1
00:00:08,549 --> 00:00:05,910
good afternoon and welcome to nasa

2
00:00:10,709 --> 00:00:08,559
headquarters in washington d.c i'm steve

3
00:00:12,709 --> 00:00:10,719
cole from the office of communications

4
00:00:15,589 --> 00:00:12,719
we're here today to bring you the latest

5
00:00:16,790 --> 00:00:15,599
findings in nasa's ongoing exploration

6
00:00:18,390 --> 00:00:16,800
of mars

7
00:00:20,870 --> 00:00:18,400
we have been following the water on the

8
00:00:23,189 --> 00:00:20,880
red planet for some time now today's

9
00:00:25,429 --> 00:00:23,199
announcement is going to add a new and

10
00:00:28,150 --> 00:00:25,439
exciting chapter to that voyage of

11
00:00:31,429 --> 00:00:28,160
scientific discovery the new results are

12
00:00:33,430 --> 00:00:31,439
based on observations from nasa's mars

13
00:00:35,910 --> 00:00:33,440

reconnaissance orbiter

14
00:00:38,389 --> 00:00:35,920
today we have five experts from

15
00:00:40,069 --> 00:00:38,399
five mars experts to tell you more about

16
00:00:42,869 --> 00:00:40,079
this new finding

17
00:00:44,950 --> 00:00:42,879
the first speaker will be michael meyer

18
00:00:46,790 --> 00:00:44,960
who is the lead scientist for the mars

19
00:00:48,470 --> 00:00:46,800
exploration program here at nasa

20
00:00:50,389 --> 00:00:48,480
headquarters

21
00:00:52,950 --> 00:00:50,399
alfred mcewen from the university of

22
00:00:55,670 --> 00:00:52,960
arizona who is the lead author of the

23
00:00:57,670 --> 00:00:55,680
paper being published today in science

24
00:01:00,310 --> 00:00:57,680
and principal investigator of the

25
00:01:02,069 --> 00:01:00,320
high-rise instrument on the orbiter the

26
00:01:04,149 --> 00:01:02,079
high-resolution imaging science

27
00:01:06,870 --> 00:01:04,159
experiment

28
00:01:08,870 --> 00:01:06,880
our third speaker is colin dundas also a

29
00:01:11,350 --> 00:01:08,880
co-author on the science paper a

30
00:01:13,109 --> 00:01:11,360
research geologist from the u.s

31
00:01:15,590 --> 00:01:13,119
geological survey

32
00:01:17,350 --> 00:01:15,600
in flagstaff arizona

33
00:01:20,310 --> 00:01:17,360
providing a broader perspective on the

34
00:01:22,550 --> 00:01:20,320
new findings will be philip christensen

35
00:01:23,830 --> 00:01:22,560
a geophysicist from arizona state

36
00:01:25,510 --> 00:01:23,840
university

37
00:01:29,030 --> 00:01:25,520
and lisa pratt

38
00:01:31,030 --> 00:01:29,040

a bio geochemist from indiana university

39
00:01:33,190 --> 00:01:31,040
after our panelist presentations we'll

40
00:01:36,149 --> 00:01:33,200
take questions from the press here in

41
00:01:38,310 --> 00:01:36,159
the auditorium and on the phone lines

42
00:01:41,190 --> 00:01:38,320
so now we can begin our first speaker

43
00:01:43,270 --> 00:01:41,200
michael meyer michael thank you steve

44
00:01:45,510 --> 00:01:43,280
the mars exploration program has a

45
00:01:47,670 --> 00:01:45,520
long-term strategy implemented through

46
00:01:50,469 --> 00:01:47,680
orbiters and landers to determine the

47
00:01:51,990 --> 00:01:50,479
planet's potential for life past present

48
00:01:53,590 --> 00:01:52,000
or future

49
00:01:56,310 --> 00:01:53,600
and along this line

50
00:01:58,630 --> 00:01:56,320
we followed the overarching theme of

51
00:02:01,350 --> 00:01:58,640
follow the water because water plays a

52
00:02:02,709 --> 00:02:01,360
