --> 00:36:33,280
habitats that vary across space

957
00:36:37,990 --> 00:36:34,880
and time and turns out that

958
00:36:41,030 --> 00:36:38,000
understanding these is pertinent as we

959
00:36:44,630 --> 00:36:41,040
um explore the surface of mars um as was

960
00:36:47,670 --> 00:36:44,640
mentioned earlier um by luther and emily

961
00:36:49,670 --> 00:36:47,680
it's been hypothesized by the mars 2020

962
00:36:51,510 --> 00:36:49,680
team that the rocks of the jezreel

963
00:36:52,710 --> 00:36:51,520

crater flora igneous and this is an

964
00:36:54,790 --> 00:36:52,720
image of

965
00:36:55,990 --> 00:36:54,800
a typical low-lying polygonally

966
00:36:58,710 --> 00:36:56,000
fractured

967
00:37:00,630 --> 00:36:58,720
paver morphology of the maaz formation

968
00:37:01,430 --> 00:37:00,640
um with this rock i've been talking

969
00:37:03,910 --> 00:37:01,440
about

970
00:37:06,150 --> 00:37:03,920
located here but the red arrow

971
00:37:09,589 --> 00:37:06,160
and we see

972
00:37:11,670 --> 00:37:09,599
this morphology can it looks similar to

973
00:37:14,550 --> 00:37:11,680
morphologies we see in igneous water

974
00:37:16,150 --> 00:37:14,560
altered systems on earth um this is an

975
00:37:17,829 --> 00:37:16,160
image of the ammon ophiolite in the

976
00:37:19,190 --> 00:37:17,839
upper right here where you can see that

977
00:37:20,069 --> 00:37:19,200
same polygonal

978
00:37:22,710 --> 00:37:20,079
um

979
00:37:23,589 --> 00:37:22,720
shape and the this is caused by fluid

980
00:37:26,150 --> 00:37:23,599
flow

981
00:37:28,390 --> 00:37:26,160
and um alteration and you see these

982
00:37:29,990 --> 00:37:28,400
sharp and repeating alteration gradients

983
00:37:32,150 --> 00:37:30,000
um caused by fluid flow through

984
00:37:34,230 --> 00:37:32,160
fractures

985
00:37:36,470 --> 00:37:34,240
um

986
00:37:37,670 --> 00:37:36,480
and that represents

987
00:37:39,510 --> 00:37:37,680
you know chemical gradients and

988
00:37:41,109 --> 00:37:39,520

disequilibrium

989
00:37:43,190 --> 00:37:41,119
and it turns out when we as i mentioned

990
00:37:44,310 --> 00:37:43,200
earlier when we drill into or braid

991
00:37:46,390 --> 00:37:44,320
these rocks

992
00:37:48,950 --> 00:37:46,400
um at rubion and the moss formation we

993
00:37:51,750 --> 00:37:48,960
found them to be um

994
00:37:53,430 --> 00:37:51,760
altered and mechanically weak

995
00:37:54,310 --> 00:37:53,440
we didn't get a sample and we started to

996
00:37:56,069 --> 00:37:54,320
wonder

997
00:37:58,310 --> 00:37:56,079
many of us if we had the opportunity to

998
00:38:00,790 --> 00:37:58,320
abrade or drill in different areas of a

999
00:38:02,470 --> 00:38:00,800
paver would we find more or less altered

1000
00:38:04,230 --> 00:38:02,480
or resistant rocks

1001
00:38:06,390 --> 00:38:04,240
depending on where exactly we drill

1002
00:38:07,829 --> 00:38:06,400
across a relatively short

1003
00:38:10,069 --> 00:38:07,839
um

1004
00:38:11,510 --> 00:38:10,079
length scale essentially wondering like

1005
00:38:13,910 --> 00:38:11,520
would we see this

1006
00:38:15,990 --> 00:38:13,920
these sharp alteration gradients buried

1007
00:38:17,670 --> 00:38:16,000
under the dust um that we can't see

1008
00:38:19,430 --> 00:38:17,680
underneath

1009
00:38:21,190 --> 00:38:19,440
in these images

1010
00:38:22,470 --> 00:38:21,200
so when i talk about alteration you're

1011
00:38:23,990 --> 00:38:22,480
probably wondering

1012
00:38:26,790 --> 00:38:24,000
what kind of alteration we're observing

1013
00:38:29,910 --> 00:38:26,800

in these moss formation um

1014
00:38:31,589 --> 00:38:29,920
rocks and in fact the guillaume had i'm

1015
00:38:34,870 --> 00:38:31,599
sorry guillaume abrasion patch was the

1016
00:38:37,030 --> 00:38:34,880
most hydrated abrasion patch that

1017
00:38:39,510 --> 00:38:37,040
has been investigated on the crater

1018
00:38:41,270 --> 00:38:39,520
floor and according to data from

1019
00:38:42,230 --> 00:38:41,280
supercam vis-a-r

1020
00:38:46,470 --> 00:38:42,240
um

1021
00:38:47,910 --> 00:38:46,480
phases that were

1022
00:38:49,829 --> 00:38:47,920
or signatures that

1023
00:38:52,069 --> 00:38:49,839
implicated iron-rich phyllosilicates to

1024
00:38:53,589 --> 00:38:52,079
be present and also salts such as

1025
00:38:57,030 --> 00:38:53,599
sulfates and perchlorates which are

1026
00:39:00,390 --> 00:38:57,040
highly soluble and um suggest that these

1027
00:39:02,470 --> 00:39:00,400
salts were a last or very late stage

1028
00:39:05,589 --> 00:39:02,480
um episode in place from the last or

1029
00:39:07,430 --> 00:39:05,599
late stage episode of aqueous activity

1030
00:39:09,270 --> 00:39:07,440
um and so we hypothesized that there are

1031
00:39:11,030 --> 00:39:09,280
two different episodes of water rock

1032
00:39:13,349 --> 00:39:11,040
reaction represented in these

1033
00:39:15,990 --> 00:39:13,359
rubion-like rocks

1034
00:39:17,589 --> 00:39:16,000
and our first stage of reaction that was

1035
00:39:19,990 --> 00:39:17,599
essentially limited to olivine

1036
00:39:21,030 --> 00:39:20,000
alteration is a hypothesis that has

1037
00:39:22,310 --> 00:39:21,040
grown out of

1038
00:39:24,790 --> 00:39:22,320

pixel

1039
00:39:26,710 --> 00:39:24,800
scan data where

1040
00:39:28,230 --> 00:39:26,720
the alteration phases those iron-rich

1041
00:39:30,230 --> 00:39:28,240
phyllosilicates

1042
00:39:31,750 --> 00:39:30,240
have been identified as

1043
00:39:33,910 --> 00:39:31,760
iron-rich serpentines if you look at

1044
00:39:36,150 --> 00:39:33,920
this ternary diagram of magnesium

1045
00:39:37,270 --> 00:39:36,160
silicone iron you can see that the data

1046
00:39:39,109 --> 00:39:37,280
in blue

1047
00:39:41,270 --> 00:39:39,119
plot mostly in these casingerite and

1048
00:39:43,750 --> 00:39:41,280
greenlight

1049
00:39:46,710 --> 00:39:43,760
fields and those are iron-rich

1050
00:39:49,349 --> 00:39:46,720
serpentine phases and if you look at the

1051
00:39:50,710 --> 00:39:49,359
pixel mineral map data

1052
00:39:52,630 --> 00:39:50,720
you can see that they're exclusively

1053
00:39:54,710 --> 00:39:52,640
associated with an iron-rich or

1054
00:39:56,230 --> 00:39:54,720
pheolytic olivine so in dark green is

1055
00:39:58,310 --> 00:39:56,240
the olivine and light green is that

1056
00:40:00,310 --> 00:39:58,320
altered olivine or olivine plus

1057
00:40:02,310 --> 00:40:00,320
phyllosilicates and you can see that

1058
00:40:03,510 --> 00:40:02,320
close association there

1059
00:40:06,069 --> 00:40:03,520
interestingly and a little bit

1060
00:40:07,589 --> 00:40:06,079
confusingly um you know we also with

1061
00:40:09,829 --> 00:40:07,599
this data it was determined that

1062
00:40:12,630 --> 00:40:09,839
plagioclase purity and iron titanium

1063
00:40:15,430 --> 00:40:12,640

oxides are present and those are occur

1064
00:40:17,030 --> 00:40:15,440
in real relatively pristine chemical

1065
00:40:18,710 --> 00:40:17,040
compositions

1066
00:40:20,790 --> 00:40:18,720
so this suggests that the water rock

1067
00:40:23,190 --> 00:40:20,800
interaction that these rubian-like or

1068
00:40:24,790 --> 00:40:23,200
moss formation rocks have

1069
00:40:26,950 --> 00:40:24,800
undergone

1070
00:40:29,190 --> 00:40:26,960
occurred under low water rock ratios and

1071
00:40:31,109 --> 00:40:29,200
rock buffered conditions this left

1072
00:40:33,190 --> 00:40:31,119
olivine heavily altered and other

1073
00:40:35,109 --> 00:40:33,200
minerals relatively intact in terms of

1074
00:40:36,710 --> 00:40:35,119
their chemical composition

1075
00:40:39,030 --> 00:40:36,720
and this has um

1076
00:40:40,790 --> 00:40:39,040
important implications for astrobiology

1077
00:40:41,910 --> 00:40:40,800
because as we know from

1078
00:40:43,990 --> 00:40:41,920
altering

1079
00:40:45,349 --> 00:40:44,000
olivine on earth you can produce

1080
00:40:46,790 --> 00:40:45,359
hydrogen gas

1081
00:40:49,030 --> 00:40:46,800
and um

1082
00:40:50,470 --> 00:40:49,040
and support life that way

1083
00:40:52,790 --> 00:40:50,480
um

1084
00:40:54,950 --> 00:40:52,800
so really quickly i'm going to also just

1085
00:40:56,790 --> 00:40:54,960
point out that um organics and i'm going

1086
00:40:59,589 --> 00:40:56,800
to show some of the same data that loser

1087
00:41:02,950 --> 00:40:59,599
and emily showed from sherlock

1088
00:41:04,309 --> 00:41:02,960

organics um perhaps consistent with one

1089
00:41:05,430 --> 00:41:04,319
ring and two ring aromatics were

1090
00:41:07,270 --> 00:41:05,440
detected

1091
00:41:09,990 --> 00:41:07,280
in association with these iglesia

1092
00:41:12,150 --> 00:41:10,000
altered materials and shelleradel

1093
00:41:15,030 --> 00:41:12,160
hypothesized that they have a possible

1094
00:41:17,030 --> 00:41:15,040
abiotic aqueous i'm sorry aqueous

1095
00:41:19,430 --> 00:41:17,040
abiotic origin

1096
00:41:21,430 --> 00:41:19,440
um and

1097
00:41:23,349 --> 00:41:21,440
and um

1098
00:41:26,230 --> 00:41:23,359
please say you have 30 seconds

1099
00:41:28,390 --> 00:41:26,240
oh okay so to sum it up ruby on like

1100
00:41:29,829 --> 00:41:28,400
rocks are a key astrobiological target

1101
00:41:32,230 --> 00:41:29,839
and they give us the opportunity to

1102
00:41:34,069 --> 00:41:32,240
understand um past habitability of an

1103
00:41:35,990 --> 00:41:34,079
altered igneous system on mars that has

1104
00:41:38,150 --> 00:41:36,000
not yet been explored

1105
00:41:39,670 --> 00:41:38,160
and how that might supply

1106
00:41:41,270 --> 00:41:39,680
energetic substrates to support

1107
00:41:42,950 --> 00:41:41,280
subsurface life

1108
00:41:44,550 --> 00:41:42,960
um and

1109
00:41:46,630 --> 00:41:44,560
we can look in further detail into

1110
00:41:48,470 --> 00:41:46,640
aqueous alteration conditions and

1111
00:41:50,150 --> 00:41:48,480
processes responsible for production of

1112
00:41:52,950 --> 00:41:50,160
organics

1113
00:41:55,270 --> 00:41:52,960

and just to wrap up really quickly um we

1114
00:41:57,190 --> 00:41:55,280
did not get a sample but of rubion but

1115
00:41:58,550 --> 00:41:57,200
we did get samples of similar rocks from

1116
00:42:01,510 --> 00:41:58,560
the crater floor

1117
00:42:02,790 --> 00:42:01,520
um though less likely less altered and

1118
00:42:04,550 --> 00:42:02,800
we can use these still to test

1119
00:42:06,309 --> 00:42:04,560
hypotheses in labs on earth and we're

1120
00:42:08,309 --> 00:42:06,319
also looking forward to further

1121
00:42:09,990 --> 00:42:08,319
exploring um

1122
00:42:11,670 --> 00:42:10,000
it looks like there's some halloween and

1123
00:42:13,829 --> 00:42:11,680
serpentine signatures and sedimentary

1124
00:42:15,670 --> 00:42:13,839
rocks in jezreel and those will hold

1125
00:42:17,910 --> 00:42:15,680
chemical energy that can be released

1126
00:42:19,430 --> 00:42:17,920
during water rock reaction perhaps being

1127
00:42:20,710 --> 00:42:19,440
even more habitable with more pore

1128
00:42:21,990 --> 00:42:20,720
spaces

1129
00:42:23,670 --> 00:42:22,000
and then we're excited to go on to the

1130
00:42:25,910 --> 00:42:23,680
extended mission to further

1131
00:42:29,990 --> 00:42:25,920
um investigate the olivine carbonate

1132
00:42:31,190 --> 00:42:30,000
units that emily was mentioning as well

1133
00:42:32,470 --> 00:42:31,200
that's it

1134
00:42:38,950 --> 00:42:32,480
thank you

1135
00:42:40,950 --> 00:42:38,960
and next we'll have danny glavin

1136
00:42:43,270 --> 00:42:40,960
presenting on the search for chiral

1137
00:42:57,829 --> 00:42:43,280
asymmetry as a potential biosignature in

1138
00:43:02,230 --> 00:42:59,910

okay great it's a pleasure to be here to

1139
00:43:03,829 --> 00:43:02,240
talk about uh chirality which is the

1140
00:43:05,990 --> 00:43:03,839
topic that i've been interested in for

1141
00:43:07,670 --> 00:43:06,000
quite a while now and how we might use

1142
00:43:09,430 --> 00:43:07,680
that as as a

1143
00:43:11,109 --> 00:43:09,440
potential biosignature and samples from

1144
00:43:13,030 --> 00:43:11,119
mars and if you're interested in this

1145
00:43:14,950 --> 00:43:13,040
topic i encourage you to visit our

1146
