
AbSciCon
2019

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

2
00:00:11,610 --> 00:00:09,200
[Applause]

3
00:00:13,320 --> 00:00:11,620
good afternoon everyone i'm andrew

4
00:00:15,000 --> 00:00:13,330
Shumway I'm a graduate researcher at the

5
00:00:16,760 --> 00:00:15,010
University of Washington I'm working

6
00:00:19,109 --> 00:00:16,770
there with Professor Jonathan toner

7
00:00:21,660 --> 00:00:19,119
studying the formation and stability of

8
00:00:24,030 --> 00:00:21,670
Bryon's as they exist on the surface of

9
00:00:28,320 --> 00:00:24,040
Mars I'm here today to present some

10
00:00:30,800 --> 00:00:28,330
results about from some experimental

11
00:00:33,090 --> 00:00:30,810
work that we've done looking at how

12
00:00:34,410 --> 00:00:33,100
brian's may exist under more extreme

13
00:00:35,130 --> 00:00:34,420

conditions than previously thought

14
00:00:37,229 --> 00:00:35,140
possible

15
00:00:39,030 --> 00:00:37,239
in fact my results likely indicate that

16
00:00:41,370 --> 00:00:39,040
under certain conditions brian's may

17
00:00:43,310 --> 00:00:41,380
exist throughout the entire year and in

18
00:00:49,020 --> 00:00:43,320
the most extreme conditions on mars

19
00:00:51,420 --> 00:00:49,030
making them effectively unfeasible so

20
00:00:53,220 --> 00:00:51,430
trans transient or perpetually liquid

21
00:00:55,350 --> 00:00:53,230
water on the surface of Mars even in

22
00:00:57,840 --> 00:00:55,360
relatively small quantities it has deep

23
00:00:59,330 --> 00:00:57,850
Astra biological significance water is

24
00:01:01,560 --> 00:00:59,340
the cornerstone in our search for

25
00:01:03,690 --> 00:01:01,570
habitable environments beyond Earth and

26
00:01:05,160 --> 00:01:03,700
there are many hazards on Mars that

27
00:01:07,469 --> 00:01:05,170
potential organisms would face including

28
00:01:09,680 --> 00:01:07,479
low temperature low pressures high

29
00:01:11,700 --> 00:01:09,690
exposure to radiation but I think

30
00:01:15,300 --> 00:01:11,710
perhaps none are as difficult to

31
00:01:16,920 --> 00:01:15,310
overcome as the lack of water so life on

32
00:01:19,770 --> 00:01:16,930
Earth can thrive in some of these most

33
00:01:22,109 --> 00:01:19,780
extreme environments but all life as we

34
00:01:24,060 --> 00:01:22,119
know it needs water to survive so if

35
00:01:25,950 --> 00:01:24,070
there are microorganisms on Mars that we

36
00:01:28,440 --> 00:01:25,960
should be able to identify their source

37
00:01:30,690 --> 00:01:28,450
of water and even if there are no

38
00:01:33,390 --> 00:01:30,700

microorganisms alive on Mars today

39
00:01:37,109 --> 00:01:33,400
soon we will be bringing our own life to

40
00:01:39,780 --> 00:01:37,119
the planet humans and for potential

41
00:01:42,060 --> 00:01:39,790
future missions and missions to Mars

42
00:01:43,679 --> 00:01:42,070
humans are gonna require water and

43
00:01:46,649 --> 00:01:43,689
likely the first missions will bring

44
00:01:48,840 --> 00:01:46,659
their own water but this is inefficient

45
00:01:52,010 --> 00:01:48,850
because water is very heavy and

46
00:01:54,149 --> 00:01:52,020
expensive to transport so a much better

47
00:01:56,760 --> 00:01:54,159
it would be much more sustainable to

48
00:01:59,399 --> 00:01:56,770
find a source of water there on Mars

49
00:02:01,319 --> 00:01:59,409
that we could use so for these reasons

50
00:02:02,789 --> 00:02:01,329
characterizing water on Mars is critical

