
AbSciCon
2019

1
00:00:00,790 --> 00:00:07,320
[Music]

2
00:00:11,940 --> 00:00:09,140
[Applause]

3
00:00:15,930 --> 00:00:11,950
all right saludos everyone thank you for

4
00:00:20,790 --> 00:00:15,940
joining me and Jen on this very last day

5
00:00:22,920 --> 00:00:20,800
of long apps icon so Vincent gave you an

6
00:00:25,890 --> 00:00:22,930
introduction into kind of a global view

7
00:00:28,349 --> 00:00:25,900
of the potential forming brines through

8
00:00:31,140 --> 00:00:28,359
deliquescent on Mars I'm not going to

9
00:00:32,760 --> 00:00:31,150
consider the local view specifically

10
00:00:35,610 --> 00:00:32,770
with implications for jezero crater

11
00:00:40,080 --> 00:00:35,620
since we're sending a robot there and I

12
00:00:42,209 --> 00:00:40,090
would like to get all this data so just

13
00:00:45,060 --> 00:00:42,219

a quick review can mana has already

14
00:00:46,920 --> 00:00:45,070
talked about this but thus far there's

15
00:00:48,840 --> 00:00:46,930
only really two missions that have been

16
00:00:52,229 --> 00:00:48,850
able to give us meteorological data and

17
00:00:56,189 --> 00:00:52,239
tell us than the potential stability of

18
00:00:58,380 --> 00:00:56,199
Bryon's at these areas and that is the

19
00:01:01,169 --> 00:00:58,390
Curiosity rover which is equatorial

20
00:01:04,829 --> 00:01:01,179
basically to about minus 4 and the

21
00:01:07,080 --> 00:01:04,839
Phoenix lander whoo that's the other one

22
00:01:10,350 --> 00:01:07,090
I was knew I was gonna do that and the

23
00:01:13,740 --> 00:01:10,360
Phoenix one which is up here about 68

24
00:01:15,719 --> 00:01:13,750
degrees north so that is polar these are

25
00:01:18,030 --> 00:01:15,729
the two that has given us meteorological

26
00:01:19,740 --> 00:01:18,040
data these are the only two that we can

27
00:01:21,560 --> 00:01:19,750
then use the T and the relative humidity

28
00:01:25,380 --> 00:01:21,570
in order to figure something out about

29
00:01:27,660 --> 00:01:25,390
the local scale environment and if

30
00:01:30,240 --> 00:01:27,670
Brian's are stable there and then just

31
00:01:32,370 --> 00:01:30,250
so you can see March 2020 will be going

32
00:01:34,160 --> 00:01:32,380
around here and ExoMars on this side so

33
00:01:36,780 --> 00:01:34,170
we're we're getting somewhere in between

34
00:01:40,550 --> 00:01:36,790
curiosity and Phoenix and I'm gonna get

35
00:01:42,990 --> 00:01:40,560
into why that tweeners zone is important

36
00:01:45,359 --> 00:01:43,000
but just as a quick introduction into

37
00:01:47,940 --> 00:01:45,369
the phase diagram since I will be

38
00:01:51,179 --> 00:01:47,950

showing this a lot so when we're looking

39
00:01:52,770 --> 00:01:51,189
at calcium perchlorate here's the it's

40
00:01:56,910 --> 00:01:52,780
phase diagram at a eutectic temperature

41
00:01:59,760 --> 00:01:56,920
198 Kelvin and an activity 0.53 I keep

42
00:02:02,580 --> 00:01:59,770
doing that that that you tectors right

43
00:02:04,770 --> 00:02:02,590
here the black line you see here that is

44
00:02:08,190 --> 00:02:04,780
the ice line so something important to

45
00:02:09,810 --> 00:02:08,200
note is that Mars rovers give you

46
00:02:16,290 --> 00:02:09,820
relative minute II but with respect to

47
00:02:18,030 --> 00:02:16,300