00:43:17,430 --> 00:43:14,960
chemical reviews paper that came out in

1147
00:43:18,870 --> 00:43:17,440
2020 that really goes into detail about

1148
00:43:21,030 --> 00:43:18,880
the criteria that we propose to

1149
00:43:23,190 --> 00:43:21,040
establish the origin and also shows how

1150
00:43:25,109 --> 00:43:23,200
this is not just applicable for mars but

1151
00:43:27,349 --> 00:43:25,119
other targets of astrobiological

1152
00:43:29,589 --> 00:43:27,359
interest in our solar system

1153
00:43:31,430 --> 00:43:29,599
so the motivation is that homochorality

1154
00:43:33,349 --> 00:43:31,440
that's the the bias towards left-handed

1155
00:43:36,390 --> 00:43:33,359
amino acids and proteins and enzymes and

1156
00:43:38,230 --> 00:43:36,400
right-handed sugars in dna and rna is

1157
00:43:40,470 --> 00:43:38,240
thought to be a unique signature of life

1158
00:43:43,589 --> 00:43:40,480
and some have argued that's a actually a

1159
00:43:45,510 --> 00:43:43,599
prerequisite for the origin of life

1160
00:43:47,430 --> 00:43:45,520
however one of the caveats with this is

1161
00:43:48,470 --> 00:43:47,440
that through analysis of meteorite

1162
00:43:50,710 --> 00:43:48,480
samples

1163
00:43:52,790 --> 00:43:50,720

which is about chemistry

1164
00:43:54,710 --> 00:43:52,800
we found large left-handed amino acid

1165
00:43:57,030 --> 00:43:54,720
excesses of some protein amino acids up

1166
00:43:59,190 --> 00:43:57,040
to 60 percent and even higher

1167
00:44:02,790 --> 00:43:59,200
and right-handed sugar acid excess is up

1168
00:44:04,470 --> 00:44:02,800
to enantio pure 100 percent d which we

1169
00:44:06,390 --> 00:44:04,480
know are produced by non-biological

1170
00:44:08,710 --> 00:44:06,400
processes so this definitely complicates

1171
00:44:11,030 --> 00:44:08,720
the use of chirality as a definitive

1172
00:44:12,950 --> 00:44:11,040
biosignature so as a result of that

1173
00:44:14,550 --> 00:44:12,960
we've proposed a set of measurement

1174
00:44:16,390 --> 00:44:14,560
criteria which is illustrated by this

1175
00:44:17,829 --> 00:44:16,400
venn diagram

1176
00:44:19,910 --> 00:44:17,839
where basically you've got to have the

1177
00:44:21,829 --> 00:44:19,920
chiral asymmetry we're looking for

1178
00:44:23,589 --> 00:44:21,839
evidence of isotopic fractionation in

1179
00:44:26,950 --> 00:44:23,599
those enantiomers as well as a simple

1180
00:44:30,309 --> 00:44:28,550
we know biochemistry at least

1181
00:44:32,470 --> 00:44:30,319
biochemistry here on earth is is very

1182
00:44:34,150 --> 00:44:32,480
distinct from about chemistry

1183
00:44:36,309 --> 00:44:34,160
there's a simple distribution of you

1184
00:44:38,390 --> 00:44:36,319
know 20 amino acids standard amino acids

1185
00:44:40,950 --> 00:44:38,400
and and and life on earth with it with a

1186
00:44:42,710 --> 00:44:40,960
heavy bias towards the left-handed form

1187
00:44:44,710 --> 00:44:42,720
in contrast meteorites have a highly

1188
00:44:46,550 --> 00:44:44,720

complex distribution of amino acids

1189
00:44:48,550 --> 00:44:46,560
we've found hundreds of different amino

1190
00:44:50,870 --> 00:44:48,560
acids in the murchison meteorite and

1191
00:44:52,790 --> 00:44:50,880
most of them are racemic equal mixtures

1192
00:44:54,390 --> 00:44:52,800
of left and right another indication of

1193
00:44:56,710 --> 00:44:54,400
about chemistry

1194
00:44:59,430 --> 00:44:56,720
there's also an isomeric preference in

1195
00:45:01,430 --> 00:44:59,440
life on earth alpha-hydrogen amino acids

1196
00:45:04,309 --> 00:45:01,440
found in protein

1197
00:45:06,309 --> 00:45:04,319
dominate life on earth and in contrast

1198
00:45:07,670 --> 00:45:06,319
meteorites don't appear to have any most

1199
00:45:09,670 --> 00:45:07,680
meteorites don't appear to have any

1200
00:45:11,910 --> 00:45:09,680
isomeric preference we see the complete

1201
00:45:13,750 --> 00:45:11,920
structural diversity of all possible

1202
00:45:15,430 --> 00:45:13,760
isomers for example you see alpha beta

1203
00:45:16,790 --> 00:45:15,440
gamma and delta

1204
00:45:19,030 --> 00:45:16,800
amino acids

1205
00:45:20,790 --> 00:45:19,040
and then finally life has a unique

1206
00:45:22,950 --> 00:45:20,800
signature of fractionation we see that

1207
00:45:25,510 --> 00:45:22,960
in the isotopes of carbon nitrogen and

1208
00:45:28,150 --> 00:45:25,520
deuterium which are heavily favored

1209
00:45:30,230 --> 00:45:28,160
towards the the lighter isotope and in

1210
00:45:32,390 --> 00:45:30,240
contrast with meteorites in general

1211
00:45:33,750 --> 00:45:32,400
especially ones that the organics formed

1212
00:45:38,550 --> 00:45:33,760
in a cold environment we see an

1213
00:45:42,950 --> 00:45:40,870

so how do we analyze samples we use a

1214
00:45:44,790 --> 00:45:42,960
solvent extraction procedure it's really

1215
00:45:47,030 --> 00:45:44,800
been around for decades

1216
00:45:48,870 --> 00:45:47,040
since the late 60s been using this to

1217
00:45:50,069 --> 00:45:48,880
analyze lunar samples and and the

1218
00:45:50,790 --> 00:45:50,079
emergence of meteorite when it first

1219
00:45:53,190 --> 00:45:50,800
fell

1220
00:45:54,870 --> 00:45:53,200
1969 and this hasn't really changed much

1221
00:45:57,430 --> 00:45:54,880
but there are a variety of steps water

1222
00:45:59,510 --> 00:45:57,440
extraction acid hydrolysis desalting

1223
00:46:01,589 --> 00:45:59,520
derivatization that's required before

1224
00:46:03,829 --> 00:46:01,599
you analyze a sample by liquid

1225
00:46:06,230 --> 00:46:03,839
chromatography high resolution mass spec

1226
00:46:07,990 --> 00:46:06,240
and gas chromatography techniques

1227
00:46:09,990 --> 00:46:08,000
to get both the enantiomeric ratio as

1228
00:46:11,510 --> 00:46:10,000
well as the isotope values i want to

1229
00:46:13,829 --> 00:46:11,520
point out that this is one of the real

1230
00:46:15,910 --> 00:46:13,839
key benefits of sample return everybody

1231
00:46:17,430 --> 00:46:15,920
seems to focus on you know the fact that

1232
00:46:19,510 --> 00:46:17,440
the instruments are more sensitive and

1233
00:46:21,109 --> 00:46:19,520
selective which is true but it's really

1234
00:46:23,109 --> 00:46:21,119
the flexibility you have in changing

1235
00:46:24,470 --> 00:46:23,119
your extraction protocol

1236
00:46:26,630 --> 00:46:24,480
which is really important because you

1237
00:46:28,230 --> 00:46:26,640
can adapt your extraction to the sample

1238
00:46:30,470 --> 00:46:28,240

chemistry

1239
00:46:32,550 --> 00:46:30,480
which is really important

1240
00:46:33,750 --> 00:46:32,560
okay so back to the criteria here and

1241
00:46:36,230 --> 00:46:33,760
i'm going to take you just through a

1242
00:46:38,309 --> 00:46:36,240
couple examples quick examples

1243
00:46:40,150 --> 00:46:38,319
here's the positive control we got some

1244
00:46:43,030 --> 00:46:40,160
soil from costa rica this was actually

1245
00:46:45,030 --> 00:46:43,040
collected because because the aquazarcus

1246
00:46:47,109 --> 00:46:45,040
carbonaceous chondrite landed there back

1247
00:46:48,230 --> 00:46:47,119
in 2019 so we're using the soil as a

1248
00:46:49,910 --> 00:46:48,240
control

1249
00:46:51,990 --> 00:46:49,920
and through liquid chromatography mass

1250
00:46:53,829 --> 00:46:52,000
spec analyses you know we see you know

1251
00:46:55,510 --> 00:46:53,839
the common protein amino acids is life

1252
00:46:56,870 --> 00:46:55,520
you see the left-handed

1253
00:46:58,950 --> 00:46:56,880
bias

1254
00:47:01,990 --> 00:46:58,960
so we have chiral asymmetry left greater

1255
00:47:04,790 --> 00:47:02,000
than right for all amino acids not just

1256
00:47:06,790 --> 00:47:04,800
a select few so that checks that box we

1257
00:47:08,470 --> 00:47:06,800
also see a simple distribution we see in

1258
00:47:10,710 --> 00:47:08,480
most cases these are all alpha-hydrogen

1259
00:47:13,270 --> 00:47:10,720
amino acids a few couple beta there's

1260
00:47:15,829 --> 00:47:13,280
one gamma delta a gamma amino acid but

1261
00:47:18,870 --> 00:47:15,839
you know much lower abundance so we see

1262
00:47:20,710 --> 00:47:18,880
that uh preference a simple distribution

1263
00:47:23,030 --> 00:47:20,720

and then of course the lys light carbon

1264
00:47:25,030 --> 00:47:23,040
isotopic composition of the amino acids

1265
00:47:27,990 --> 00:47:25,040
which range from minus 18 to minus 5 per

1266
00:47:30,150 --> 00:47:28,000
ml so here you know not surprisingly you

1267
00:47:31,990 --> 00:47:30,160
know that that's a pretty good biotic

1268
00:47:33,910 --> 00:47:32,000
signature

1269
00:47:35,390 --> 00:47:33,920
this is a really interesting example

1270
00:47:38,470 --> 00:47:35,400
martian meteorite

1271
00:47:41,109 --> 00:47:38,480
rbto4262 this is a sugar tight it's an

1272
00:47:42,870 --> 00:47:41,119
igneous rock 225 million years was

1273
00:47:45,670 --> 00:47:42,880
ejected from mars about 3 million years

1274
00:47:46,710 --> 00:47:45,680
ago recovered in antarctica in 2004 by

1275
00:47:48,549 --> 00:47:46,720
anzma

1276
00:47:50,150 --> 00:47:48,559
and today this is the cleanest martian

1277
00:47:53,190 --> 00:47:50,160
meteorite we've ever seen with respect

1278
00:47:55,430 --> 00:47:53,200
to organic and biological contamination

1279
00:47:57,109 --> 00:47:55,440
there's just no evidence that the amino

1280
00:47:58,309 --> 00:47:57,119
acids

1281
00:48:00,230 --> 00:47:58,319
you know came from the terrestrial

1282
00:48:01,750 --> 00:48:00,240
environment this is even cleaner than

1283
00:48:03,190 --> 00:48:01,760
the tessent meteorite which i know

1284
00:48:04,390 --> 00:48:03,200
earlier in the meeting folks were

1285
00:48:06,390 --> 00:48:04,400
talking about how pristine that

1286
00:48:08,309 --> 00:48:06,400
meteorite is not from amino acid

1287
00:48:09,510 --> 00:48:08,319
perspective the tissue really has

1288
00:48:11,589 --> 00:48:09,520

evidence of

1289
00:48:14,790 --> 00:48:11,599
amino acid contaminants from the desert

1290
00:48:16,309 --> 00:48:14,800
soil but rbt is special

1291
00:48:18,309 --> 00:48:16,319
you know we see the this evidence of

1292
00:48:20,470 --> 00:48:18,319
straight chain and omega amino acids

1293
00:48:22,950 --> 00:48:20,480
here beta alanine gamma amino ambiter

1294
00:48:24,309 --> 00:48:22,960
delta amino valeric and the pattern is

1295
00:48:25,910 --> 00:48:24,319
really similar to what we've seen in

1296
00:48:28,069 --> 00:48:25,920
thermally altered meteorites

1297
00:48:30,390 --> 00:48:28,079
carbonaceous chondrites kind of hinting

1298
00:48:31,829 --> 00:48:30,400
at its origin there but you know we

1299
00:48:33,910 --> 00:48:31,839
checked that first box if you're going

1300
00:48:35,190 --> 00:48:33,920
to use the criteria we do see a simple

1301
00:48:37,190 --> 00:48:35,200
distribution

1302
00:48:38,870 --> 00:48:37,200
we also see a light carbon isotopic

1303
00:48:41,030 --> 00:48:38,880
composition we first measured this we

1304
00:48:43,190 --> 00:48:41,040
saw we thought oh god this is

1305
00:48:45,109 --> 00:48:43,200
for sure contamination but i'll point

1306
00:48:46,870 --> 00:48:45,119
out that this carbon isotope ratio is is

1307
00:48:49,510 --> 00:48:46,880
highly consistent with the magmatic

1308
00:48:51,510 --> 00:48:49,520
carbon ignis carbon that steel and

1309
00:48:52,950 --> 00:48:51,520
co-workers have reported in a variety of

1310
00:48:55,109 --> 00:48:52,960
different mars meteorites falls right

1311
00:48:57,109 --> 00:48:55,119
within that range so completely

1312
00:48:59,109 --> 00:48:57,119
plausible that this is martian

1313
00:49:01,670 --> 00:48:59,119

but where we don't check the boxes all

1314
00:49:03,510 --> 00:49:01,680
of these amino acids are a chiral

1315
00:49:05,430 --> 00:49:03,520
so if you think chirality is important

1316
00:49:06,630 --> 00:49:05,440
for life you know you can't check this

1317
00:49:08,390 --> 00:49:06,640
box

1318
00:49:10,150 --> 00:49:08,400
so we think that this is

1319
00:49:11,750 --> 00:49:10,160
maybe a fish or trope type haberbash

1320
00:49:12,870 --> 00:49:11,760
synthesis something happening at high

1321
00:49:14,549 --> 00:49:12,880