51
00:02:05,010 --> 00:02:02,799
in defining both present and future

52
00:02:05,880 --> 00:02:05,020
habitability of the planet and it's

53
00:02:08,550 --> 00:02:05,890
central to our mission as

54
00:02:09,569 --> 00:02:08,560
astrobiologists this presents a

55
00:02:11,640 --> 00:02:09,579
challenge though because when we look at

56
00:02:13,830 --> 00:02:11,650
the surface of Mars today we find a very

57
00:02:15,930 --> 00:02:13,840
cold and dry place it's not an ideal

58
00:02:17,400 --> 00:02:15,940
environment for life to exist and while

59
00:02:20,909 --> 00:02:17,410
there's past evidence that liquid water

60
00:02:25,340 --> 00:02:20,919
existed the water that is there or that

61
00:02:29,880 --> 00:02:27,680
if we look at the phase diagram of water

62
00:02:31,860 --> 00:02:29,890
and the range of Martian service

63
00:02:34,710 --> 00:02:31,870

conditions we can see that any pure h2o

64
00:02:37,740 --> 00:02:34,720
would exist only as a solid ice or as a

65
00:02:40,230 --> 00:02:37,750
water vapor gas but the surface of Mars

66
00:02:45,510 --> 00:02:40,240
is rich in salts which reduces the

67
00:02:51,990 --> 00:02:45,520
evaporation rate and can allow water to

68
00:02:52,950 --> 00:02:52,000
exist under these extreme conditions so

69
00:02:54,780 --> 00:02:52,960
a great deal of work has already been

70
00:02:58,470 --> 00:02:54,790
done to characterize Martian brian's

71
00:03:00,060 --> 00:02:58,480
like these brands made from Mars salts

72
00:03:02,460 --> 00:03:00,070
can have extremely low freezing points

73
00:03:04,950 --> 00:03:02,470
down to negative 74 degrees Celsius in

74
00:03:06,720 --> 00:03:04,960
the case of calcium perchlorate another

75
00:03:09,120 --> 00:03:06,730
way that water is predicted to exist on

76
00:03:11,430 --> 00:03:09,130
Mars is as adsorbed brines or as

77
00:03:14,820 --> 00:03:11,440
adsorbed water what's happening here is

78
00:03:17,880 --> 00:03:14,830
that water vapor will adhere to surfaces

79
00:03:19,830 --> 00:03:17,890
in this case soil this adhesion is just

80
00:03:22,590 --> 00:03:19,840
driven by Van der Waals forces which are

81
00:03:24,480 --> 00:03:22,600
weak electromagnetic interactions but

82
00:03:26,040 --> 00:03:24,490
neither of these previously studied

83
00:03:29,190 --> 00:03:26,050
systems tells the whole story

84
00:03:32,640 --> 00:03:29,200
realistically any brines that likely

85
00:03:33,840 --> 00:03:32,650
exists on Mars are within the soil so

86
00:03:36,510 --> 00:03:33,850
it's essential to understand the

87
00:03:38,490 --> 00:03:36,520
properties of soil brien mixtures soil

88
00:03:40,050 --> 00:03:38,500

and salt and water what distinguishes

89
00:03:42,360 --> 00:03:40,060
our expand experiment from these

90
00:03:44,580 --> 00:03:42,370
previously studied systems is that we

91
00:03:46,230 --> 00:03:44,590
investigate samples of soil and brine

92
00:03:48,150 --> 00:03:46,240
and find that they do not behave

93
00:03:51,600 --> 00:03:48,160
identically to either of these

94
00:03:52,680 --> 00:03:51,610
previously studied systems so the goal

95
00:03:54,510 --> 00:03:52,690
in this experiment is to answer the

96
00:03:57,540 --> 00:03:54,520
question under what conditions can Mars

97
00:04:00,090 --> 00:03:57,550
akan brines exist in Martian soils this

98
00:04:02,160 --> 00:04:00,100
comes in two steps the first is to study

99
00:04:04,110 --> 00:04:02,170
how brian's form the soil by taking up