ice okay the activity of a brine can be

48
00:02:20,460 --> 00:02:18,040
related to the relative humidity but

49
00:02:21,270 --> 00:02:20,470
only with respect to liquid all right so

50
00:02:23,250 --> 00:02:21,280
you're divining

51
00:02:25,590 --> 00:02:23,260
thing by a piece a device versus a piece

52
00:02:27,330 --> 00:02:25,600
add of liquid so when you're talking

53
00:02:29,250 --> 00:02:27,340
about the ice line you're talking about

54
00:02:33,000 --> 00:02:29,260
relative mean this line is relative nity

55
00:02:35,190 --> 00:02:33,010
with respect to ice equals 100% on an RH

56
00:02:37,350 --> 00:02:35,200
of liquid diagram okay keep that in mind

57
00:02:39,780 --> 00:02:37,360
this blue line that's the deliquescent

58
00:02:41,340 --> 00:02:39,790
relative humidity if we cross that line

59
00:02:44,640 --> 00:02:41,350
that's when we would be able to have a

60
00:02:46,560 --> 00:02:44,650
liquid now as vincent mentioned you do

61
00:02:48,840 --> 00:02:46,570
end up having metastable solutions and

62
00:02:51,210 --> 00:02:48,850
the hysteresis effects so if i'm

63
00:02:53,760 --> 00:02:51,220

trucking along here i'm a tea in an RH

64
00:02:57,300 --> 00:02:53,770
and I suddenly cross here yeah I'm a

65
00:03:00,570 --> 00:02:57,310
liquid many experiments from Katy prim

66
00:03:03,270 --> 00:03:00,580
renege off Daniel noting even from the

67
00:03:05,610 --> 00:03:03,280
group f9 has shown if you cross this

68
00:03:07,290 --> 00:03:05,620
line you don't immediately become ice

69
00:03:09,330 --> 00:03:07,300
you kind of have like I imagine it as a

70
00:03:12,620 --> 00:03:09,340
slushy I haven't seen pictures from

71
00:03:15,330 --> 00:03:12,630
these experiments but I think slushies

72
00:03:18,870 --> 00:03:15,340
so around here you have a little slushy

73
00:03:21,720 --> 00:03:18,880
and then the temperatures and RH starts

74
00:03:23,370 --> 00:03:21,730
swinging back and you should see

75
00:03:25,229 --> 00:03:23,380
erratically right around here give up

76
00:03:26,729 --> 00:03:25,239
your water but you don't you have to

77
00:03:28,199 --> 00:03:26,739
wait until you hit the erh the

78
00:03:30,330 --> 00:03:28,209
efflorescence relative humidity so

79
00:03:31,979 --> 00:03:30,340
that's a hysteresis effect so you have

80
00:03:34,259 --> 00:03:31,989
liquid and then you continue having

81
00:03:37,789 --> 00:03:34,269
liquid until you pass this line on this

82
00:03:42,199 --> 00:03:37,799
side so the liquid stability area is

83
00:03:48,300 --> 00:03:45,030
efflorescence relative humidity so

84
00:03:50,819 --> 00:03:48,310
that's where you lose the the liquid and

85
00:03:52,170 --> 00:03:50,829
it goes back so the salt will transition

86
00:03:55,470 --> 00:03:52,180
from the aqueous solution back into the

87
00:03:57,240 --> 00:03:55,480
solid crystalline site all right so now

88
00:03:58,410 --> 00:03:57,250

that we got that introduction into the

89
00:04:00,720 --> 00:03:58,420
face diagram we're going to start

90
00:04:02,699 --> 00:04:00,730
putting pretty dots on it so this is the

91
00:04:03,630 --> 00:04:02,709
Phoenix data and run has shown this to

92
00:04:06,300 --> 00:04:03,640
you

93
00:04:07,710 --> 00:04:06,310
this was the newly recalibrated data

94
00:04:09,509 --> 00:04:07,720
thank you head man for doing that