temperature

1322
00:49:16,390 --> 00:49:14,559
potentially even during the impact when

1323
00:49:18,309 --> 00:49:16,400
this thing was ejected we're not sure

1324
00:49:19,349 --> 00:49:18,319
but so far this is the best evidence we

1325
00:49:21,910 --> 00:49:19,359
have for

1326
00:49:23,109 --> 00:49:21,920
amino acids on mars now the problem that

1327
00:49:24,630 --> 00:49:23,119
we have

1328
00:49:26,630 --> 00:49:24,640
especially with the return samples is

1329
00:49:28,150 --> 00:49:26,640
going to be the radiolysis of organic

1330
00:49:30,309 --> 00:49:28,160
molecules we heard a lot about that in

1331
00:49:32,549 --> 00:49:30,319
the meeting alex pavlov gave a talk on

1332
00:49:34,710 --> 00:49:32,559
monday there was another one today

1333
00:49:36,549 --> 00:49:34,720
as well and this ionizing radiation can

1334
00:49:38,950 --> 00:49:36,559
penetrate penetrate down to you know a

1335
00:49:41,109 --> 00:49:38,960
couple meters or so and break down large

1336
00:49:43,349 --> 00:49:41,119
molecules and eventually destroy them

1337
00:49:45,270 --> 00:49:43,359
with time we know for example in gale

1338
00:49:47,589 --> 00:49:45,280

crater that the cosmic ray exposure age

1339
00:49:50,230 --> 00:49:47,599
of the cumberland mudstone um was

1340
00:49:51,829 --> 00:49:50,240
roughly 80 million years so um you know

1341
00:49:53,750 --> 00:49:51,839
it's not unlikely that we'll encounter

1342
00:49:55,430 --> 00:49:53,760
even in jezreel samples that you know

1343
00:49:59,030 --> 00:49:55,440
have experienced tens of millions of

1344
00:50:01,589 --> 00:49:59,040
years of cosmic ray exposure and this is

1345
00:50:03,589 --> 00:50:01,599
taken from alex's uh talk here it's also

1346
00:50:06,230 --> 00:50:03,599
coming out in astrobiology soon but this

1347
00:50:08,230 --> 00:50:06,240
shows basically the degradation of amino

1348
00:50:10,309 --> 00:50:08,240
acids after the equivalent of 80 million

1349
00:50:12,390 --> 00:50:10,319
years of ionizing radiation exposure we

1350
00:50:14,150 --> 00:50:12,400
use gamma and you can see that you know

1351
00:50:15,510 --> 00:50:14,160
at the sampling depth you know there's

1352
00:50:17,829 --> 00:50:15,520
definitely some destruction there

1353
00:50:19,670 --> 00:50:17,839
especially if you have amino acids uh

1354
00:50:21,829 --> 00:50:19,680
mixed with uh hydrated silicates and

1355
00:50:24,309 --> 00:50:21,839
perchlorates um you see a lot of

1356
00:50:26,710 --> 00:50:24,319
degradation you know even in you know 10

1357
00:50:28,470 --> 00:50:26,720
20 million years so you really have to

1358
00:50:30,549 --> 00:50:28,480
go deep you know

1359
00:50:32,549 --> 00:50:30,559
to get access to more pristine material

1360
00:50:34,950 --> 00:50:32,559
now the caveat here is that when we look

1361
00:50:36,630 --> 00:50:34,960
at pure amino acids or bound amino acids

1362
00:50:38,870 --> 00:50:36,640
or amino acids are associated with maybe

1363
00:50:40,710 --> 00:50:38,880

a more reduced organic phase you get

1364
00:50:42,069 --> 00:50:40,720
better preservation so there's there's

1365
00:50:43,430 --> 00:50:42,079
still hope here

1366
00:50:44,790 --> 00:50:43,440
if we can find some carriage and like

1367
00:50:45,829 --> 00:50:44,800
material and there are amino acids in

1368
00:50:47,270 --> 00:50:45,839
there maybe maybe there's some

1369
00:50:49,030 --> 00:50:47,280
preservation

1370
00:50:50,950 --> 00:50:49,040
um one piece of good news here is we

1371
00:50:52,230 --> 00:50:50,960
didn't see any evidence for rasmussation

1372
00:50:54,390 --> 00:50:52,240
that's the conversion of left and

1373
00:50:56,390 --> 00:50:54,400
right-handed amino acids so that's great

1374
00:50:58,470 --> 00:50:56,400
that means even if there was degradation

1375
00:51:00,710 --> 00:50:58,480
due to cosmic ray exposure that the iso

1376
00:51:01,990 --> 00:51:00,720
the enantiomer enantiomeric ratio should

1377
00:51:03,670 --> 00:51:02,000
be preserved

1378
00:51:05,589 --> 00:51:03,680
and then finally just looking ahead to

1379
00:51:08,390 --> 00:51:05,599
sample return on you know this is really

1380
00:51:10,630 --> 00:51:08,400
exciting um you know up to 30 of the the

1381
00:51:13,030 --> 00:51:10,640
samples that are being collected by mars

1382
00:51:15,349 --> 00:51:13,040
2020 uh will be could be returned to

1383
00:51:17,589 --> 00:51:15,359
earth in 2033 and just a really

1384
00:51:19,750 --> 00:51:17,599
important opportunity um to look for

1385
00:51:21,589 --> 00:51:19,760
chemical biospheres not just amino acids

1386
00:51:23,349 --> 00:51:21,599
but other chemicals we know there are

1387
00:51:25,750 --> 00:51:23,359
organics in these samples right we just

1388
00:51:28,470 --> 00:51:25,760

need to really look closely at their

1389
00:51:30,230 --> 00:51:28,480
distribution their isotopic compositions

1390
00:51:32,390 --> 00:51:30,240
i would say that you know i'm not on the

1391
00:51:34,230 --> 00:51:32,400
mars 2020 team but i'm sure there are

1392
00:51:35,589 --> 00:51:34,240
discussions about finding samples that

1393
00:51:37,030 --> 00:51:35,599
have experienced

1394
00:51:38,790 --> 00:51:37,040
recent erosion

1395
00:51:40,309 --> 00:51:38,800
maybe higher wind erosion rates so that

1396
00:51:42,309 --> 00:51:40,319
we can try to get samples back that

1397
00:51:44,630 --> 00:51:42,319
haven't you know experienced 80 plus

1398
00:51:46,230 --> 00:51:44,640
million years of cosmic ray exposure

1399
00:51:47,510 --> 00:51:46,240
that could be important

1400
00:51:49,910 --> 00:51:47,520
looking forward to the coordinated

1401
00:51:51,430 --> 00:51:49,920
analyses that will be possible um the

1402
00:51:53,670 --> 00:51:51,440
wet chemistry techniques that you know

1403
00:51:55,190 --> 00:51:53,680
we just can't do on mars right now

1404
00:51:56,790 --> 00:51:55,200
and the search for amino acids and

1405
00:51:58,150 --> 00:51:56,800
chirality and i'll point out that you

1406
00:52:00,069 --> 00:51:58,160
know even if the amino acids are

1407
00:52:01,589 --> 00:52:00,079
destroyed we find nothing that's still

1408
00:52:03,510 --> 00:52:01,599
going to be really important for the the

1409
00:52:06,150 --> 00:52:03,520
sample safety assessment the biohazard

1410
00:52:07,910 --> 00:52:06,160
assessment if we do find amino acids and

1411
00:52:10,390 --> 00:52:07,920
they're chiral well things get pretty

1412
00:52:11,910 --> 00:52:10,400
interesting okay

1413
00:52:13,829 --> 00:52:11,920

and then you know we can start looking

1414
00:52:14,870 --> 00:52:13,839
at the possibility of life and that kind

1415
00:52:16,390 --> 00:52:14,880
of thing

1416
00:52:18,390 --> 00:52:16,400
and i just want to acknowledge my

1417
00:52:20,230 --> 00:52:18,400
co-authors and team members in the

1418
00:52:21,510 --> 00:52:20,240
astrobiology analytical lab at goddard

1419
00:52:24,309 --> 00:52:21,520
couldn't do any of this without their

1420
00:52:38,630 --> 00:52:24,319
support and the funding sources so thank

1421
00:52:43,270 --> 00:52:40,710
and next up we have

1422
00:52:45,430 --> 00:52:43,280
mark sefton presenting on the effects of

1423
00:53:01,190 --> 00:52:45,440
temperature and time on samples returned

1424
00:53:01,200 --> 00:53:15,990
you're still muted

1425
00:53:23,670 --> 00:53:17,430
mark if you're speaking we cannot hear

1426
00:53:27,670 --> 00:53:25,750
but we see your slides

1427
00:53:30,549 --> 00:53:27,680
sorry um

1428
00:53:32,069 --> 00:53:30,559
so thank you um so i'm going to talk

1429
00:53:34,309 --> 00:53:32,079
about the effects of temperature and

1430
00:53:36,790 --> 00:53:34,319
time on the samples coming back from a

1431
00:53:39,510 --> 00:53:36,800
mild sample return and up front huge

1432
00:53:40,790 --> 00:53:39,520
thanks to the heroic efforts of the of

1433
00:53:43,270 --> 00:53:40,800
the full team

1434
00:53:45,349 --> 00:53:43,280
that i was very lucky to to work with

1435
00:53:48,710 --> 00:53:45,359
me and kate freeman were chairs but

1436
00:53:50,630 --> 00:53:48,720
there was substantial inputs by

1437
00:53:52,230 --> 00:53:50,640
some key members of the team and all of

1438
00:53:53,990 --> 00:53:52,240

the team

1439
00:53:56,549 --> 00:53:54,000
um so we're talking about mars sample

1440
00:53:57,990 --> 00:53:56,559
return in this session and these are

1441
00:53:59,589 --> 00:53:58,000
going to be pressure samples half a

1442
00:54:01,990 --> 00:53:59,599
kilogram that's going to be coming back

1443
00:54:04,150 --> 00:54:02,000
we really want the best records of

1444
00:54:06,630 --> 00:54:04,160
martian conditions so the fidelity of

1445
00:54:08,309 --> 00:54:06,640
the samples are very important

1446
00:54:10,069 --> 00:54:08,319
sorry about this

1447
00:54:12,150 --> 00:54:10,079
the fidelity of these samples are very

1448
00:54:13,270 --> 00:54:12,160
important we want the samples in as good

1449
00:54:14,630 --> 00:54:13,280
a condition

1450
00:54:17,030 --> 00:54:14,640
as possible

1451
00:54:19,910 --> 00:54:17,040
and so changes in temperature uh can be

1452
00:54:22,390 --> 00:54:19,920
quite an issue and the allowable flight

1453
00:54:24,710 --> 00:54:22,400
temperature limits currently are minus

1454
00:54:27,190 --> 00:54:24,720
20 degrees c maximum

1455
00:54:29,030 --> 00:54:27,200
but plus 30 is allowed for unavoidable

1456
00:54:31,510 --> 00:54:29,040
operational transients

1457
00:54:33,430 --> 00:54:31,520
and these transients have to be modeled

1458
00:54:36,230 --> 00:54:33,440
and these models have a certain level of

1459
00:54:38,549 --> 00:54:36,240
accuracy anything over 30 degrees would

1460
00:54:41,750 --> 00:54:38,559
be managed by a case-by-case

1461
00:54:43,349 --> 00:54:41,760
assessment of review and approval by the

1462
00:54:44,630 --> 00:54:43,359
mars sample return

1463
00:54:47,270 --> 00:54:44,640

program

1464
00:54:49,670 --> 00:54:47,280
so we feel that requests to exceed 30

1465
00:54:51,589 --> 00:54:49,680
degrees celsius are likely

1466
00:54:54,470 --> 00:54:51,599
and these can be during surface

1467
00:54:56,630 --> 00:54:54,480
transport on mars due to diurnal heating

1468
00:54:58,710 --> 00:54:56,640
or during heat sealing of the primary

1469
00:55:00,390 --> 00:54:58,720
containment vessel

1470
00:55:02,309 --> 00:55:00,400
and in the worst case scenarios we're

1471
00:55:05,190 --> 00:55:02,319
looking at the sample tubes reaching 60

1472
00:55:07,990 --> 00:55:05,200
degrees celsius in both situations

1473
00:55:10,870 --> 00:55:08,000
so the goal of the team was to consider

1474
00:55:13,349 --> 00:55:10,880
the scientific risks and use this risk

1475
00:55:15,190 --> 00:55:13,359
informed decision making process to come

1476
00:55:16,870 --> 00:55:15,200
up with some sort of assessment of what

1477
00:55:18,549 --> 00:55:16,880
the impacts would be

1478
00:55:21,109 --> 00:55:18,559
so the tasks were to consider the risk

1479
00:55:23,589 --> 00:55:21,119
to science if the samples went from 30

1480
00:55:26,710 --> 00:55:23,599
degrees to 40 degrees 40 to 50 and 50 to

1481
00:55:28,470 --> 00:55:26,720
60 and also how long samples can be

1482
00:55:30,470 --> 00:55:28,480
exposed to these temperatures without

1483
00:55:32,150 --> 00:55:30,480
negative effects

1484
00:55:34,230 --> 00:55:32,160
and because there are lots of ways that

1485
00:55:35,990 --> 00:55:34,240
we can look at this we obtain practical

1486
00:55:39,910 --> 00:55:36,000
focus by considering impacts on

1487
00:55:41,510 --> 00:55:39,920
biosignatures and hydrated minerals

1488
00:55:43,990 --> 00:55:41,520

so we identified a number of key

1489
00:55:45,510 --> 00:55:44,000
processes these key processes were the

1490
00:55:48,069 --> 00:55:45,520
the things that were going to cause the

1491
00:55:50,069 --> 00:55:48,079
changes in the sample samples and these

1492
00:55:53,109 --> 00:55:50,079
were volatilization the daily questions

1493
00:55:55,670 --> 00:55:53,119
of salts acid-base interactions aqueous

1494
00:55:58,549 --> 00:55:55,680
redux reactions isotope exchange all of

1495
00:56:00,950 --> 00:55:58,559
those related to heating effect but also

1496
00:56:02,549 --> 00:56:00,960