100
00:04:06,450 --> 00:04:04,120
water from the atmosphere and we did

101
00:04:09,060 --> 00:04:06,460
this by measuring the water activity if

102
00:04:12,900 --> 00:04:09,070
you are not familiar with water activity

103
00:04:14,520 --> 00:04:12,910
essentially it is a measure of the the

104
00:04:16,979 --> 00:04:14,530
effective concentration of water or how

105
00:04:20,550 --> 00:04:16,989
much water is available for chemical and

106
00:04:23,970 --> 00:04:20,560
biological interactions next we looked

107
00:04:26,040 --> 00:04:23,980
at brine stability to identify phase

108
00:04:27,780 --> 00:04:26,050
transitions such as freezing salt

109
00:04:29,910 --> 00:04:27,790
precipitation and glass formation and

110
00:04:31,860 --> 00:04:29,920
soil brian mixtures this phase diagram

111
00:04:33,840 --> 00:04:31,870
shows the phases for pure magnesium

112
00:04:35,309 --> 00:04:33,850
perchlorate brian as a function of

113
00:04:38,700 --> 00:04:35,319

concentration and temperature

114
00:04:41,119 --> 00:04:38,710
and we find that soils cause Bryan's to

115
00:04:44,219 --> 00:04:41,129
deviate strongly from this picture in

116
00:04:45,659 --> 00:04:44,229
order to investigate these two themes we

117
00:04:47,939 --> 00:04:45,669
created soil Brian samples that are

118
00:04:51,239 --> 00:04:47,949
analogous to what we expect to find on

119
00:04:52,739 --> 00:04:51,249
Mars so we've never had a return mission

120
00:04:54,179 --> 00:04:52,749
from Mars so we don't have any real Mars

121
00:04:54,719 --> 00:04:54,189
soil to work with so we have the next

122
00:04:56,670 --> 00:04:54,729
best thing

123
00:04:58,829 --> 00:04:56,680
Mars soil simulant which is essentially

124
00:05:01,409 --> 00:04:58,839
just crushed weathered basaltic mimics

125
00:05:03,719 --> 00:05:01,419
the composition of Martian soil and for

126
00:05:07,170 --> 00:05:03,729
our salt we chose magnesium perchlorate

127
00:05:08,760 --> 00:05:07,180
we chose that this because the wet

128
00:05:10,799 --> 00:05:08,770
chemistry experiments on the Phoenix

129
00:05:12,029 --> 00:05:10,809
lander found approximately 0.6 weight

130
00:05:14,670 --> 00:05:12,039
percent per chlorate

131
00:05:15,679 --> 00:05:14,680
in Martian soil at its landing site so

132
00:05:17,639 --> 00:05:15,689
when you put it all together you get

133
00:05:20,489 --> 00:05:17,649
soil Brian sample that looks something

134
00:05:22,109 --> 00:05:20,499
like this and using these soil Brian

135
00:05:24,600 --> 00:05:22,119
mixtures our first task was to measure

136
00:05:27,629 --> 00:05:24,610
the water activity as a function of

137
00:05:29,399 --> 00:05:27,639
Brian salt concentration the way that we

138
00:05:31,439 --> 00:05:29,409

did this is we have our soil Brian

139
00:05:33,839 --> 00:05:31,449
sample of an unknown water activity and

140
00:05:35,159 --> 00:05:33,849
we introduce it to a reference material

141
00:05:37,439 --> 00:05:35,169
for which the water activity is known

142
00:05:39,179 --> 00:05:37,449
both of these materials are put into an

143
00:05:41,579 --> 00:05:39,189
evacuated chamber and held at a constant

144
00:05:43,949 --> 00:05:41,589
temperature and water vapor is allowed

145
00:05:47,850 --> 00:05:43,959
is able to exchange between the two

146
00:05:50,639 --> 00:05:47,860
samples until equilibrium is reached at

147
00:05:53,540 --> 00:05:50,649
that point we can compare the mass

148
00:05:56,040 --> 00:05:53,550