95
00:04:11,880 --> 00:04:09,519
because the Phoenix data made no sense

96
00:04:14,550 --> 00:04:11,890
to me when we saw it but as you can see

97
00:04:15,810 --> 00:04:14,560
here if you put the raw data and then so

98
00:04:18,599 --> 00:04:15,820
that's what you're seeing in the dark

99
00:04:20,729 --> 00:04:18,609
purple and then I took the early

100
00:04:23,820 --> 00:04:20,739
averages and that is in the pretty

101
00:04:26,219 --> 00:04:23,830
magenta and you can see that at Phoenix

102
00:04:28,890 --> 00:04:26,229
we we have several points that nicely

103
00:04:30,180 --> 00:04:28,900
cross into that liquid state and so it

104
00:04:31,890 --> 00:04:30,190
this wouldn't mean that you would just

105
00:04:33,420 --> 00:04:31,900
have a liquid there it means you now

106
00:04:35,809 --> 00:04:33,430
again like I mentioned have to wait

107
00:04:37,890 --> 00:04:35,819
until you hit back into the Year

108
00:04:41,400 --> 00:04:37,900
so a Phoenix things are a little bit

109
00:04:42,960 --> 00:04:41,410
easy let's compare this to an assault

110
00:04:46,950 --> 00:04:42,970
ooh

111
00:04:48,869 --> 00:04:46,960
MSL is tough alright so here and here's

112
00:04:51,180 --> 00:04:48,879
the other reason why MSL is tough error

113
00:04:56,730 --> 00:04:51,190

bars whoa that's a thing

114
00:04:58,559 --> 00:04:56,740
so MSL actually um within error a

115
00:05:01,800 --> 00:04:58,569
relative humidity measurement somewhere

116
00:05:04,320 --> 00:05:01,810
down here could be negative and so when

117
00:05:06,270 --> 00:05:04,330
that happens I say you are unreal the

118
00:05:07,740 --> 00:05:06,280
instrument probably is a little shaky so

119
00:05:09,809 --> 00:05:07,750
I throw that data out that's why you're

120
00:05:11,580 --> 00:05:09,819
not seeing things going this way because

121
00:05:14,159 --> 00:05:11,590
with an error that data point makes no

122
00:05:15,990 --> 00:05:14,169
sense also side note with an error you

123
00:05:17,909 --> 00:05:16,000
can have relative humidity with respect

124
00:05:20,339 --> 00:05:17,919
to liquid of about a thousand percent

125
00:05:22,110 --> 00:05:20,349
and I thought that was weird so

126
00:05:25,020 --> 00:05:22,120
engineers please make better instruments

127
00:05:29,129 --> 00:05:25,030
thank you so but if you account for the

128
00:05:31,529 --> 00:05:29,139
error bars for these points I have drawn

129
00:05:33,300 --> 00:05:31,539
boxes around two points that within

130
00:05:34,860 --> 00:05:33,310
error you would actually be in the

131
00:05:37,700 --> 00:05:34,870
liquid state

132
00:05:40,770 --> 00:05:37,710
those will happen in SOL 12:32 and Sol

133
00:05:45,300 --> 00:05:40,780
1311 specifically during the morning and

134
00:05:47,430 --> 00:05:45,310
late evening I then have a fully coupled

135
00:05:49,860 --> 00:05:47,440
heat and mass transfer model and so I

136
00:05:53,430 --> 00:05:49,870
decided to look at pairs of albedo and

137
00:05:57,089 --> 00:05:53,440
thermal inertia that were at least kind

138
00:05:59,189 --> 00:05:57,099

of seen by MSL just to see and be able

139
00:06:02,040 --> 00:05:59,199
to predict for amasau where it could

140
00:06:05,189 --> 00:06:02,050
potentially see liquid formation and

141
00:06:06,870 --> 00:06:05,199
this is so unlike for Vince's plot where