with cooling subsequently condensation

1497
00:56:05,190 --> 00:56:02,559
and freezing and interactions with the

1498
00:56:07,270 --> 00:56:05,200
container would also be important and of

1499
00:56:10,630 --> 00:56:07,280
course there's potential for multiple

1500
00:56:12,069 --> 00:56:10,640
interactions and overlapping effects

1501
00:56:13,910 --> 00:56:12,079
so we wanted to develop a caution

1502
00:56:16,150 --> 00:56:13,920
classification system that was developed

1503
00:56:17,109 --> 00:56:16,160
initially for the integrity of organic

1504
00:56:19,109 --> 00:56:17,119
matter

1505
00:56:20,950 --> 00:56:19,119
and the integrity would be reliance on a

1506
00:56:23,030 --> 00:56:20,960
number of processes and we recognized

1507
00:56:24,230 --> 00:56:23,040
that changing one component would have

1508
00:56:25,910 --> 00:56:24,240
an impact

1509
00:56:27,430 --> 00:56:25,920
on another and here on the right you can

1510
00:56:29,589 --> 00:56:27,440
see that heat would mobilize water

1511
00:56:33,270 --> 00:56:29,599
radicals and oxidants and these together

1512
00:56:34,710 --> 00:56:33,280
can lead to organic degradation

1513
00:56:36,789 --> 00:56:34,720

and here's our costed caution

1514
00:56:38,870 --> 00:56:36,799
classification system we had colors that

1515
00:56:41,270 --> 00:56:38,880
are green yellow and red green would

1516
00:56:43,829 --> 00:56:41,280
have little impacts on science yellow

1517
00:56:46,470 --> 00:56:43,839
we'd have unwantable but acceptable

1518
00:56:49,030 --> 00:56:46,480
losses of size whereas red would be

1519
00:56:50,950 --> 00:56:49,040
substantial losses of signs and you

1520
00:56:53,910 --> 00:56:50,960
consider the effects of temperature

1521
00:56:55,670 --> 00:56:53,920
and time not linear this is kinetics you

1522
00:56:57,109 --> 00:56:55,680
double you increase the temperature by

1523
00:57:00,309 --> 00:56:57,119
10 degrees c you double the reaction

1524
00:57:02,230 --> 00:57:00,319
rate so we really want to constrain our

1525
00:57:04,230 --> 00:57:02,240
temperature excursions

1526
00:57:05,910 --> 00:57:04,240
here's an example of

1527
00:57:08,390 --> 00:57:05,920
one of the inorganic process that we

1528
00:57:10,069 --> 00:57:08,400
examined this is aqueous processes

1529
00:57:12,549 --> 00:57:10,079
involving the dissolution of solids that

1530
00:57:14,950 --> 00:57:12,559
can really release encapsulated organics

1531
00:57:16,630 --> 00:57:14,960
making them accessible to degradation

1532
00:57:17,750 --> 00:57:16,640
production of nitrate to ammonia in the

1533
00:57:19,910 --> 00:57:17,760
presence of

1534
00:57:22,390 --> 00:57:19,920
ferrocyan canola

1535
00:57:24,390 --> 00:57:22,400
ratios oxidation of sulfides producing

1536
00:57:25,670 --> 00:57:24,400
sulfuric acid that can lead to acid

1537
00:57:27,670 --> 00:57:25,680
hydrolysis

1538
00:57:30,150 --> 00:57:27,680

and the effects get worse at higher

1539
00:57:31,670 --> 00:57:30,160
temperatures so for inorganic science

1540
00:57:33,990 --> 00:57:31,680
and the loss of science related to

1541
00:57:36,309 --> 00:57:34,000
inorganic materials we felt that every

1542
00:57:38,470 --> 00:57:36,319
temperature uh would lead to every

1543
00:57:40,950 --> 00:57:38,480
change in temperature between 30 and 60

1544
00:57:43,750 --> 00:57:40,960
would lead to a substantial loss of

1545
00:57:48,950 --> 00:57:46,789
and so here's a summary of the the whole

1546
00:57:50,630 --> 00:57:48,960
number of processes that we examined and

1547
00:57:53,190 --> 00:57:50,640
you can see that over long time scales

1548
00:57:56,870 --> 00:57:53,200
that is hours to days no temperature

1549
00:57:58,309 --> 00:57:56,880
excursion uh could uh give a minimal

1550
00:58:00,309 --> 00:57:58,319
impact on science they all gave a

1551
00:58:02,950 --> 00:58:00,319
substantial impact and other short time

1552
00:58:03,910 --> 00:58:02,960
skills as well still a substantial

1553
00:58:06,309 --> 00:58:03,920
impact

1554
00:58:08,390 --> 00:58:06,319
and loss of science

1555
00:58:09,510 --> 00:58:08,400
here we have an example of organic

1556
00:58:12,150 --> 00:58:09,520
structures

1557
00:58:14,470 --> 00:58:12,160
and between 30 and 40 degrees celsius

1558
00:58:15,990 --> 00:58:14,480
absorption evaporation of volatile

1559
00:58:18,390 --> 00:58:16,000
compounds radical reactions are

1560
00:58:19,910 --> 00:58:18,400
initiated we know that from vitaling and

1561
00:58:21,750 --> 00:58:19,920
acid hydrolysis occurs at low

1562
00:58:23,349 --> 00:58:21,760
temperatures as well

1563
00:58:25,430 --> 00:58:23,359

higher temperatures larger organic

1564
00:58:27,510 --> 00:58:25,440
molecules can be dissolved or evaporated

1565
00:58:29,910 --> 00:58:27,520
there's more risk of radical induced

1566
00:58:32,069 --> 00:58:29,920
oxidation but importantly the 3d

1567
00:58:34,150 --> 00:58:32,079
structure of any proteins or

1568
00:58:36,150 --> 00:58:34,160
biomaterials would be lost so that's a

1569
00:58:37,589 --> 00:58:36,160
bit of a bit of a red line and again

1570
00:58:39,990 --> 00:58:37,599
higher temperatures faster rates of

1571
00:58:42,870 --> 00:58:40,000
reaction and so we would say 30 to 40

1572
00:58:45,349 --> 00:58:42,880
degrees celsius we could live with

1573
00:58:47,750 --> 00:58:45,359
above 30 to 40 degrees then we have the

1574
00:58:49,829 --> 00:58:47,760
substantial loss of science

1575
00:58:50,950 --> 00:58:49,839
and over hours to days

1576
00:58:52,549 --> 00:58:50,960
everything

1577
00:58:55,829 --> 00:58:52,559
within that temperature range of 30 to

1578
00:58:58,549 --> 00:58:55,839
60 would cause a significant substantial

1579
00:59:00,950 --> 00:58:58,559
loss of science

1580
00:59:03,990 --> 00:59:00,960
again a summary table for the impacts on

1581
00:59:06,470 --> 00:59:04,000
organic matter over long time scales

1582
00:59:08,470 --> 00:59:06,480
everything would cause a substantial

1583
00:59:12,230 --> 00:59:08,480
loss of science and over short time

1584
00:59:15,910 --> 00:59:12,240
skills um up to 40 we we we feel would

1585
00:59:19,990 --> 00:59:15,920
be livable and uh above 40 then uh

1586
00:59:22,470 --> 00:59:20,000
you're leading two substantial losses

1587
00:59:25,589 --> 00:59:22,480
we can combine our for a holistic view

1588
00:59:27,829 --> 00:59:25,599

our organic and inorganic

1589
00:59:29,910 --> 00:59:27,839
deliberations and considerations and you

1590
00:59:31,109 --> 00:59:29,920
can see that the really only temperature

1591
00:59:33,190 --> 00:59:31,119
range

1592
00:59:34,870 --> 00:59:33,200
that

1593
00:59:36,789 --> 00:59:34,880
wouldn't lead to a substantial loss of

1594
00:59:40,069 --> 00:59:36,799
science according to the team would be

1595
00:59:41,750 --> 00:59:40,079
30 to 40 degrees celsius over

1596
00:59:43,270 --> 00:59:41,760
minutes to hours

1597
00:59:45,030 --> 00:59:43,280
higher temperatures and for longer

1598
00:59:47,349 --> 00:59:45,040
periods than a substantial loss of

1599
00:59:51,750 --> 00:59:47,359
science would occur and so would be

1600
00:59:53,750 --> 00:59:51,760
avoided should be avoided if possible

1601
00:59:55,910 --> 00:59:53,760
an explanatory note and that is the

1602
00:59:58,710 --> 00:59:55,920
interactions are possible between

1603
01:00:00,470 --> 00:59:58,720
inorganic and organic material

1604
01:00:02,150 --> 01:00:00,480
organic matter is reducing and if you

1605
01:00:04,230 --> 01:00:02,160
heat organic in the presence of minerals

1606
01:00:06,309 --> 01:00:04,240
it changes the nature of the minerals

1607
01:00:07,990 --> 01:00:06,319
but we don't see this too much uh below

1608
01:00:09,030 --> 01:00:08,000
60 degrees celsius so we think that's

1609
01:00:11,270 --> 01:00:09,040
okay

1610
01:00:12,630 --> 01:00:11,280
and inorganic materials well you degrade

1611
01:00:14,230 --> 01:00:12,640
those and you start to produce water

1612
01:00:16,230 --> 01:00:14,240
radicals and oxidants and they can

1613
01:00:18,150 --> 01:00:16,240

affect organic matter but it all depends

1614
01:00:21,349 --> 01:00:18,160
on the concentrations if you have lots

1615
01:00:22,710 --> 01:00:21,359
of inorganics and a few organics then

1616
01:00:26,230 --> 01:00:22,720
the inorganics can really affect the

1617
01:00:28,230 --> 01:00:26,240
organic matter and vice versa

1618
01:00:29,990 --> 01:00:28,240
so what's the bottom line well other

1619
01:00:31,589 --> 01:00:30,000
than for organics and the 30 to 40

1620
01:00:33,589 --> 01:00:31,599
degrees celsius temperature range and

1621
01:00:36,390 --> 01:00:33,599
the minutes to hours duration everything

1622
01:00:37,990 --> 01:00:36,400
else results in a substantial loss of

1623
01:00:39,910 --> 01:00:38,000
size

1624
01:00:41,910 --> 01:00:39,920
and that's it sorry if i was trying to

1625
01:00:43,750 --> 01:00:41,920
keep up with the timing that seems to be

1626
01:00:44,630 --> 01:00:43,760
happening on my slides but

1627
01:00:46,390 --> 01:00:44,640
um

1628
01:00:47,750 --> 01:00:46,400
finally thank you to the audience for

1629
01:00:50,789 --> 01:00:47,760
listening to the temperature and time

1630
01:00:52,630 --> 01:00:50,799
team um for their efforts

1631
01:00:53,829 --> 01:00:52,640
help us out

1632
01:00:56,390 --> 01:00:53,839
thank you

1633
01:01:01,589 --> 01:00:56,400
thanks and with that we'll move to our

1634
01:01:07,190 --> 01:01:04,150
to close our session today we'll have

1635
01:01:10,549 --> 01:01:07,200
uh christopher house

1636
01:01:13,190 --> 01:01:10,559
discussing using mars science laboratory

1637
01:01:15,510 --> 01:01:13,200
and c2 isotope measurements

1638
01:01:17,990 --> 01:01:15,520

to plan mars sample return science

1639
01:01:20,069 --> 01:01:18,000
methane evolved from gale crater rock

1640
01:01:25,270 --> 01:01:20,079
samples show a wide range of carbon

1641
01:01:29,829 --> 01:01:27,750
okay thank you everybody um hopefully

1642
01:01:32,069 --> 01:01:29,839
you can hear me and uh my slides are

1643
01:01:33,829 --> 01:01:32,079
showing i did want to say just quickly

1644
01:01:36,069 --> 01:01:33,839
that i had planned to be there and i

1645
01:01:38,710 --> 01:01:36,079
wish i was there with you guys um

1646
01:01:40,950 --> 01:01:38,720
it turns out on sunday morning my

1647
01:01:42,789 --> 01:01:40,960
youngest daughter got covered and uh

1648
01:01:45,109 --> 01:01:42,799
that was a shock to us all and i didn't

1649
01:01:46,870 --> 01:01:45,119
get on my airplane so uh

1650
01:01:49,349 --> 01:01:46,880
and don't worry she's doing fine but

1651
01:01:52,150 --> 01:01:49,359
it's been it's been a multitasking week

1652
01:01:55,910 --> 01:01:52,160
um i would like to talk to you about an

1653
01:01:57,510 --> 01:01:55,920
unusual uh carbon that uh msl team

1654
01:02:00,549 --> 01:01:57,520
discovered and written and ultimately

1655
01:02:01,670 --> 01:02:00,559
reported on in a paper in january

1656
01:02:03,349 --> 01:02:01,680
um

1657
01:02:05,829 --> 01:02:03,359
and and because it might give guidance

1658
01:02:08,470 --> 01:02:05,839
to the pure the perseverance team on on

1659
01:02:09,750 --> 01:02:08,480
a unique sample that may be present

1660
01:02:11,589 --> 01:02:09,760
there as well

1661
01:02:13,109 --> 01:02:11,599
so this is ultimately we're talking

1662
01:02:15,029 --> 01:02:13,119
about the paralysis

1663
01:02:18,230 --> 01:02:15,039

results from the sam

1664
01:02:21,190 --> 01:02:18,240
experiment on mars so in that uh that

1665
01:02:24,309 --> 01:02:21,200
that kind of experimental um

1666
01:02:26,470 --> 01:02:24,319
approach we take solid mars samples put

1667
01:02:28,710 --> 01:02:26,480
them in the sam oven

1668
01:02:30,470 --> 01:02:28,720
then the sam oven heats them up

1669
01:02:31,750 --> 01:02:30,480
and a certain temperature cut is

1670
01:02:33,029 --> 01:02:31,760
diverted to the tunable laser

1671
01:02:35,270 --> 01:02:33,039
spectrometer

1672
01:02:36,069 --> 01:02:35,280
and we can then measure

1673
01:02:39,190 --> 01:02:36,079
the

1674
01:02:41,829 --> 01:02:39,200
methane that is released from pyrolysis

1675
01:02:44,150 --> 01:02:41,839
and um

1676
01:02:48,309 --> 01:02:44,160