major role in geological processes and

53
00:02:05,190 --> 00:02:02,719
climate

54
00:02:07,510 --> 00:02:05,200
in future human exploration and in the

55
00:02:09,430 --> 00:02:07,520
potential for life

56
00:02:11,750 --> 00:02:09,440
what we found on earth is if there's

57
00:02:13,110 --> 00:02:11,760
life there's if there's water there's

58
00:02:15,510 --> 00:02:13,120
life

59
00:02:17,030 --> 00:02:15,520
and this is true for mars

60
00:02:18,869 --> 00:02:17,040
the marsh reconnaissance orbiter has

61
00:02:22,869 --> 00:02:18,879
been a critical piece in our long-term

62
00:02:24,790 --> 00:02:22,879
strategy launched in august of 2005 is

63
00:02:26,630 --> 00:02:24,800

been in the work in orbit around mars

64
00:02:27,670 --> 00:02:26,640
since 2006

65
00:02:30,550 --> 00:02:27,680
and has

66
00:02:32,470 --> 00:02:30,560
imaged the planet in high spectral and

67
00:02:34,550 --> 00:02:32,480
spatial resolution

68
00:02:37,990 --> 00:02:34,560
in its extended mission has already

69
00:02:41,910 --> 00:02:38,000
collected an unprecedented 17.5

70
00:02:47,110 --> 00:02:44,390
and it is really pointed away to future

71
00:02:48,550 --> 00:02:47,120
landing sites it served as a relay for

72
00:02:51,430 --> 00:02:48,560
landed assets

73
00:02:53,750 --> 00:02:51,440
and also as image given a spectacular

74
00:02:57,670 --> 00:02:53,760
images of the red planet

75
00:02:59,110 --> 00:02:57,680
and mro and the program have found water

76
00:03:01,350 --> 00:02:59,120
in the form of

77
00:03:04,390 --> 00:03:01,360
ancient banks on rivers

78
00:03:06,949 --> 00:03:04,400
shorelines of long gone lakes

79
00:03:10,309 --> 00:03:06,959
minerals that form in water

80
00:03:12,710 --> 00:03:10,319
abundant water ice and polar areas

81
00:03:16,630 --> 00:03:12,720
near surface ice in the mid latitudes

82
00:03:17,430 --> 00:03:16,640
exposed in fresh like fresh craters

83
00:03:19,589 --> 00:03:17,440
and

84
00:03:24,789 --> 00:03:19,599
all very promising

85
00:03:28,630 --> 00:03:26,869
today we're going to hear about one of

86
00:03:32,309 --> 00:03:28,640
the benefits of having a long-term

87
00:03:34,470 --> 00:03:32,319
program catching mars and the act we

88
00:03:36,949 --> 00:03:34,480

have followed the water

89
00:03:38,470 --> 00:03:36,959
and we have found

90
00:03:40,630 --> 00:03:38,480
repeated

91
00:03:42,710 --> 00:03:40,640
and predictable evidence suggesting

92
00:03:44,470 --> 00:03:42,720
water flowing on mars

93
00:03:46,309 --> 00:03:44,480
and to tell us more about that i'm

94
00:03:48,470 --> 00:03:46,319
turning to the principal investigator of

95
00:03:49,990 --> 00:03:48,480
highrise alfred mcewen

96
00:03:51,430 --> 00:03:50,000
thank you michael

97
00:03:53,509 --> 00:03:51,440
so we have been

98
00:03:56,390 --> 00:03:53,519
observing mars with highrise for two and

99
00:03:57,830 --> 00:03:56,400
a half mars years now and one of our

100
00:04:00,229 --> 00:03:57,840
highest priorities has been to

101
00:04:02,390 --> 00:04:00,239
understand active mars changes on the

102
00:04:04,789 --> 00:04:02,400
surface today and we've seen lots of

103
00:04:06,630 --> 00:04:04,799
interesting things new impact craters

104
00:04:09,190 --> 00:04:06,640
dust avalanches

105
00:04:11,670 --> 00:04:09,200
sand bodies shifting

106
00:04:13,910 --> 00:04:11,680
in the polar regions associated with the

107