142
00:06:08,760 --> 00:06:06,880
he showed percent of year that was at

143
00:06:11,580 --> 00:06:08,770
the surface my percent of year is summed

144
00:06:13,290 --> 00:06:11,590
over the subsurface up to the surface so

145
00:06:16,320 --> 00:06:13,300
I'm setting up all the potential hours

146
00:06:17,519 --> 00:06:16,330
that could have happened there in the so

147
00:06:20,760 --> 00:06:17,529
that's what you're seeing here in color

148
00:06:23,249 --> 00:06:20,770
the percent of the year so up here

149
00:06:25,170 --> 00:06:23,259
apparently it's happy-go-lucky so if you

150
00:06:27,180 --> 00:06:25,180
were high albedo really low thermal

151
00:06:28,709 --> 00:06:27,190
inertia that would be great however I

152
00:06:31,050 --> 00:06:28,719
looked at a map of Mars and I did not

153
00:06:33,659 --> 00:06:31,060
see that combination so forget about

154
00:06:35,640 --> 00:06:33,669
that in the white dots you see the

155
00:06:37,860 --> 00:06:35,650
combinations of thermal inertia and I'll

156
00:06:39,450 --> 00:06:37,870
be though the MSL actually saw so most

157
00:06:42,560 --> 00:06:39,460
of the time it's in this black zone so

158
00:06:45,300 --> 00:06:42,570
that means nope nope but over here on

159
00:06:48,360 --> 00:06:45,310
thermal inertia 180 albedo point one one

160
00:06:49,110 --> 00:06:48,370
soul twelve thirty two it turns out you

161
00:06:51,330 --> 00:06:49,120
do have

162
00:06:53,010 --> 00:06:51,340
and remember that's also the data point

163
00:06:55,830 --> 00:06:53,020

in the previous plot that I said with an

164
00:06:57,780 --> 00:06:55,840
error it would be in liquid so the model

165
00:07:00,630 --> 00:06:57,790
says yay

166
00:07:02,220 --> 00:07:00,640
and then Vinson had told you that when

167
00:07:05,430 --> 00:07:02,230
you're considering diffusion into the

168
00:07:06,930 --> 00:07:05,440
regolith the reasons kind of easy on

169
00:07:08,460 --> 00:07:06,940
Mars is because things look like a beach

170
00:07:09,720 --> 00:07:08,470
I'm from Puerto Rico so I'm used to

171
00:07:12,270 --> 00:07:09,730
seeing these kind of things except I

172
00:07:14,520 --> 00:07:12,280
demand the actual ocean there and the

173
00:07:17,880 --> 00:07:14,530
pina colada and that's another thing

174
00:07:20,430 --> 00:07:17,890
today but this would be sold 12:30 to

175
00:07:24,840 --> 00:07:20,440
where potentially MSL had trucked over

176
00:07:27,330 --> 00:07:24,850
from forming liquids there okay

177
00:07:28,770 --> 00:07:27,340
introduction into you those two those

178
00:07:30,720 --> 00:07:28,780
are the extremes right something you

179
00:07:33,030 --> 00:07:30,730
could Turin something polar and now

180
00:07:35,490 --> 00:07:33,040
we're gonna go over to March 2020 which

181
00:07:37,560 --> 00:07:35,500
will be somewhere in between ish I think

182
00:07:39,900 --> 00:07:37,570
it was like 20 degrees north latitude

183
00:07:42,090 --> 00:07:39,910
and what I want to look at is apply

184
00:07:44,610 --> 00:07:42,100
these same techniques except in this

185
00:07:46,740 --> 00:07:44,620
case also use a GCM to be able to

186
00:07:49,740 --> 00:07:46,750
predict what the surface condition would

187
00:07:52,620 --> 00:07:49,750
be at jezero crater see do we ever cross

188