and also if there's enough methane the

1677
01:02:50,710 --> 01:02:48,319
isotopes abundance of the c13 isotopes

1678
01:02:53,990 --> 01:02:50,720
so we're talking about uh in this case

1679
01:02:55,990 --> 01:02:54,000
nine years of exploration so 24 samples

1680
01:02:58,549 --> 01:02:56,000
uh the methane was released

1681
01:03:00,549 --> 01:02:58,559
uh showed a huge wide range of carbon

1682
01:03:04,789 --> 01:03:00,559
isotope compositions the whole range is

1683
01:03:06,950 --> 01:03:04,799
is plus 22 down to minus 137

1684
01:03:09,990 --> 01:03:06,960
of some uncertainty there

1685
01:03:13,670 --> 01:03:10,000
two samples then have enriched c13

1686
01:03:15,910 --> 01:03:13,680
methane released plus 11 and plus 22 and

1687
01:03:18,870 --> 01:03:15,920
nine samples showed strongly depleted

1688
01:03:19,829 --> 01:03:18,880

values of something like uh beyond

1689
01:03:22,150 --> 01:03:19,839
negative

1690
01:03:24,710 --> 01:03:22,160
70 per ml and that's at six different

1691
01:03:26,549 --> 01:03:24,720
gale look uh crater locations

1692
01:03:28,470 --> 01:03:26,559
and ultimately i'll

1693
01:03:30,549 --> 01:03:28,480
guess this later but there may be some

1694
01:03:33,029 --> 01:03:30,559
association of the ones that show the

1695
01:03:34,470 --> 01:03:33,039
strong depletion in c13 in the released

1696
01:03:36,549 --> 01:03:34,480
methane

1697
01:03:38,470 --> 01:03:36,559
might be associated with a paleo surface

1698
01:03:40,150 --> 01:03:38,480
and that's why i wanted to mention it to

1699
01:03:42,470 --> 01:03:40,160
the perseverance team and people can

1700
01:03:44,549 --> 01:03:42,480
look out for such a surface

1701
01:03:46,309 --> 01:03:44,559
uh real quick uh

1702
01:03:48,470 --> 01:03:46,319
explanation of carbon isotopes for those

1703
01:03:50,789 --> 01:03:48,480
that don't deal with that very often

1704
01:03:52,950 --> 01:03:50,799
uh during historical

1705
01:03:54,789 --> 01:03:52,960
contingency we we measure carbon we

1706
01:03:57,190 --> 01:03:54,799
report carbon isotopes relative to the

1707
01:03:59,750 --> 01:03:57,200
pd bellonite which is a fossil from

1708
01:04:01,829 --> 01:03:59,760
south carolina it's a carbonate fossil

1709
01:04:04,069 --> 01:04:01,839
so typically if you just took a snapshot

1710
01:04:05,829 --> 01:04:04,079
of the earth's ocean today carbonates

1711
01:04:08,150 --> 01:04:05,839
tend to be around zero per ml in our

1712
01:04:10,710 --> 01:04:08,160
scale organic matter tends to be around

1713
01:04:12,630 --> 01:04:10,720

minus 28 on our scale

1714
01:04:16,630 --> 01:04:12,640
and and in this case the the mantle

1715
01:04:18,069 --> 01:04:16,640
carbon on earth is around minus

1716
01:04:21,190 --> 01:04:18,079
seven

1717
01:04:23,190 --> 01:04:21,200
and incoming a sea floor or atoms

1718
01:04:24,549 --> 01:04:23,200
has a wide range uh thermogenic methane

1719
01:04:26,549 --> 01:04:24,559
all the way to very strongly biogenic

1720
01:04:29,750 --> 01:04:26,559
methane can something range from minus

1721
01:04:31,829 --> 01:04:29,760
40 to -110 typically

1722
01:04:34,710 --> 01:04:31,839
and here's the data we got from

1723
01:04:37,349 --> 01:04:34,720
uh from uh the samples on mars from kale

1724
01:04:39,990 --> 01:04:37,359
crater so there's the whole

1725
01:04:41,990 --> 01:04:40,000
data table from the from the paper and

1726
01:04:43,910 --> 01:04:42,000
i've color coded it here to highlight

1727
01:04:47,190 --> 01:04:43,920
the ones in blue are samples that gave

1728
01:04:49,029 --> 01:04:47,200
strongly depleted delta c13 values for

1729
01:04:50,549 --> 01:04:49,039
the methane coming out of the sample

1730
01:04:52,950 --> 01:04:50,559
when it was heated

1731
01:04:55,670 --> 01:04:52,960
and so that's the cumberland samples and

1732
01:04:58,870 --> 01:04:55,680
then there's also a scoop of sand from

1733
01:05:00,549 --> 01:04:58,880
the from the bangle of pagoda dunes

1734
01:05:02,630 --> 01:05:00,559
uh there's the couple of samples at the

1735
01:05:05,670 --> 01:05:02,640
beer rupin ridge top

1736
01:05:08,309 --> 01:05:05,680
um and then there is um also just below

1737
01:05:10,069 --> 01:05:08,319
and just above the pediment the pediment

1738
01:05:11,670 --> 01:05:10,079

being made of stimson formation

1739
01:05:13,510 --> 01:05:11,680
sandstone

1740
01:05:15,430 --> 01:05:13,520
so um

1741
01:05:17,029 --> 01:05:15,440
so across the whole mission

1742
01:05:18,549 --> 01:05:17,039
multiple times we've seen it and and

1743
01:05:19,829 --> 01:05:18,559
represented repeatedly in certain

1744
01:05:21,430 --> 01:05:19,839
locations like

1745
01:05:23,430 --> 01:05:21,440
ridge

1746
01:05:24,870 --> 01:05:23,440
and it's possible one way to link these

1747
01:05:28,549 --> 01:05:24,880
different samples is if there was a

1748
01:05:29,430 --> 01:05:28,559
paleo surface that um that ran ran out

1749
01:05:30,870 --> 01:05:29,440
from

1750
01:05:32,309 --> 01:05:30,880
the cumberland sample would be it then

1751
01:05:34,470 --> 01:05:32,319
in that in that interpretation in the

1752
01:05:37,029 --> 01:05:34,480
end the piece of alice fan the very end

1753
01:05:38,230 --> 01:05:37,039
of the peaceful span

1754
01:05:40,150 --> 01:05:38,240
the the

1755
01:05:42,069 --> 01:05:40,160
sand scoop would have to be derived from

1756
01:05:43,270 --> 01:05:42,079
stimson formation

1757
01:05:46,710 --> 01:05:43,280
cap rock

1758
01:05:48,870 --> 01:05:46,720
which uh has a a surface eroded

1759
01:05:51,349 --> 01:05:48,880
so it's it's it's a

1760
01:05:53,510 --> 01:05:51,359
deposit on top of an unconformity then

1761
01:05:55,190 --> 01:05:53,520
it's also eroded off itself

1762
01:05:56,789 --> 01:05:55,200
uh in that surface then would have to be

1763
01:06:00,069 --> 01:05:56,799

the part of the paleo surface either

1764
01:06:01,589 --> 01:06:00,079
below or above the cap

1765
01:06:03,750 --> 01:06:01,599
and then another interesting feature

1766
01:06:06,150 --> 01:06:03,760
that we that should be noted is that

1767
01:06:09,109 --> 01:06:06,160
often this strongly depleted

1768
01:06:11,910 --> 01:06:09,119
c13 values are seeing the same samples

1769
01:06:14,789 --> 01:06:11,920
as we see reduced sulfur released during

1770
01:06:17,190 --> 01:06:14,799
the evolved gas analysis

1771
01:06:18,710 --> 01:06:17,200
and also times when we see

1772
01:06:19,990 --> 01:06:18,720
strong negative

1773
01:06:20,710 --> 01:06:20,000
delta

1774
01:06:24,390 --> 01:06:20,720
um

1775
01:06:26,710 --> 01:06:24,400
s34 values in the so2 release so this

1776
01:06:28,950 --> 01:06:26,720
graph on the right shows the chord

1777
01:06:31,510 --> 01:06:28,960
i want to call the correlation shows

1778
01:06:35,190 --> 01:06:31,520
the co-occurrence of strongly negative

1779
01:06:38,710 --> 01:06:35,200
c13 methane involved and as well as

1780
01:06:40,309 --> 01:06:38,720
negative delta 34s so2 involved so

1781
01:06:42,470 --> 01:06:40,319
that's at least a constraint that needs

1782
01:06:44,230 --> 01:06:42,480
to be considered as well

1783
01:06:46,470 --> 01:06:44,240
so we we thought about a lot of

1784
01:06:48,630 --> 01:06:46,480
different scenarios and so i just want

1785
01:06:50,950 --> 01:06:48,640
to just throw out a couple of different

1786
01:06:53,349 --> 01:06:50,960
scenarios one the first of which we

1787
01:06:54,710 --> 01:06:53,359
don't favor but should be mentioned is

1788
01:06:55,750 --> 01:06:54,720

that if you saw this on earth you would

1789
01:06:58,069 --> 01:06:55,760
you would say that this was

1790
01:07:01,349 --> 01:06:58,079
methanotrophy from from atmospheric

1791
01:07:04,230 --> 01:07:01,359
methane or from seafloor methane

1792
01:07:06,950 --> 01:07:04,240
we see that uh in the tubiana formation

1793
01:07:08,789 --> 01:07:06,960
of west australia with whole rock values

1794
01:07:10,549 --> 01:07:08,799
of down to minus 60

1795
01:07:13,190 --> 01:07:10,559
in the eel river basin

1796
01:07:15,029 --> 01:07:13,200
uh and other met cold seeps around the

1797
01:07:18,230 --> 01:07:15,039
margins around the world you see

1798
01:07:20,549 --> 01:07:18,240
strongly depleted uh archaeal signatures

1799
01:07:23,589 --> 01:07:20,559
or kill lipids and you start to see

1800
01:07:25,190 --> 01:07:23,599
strongly depleted cells on the right

1801
01:07:27,589 --> 01:07:25,200
so so that's that's how you might

1802
01:07:29,829 --> 01:07:27,599
interpret this data from from earth

1803
01:07:31,430 --> 01:07:29,839
we don't favor this this hypothesis uh

1804
01:07:33,349 --> 01:07:31,440
too much because our

1805
01:07:34,789 --> 01:07:33,359
without more cemetery data we don't see

1806
01:07:35,910 --> 01:07:34,799
any evidence for

1807
01:07:38,549 --> 01:07:35,920
surface

1808
01:07:40,390 --> 01:07:38,559
methanotrophy like like mats or

1809
01:07:42,470 --> 01:07:40,400
or other sedimentary features you might

1810
01:07:45,109 --> 01:07:42,480
see in those sandstones

1811
01:07:46,309 --> 01:07:45,119
so the another scenario which which is

1812
01:07:49,190 --> 01:07:46,319
plausible

1813
01:07:51,349 --> 01:07:49,200

and uh kind of out there i was put was

1814
01:07:52,470 --> 01:07:51,359
suggested by alex pavlov and it's really

1815
01:07:54,069 --> 01:07:52,480
creative

1816
01:07:55,109 --> 01:07:54,079
and can't be ruled out and might

1817
01:07:56,390 --> 01:07:55,119
actually be

1818
01:07:58,309 --> 01:07:56,400
be the case

1819
01:08:00,069 --> 01:07:58,319
is that the solar system every couple

1820
01:08:02,069 --> 01:08:00,079
hundred million years goes through a

1821
01:08:04,470 --> 01:08:02,079
giant molecular cloud and if you look in

1822
01:08:07,430 --> 01:08:04,480
the giant molecular clouds you have a

1823
01:08:08,309 --> 01:08:07,440
gas partitioning between dust and and uh

1824
01:08:10,309 --> 01:08:08,319
and

1825
01:08:12,549 --> 01:08:10,319
the carbon isotopes could partition

1826
01:08:14,390 --> 01:08:12,559
between gas and dust by the by the

1827
01:08:16,229 --> 01:08:14,400
uv photochemistry

1828
01:08:18,470 --> 01:08:16,239
about one percent that dust that cloud

1829
01:08:20,070 --> 01:08:18,480
is dust so as the solar system goes

1830
01:08:21,430 --> 01:08:20,080
through it that dust then gets rained

1831
01:08:23,829 --> 01:08:21,440
out on all the terrestrial plants

1832
01:08:25,749 --> 01:08:23,839
including mars we hardly notice on earth

1833
01:08:28,070 --> 01:08:25,759
because we have so much organic matter

1834
01:08:29,510 --> 01:08:28,080
uh whenever this would happen uh and we

1835
01:08:31,829 --> 01:08:29,520
we have erosion and all kinds of other

1836
01:08:33,749 --> 01:08:31,839
processes to mix that carbon in but on

1837
01:08:37,829 --> 01:08:33,759
mars you might accumulate that kind of

1838
01:08:40,550 --> 01:08:37,839

dust on top this was 10 to 17 grams

1839
01:08:43,510 --> 01:08:40,560
you might accumulate that 10 to 17 grams

1840
01:08:45,269 --> 01:08:43,520
of carbon on a glaciate surface because

1841
01:08:47,189 --> 01:08:45,279
the dust would trigger trigger

1842
01:08:48,789 --> 01:08:47,199
glaciation so that might explain the

1843
01:08:50,149 --> 01:08:48,799
paleo surface it might explain the

1844
01:08:53,110 --> 01:08:50,159
accumulation of the weird ice tip

1845
01:08:55,189 --> 01:08:53,120
signature on top of it another scenario

1846
01:08:56,149 --> 01:08:55,199
which we can't rule out and put for the

1847
01:08:58,789 --> 01:08:56,159
paper

1848
01:09:01,749 --> 01:08:58,799
is that you could have plumes of methane

1849
01:09:03,829 --> 01:09:01,759
which uh msl has detected over time

1850
01:09:06,390 --> 01:09:03,839
and every every now and then and that

1851
01:09:07,829 --> 01:09:06,400
those plumes of methane in ancient times

1852
01:09:10,229 --> 01:09:07,839
might have

1853
01:09:12,709 --> 01:09:10,239
coincided with eruptions of volcanic

1854
01:09:14,709 --> 01:09:12,719
gases and you could get then co2 and so2

1855
01:09:16,309 --> 01:09:14,719
reacting with methane

1856
01:09:17,590 --> 01:09:16,319
uh

1857
01:09:19,910 --> 01:09:17,600
with the

1858
01:09:22,149 --> 01:09:19,920
photochemistry and deposit the vein as

1859