before and after equilibration and

149
00:05:57,540 --> 00:05:56,050
calculate the water activity so the

150
00:06:00,719 --> 00:05:57,550
water activities for both of the

151
00:06:02,579 --> 00:06:00,729
materials would be identical so

152
00:06:05,309 --> 00:06:02,589
calculating the water activity and the

153
00:06:07,920 --> 00:06:05,319
brian concentration so here are the

154
00:06:10,429 --> 00:06:07,930
results from that but first actually i

155
00:06:13,219 --> 00:06:10,439
want to show you this is what for the

156
00:06:16,139 --> 00:06:13,229
pure magnesium perchlorate solution

157
00:06:18,540 --> 00:06:16,149
would look like for water activity as a

158
00:06:20,040 --> 00:06:18,550
function of salt concentration you can

159
00:06:22,049 --> 00:06:20,050
see that water activity is lower at

160
00:06:23,670 --> 00:06:22,059
higher salt concentrations this is

161
00:06:25,259 --> 00:06:23,680
because at these higher concentrations

162
00:06:27,540 --> 00:06:25,269
more of the water is interacting with

163
00:06:30,570 --> 00:06:27,550

assault so less of it is available to be

164
00:06:35,369 --> 00:06:30,580
used in other processes here in black

165
00:06:37,290 --> 00:06:35,379
are the data for a mixture of martian

166
00:06:39,689 --> 00:06:37,300
soil simulant and magnesium perchlorate

167
00:06:42,209 --> 00:06:39,699
Brian the concentration of salt in this

168
00:06:45,029 --> 00:06:42,219
experiment was one weight percent that's

169
00:06:47,670 --> 00:06:45,039
because it's very similar to the what

170
00:06:49,230 --> 00:06:47,680
was detected by the Phoenix lander we

171
00:06:51,330 --> 00:06:49,240
also studied soil Brian mixtures

172
00:06:53,249 --> 00:06:51,340
higher salt concentrations so you can

173
00:06:56,430 --> 00:06:53,259
see here in orange is to weight percent

174
00:06:58,740 --> 00:06:56,440
and in red 5 weight percent and as we

175
00:07:02,689 --> 00:06:58,750
get higher and higher concentrations it

176
00:07:05,430 --> 00:07:02,699
approaches the trend for the pure brine

177
00:07:06,870 --> 00:07:05,440
so this has really big implications for

178
00:07:09,270 --> 00:07:06,880
the way that we study Mars relevant

179
00:07:11,879 --> 00:07:09,280
brian's the lower water activity means

180
00:07:13,409 --> 00:07:11,889
that brian's absorbed onto soil are less

181
00:07:15,510 --> 00:07:13,419
available to chemical and biological

182
00:07:17,550 --> 00:07:15,520
processes further to address the

183
00:07:19,650 --> 00:07:17,560
question of stability and when these

184
00:07:21,390 --> 00:07:19,660
brian's actually remain liquid this drop

185
00:07:24,320 --> 00:07:21,400
and water activity should correspond to

186
00:07:26,159 --> 00:07:24,330
depressed freezing point temperatures

187
00:07:28,170 --> 00:07:26,169
meaning that the brian's will be more

188
00:07:30,600 --> 00:07:28,180

stable than previously thought and we

189
00:07:31,980 --> 00:07:30,610
can confirm this by measuring the phase

190
00:07:34,950 --> 00:07:31,990
transitions directly using a

191
00:07:37,469 --> 00:07:34,960
differential scanning calorimeter DSC is

192
00:07:39,510 --> 00:07:37,479
it what it does is it identify his phase

193
00:07:44,120 --> 00:07:39,520
transitions by measuring the heat flow

194
00:07:47,640 --> 00:07:46,379
anytime that a phase transition occurs

195
00:07:49,800 --> 00:07:47,650
there will be a characteristic

196
00:07:52,589 --> 00:07:49,810