00:07:53,880 --> 00:07:52,630

that DRH line and then once we do how

189
00:07:56,730 --> 00:07:53,890
long do you have a liquid until you go

190
00:07:59,550 --> 00:07:56,740
back to that erh line and are these

191
00:08:01,980 --> 00:07:59,560
liquids habitable to life as we know it

192
00:08:04,940 --> 00:08:01,990
and I think Vince already gave the

193
00:08:09,390 --> 00:08:04,950
punchline away which is nope nope Segen

194
00:08:12,030 --> 00:08:09,400
all right so I have this this is my part

195
00:08:12,810 --> 00:08:12,040
down here this and by the way I am no

196
00:08:14,880 --> 00:08:12,820
James

197
00:08:17,490 --> 00:08:14,890
Tuttle Kean I am NOT an artist this is

198
00:08:20,310 --> 00:08:17,500
my ability to be an artist a box with a

199
00:08:22,670 --> 00:08:20,320
pretty cloud on top and that cloud was

200
00:08:26,400 --> 00:08:22,680
made by PowerPoint thank you so

201
00:08:29,610 --> 00:08:26,410
Alejandro Soto has ran the Mars Worf

202
00:08:32,670 --> 00:08:29,620
model for us here you have so it's a

203
00:08:36,240 --> 00:08:32,680
resolution 5 by 5 52 vertical levels I

204
00:08:39,329 --> 00:08:36,250
then take the lower values for T and P

205
00:08:41,670 --> 00:08:39,339
h2o I allow that to diffuse through a

206
00:08:43,140 --> 00:08:41,680
regolith column I go several times the

207
00:08:45,690 --> 00:08:43,150
annual skin depth that way I can

208
00:08:47,640 --> 00:08:45,700
actually see the full diffusion and it's

209
00:08:51,000 --> 00:08:47,650
not only in heat but it's also a mass

210
00:08:53,220 --> 00:08:51,010
and then my vertical resolution there's

211
00:08:55,400 --> 00:08:53,230
1 centimeters and it's very tiny time

212
00:08:59,220 --> 00:08:55,410
steps but I saved the conditions hourly

213
00:09:01,199 --> 00:08:59,230

and then within every element I check if

214
00:09:02,960 --> 00:09:01,209
the TN RH combination actually allows

215
00:09:07,019 --> 00:09:02,970
for deliquescent

216
00:09:10,109 --> 00:09:07,029
so here is the quick glimpse of these

217
00:09:11,699 --> 00:09:10,119
results in the gray scaling you're

218
00:09:14,340 --> 00:09:11,709
seeing from one centimeter all the way

219
00:09:18,359 --> 00:09:14,350
over to 10 centimeters and as you can

220
00:09:20,699 --> 00:09:18,369
see we get really close so close but not

221
00:09:23,069 --> 00:09:20,709
quite there yet now as we all know

222
00:09:24,480 --> 00:09:23,079
though GCMs have knobs on them and then

223
00:09:26,669 --> 00:09:24,490
you can just go and go tweak tweak tweak

224
00:09:30,449 --> 00:09:26,679
to the rhythm of the beat hey and then

225
00:09:32,189 --> 00:09:30,459
things work so because what if something

226
00:09:33,960 --> 00:09:32,199
random happens at the near surface what

227
00:09:35,999 --> 00:09:33,970
if there was a dust storm what if the

228
00:09:36,929 --> 00:09:36,009
thermal inertia and albedo locally is a

229
00:09:39,359 --> 00:09:36,939
little bit different than what's

230
00:09:41,400 --> 00:09:39,369
considered a GCM but just to show you

231
00:09:46,290 --> 00:09:41,410
that within the tolerance level of a

232
00:09:48,600 --> 00:09:46,300
Kelvin and a 1% in our age we do

233
00:09:51,780 --> 00:09:48,610
actually enter the liquid zone here and

234
00:09:53,249 --> 00:09:51,790
really within numerical error going plus