01:09:24,470 --> 01:09:22,159
as acetylene some other other

1860
01:09:26,709 --> 01:09:24,480
compounds onto the surface and that

1861
01:09:28,149 --> 01:09:26,719
would work except the only caveat here

1862
01:09:30,309 --> 01:09:28,159
is that the

1863
01:09:31,269 --> 01:09:30,319

the methane would have to be biological

1864
01:09:33,349 --> 01:09:31,279
because you

1865
01:09:35,829 --> 01:09:33,359
the photochemistry of methane

1866
01:09:37,829 --> 01:09:35,839
polymerization isn't strong enough

1867
01:09:40,390 --> 01:09:37,839
a fractionation to explain the really

1868
01:09:42,070 --> 01:09:40,400
strong isotopes so if you want to use

1869
01:09:44,070 --> 01:09:42,080
methane to get there you have to have it

1870
01:09:45,910 --> 01:09:44,080
be biomethane

1871
01:09:49,269 --> 01:09:45,920
and then finally

1872
01:09:51,669 --> 01:09:49,279
the patosis of co2 might produce

1873
01:09:53,349 --> 01:09:51,679
organics uh and certainly can produce

1874
01:09:54,870 --> 01:09:53,359
organics in the lab

1875
01:09:57,030 --> 01:09:54,880
and that that

1876
01:09:59,510 --> 01:09:57,040
fractionation appears to be large

1877
01:10:02,470 --> 01:09:59,520
there's a theoretical paper in pnas and

1878
01:10:06,310 --> 01:10:02,480
then there's also some some data in

1879
01:10:08,470 --> 01:10:06,320
prep from euruchio yuno's lab in japan

1880
01:10:10,470 --> 01:10:08,480
so as as that unfolds this certainly

1881
01:10:12,630 --> 01:10:10,480
looks like a plausible mechanism that

1882
01:10:14,229 --> 01:10:12,640
you might get photochemistry of co2 in

1883
01:10:16,470 --> 01:10:14,239
the martian atmosphere depositing this

1884
01:10:17,750 --> 01:10:16,480
material on the surface even today

1885
01:10:19,910 --> 01:10:17,760
that would be the implications in this

1886
01:10:21,189 --> 01:10:19,920
case that would be ongoing

1887
01:10:23,830 --> 01:10:21,199
and again it would be deposited on

1888
01:10:28,070 --> 01:10:25,590

so we don't know the origin of this

1889
01:10:31,430 --> 01:10:28,080
weird carbon but we've put forward a

1890
01:10:33,030 --> 01:10:31,440
couple of hypotheses here there is um

1891
01:10:35,590 --> 01:10:33,040
shown in this figure one would be

1892
01:10:37,669 --> 01:10:35,600
biological subsurface methane production

1893
01:10:39,510 --> 01:10:37,679
that then resulted in organics deposit

1894
01:10:40,870 --> 01:10:39,520
surface another would be volcanic

1895
01:10:42,470 --> 01:10:40,880
outgassing

1896
01:10:44,950 --> 01:10:42,480
including uh

1897
01:10:46,630 --> 01:10:44,960
that then release leads to uv re

1898
01:10:48,470 --> 01:10:46,640
reactions the atmosphere that deposit

1899
01:10:49,910 --> 01:10:48,480
organics on the surface and finally

1900
01:10:51,830 --> 01:10:49,920
there would be giant molecular cloud

1901
01:10:53,669 --> 01:10:51,840
dust every couple hundred million years

1902
01:10:55,510 --> 01:10:53,679
deposited the service

1903
01:10:56,950 --> 01:10:55,520
so i put forward that the perseverance

1904
01:10:58,950 --> 01:10:56,960
river might want to think about looking

1905
01:11:01,669 --> 01:10:58,960
for these kinds of um

1906
01:11:04,149 --> 01:11:01,679
surfaces maybe a road off terrace that

1907
01:11:05,110 --> 01:11:04,159
might imply uh occurred during glacial

1908
01:11:07,189 --> 01:11:05,120
period

1909
01:11:09,189 --> 01:11:07,199
uh as a possible

1910
01:11:11,830 --> 01:11:09,199
you know this if this was

1911
01:11:13,270 --> 01:11:11,840
getting mars wide we might be able to

1912
01:11:14,470 --> 01:11:13,280
collect one

1913
01:11:28,470 --> 01:11:14,480

examples and bring it back and

1914
01:11:32,630 --> 01:11:30,630
thank you so much chris and thanks to

1915
01:11:36,310 --> 01:11:32,640
all of our speakers

1916
01:11:37,110 --> 01:11:36,320
so we have time now um for a discussion

1917
01:11:40,070 --> 01:11:37,120
and

1918
01:11:42,070 --> 01:11:40,080
um michael is not bailing because he's

1919
01:11:44,550 --> 01:11:42,080
so done with the conversation but he's

1920
01:11:47,189 --> 01:11:44,560
going to run our online our online

1921
01:11:49,590 --> 01:11:47,199
sessions um that will begin at 2 30

1922
01:11:51,510 --> 01:11:49,600
eastern so we are holding this time

1923
01:11:55,030 --> 01:11:51,520
separate in the hopes that we can have a

1924
01:11:57,430 --> 01:11:55,040
discussion based on these presentations

1925
01:11:59,590 --> 01:11:57,440
um so i know we have a few folks online

1926
01:12:01,990 --> 01:11:59,600
again folks can can jump in online

1927
01:12:04,709 --> 01:12:02,000
either on chat or especially our

1928
01:12:06,550 --> 01:12:04,719
speakers can jump back in to address

1929
01:12:08,630 --> 01:12:06,560
questions

1930
01:12:10,870 --> 01:12:08,640
but can we motivate folks to to start a

1931
01:12:12,470 --> 01:12:10,880
discussion on on the material they've

1932
01:12:13,669 --> 01:12:12,480
heard today or to ask additional

1933
01:12:23,750 --> 01:12:13,679
questions

1934
01:12:27,030 --> 01:12:25,430
hey this is uh andy chaiya from

1935
01:12:29,110 --> 01:12:27,040
university of cincinnati

1936
01:12:29,910 --> 01:12:29,120
uh uh i guess this question's for chris

1937
01:12:32,229 --> 01:12:29,920
uh

1938
01:12:34,950 --> 01:12:32,239

nice talk chris um i enjoyed the paper

1939
01:12:37,669 --> 01:12:34,960
too i just um i noticed at the very end

1940
01:12:40,310 --> 01:12:37,679
you had a call out for a

1941
01:12:42,470 --> 01:12:40,320
poster on carbon concentrations and that

1942
01:12:45,590 --> 01:12:42,480
was my question so i was wondering how

1943
01:12:49,910 --> 01:12:45,600
much carbon was in these samples that

1944
01:12:54,709 --> 01:12:52,149
yeah i imagine it varied but

1945
01:12:56,550 --> 01:12:54,719
it's a really good question and and um

1946
01:13:01,510 --> 01:12:56,560
let me

1947
01:13:03,830 --> 01:13:01,520
there is a paper uh an abstract from uh

1948
01:13:06,390 --> 01:13:03,840
jen stern about organic carbon

1949
01:13:08,310 --> 01:13:06,400
concentrations in in the mudstones

1950
01:13:09,750 --> 01:13:08,320
there's also a paper in that was

1951
01:13:12,470 --> 01:13:09,760
published

1952
01:13:13,830 --> 01:13:12,480
some years ago in jgr by brad sutter on

1953
01:13:15,590 --> 01:13:13,840
the topic

1954
01:13:18,390 --> 01:13:15,600
those estimates are based on the

1955
01:13:19,910 --> 01:13:18,400
paralysis of carbon uh well brad

1956
01:13:21,910 --> 01:13:19,920
sutter's papers on the paralysis of

1957
01:13:24,630 --> 01:13:21,920
carbon to co2

1958
01:13:26,550 --> 01:13:24,640
and jan stern's paper uh that's now

1959
01:13:30,229 --> 01:13:26,560
impressed actually pns

1960
01:13:33,189 --> 01:13:30,239
uh is on the um

1961
01:13:35,430 --> 01:13:33,199
uh the combustion experiment done uh

1962
01:13:37,510 --> 01:13:35,440
early on in the mission to

1963
01:13:39,669 --> 01:13:37,520

that that then you have oxygen present

1964
01:13:42,149 --> 01:13:39,679
during your heating and so you move all

1965
01:13:43,910 --> 01:13:42,159
the carbon over to co2 so those are

1966
01:13:45,189 --> 01:13:43,920
better estimates of how much carbon's in

1967
01:13:48,630 --> 01:13:45,199
the rock

1968
01:13:51,270 --> 01:13:48,640
the the tricky thing about the methane

1969
01:13:52,950 --> 01:13:51,280
data that i showed is it's a very very

1970
01:13:54,709 --> 01:13:52,960
small signal in terms of the amount of

1971
01:13:56,950 --> 01:13:54,719
methane being produced

1972
01:13:58,950 --> 01:13:56,960
and it so it doesn't represent the large

1973
01:14:01,590 --> 01:13:58,960
bulk of the carbon in the rock it

1974
01:14:03,830 --> 01:14:01,600
represents an unusual phase of carbon

1975
01:14:06,229 --> 01:14:03,840
that is releasing methane

1976
01:14:07,430 --> 01:14:06,239
during paralysis and we see it in some

1977
01:14:09,350 --> 01:14:07,440
analyses

1978
01:14:11,669 --> 01:14:09,360
and we don't see it when there's a huge

1979
01:14:14,070 --> 01:14:11,679
uh you know another big signal it may be

1980
01:14:22,390 --> 01:14:14,080
there other times but we only see it in

1981
01:14:26,070 --> 01:14:24,870
washed out by my other carbon releasing

1982
01:14:27,830 --> 01:14:26,080
methane

1983
01:14:29,910 --> 01:14:27,840
and so in particular we have we have

1984
01:14:31,510 --> 01:14:29,920
mtbsdfa background in the instrument

1985
01:14:33,750 --> 01:14:31,520
another organic instrument

1986
01:14:36,470 --> 01:14:33,760
instrument that methane has a nice type

1987
01:14:38,870 --> 01:14:36,480
of composition around -35 and a lot of

1988
01:14:41,910 --> 01:14:38,880

our samples then also show methane

1989
01:14:43,910 --> 01:14:41,920
produced at -35 so so that's why the

1990
01:14:45,590 --> 01:14:43,920
paper focused on the extremes but this

1991
01:14:47,030 --> 01:14:45,600
is paper is not the right paper to get

1992
01:14:49,430 --> 01:14:47,040
an estimate of how much carbon's in the

1993
01:14:51,510 --> 01:14:49,440
rock because it's it's an unusual phase

1994
01:14:53,910 --> 01:14:51,520
that's just producing

1995
01:14:57,350 --> 01:14:53,920
cleaving off methyl groups or whatever

1996
01:14:59,030 --> 01:14:57,360
it's not the bulk of the carbon the rock

1997
01:15:01,110 --> 01:14:59,040
all right thanks actually can i just ask

1998
01:15:03,110 --> 01:15:01,120
one more uh just quickly uh just a sort

1999
01:15:05,590 --> 01:15:03,120
of a method question um

2000
01:15:07,270 --> 01:15:05,600
were these samples uh

2001
01:15:08,630 --> 01:15:07,280
i mean these were collected over nine

2002
01:15:11,189 --> 01:15:08,640
years you said

2003
01:15:13,270 --> 01:15:11,199
uh were these analyzed over nine years

2004
01:15:15,510 --> 01:15:13,280
and then the data was now just

2005
01:15:18,070 --> 01:15:15,520
kind of reduced and and

2006
01:15:20,310 --> 01:15:18,080
and looked at or do you are there is

2007
01:15:22,709 --> 01:15:20,320
there material preserved inside of the

2008
01:15:24,870 --> 01:15:22,719
rover that can be analyzed later

2009
01:15:27,430 --> 01:15:24,880
right so good question so the this this

2010
01:15:29,430 --> 01:15:27,440
is um the paper that came in january was

2011
01:15:32,149 --> 01:15:29,440
report reporting analyses that had been

2012
01:15:35,189 --> 01:15:32,159
done over nine years um the data would

2013
01:15:36,470 --> 01:15:35,199

go the raw data would go to pa uh the

2014
01:15:39,590 --> 01:15:36,480
pds

2015
01:15:42,709 --> 01:15:39,600
and uh actually uh the range of data was

2016
01:15:45,590 --> 01:15:42,719
mentioned in this a supplementary um

2017
01:15:47,750 --> 01:15:45,600
uh online supplement to to uh chris

2018
01:15:48,709 --> 01:15:47,760
webster's 2015 paper

2019
01:15:50,790 --> 01:15:48,719
um

2020
01:15:52,870 --> 01:15:50,800
but wasn't on this topic

2021
01:15:54,229 --> 01:15:52,880
so so you know it's been out there a

2022
01:15:57,510 --> 01:15:54,239
little bit and this finally was the

2023
01:15:59,350 --> 01:15:57,520
paper uh in january of the team

2024
01:16:01,270 --> 01:15:59,360
interpreting what we think is going on

2025
01:16:04,310 --> 01:16:01,280
now the second part of your question

2026
01:16:07,030 --> 01:16:04,320
occasionally msl does store samples uh

2027
01:16:09,990 --> 01:16:07,040
in the carousel for future analysis so

2028
01:16:11,590 --> 01:16:10,000
we have um a handful

2029
01:16:15,030 --> 01:16:11,600
maybe a half a dozen

2030
01:16:20,390 --> 01:16:15,040
uh past drill samples we can go back to

2031
01:16:23,990 --> 01:16:22,149
thanks so much chris let's take a

2032
01:16:25,510 --> 01:16:24,000
question from over here

2033
01:16:27,910 --> 01:16:25,520
uh this is a question for chris house

2034
01:16:29,590 --> 01:16:27,920
this is tristan caro from cu boulder um

2035
01:16:33,110 --> 01:16:29,600
i'm curious i'm not familiar with the

2036
01:16:35,270 --> 01:16:33,120
co2 and so2 photo lysis that you uh

2037
01:16:36,630 --> 01:16:35,280
mentioned and so i'm curious if that

2038
01:16:38,630 --> 01:16:36,640

reaction

2039
01:16:40,390 --> 01:16:38,640
network or pathway could be implicated

2040
01:16:42,709 --> 01:16:40,400
in the formation of the sulfur

2041
01:16:44,630 --> 01:16:42,719