absorption or release of heat and the

197
00:07:54,330 --> 00:07:52,599
DSC measures those changes so here's the

198
00:07:56,189 --> 00:07:54,340
heat flow through one sample of one

199
00:07:59,430 --> 00:07:56,199
weight percent soil brine mixture and an

200
00:08:02,010 --> 00:07:59,440
activity of 0.91 the sample was cooled

201
00:08:04,050 --> 00:08:02,020
down to negative 150 degrees Celsius and

202
00:08:09,899 --> 00:08:04,060
this plot shows you the change in heat

203
00:08:11,670 --> 00:08:09,909
as we slowly warm it up towards zero at

204
00:08:14,129 --> 00:08:11,680
this point here the heat flow drops

205
00:08:16,409 --> 00:08:14,139
suddenly melting ice is an endothermic

206
00:08:17,520 --> 00:08:16,419
process meaning that it absorbs heat so

207
00:08:20,520 --> 00:08:17,530
and that's exactly what we're seeing

208
00:08:23,520 --> 00:08:20,530
here we see similar features at lower

209
00:08:24,870 --> 00:08:23,530
water activities 0.8 0.73 but when we

210
00:08:26,850 --> 00:08:24,880
get to really really low water

211
00:08:31,290 --> 00:08:26,860
activities below 0.5 this feature

212
00:08:34,199 --> 00:08:31,300
disappears entirely it doesn't appear so

213
00:08:36,000 --> 00:08:34,209

what this says is that water it never

214
00:08:38,459 --> 00:08:36,010
freezes in these samples even though it

215
00:08:43,740 --> 00:08:38,469
we lowered the temperature to negative

216
00:08:45,720 --> 00:08:43,750
150 degrees Celsius so let's go back to

217
00:08:47,130 --> 00:08:45,730
this figure which compares a pure brine

218
00:08:49,829 --> 00:08:47,140
with a one weight percent magnesium

219
00:08:51,510 --> 00:08:49,839
perchlorate Brian soil mixture like I

220
00:08:54,300 --> 00:08:51,520
mentioned before this decrease in water

221
00:08:55,980 --> 00:08:54,310
activity caused by the soil does in fact

222
00:08:58,579 --> 00:08:55,990
correspond to a decrease in freezing

223
00:09:00,960 --> 00:08:58,589
temperature the depression of the

224
00:09:03,040 --> 00:09:00,970
freezing point is so strong then in

225
00:09:05,019 --> 00:09:03,050
samples below 0.5

226
00:09:06,610 --> 00:09:05,029
water activity the Bryan's never freeze

227
00:09:08,740 --> 00:09:06,620
and this is what we deem unfreeze

228
00:09:10,660 --> 00:09:08,750
suitable water because in these dry

229
00:09:12,220 --> 00:09:10,670
Martian conditions such Bryan's will

230
00:09:16,090 --> 00:09:12,230
remain liquid over the full range of

231
00:09:17,829 --> 00:09:16,100
Mars's temperatures as I wrap up I'd

232
00:09:20,290 --> 00:09:17,839
like to leave you with just a few

233
00:09:22,720 --> 00:09:20,300
closing thoughts Brian's on Mars will

234
00:09:25,509 --> 00:09:22,730
likely exist as adsorbed phases onto

235
00:09:28,120 --> 00:09:25,519
soil and they will remain liquid at much

236
00:09:29,620 --> 00:09:28,130
lower temperatures than pure brines this

237
00:09:31,180 --> 00:09:29,630
expands the range of conditions where

238
00:09:32,650 --> 00:09:31,190

liquid water is stable and allows it to

239
00:09:36,190 --> 00:09:32,660
be available in some of the most extreme

240
00:09:37,540 --> 00:09:36,200
and conditions on the planet adsorbed

241
00:09:40,240 --> 00:09:37,550
brian's could serve as a potential

242
00:09:41,740 --> 00:09:40,250
source of water for microbes on mars but

243
00:09:43,420 --> 00:09:41,750
it would be an extremely hostile

244
00:09:45,280 --> 00:09:43,430
environment because of these very very