235
00:09:55,889 --> 00:09:53,259
or minus one Kelvin and going plus or

236
00:09:57,749 --> 00:09:55,899
minus RH 1% that's that's with an error

237
00:10:00,780 --> 00:09:57,759
so that's fine so within the error and

238
00:10:04,230 --> 00:10:00,790

within knob twisting we would be able to

239
00:10:06,689 --> 00:10:04,240
form liquids at jezzer crater these type

240
00:10:09,269 --> 00:10:06,699
of liquids would be there between LS 160

241
00:10:11,730 --> 00:10:09,279
and 190 forming in the late evening and

242
00:10:14,579 --> 00:10:11,740
shortly after midnight and only for

243
00:10:18,210 --> 00:10:14,589
about 0.6% of the years so not a whole

244
00:10:19,949 --> 00:10:18,220
lot but something now going back to that

245
00:10:23,129 --> 00:10:19,959
special region because I said are these

246
00:10:25,049 --> 00:10:23,139
liquids habitable so just remember we

247
00:10:27,720 --> 00:10:25,059
were really close here and I want to

248
00:10:29,939 --> 00:10:27,730
come up here so yeah that's not gonna

249
00:10:33,030 --> 00:10:29,949
happen but here's another way of looking

250
00:10:35,189 --> 00:10:33,040
at it if you have a liquid on Mars and

251
00:10:37,319 --> 00:10:35,199
it's stable against boiling and

252
00:10:38,819 --> 00:10:37,329
evaporation that means it has to be in

253
00:10:42,030 --> 00:10:38,829
equilibrium with the near surface

254
00:10:43,710 --> 00:10:42,040
atmosphere so then if I am at this box

255
00:10:46,499 --> 00:10:43,720
at the edge of this box right there

256
00:10:49,769 --> 00:10:46,509
where T's 255 Kelvin the activity of

257
00:10:53,069 --> 00:10:49,779
that solution is 0.6 for the activity

258
00:10:55,379 --> 00:10:53,079
for an a solution at an activity 0.6 to

259
00:10:57,119 --> 00:10:55,389
be stable against the atmosphere the

260
00:11:00,329 --> 00:10:57,129
relative humidity of the atmosphere plus

261
00:11:02,910 --> 00:11:00,339
then be 60% with respect to liquid so at

262
00:11:06,119 --> 00:11:02,920
that temperature the pH - oh you need to

263
00:11:07,559 --> 00:11:06,129

do that is 90 Pascal's if you find

264
00:11:09,310 --> 00:11:07,569
somewhere on Mars where that happens

265
00:11:11,680 --> 00:11:09,320
please let me know

266
00:11:16,480 --> 00:11:11,690
cuz yeah that's not gonna happen this is

267
00:11:20,800 --> 00:11:16,490
Puerto Rico PR is habitable I agree you

268
00:11:22,750 --> 00:11:20,810
should all go there so um but I'm a very

269
00:11:25,030 --> 00:11:22,760
quantitative person so I wanted to at

270
00:11:27,760 --> 00:11:25,040
least be able to compare MSL Jezz Roe

271
00:11:30,160 --> 00:11:27,770
and Phoenix so I'm going to suggest and

272
00:11:32,860 --> 00:11:30,170
I'm very open to suggestions from you to

273
00:11:34,840 --> 00:11:32,870
is a metric based on the special region

274
00:11:36,460 --> 00:11:34,850
quote-unquote that NASA is using to

275
00:11:38,740 --> 00:11:36,470
define whether an area should be

276
00:11:40,360 --> 00:11:38,750
protected or not and so this is a very

277
00:11:42,780 --> 00:11:40,370
basic metric where we're looking at the

278
00:11:45,850 --> 00:11:42,790
distance away from that special region

279
00:11:47,380 --> 00:11:45,860
and I normalized that such that at the

280
00:11:49,840 --> 00:11:47,390