00:04:16,390 --> 00:04:13,920
seasonal co2 frost we see a whole suite

108
00:04:18,949 --> 00:04:16,400
of bizarre phenomenon

109
00:04:21,670 --> 00:04:18,959
none of these however seem to suggest or

110
00:04:24,070 --> 00:04:21,680
require liquid water in any way

111
00:04:25,670 --> 00:04:24,080
until recently we found found something

112
00:04:26,870 --> 00:04:25,680
that had slipped our attention

113
00:04:28,870 --> 00:04:26,880

previously

114
00:04:30,150 --> 00:04:28,880
that is is quite different from all this

115
00:04:32,950 --> 00:04:30,160
other activity in terms of the

116
00:04:35,030 --> 00:04:32,960
particular environmental requirements

117
00:04:37,030 --> 00:04:35,040
and its behavior

118
00:04:38,870 --> 00:04:37,040
why don't we start the the video as i

119
00:04:41,030 --> 00:04:38,880
describe these in more detail so you can

120
00:04:43,430 --> 00:04:41,040
see this for yourself here's a globe of

121
00:04:44,390 --> 00:04:43,440
mars and we're going to zoom in

122
00:04:46,550 --> 00:04:44,400
on the

123
00:04:49,189 --> 00:04:46,560
southern mid-latitude which is where we

124
00:04:51,590 --> 00:04:49,199
find these features

125
00:04:53,909 --> 00:04:51,600
this big crater there is newton crater

126
00:04:58,629 --> 00:04:53,919
and

127
00:05:00,870 --> 00:04:58,639
there's a crater on its floor

128
00:05:03,110 --> 00:05:00,880
there's the high-rise field of view so

129
00:05:06,230 --> 00:05:03,120
we'll zoom in on that

130
00:05:08,150 --> 00:05:06,240
high-rise images that point at 25

131
00:05:10,550 --> 00:05:08,160
centimeters per pixel so we get very

132
00:05:11,590 --> 00:05:10,560
high resolution so what we're going to

133
00:05:14,790 --> 00:05:11,600
see here

134
00:05:17,270 --> 00:05:14,800
is a time sequence with images taken

135
00:05:18,950 --> 00:05:17,280
weeks to months apart in time cycling

136
00:05:20,870 --> 00:05:18,960
through the year with emphasis on the

137
00:05:21,909 --> 00:05:20,880
late spring and summer

138
00:05:23,990 --> 00:05:21,919

period

139
00:05:28,950 --> 00:05:24,000
so the slope features they're in the

140
00:05:33,830 --> 00:05:31,909
start to form in the late spring

141
00:05:36,710 --> 00:05:33,840
there's the winter time there's early

142
00:05:39,590 --> 00:05:36,720
late spring early summer mid-summer

143
00:05:41,110 --> 00:05:39,600
late summer later summer back to early

144
00:05:45,110 --> 00:05:41,120
spring

145
00:05:47,029 --> 00:05:45,120
and so these form and and grow they

146
00:05:49,350 --> 00:05:47,039
darken

147
00:05:52,710 --> 00:05:49,360
some of them start fading while new

148
00:05:54,710 --> 00:05:52,720
liniments are forming and growing still

149
00:05:58,469 --> 00:05:54,720
eventually they all fade

150
00:06:01,029 --> 00:05:58,479
and eventually they completely disappear

151
00:06:03,270 --> 00:06:01,039
as you can see as we scroll to the north

152
00:06:05,990 --> 00:06:03,280
here there's a very large number of

153
00:06:07,830 --> 00:06:06,000
these flows we estimate about a thousand

154
00:06:09,909 --> 00:06:07,840
of these individual flows in this just

155
00:06:11,990 --> 00:06:09,919
this one crater

156
00:06:14,150 --> 00:06:12,000
however these are actually rare the

157
00:06:16,230 --> 00:06:14,160
sites where we find these are rare we

158
00:06:19,189 --> 00:06:16,240
have found seven confirmed sites and

159