containing organics that sam has picked

2042
01:16:46,870 --> 01:16:44,640
up in the past or if that's a totally

2043
01:16:48,790 --> 01:16:46,880
different uh set of reactions that we're

2044
01:16:50,870 --> 01:16:48,800
talking about a good question really

2045
01:16:51,990 --> 01:16:50,880
good question so um

2046
01:16:53,750 --> 01:16:52,000
the reason i

2047
01:16:55,910 --> 01:16:53,760
so so there isn't much study on this

2048
01:16:57,750 --> 01:16:55,920
kinds of reaction networks um there you

2049
01:17:00,390 --> 01:16:57,760
know i referenced some papers to try to

2050
01:17:02,310 --> 01:17:00,400
show there could be a set of reactions

2051
01:17:03,830 --> 01:17:02,320
that could could form things like style

2052
01:17:06,070 --> 01:17:03,840
formaldehyde and

2053
01:17:07,189 --> 01:17:06,080
you know uh carbonyl sulfide and other

2054
01:17:09,189 --> 01:17:07,199
various things

2055
01:17:11,350 --> 01:17:09,199
um

2056
01:17:13,990 --> 01:17:11,360
certainly co2 to formaldehyde is the

2057
01:17:17,430 --> 01:17:14,000
well is the well understood

2058
01:17:21,830 --> 01:17:17,440
case and that that case for co2 goes co

2059
01:17:24,390 --> 01:17:21,840
co goes to co2 sorry co2 goes to co co

2060
01:17:26,630 --> 01:17:24,400
goes to formaldehyde the problem is the

2061
01:17:29,270 --> 01:17:26,640
formaldehyde will back react with uv

2062
01:17:31,110 --> 01:17:29,280
back to all the way back to co2 so it

2063
01:17:32,550 --> 01:17:31,120

doesn't accumulate and mark the martian

2064
01:17:34,470 --> 01:17:32,560
surface very well

2065
01:17:36,709 --> 01:17:34,480
so we if you want to invoke that set of

2066
01:17:38,310 --> 01:17:36,719
reactions you need to have mechanisms by

2067
01:17:40,149 --> 01:17:38,320
which that signal gets somehow

2068
01:17:41,350 --> 01:17:40,159
incorporated into the rock and protected

2069
01:17:43,189 --> 01:17:41,360
from uv

2070
01:17:45,750 --> 01:17:43,199
ice might do it

2071
01:17:47,430 --> 01:17:45,760
you know fluids

2072
01:17:49,669 --> 01:17:47,440
percolating down into the first few

2073
01:17:51,110 --> 01:17:49,679
centimeters the rock might do it uh you

2074
01:17:52,630 --> 01:17:51,120
know we don't know that's something that

2075
01:17:55,030 --> 01:17:52,640
needs to be looked at

2076
01:17:56,070 --> 01:17:55,040
your second question is does it explain

2077
01:18:00,149 --> 01:17:56,080
the other

2078
01:18:01,830 --> 01:18:00,159
papers from msl on organics again no

2079
01:18:04,470 --> 01:18:01,840
you know i mean

2080
01:18:05,590 --> 01:18:04,480
well maybe but but this was put forward

2081
01:18:07,669 --> 01:18:05,600
as

2082
01:18:09,990 --> 01:18:07,679
a way to get a trace amount of organic

2083
01:18:12,950 --> 01:18:10,000
matter onto the surface that might give

2084
01:18:15,669 --> 01:18:12,960
this weird isotope signature the bulk of

2085
01:18:16,390 --> 01:18:15,679
organic carbon found by msl and probably

2086
01:18:18,470 --> 01:18:16,400
the

2087
01:18:19,430 --> 01:18:18,480
amazing organic carbon that was reported

2088
01:18:22,310 --> 01:18:19,440

today

2089
01:18:23,189 --> 01:18:22,320
uh you know from perseverance

2090
01:18:28,070 --> 01:18:23,199
is

2091
01:18:29,430 --> 01:18:28,080
there a lot more and it's not it's not

2092
01:18:32,149 --> 01:18:29,440
you're probably not giving this crazy

2093
01:18:34,790 --> 01:18:32,159
iced up signature um so i would

2094
01:18:38,070 --> 01:18:34,800
interpret you look at the msl papers

2095
01:18:41,270 --> 01:18:38,080
those are those carbon sulfur compounds

2096
01:18:43,750 --> 01:18:41,280
are are released and being analyzed at

2097
01:18:46,149 --> 01:18:43,760
high temperature temperature cuts 450

2098
01:18:48,790 --> 01:18:46,159
degrees c the reason for that is we're

2099
01:18:51,830 --> 01:18:48,800
trying to avoid the area where the mtbs

2100
01:18:52,950 --> 01:18:51,840
tfa organics come off and cause a big

2101
01:18:54,550 --> 01:18:52,960
mess for us

2102
01:18:56,630 --> 01:18:54,560
um so that you know there are there

2103
01:18:58,470 --> 01:18:56,640
could be peaks at lower temperature but

2104
01:19:01,270 --> 01:18:58,480
we're looking at a much more uh

2105
01:19:03,750 --> 01:19:01,280
recalcitrant refractory component of the

2106
01:19:06,550 --> 01:19:03,760
martian organic matter because that's

2107
01:19:07,750 --> 01:19:06,560
where our system is cleanest

2108
01:19:09,750 --> 01:19:07,760
and so it's probably more like a

2109
01:19:11,910 --> 01:19:09,760
carriage to be honest

2110
01:19:13,350 --> 01:19:11,920
not like not like the crazy molecules i

2111
01:19:15,590 --> 01:19:13,360
showed in my talk

2112
01:19:17,750 --> 01:19:15,600
thank you thank you chris and let's take

2113
01:19:18,630 --> 01:19:17,760

a question from the audience on the left

2114
01:19:20,390 --> 01:19:18,640
side

2115
01:19:21,910 --> 01:19:20,400
yeah becky mccauley wrench nasa

2116
01:19:24,550 --> 01:19:21,920
headquarters i have one question for

2117
01:19:25,910 --> 01:19:24,560
chris and one for danny actually um

2118
01:19:27,510 --> 01:19:25,920
chris um

2119
01:19:29,030 --> 01:19:27,520
so

2120
01:19:31,510 --> 01:19:29,040
with the samples that have already been

2121
01:19:33,669 --> 01:19:31,520
collected for perseverance i wonder if

2122
01:19:35,910 --> 01:19:33,679
there are any that you think are well

2123
01:19:37,590 --> 01:19:35,920
suited um for the analysis or if there

2124
01:19:39,430 --> 01:19:37,600
are any particular criteria you'd like

2125
01:19:42,470 --> 01:19:39,440
to see in future samples

2126
01:19:44,550 --> 01:19:42,480
um to be able to do the analysis

2127
01:19:46,550 --> 01:19:44,560
well i think the the current samples

2128
01:19:48,070 --> 01:19:46,560
collected are amazing and amazing for

2129
01:19:49,750 --> 01:19:48,080
different reasons you know i think that

2130
01:19:51,910 --> 01:19:49,760
i think that you know this

2131
01:19:52,950 --> 01:19:51,920
they remind me more of the uh

2132
01:19:55,510 --> 01:19:52,960
uh

2133
01:19:58,870 --> 01:19:55,520
andrew steely and others um

2134
01:20:00,229 --> 01:19:58,880
investigation of the allen hills 8401

2135
01:20:02,390 --> 01:20:00,239
rock where it looks like clearly

2136
01:20:04,070 --> 01:20:02,400
serpentization happens on mars it makes

2137
01:20:05,430 --> 01:20:04,080
organic matter it probably would make

2138
01:20:06,629 --> 01:20:05,440

this patchy organic matter they're

2139
01:20:08,390 --> 01:20:06,639
seeing and i think that's totally

2140
01:20:10,390 --> 01:20:08,400
phenomenal and amazing

2141
01:20:11,910 --> 01:20:10,400
um it and i suspect that our that

2142
01:20:14,149 --> 01:20:11,920
organic matter does not have this crazy

2143
01:20:15,669 --> 01:20:14,159
ice signature so this this talk is

2144
01:20:17,990 --> 01:20:15,679
really meant more like

2145
01:20:20,310 --> 01:20:18,000
as you go up further you know next you

2146
01:20:22,790 --> 01:20:20,320
want to see those those sediments you

2147
01:20:25,270 --> 01:20:22,800
want to see the the um

2148
01:20:27,350 --> 01:20:25,280
the uh sediments that uh

2149
01:20:29,110 --> 01:20:27,360
the reason we went there right for the

2150
01:20:31,350 --> 01:20:29,120
for the delta

2151
01:20:32,870 --> 01:20:31,360
and maybe after that when you get up to

2152
01:20:35,590 --> 01:20:32,880
into where that where those sediments

2153
01:20:37,669 --> 01:20:35,600
are eroded off maybe that's the place to

2154
01:20:39,110 --> 01:20:37,679
look and so you know i don't want to i

2155
01:20:40,629 --> 01:20:39,120
don't think that this is

2156
01:20:43,110 --> 01:20:40,639
should be driving the mission anytime

2157
01:20:43,990 --> 01:20:43,120
soon i think it's it's it's it's a point

2158
01:20:45,910 --> 01:20:44,000
that

2159
01:20:47,910 --> 01:20:45,920
we we never expected to find things in

2160
01:20:50,470 --> 01:20:47,920
the sandstone that had an erosionary

2161
01:20:52,790 --> 01:20:50,480
surface on top of it but that's that's

2162
01:20:55,110 --> 01:20:52,800
basically where the signal is strongest

2163
01:20:57,510 --> 01:20:55,120

thanks chris um and then danny my

2164
01:21:00,310 --> 01:20:57,520
question for you was um i really liked

2165
01:21:01,830 --> 01:21:00,320
um you know kind of the the three tiers

2166
01:21:03,990 --> 01:21:01,840
you know and kind of bringing together

2167
01:21:05,750 --> 01:21:04,000
different kinds of data uh to identify

2168
01:21:06,870 --> 01:21:05,760
biosignatures i wondered if you wanted

2169
01:21:11,830 --> 01:21:06,880
to

2170
01:21:13,830 --> 01:21:11,840
always really fascinated me because

2171
01:21:15,189 --> 01:21:13,840
there's just there's so much information

2172
01:21:16,709 --> 01:21:15,199
stuck in them and there's so much

2173
01:21:17,669 --> 01:21:16,719
history in terms of where they've come

2174
01:21:19,590 --> 01:21:17,679
from and how they've gotten the

2175
01:21:21,350 --> 01:21:19,600
signature they've gotten and so i

2176
01:21:23,270 --> 01:21:21,360
wondered other than just you know

2177
01:21:24,390 --> 01:21:23,280
depletion and enrichment are there any

2178
01:21:27,910 --> 01:21:24,400
other

2179
01:21:29,030 --> 01:21:27,920
values that you think would be relevant

2180
01:21:33,110 --> 01:21:29,040
to your

2181
01:21:38,070 --> 01:21:35,669
um yeah we tend to think in extremes you

2182
01:21:39,830 --> 01:21:38,080
know chris was talking about that

2183
01:21:41,430 --> 01:21:39,840
uh because you you maybe believe it a

2184
01:21:43,430 --> 01:21:41,440
little more

2185
01:21:45,350 --> 01:21:43,440
but certainly you know it's looking like

2186
01:21:47,910 --> 01:21:45,360
on mars you know one of the issues with

2187
01:21:49,750 --> 01:21:47,920
carbon to be frank and the isotope value

2188
01:21:51,750 --> 01:21:49,760

there is that on mars it's really

2189
01:21:54,550 --> 01:21:51,760
similar to earth actually

2190
01:21:57,510 --> 01:21:54,560
the magmatic carbon right it's minus 25

2191
01:21:59,510 --> 01:21:57,520
minus so you know we're actually the

2192
01:22:01,830 --> 01:21:59,520
next step is to maybe look at uh

2193
01:22:03,510 --> 01:22:01,840
nitrogen for example that might be that

2194
01:22:05,510 --> 01:22:03,520
we know is a little more enriched on

2195
01:22:07,669 --> 01:22:05,520
mars so that might be another thing that

2196
01:22:09,350 --> 01:22:07,679
we'd want to measure in an amino acid or

2197
01:22:11,350 --> 01:22:09,360
any nitrogen-containing compound so we

2198
01:22:13,830 --> 01:22:11,360
don't want to rely just on carbon i

2199
01:22:16,390 --> 01:22:13,840
think we need to be looking at 15 to 14

2200
01:22:18,390 --> 01:22:16,400
nitrogen and ddh as well to try to put

2201
01:22:20,390 --> 01:22:18,400
the story together

2202
01:22:22,149 --> 01:22:20,400
the caveat with all this is it tends to

2203
01:22:24,550 --> 01:22:22,159
take a lot of sample to do these

2204
01:22:26,229 --> 01:22:24,560
compound specific isotope measurements

2205
01:22:27,830 --> 01:22:26,239
so you know if we've got samples that

2206
01:22:30,070 --> 01:22:27,840
have been cooked by radiation and

2207
01:22:32,310 --> 01:22:30,080
there's part per billion levels of amino

2208
01:22:34,709 --> 01:22:32,320
acids we may be just limited to looking

2209
01:22:36,790 --> 01:22:34,719
at chirality and distributions

2210
01:22:38,709 --> 01:22:36,800
the isotope measurement may be hard but

2211
01:22:41,110 --> 01:22:38,719
i hope i'm wrong about that

2212
01:22:42,709 --> 01:22:41,120
um but because isotopes are important

2213
01:22:43,590 --> 01:22:42,719

they really are to help constrain the

2214
01:22:45,990 --> 01:22:43,600
origin

2215
01:22:48,070 --> 01:22:46,000
great thanks danny

2216
01:22:49,430 --> 01:22:48,080
what can i just introduce one one point

2217
01:22:52,950 --> 01:22:49,440
for danny too

2218
01:22:55,669 --> 01:22:52,960
um and that you know that is another

2219
01:22:57,590 --> 01:22:55,679
another aspect would be if the uh

2220
01:22:59,430 --> 01:22:57,600
if we knew that the organic matter was

2221
01:23:01,910 --> 01:22:59,440
coming from the really really enriched

2222
01:23:03,430 --> 01:23:01,920