furthest point here zero relative

281
00:11:52,510 --> 00:11:49,850
humidity and really cold 150 Kelvin I

282
00:11:54,610 --> 00:11:52,520
defined that to be equal one and once

283
00:11:56,740 --> 00:11:54,620
you do that then you can scale

284
00:11:58,720 --> 00:11:56,750
everything else have the distances away

285
00:12:01,660 --> 00:11:58,730
and then I was told that people when

286
00:12:03,220 --> 00:12:01,670
they consider zero which in my model

287
00:12:06,070 --> 00:12:03,230
would be zero distance would be there

288
00:12:08,320 --> 00:12:06,080

when people say zero that means bad so I

289
00:12:10,690 --> 00:12:08,330
said fine say 1 minus distance and now

290
00:12:12,670 --> 00:12:10,700
one equals good and zero goes bad great

291
00:12:14,050 --> 00:12:12,680
so that's what I did here so that's why

292
00:12:16,840 --> 00:12:14,060
the colors aren't following the quote

293
00:12:19,210 --> 00:12:16,850
unquote distance so then if we apply

294
00:12:20,440 --> 00:12:19,220
this metric to J's Rho Gale Crater and

295
00:12:24,310 --> 00:12:20,450
Phoenix landing site

296
00:12:26,320 --> 00:12:24,320
I find the mode from this metric you can

297
00:12:29,260 --> 00:12:26,330
see that Phoenix is happy-go-lucky up

298
00:12:32,170 --> 00:12:29,270
about point six Gale craters you know as

299
00:12:34,000 --> 00:12:32,180
expected 0.25 very low and J's Row is

300
00:12:37,060 --> 00:12:34,010
not quite in between but it is much

301
00:12:40,270 --> 00:12:37,070
better than Gale so if I were march 2020

302
00:12:41,500 --> 00:12:40,280
and I'd be roving around I'd think that

303
00:12:43,330 --> 00:12:41,510
there might be a potential reformed

304
00:12:44,800 --> 00:12:43,340
liquids but those liquids are not

305
00:12:46,720 --> 00:12:44,810
habitable to life as we know it but

306
00:12:48,810 --> 00:12:46,730
maybe we don't know life quite well yet

307
00:12:52,150 --> 00:12:48,820
so Brian's May format jezero crater

308
00:12:55,120 --> 00:12:52,160
during that period the brines that are

309
00:12:57,610 --> 00:12:55,130
produced are not special at all and I am

310
00:12:59,800 --> 00:12:57,620
suggesting that maybe in order to

311
00:13:01,240 --> 00:12:59,810
quantify the distribution of habitable

312
00:13:02,770 --> 00:13:01,250
quote-unquote environments on Mars if we

313
00:13:04,900 --> 00:13:02,780

were actually keen and using this

314
00:13:07,510 --> 00:13:04,910
special Regents definition that maybe we

315
00:13:10,390 --> 00:13:07,520
can use this new metric to actually do

316
00:13:12,280 --> 00:13:10,400
that and before I let you all go I am

317
00:13:13,600 --> 00:13:12,290
the lead convener for this conference

318
00:13:15,730 --> 00:13:13,610
down here first billion years

319
00:13:17,200 --> 00:13:15,740
habitability happening Big Sky Montana

320
00:13:19,750 --> 00:13:17,210
we're gonna go into Yellowstone National

321
00:13:21,460 --> 00:13:19,760
Park we're gonna have fun and then we're

322
00:13:22,809 --> 00:13:21,470
going to talk about how life could have

323
00:13:24,669 --> 00:13:22,819
originated on earth

324
00:13:27,009 --> 00:13:24,679
in other planets and even with extension

325
00:13:31,060 --> 00:13:27,019
so exoplanets abstract deadline is July

326
00:13:31,280 --> 00:13:31,070
3rd so please submit thank you very much