00:06:23,350 --> 00:06:19,199
about 20 candidates that we haven't

160
00:06:27,350 --> 00:06:25,189
something else you can see here sort of

161
00:06:29,029 --> 00:06:27,360
on the right side is where these dark

162
00:06:30,870 --> 00:06:29,039
flows terminate

163
00:06:33,830 --> 00:06:30,880

there is a bright there are bright

164
00:06:36,309 --> 00:06:33,840
smooth areas and that appears to be some

165
00:06:40,390 --> 00:06:36,319
sort of deposit or residue left behind

166
00:06:44,790 --> 00:06:42,790
okay so in the next video that we'll go

167
00:06:47,029 --> 00:06:44,800
right to it we'll show the same uh

168
00:06:50,950 --> 00:06:47,039
crater again but this time we'll show a

169
00:06:53,990 --> 00:06:50,960
3d view of the crater flyover movie and

170
00:06:55,749 --> 00:06:54,000
this time the jpl visualization wizards

171
00:06:58,150 --> 00:06:55,759
have outdone themselves and will show

172
00:06:59,589 --> 00:06:58,160
the time sequence as we fly by in three

173
00:07:02,230 --> 00:06:59,599
dimensions

174
00:07:04,230 --> 00:07:02,240
so here we are zooming in on the crater

175
00:07:07,029 --> 00:07:04,240
this is no vertical exaggeration these

176
00:07:09,670 --> 00:07:07,039
are really steep slopes about 35 degree

177
00:07:15,110 --> 00:07:11,510
these dark flows

178
00:07:16,629 --> 00:07:15,120
appear to emanate from bedrock outcrops

179
00:07:18,870 --> 00:07:16,639
sometimes in places we see them

180
00:07:21,670 --> 00:07:18,880
emanating from rocky slopes where we can

181
00:07:27,430 --> 00:07:21,680
infer shallow bedrock so there is some

182
00:07:32,070 --> 00:07:29,350
now we see these in the there are

183
00:07:33,350 --> 00:07:32,080
several characteristics of of these

184
00:07:35,670 --> 00:07:33,360
sites

185
00:07:37,589 --> 00:07:35,680
that suggest to us that a volatile

186
00:07:39,189 --> 00:07:37,599
material of some sort is involved in

187
00:07:40,710 --> 00:07:39,199
this activity

188
00:07:44,390 --> 00:07:40,720

first they're concentrating the middle

189
00:07:46,070 --> 00:07:44,400
latitudes uh where volatiles might be

190
00:07:48,230 --> 00:07:46,080
more likely to be found

191
00:07:50,070 --> 00:07:48,240
but they also require warm temperatures

192
00:07:51,670 --> 00:07:50,080
so the equator facing slopes in the

193
00:07:53,510 --> 00:07:51,680
mid-latitude especially southern

194
00:07:57,270 --> 00:07:53,520
mid-latitude is the intersection of

195
00:08:02,070 --> 00:07:59,990
and we see these grow incrementally and

196
00:08:05,270 --> 00:08:02,080
fade so all of these behaviors suggest

197
00:08:07,670 --> 00:08:05,280
some sort of volatile material to us

198
00:08:09,670 --> 00:08:07,680
we have one more video here in which we

199
00:08:11,029 --> 00:08:09,680
will look at a particular site of

200
00:08:13,749 --> 00:08:11,039
interest

201
00:08:15,990 --> 00:08:13,759
where

202
00:08:17,189 --> 00:08:16,000
in the southern mid-latitudes on another

203
00:08:18,790 --> 00:08:17,199
crater floor

204
00:08:21,029 --> 00:08:18,800
but this is the one site where we've

205
00:08:24,790 --> 00:08:21,039
observed this activity in

206
00:08:27,830 --> 00:08:24,800
three subsequent martian uh summers so

207
00:08:29,909 --> 00:08:27,840
they definitely repeat every year not

208
00:08:32,469 --> 00:08:29,919
exactly in the same place they may be

209
00:08:34,389 --> 00:08:32,479