co2 atmosphere then you then you might

2223
01:23:05,590 --> 01:23:03,440
be able to work it out

2224
01:23:10,390 --> 01:23:05,600
being not earth by actually being you

2225
01:23:13,910 --> 01:23:12,390
and next we'll take a question from the

2226
01:23:15,590 --> 01:23:13,920
audience

2227
01:23:17,189 --> 01:23:15,600
hi i'm ann lee from the university of

2228
01:23:19,910 --> 01:23:17,199
washington and i just had a quick

2229
01:23:21,910 --> 01:23:19,920
clarification question for emily i was

2230
01:23:23,270 --> 01:23:21,920
wondering so you saw the fluorescence

2231
01:23:24,790 --> 01:23:23,280
between the

2232
01:23:27,030 --> 01:23:24,800
carbonate and then also the silicate

2233
01:23:29,830 --> 01:23:27,040
grains at guard did you also see that at

2234
01:23:32,790 --> 01:23:29,840
dorb or was it just guard

2235
01:23:36,390 --> 01:23:32,800
we did see that so in the particular

2236
01:23:37,669 --> 01:23:36,400
area that sherlock analyzed for

2237
01:23:41,350 --> 01:23:37,679
for dorb

2238
01:23:44,149 --> 01:23:41,360

where we had the pixel overlay we had

2239
01:23:47,669 --> 01:23:44,159
less carbonate but we also saw silicate

2240
01:23:49,510 --> 01:23:47,679
or sorry amorphous silicate as well as

2241
01:23:54,070 --> 01:23:49,520
additional phosphate detections and i

2242
01:23:56,310 --> 01:23:54,080
believe some sulfate detections as well

2243
01:23:58,550 --> 01:23:56,320
so slightly different but

2244
01:24:00,470 --> 01:23:58,560
less less carbonate in the region that

2245
01:24:01,750 --> 01:24:00,480
we analyzed for sherlock

2246
01:24:02,709 --> 01:24:01,760
than in guard

2247
01:24:04,470 --> 01:24:02,719
and then

2248
01:24:06,229 --> 01:24:04,480
no organics

2249
01:24:08,229 --> 01:24:06,239
there otherwise like

2250
01:24:10,950 --> 01:24:08,239
you mentioned the double

2251
01:24:13,030 --> 01:24:10,960
aromatics that you saw at guard but you

2252
01:24:14,550 --> 01:24:13,040
didn't see that at dorne

2253
01:24:17,669 --> 01:24:14,560
or

2254
01:24:19,110 --> 01:24:17,679
uh it wasn't localized to the the

2255
01:24:22,950 --> 01:24:19,120
carbonate in the same way at least for

2256
01:24:27,669 --> 01:24:25,270
and there's a question online that i'm

2257
01:24:30,229 --> 01:24:27,679
gonna relay and i'm probably gonna pass

2258
01:24:32,709 --> 01:24:30,239
it to emily to answer then so

2259
01:24:34,470 --> 01:24:32,719
peter's asked

2260
01:24:36,310 --> 01:24:34,480
can the sherlock folks comment on the

2261
01:24:38,390 --> 01:24:36,320
next steps for optimizing the use of

2262
01:24:40,229 --> 01:24:38,400
sherlock to detect organics for the rest

2263
01:24:41,910 --> 01:24:40,239

of the mission did we learn things from

2264
01:24:43,750 --> 01:24:41,920
the crater floor measurements that

2265
01:24:45,830 --> 01:24:43,760
suggest ways to optimize organics

2266
01:24:47,590 --> 01:24:45,840
detection later in the mission

2267
01:24:48,950 --> 01:24:47,600
also how about combining sherlock

2268
01:24:51,189 --> 01:24:48,960
measurements with other instrument

2269
01:24:52,390 --> 01:24:51,199
measurements to optimize those organics

2270
01:24:53,110 --> 01:24:52,400
detections

2271
01:24:56,310 --> 01:24:53,120
so

2272
01:24:59,110 --> 01:24:56,320
three questions and one for you

2273
01:25:02,390 --> 01:24:59,120
okay thank you peter uh i might answer

2274
01:25:05,830 --> 01:25:02,400
the the bottom question first so

2275
01:25:07,910 --> 01:25:05,840
as we continue into the mission um

2276
01:25:09,430 --> 01:25:07,920
it will continue to get colder which is

2277
01:25:13,110 --> 01:25:09,440
great for sherlock

2278
01:25:15,510 --> 01:25:13,120
uh and and operating so

2279
01:25:16,629 --> 01:25:15,520
that that will be a plus in terms of

2280
01:25:19,030 --> 01:25:16,639
making

2281
01:25:21,750 --> 01:25:19,040
measurements to optimize organic

2282
01:25:24,550 --> 01:25:21,760
detection uh

2283
01:25:26,950 --> 01:25:24,560
what luther mentioned before in terms of

2284
01:25:29,270 --> 01:25:26,960
agreeing on specific

2285
01:25:32,149 --> 01:25:29,280
places to take these observations i

2286
01:25:33,590 --> 01:25:32,159
think is one of the most challenging uh

2287
01:25:36,390 --> 01:25:33,600
parts because

2288
01:25:38,550 --> 01:25:36,400

proximity science takes uh additional

2289
01:25:42,550 --> 01:25:38,560
resources and certainly

2290
01:25:44,709 --> 01:25:42,560
having evidence from the other remote

2291
01:25:46,390 --> 01:25:44,719
remote sensing instruments that are

2292
01:25:48,390 --> 01:25:46,400
capable of being deployed with less

2293
01:25:49,510 --> 01:25:48,400
resources i think is critical in

2294
01:25:50,390 --> 01:25:49,520
selection

2295
01:25:51,430 --> 01:25:50,400
and

2296
01:25:58,470 --> 01:25:51,440
in

2297
01:26:00,070 --> 01:25:58,480
analyses performed by super cam as well

2298
01:26:04,950 --> 01:26:00,080
as

2299
01:26:07,510 --> 01:26:04,960
different

2300
01:26:08,870 --> 01:26:07,520
details about each abrasion patch but

2301
01:26:10,790 --> 01:26:08,880
for example

2302
01:26:13,350 --> 01:26:10,800
with the guard abrasion patch that i

2303
01:26:14,709 --> 01:26:13,360
talked about today we were able to

2304
01:26:16,470 --> 01:26:14,719
see

2305
01:26:18,310 --> 01:26:16,480
super cam

2306
01:26:20,229 --> 01:26:18,320
at least one point that was

2307
01:26:21,830 --> 01:26:20,239
consistent with the carbonate which made

2308
01:26:24,149 --> 01:26:21,840
us feel better about our detection in

2309
01:26:27,750 --> 01:26:24,159
terms of moving forward and detecting

2310
01:26:30,070 --> 01:26:27,760
organic supercam also has a ramen so if

2311
01:26:32,870 --> 01:26:30,080
we have

2312
01:26:34,950 --> 01:26:32,880
a higher concentration of organics it is

2313
01:26:37,030 --> 01:26:34,960

possible that we'll be able to detect

2314
01:26:38,629 --> 01:26:37,040
the organics with uh

2315
01:26:39,910 --> 01:26:38,639
sherlock the brahmin as well as

2316
01:26:42,310 --> 01:26:39,920
fluorescence

2317
01:26:44,229 --> 01:26:42,320
and potentially with uh

2318
01:26:45,830 --> 01:26:44,239
with supercam if the concentrations are

2319
01:26:48,149 --> 01:26:45,840
high enough

2320
01:26:50,310 --> 01:26:48,159
and

2321
01:26:51,910 --> 01:26:50,320
is that all the questions can i ask

2322
01:26:53,350 --> 01:26:51,920
actually a little follow-up on to that

2323
01:26:56,229 --> 01:26:53,360
so and

2324
01:26:59,510 --> 01:26:56,239
i know you're sherlock and super cam but

2325
01:27:01,830 --> 01:26:59,520
are there going to be um

2326
01:27:03,750 --> 01:27:01,840
actually like fluorescence issues with

2327
01:27:05,510 --> 01:27:03,760
super camera i'm on for the wavelength

2328
01:27:07,350 --> 01:27:05,520
of their laser isn't there is there an

2329
01:27:09,270 --> 01:27:07,360
issue with

2330
01:27:10,950 --> 01:27:09,280
detecting organics

2331
01:27:13,189 --> 01:27:10,960
yeah

2332
01:27:14,870 --> 01:27:13,199
i don't know maybe you don't know

2333
01:27:16,310 --> 01:27:14,880
i think i'm going to defer to the super

2334
01:27:18,550 --> 01:27:16,320
cam book right

2335
01:27:20,229 --> 01:27:18,560
i think that's a little far out of uh

2336
01:27:20,950 --> 01:27:20,239
but that's a great question amy in terms

2337
01:27:23,430 --> 01:27:20,960
of

2338
01:27:26,629 --> 01:27:23,440

getting additional observations i think

2339
01:27:28,790 --> 01:27:26,639
that getting the overlapping uh

2340
01:27:30,790 --> 01:27:28,800
overlapping measurements are critical in

2341
01:27:33,990 --> 01:27:30,800
moving from an outcrop understanding

2342
01:27:35,270 --> 01:27:34,000
down to the micron understanding

2343
01:27:37,590 --> 01:27:35,280
especially since we have to be so

2344
01:27:40,070 --> 01:27:37,600
targeted in the in the samples that we

2345
01:27:42,310 --> 01:27:40,080
select and then the further refining

2346
01:27:45,510 --> 01:27:42,320
from there and i think we did learn

2347
01:27:46,790 --> 01:27:45,520
quite a bit in terms of uh

2348
01:27:48,709 --> 01:27:46,800
how to

2349
01:27:50,229 --> 01:27:48,719
do scans in terms of

2350
01:27:52,550 --> 01:27:50,239
uh

2351
01:27:55,110 --> 01:27:52,560
it's nice to do the same types of scans

2352
01:27:57,189 --> 01:27:55,120
between sites so you're able to compare

2353
01:28:00,070 --> 01:27:57,199
the survey scans that are the same that

2354
01:28:01,990 --> 01:28:00,080
are the same conditions as well as the

2355
01:28:03,830 --> 01:28:02,000
hdr scans which are the higher pulses

2356
01:28:04,790 --> 01:28:03,840
per point scans that are spaced farther

2357
01:28:06,390 --> 01:28:04,800
apart

2358
01:28:08,950 --> 01:28:06,400
so i think

2359
01:28:10,149 --> 01:28:08,960
all those as well as the settings there

2360
01:28:12,310 --> 01:28:10,159
are a number of settings that we can

2361
01:28:15,430 --> 01:28:12,320
customize the sherlock so

2362
01:28:17,830 --> 01:28:15,440
i think we've determined that where we

2363
01:28:20,310 --> 01:28:17,840

can work where we can place pixel is

2364
01:28:22,229 --> 01:28:20,320
really uh a strong driver and where

2365
01:28:25,990 --> 01:28:22,239
sherlock wants to be placed so we do get

2366
01:28:27,910 --> 01:28:26,000
those overlapping uh measurements

2367
01:28:29,910 --> 01:28:27,920
do you think that they're

2368
01:28:33,990 --> 01:28:29,920
the opportunity to do

2369
01:28:36,709 --> 01:28:34,000
peroxide on um a natural target

2370
01:28:38,709 --> 01:28:36,719
um especially by deploying sherlock is

2371
01:28:40,310 --> 01:28:38,719
that does that have the potential to

2372
01:28:44,470 --> 01:28:40,320
really help us

2373
01:28:46,950 --> 01:28:44,480
triage the best samples for for

2374
01:28:49,189 --> 01:28:46,960
abrasion and sampling are there are

2375
01:28:51,030 --> 01:28:49,199
there concerns that the dust cover for

2376
01:28:52,629 --> 01:28:51,040
example is going to be challenging for

2377
01:28:55,189 --> 01:28:52,639
sherlock to

2378
01:28:57,910 --> 01:28:55,199
to see the organics through

2379
01:29:00,629 --> 01:28:57,920
i think and especially based on the uh

2380
01:29:02,950 --> 01:29:00,639
talks that we saw later in the session i

2381
01:29:05,669 --> 01:29:02,960
would be very excited to have pixel and

2382
01:29:06,470 --> 01:29:05,679
sherlock measurements of the regolith

2383
01:29:08,470 --> 01:29:06,480
uh

2384
01:29:11,430 --> 01:29:08,480
in jezreel since we will be taking a

2385
01:29:13,669 --> 01:29:11,440
regolith sample and

2386
01:29:15,510 --> 01:29:13,679
we should be able to detect organics if

2387
01:29:18,550 --> 01:29:15,520
they're present and we don't have to

2388
01:29:20,790 --> 01:29:18,560

worry about abrading per se

2389
01:29:22,229 --> 01:29:20,800
because we're interested in the

2390
01:29:23,350 --> 01:29:22,239
regolith

2391
01:29:25,590 --> 01:29:23,360
excellent and then there's one more

2392
01:29:28,390 --> 01:29:25,600
question from chris house online what is

2393
01:29:30,070 --> 01:29:28,400
the carbon range of percent carbon being

2394
01:29:33,030 --> 01:29:30,080
seen

2395
01:29:35,669 --> 01:29:33,040
i don't know if we figured that out yet

2396
01:29:39,110 --> 01:29:35,679
and is that question related to uh the

2397
01:29:43,189 --> 01:29:39,120
organic detection or the carbonates

2398
01:29:46,950 --> 01:29:43,199
sorry i meant the organic fluorescence

2399
01:29:51,590 --> 01:29:48,229
i would say it's

2400
01:29:56,709 --> 01:29:53,750
uh

2401
01:30:02,070 --> 01:29:56,719
lower than ppm yeah lower than ppm

2402
01:30:04,629 --> 01:30:03,669
all right so i mean we have one minute

2403
01:30:11,270 --> 01:30:04,639
left

2404
01:30:15,110 --> 01:30:12,950
all right then i i want to thank

2405
01:30:17,430 --> 01:30:15,120
everyone for your attendance and

2406
01:30:19,669 --> 01:30:17,440
participation and attention uh during

2407
01:30:21,270 --> 01:30:19,679
this session so a reminder that there's

2408
01:30:24,310 --> 01:30:21,280
a continuation

2409
01:30:26,149 --> 01:30:24,320
online starting right now so if you're

2410
01:30:27,990 --> 01:30:26,159
interested please feel free to log in

2411
01:30:30,140 --> 01:30:28,000
and support the rest of our speakers and