245
00:09:47,530 --> 00:09:45,290
low water activities that we're

246
00:09:49,060 --> 00:09:47,540
measuring and so this project has only

247
00:09:50,860 --> 00:09:49,070
just scratched the surface of this

248
00:09:53,889 --> 00:09:50,870
there's plenty of more future work to do

249
00:09:56,290 --> 00:09:53,899
many more salts to investigate many

250
00:09:58,480 --> 00:09:56,300
different types of soils that we can use

251
00:09:59,740 --> 00:09:58,490
clays as well so that's the direction

252
00:10:01,870 --> 00:09:59,750
that I'd like to go in the future with

253
00:10:04,240 --> 00:10:01,880
this project but to wrap up I'd just

254
00:10:06,400 --> 00:10:04,250
like to think like my sponsors and my

255
00:10:12,410 --> 00:10:06,410
home department and I'll take any

256
00:10:15,500 --> 00:10:14,340
you know we have time for a few

257
00:10:18,510 --> 00:10:15,510
questions

258
00:10:20,220 --> 00:10:18,520
hi Herman Martinez from the University

259
00:10:21,990 --> 00:10:20,230
of Michigan a very interesting

260
00:10:24,360 --> 00:10:22,000
presentation thank you very much for

261
00:10:27,060 --> 00:10:24,370
that I was wondering about the Mars

262
00:10:29,610 --> 00:10:27,070
analog soil that you that you'd used

263
00:10:32,220 --> 00:10:29,620

where did you get it from exactly or

264
00:10:34,830 --> 00:10:32,230
have you do you have details on that one

265
00:10:39,000 --> 00:10:34,840
yes you can actually buy it online it's

266
00:10:40,110 --> 00:10:39,010
that uh it is Mars Mojave simulant I

267
00:10:41,040 --> 00:10:40,120
bought this one name in soil it's

268
00:10:43,140 --> 00:10:41,050
Martian Gardens

269
00:10:48,420 --> 00:10:43,150
namely Mojave yes yes thank you very

270
00:10:50,820 --> 00:10:48,430
much Alex Paul of NASA gloried so when

271
00:10:55,950 --> 00:10:50,830
you did this experiment when you put

272
00:10:57,980 --> 00:10:55,960
both soil perchlorate and another

273
00:11:00,810 --> 00:10:57,990
solution with no one activity together

274
00:11:03,210 --> 00:11:00,820
how big are those samples whenever you

275
00:11:05,790 --> 00:11:03,220
put with what you try to equilibrate so

276
00:11:07,620 --> 00:11:05,800
the soil sample is about half a gram yes

277
00:11:09,450 --> 00:11:07,630
they're they're pretty small okay

278
00:11:11,790 --> 00:11:09,460
because concern was whenever I do

279
00:11:13,290 --> 00:11:11,800
experiments with quarries is that you

280
00:11:14,970 --> 00:11:13,300
can form like a crust

281
00:11:17,610 --> 00:11:14,980
you know whenever you know a particular

282
00:11:19,050 --> 00:11:17,620
pressure so it can be deceptiveness but

283
00:11:26,430 --> 00:11:19,060
you know at Papa Graham it's probably

284
00:11:28,980 --> 00:11:26,440
not the fact mm-hmm Jennifer Hanley low

285
00:11:32,130 --> 00:11:28,990
observatory can you explain again how

286
00:11:37,260 --> 00:11:32,140
you determine the activity water in your

287
00:11:41,070 --> 00:11:37,270
soil plus salt plus water one got it

288
00:11:42,120 --> 00:11:41,080

from the water plus salt one can just

289
00:11:44,520 --> 00:11:42,130
explain like made me go back to that

290
00:11:46,620 --> 00:11:44,530
slide and explain again please sure I

291
00:11:48,450 --> 00:11:46,630
don't want to go too far back but

292
00:11:50,820 --> 00:11:48,460
there's there's an equation to calculate

293
00:11:52,680 --> 00:11:50,830
it so we weighed the sample before

294