more or less active from year to year

210
00:08:36,550 --> 00:08:34,399
this goes by kind of fast but there's

211
00:08:40,870 --> 00:08:36,560
actually three mars summers mixed into

212
00:08:43,029 --> 00:08:40,880
the sequence here as we scroll along

213
00:08:45,509 --> 00:08:43,039

so as i was saying we suspect a volatile

214
00:08:47,829 --> 00:08:45,519
material these slopes are far too warm

215
00:08:50,550 --> 00:08:47,839
for carbon dioxide frost

216
00:08:51,829 --> 00:08:50,560
we have phil's themis instrument on mars

217
00:08:53,990 --> 00:08:51,839
odyssey

218
00:08:55,829 --> 00:08:54,000
to measure the temperatures and we we

219
00:08:57,590 --> 00:08:55,839
measure these temperatures on the 100

220
00:09:01,030 --> 00:08:57,600
meter scale to be from

221
00:09:03,430 --> 00:09:01,040
about minus 23 to plus 27 centigrade

222
00:09:04,470 --> 00:09:03,440
which is minus 10 to plus

223
00:09:06,550 --> 00:09:04,480
80

224
00:09:08,710 --> 00:09:06,560
fahrenheit

225
00:09:10,710 --> 00:09:08,720
so these are temperatures appropriate

226
00:09:13,190 --> 00:09:10,720
for well those above freezing are

227
00:09:16,310 --> 00:09:13,200
appropriate for even pure water

228
00:09:18,949 --> 00:09:16,320
but uh we expect water on mars to be

229
00:09:21,190 --> 00:09:18,959
briny to be salty because we know that

230
00:09:23,509 --> 00:09:21,200
the surface is salty from

231
00:09:25,269 --> 00:09:23,519
all of the past landers and rovers from

232
00:09:27,269 --> 00:09:25,279
martian meteorites from orbital remote

233
00:09:29,509 --> 00:09:27,279
sensing so any water that flows in the

234
00:09:30,550 --> 00:09:29,519
subsurface or surface is going to get

235
00:09:32,949 --> 00:09:30,560
salty

236
00:09:35,110 --> 00:09:32,959
furthermore the salt serves to depress

237
00:09:36,710 --> 00:09:35,120
the freezing point of the water so

238
00:09:38,790 --> 00:09:36,720

in places where it's below freezing and

239
00:09:43,670 --> 00:09:38,800
we see this activity it is still

240
00:09:48,550 --> 00:09:45,910
now so we have this circumstantial

241
00:09:51,190 --> 00:09:48,560
evidence for for water flowing on mars

242
00:09:53,670 --> 00:09:51,200
we have no direct detection of water

243
00:09:55,350 --> 00:09:53,680
there is an instrument on mro called the

244
00:09:58,310 --> 00:09:55,360
compact reconnaissance imaging

245
00:09:59,829 --> 00:09:58,320
spectrometer for mars chrism

246
00:10:03,030 --> 00:09:59,839
which acquires

247
00:10:06,710 --> 00:10:03,040
spectra in many wavelengths

248
00:10:09,269 --> 00:10:06,720
at a maximum a a best scale of about 18

249
00:10:12,630 --> 00:10:09,279
meters per pixel these features are one

250
00:10:13,670 --> 00:10:12,640
to a few uh meters wide

251
00:10:14,470 --> 00:10:13,680
so

252
00:10:16,949 --> 00:10:14,480
uh

253
00:10:20,310 --> 00:10:16,959
they're not fully resolved and they do

254
00:10:21,269 --> 00:10:20,320
not see chrism does not see water

255
00:10:23,990 --> 00:10:21,279
now

256
00:10:25,910 --> 00:10:24,000
we suspect that there is water present

257
00:10:27,910 --> 00:10:25,920
at the surface only in small areas for

258
00:10:30,710 --> 00:10:27,920
short periods of time which would be

259
00:10:32,389 --> 00:10:30,720
consistent with the chrism data

260
00:10:33,829 --> 00:10:32,399
it's important to bear in mind that the

261
00:10:35,509 --> 00:10:33,839