00:11:54,510 --> 00:11:52,690
calibration and after collaboration so

295
00:11:57,510 --> 00:11:54,520
we can know precisely how much water is

296
00:11:58,890 --> 00:11:57,520
in each sample and from that amount of

297
00:12:00,690 --> 00:11:58,900
water you can back out the brine

298
00:12:04,500 --> 00:12:00,700
concentration and use that to calculate

299
00:12:06,630 --> 00:12:04,510
water so your how's the water getting in

300
00:12:11,090 --> 00:12:06,640
there it's exchanged through water

301
00:12:14,370 --> 00:12:11,100
vapour okay okay

302
00:12:17,430 --> 00:12:14,380
David Stillman's very similar kind of

303
00:12:20,550 --> 00:12:17,440
question how much water do you have in

304
00:12:22,350 --> 00:12:20,560
this one weight percent sample like did

305
00:12:25,500 --> 00:12:22,360
you start with a known amount or a

306
00:12:28,170 --> 00:12:25,510
because yeah are you daily

307
00:12:30,330 --> 00:12:28,180
singing it in and then waiting and then

308
00:12:32,550 --> 00:12:30,340
making the water activity measurement

309
00:12:35,220 --> 00:12:32,560
sure so we start with perfectly dry soil

310
00:12:39,570 --> 00:12:35,230
we dehydrate it and treat it with a

311
00:12:43,040 --> 00:12:39,580
magnesium solution and then add we

312
00:12:46,320 --> 00:12:43,050
pipette in magnesium perchlorate brine

313
00:12:53,070 --> 00:12:46,330

and then allowed to equilibrate at a

314
00:12:56,240 --> 00:12:53,080
water activity all right and I've won -

315
00:13:00,540 --> 00:12:56,250
and I'm gonna pile on top of that but

316
00:13:02,270 --> 00:13:00,550
yeah and I get your process but it's all

317
00:13:04,860 --> 00:13:02,280
based on the mass balance

318
00:13:05,510 --> 00:13:04,870
have you taken into account that

319
00:13:07,740 --> 00:13:05,520
sorption

320
00:13:09,870 --> 00:13:07,750
because if you start from a perfectly

321
00:13:11,670 --> 00:13:09,880
dry so you're gonna probably adds up a

322
00:13:13,740 --> 00:13:11,680
significant amount of water and you have

323
00:13:16,410 --> 00:13:13,750
only one weight percent of perchlorate

324
00:13:20,070 --> 00:13:16,420
so it's really small so if you want to

325
00:13:22,410 --> 00:13:20,080
make sure that you really estimate

326
00:13:24,240 --> 00:13:22,420
properly the amount of water that goes

327
00:13:26,850 --> 00:13:24,250
in the liquid phase of the back row each

328
00:13:29,880 --> 00:13:26,860
enemy to make the same mass balance on

329
00:13:31,260 --> 00:13:29,890
the dry salt without a fly right yes we

330
00:13:32,640 --> 00:13:31,270
have done knowledge not include the

331
00:13:34,410 --> 00:13:32,650
results in this in this presentation

332
00:13:36,570 --> 00:13:34,420
yeah we did we did the same experiment

333
00:13:39,780 --> 00:13:36,580
without perchlorates just a soil sample

334
00:13:46,790 --> 00:13:39,790
to see the effect of adsorption when I

335
00:13:50,280 --> 00:13:46,800
salts do we have any other question no

336
00:13:51,960 --> 00:13:50,290
did those freeze if it was just absorb

337
00:13:55,650 --> 00:13:51,970
water cuz I would expect it wouldn't

338
00:13:57,840 --> 00:13:55,660

freeze we did not put those through the

339
00:13:59,190 --> 00:13:57,850
DSC okay yeah so we didn't measure the

340
00:14:04,410 --> 00:13:59,200
phase transitions but that's a very good

341
00:14:08,130 --> 00:14:04,420
interesting feature all right so let's

342
00:14:10,800 --> 00:14:08,140
think again our speaker for the money