environment of mars is very different

262
00:10:37,190 --> 00:10:35,519
from earth the atmospheric pressure is

263
00:10:39,350 --> 00:10:37,200

less than one percent of that of earth

264
00:10:41,350 --> 00:10:39,360
pure water on these sites at these

265
00:10:42,870 --> 00:10:41,360
temperatures would boil

266
00:10:46,389 --> 00:10:42,880
in spite of it being well below the

267
00:10:48,470 --> 00:10:46,399
boiling point at one bar on earth

268
00:10:52,310 --> 00:10:48,480
now salty water probably doesn't boil

269
00:10:54,870 --> 00:10:52,320
but it still evaporates very rapidly so

270
00:10:57,269 --> 00:10:54,880
we think we can explain that away but

271
00:10:59,590 --> 00:10:57,279
nevertheless we lack that direct

272
00:11:01,829 --> 00:10:59,600
confirmation of water so

273
00:11:04,790 --> 00:11:01,839
how can we understand these for sure how

274
00:11:06,389 --> 00:11:04,800
can we confirm what these are

275
00:11:08,710 --> 00:11:06,399
what we'll be doing is continuing to

276
00:11:10,150 --> 00:11:08,720
acquire mro observations to to

277
00:11:12,870 --> 00:11:10,160
understand all the observational

278
00:11:15,670 --> 00:11:12,880
constraints especially the extremes of

279
00:11:17,829 --> 00:11:15,680
temperature and latitude and season

280
00:11:19,910 --> 00:11:17,839
and then i think it's laboratory

281
00:11:22,310 --> 00:11:19,920
experiments that are really going to

282
00:11:24,230 --> 00:11:22,320
provide some the next major step forward

283
00:11:25,590 --> 00:11:24,240
in understanding these these are small

284
00:11:27,110 --> 00:11:25,600
scale features

285
00:11:29,910 --> 00:11:27,120
so you can simulate these in the

286
00:11:31,030 --> 00:11:29,920
laboratory at only a factor of 10 or a

287
00:11:32,870 --> 00:11:31,040
little more

288
00:11:34,870 --> 00:11:32,880

reduced scale

289
00:11:37,110 --> 00:11:34,880
that's much better than you can do with

290
00:11:38,470 --> 00:11:37,120
many geologic processes like earthquakes

291
00:11:42,069 --> 00:11:38,480
where it's

292
00:11:44,069 --> 00:11:42,079
many factors of 10 a difference in scale

293
00:11:45,670 --> 00:11:44,079
and and controlling the atmospheric

294
00:11:47,750 --> 00:11:45,680
pressure and temperatures to mars-like

295
00:11:49,269 --> 00:11:47,760
conditions is is quite possible there's

296
00:11:53,110 --> 00:11:49,279
quite a number of labs around this

297
00:11:54,550 --> 00:11:53,120
country and europe that can do this

298
00:11:57,750 --> 00:11:54,560
furthermore there are future missions

299
00:11:59,910 --> 00:11:57,760
coming the trace gas orbiter from 2016

300
00:12:01,509 --> 00:11:59,920
might acquire some interesting

301
00:12:03,990 --> 00:12:01,519
observations and we're currently

302
00:12:05,590 --> 00:12:04,000
discussing what it might see

303
00:12:08,629 --> 00:12:05,600
and there's always a possibility of

304
00:12:12,069 --> 00:12:08,639
future landers and rovers

305
00:12:14,710 --> 00:12:12,079
now uh we see these uh we've heard about

306
00:12:16,870 --> 00:12:14,720
the gullies on mars previously and these

307
00:12:18,550 --> 00:12:16,880
uh flows are associated with small

308
00:12:20,310 --> 00:12:18,560
channels in some place so what is the

309
00:12:23,110 --> 00:12:20,320
relationship between these features and

310
00:12:25,110 --> 00:12:23,120
flows to address that in more detail

311
00:12:26,870 --> 00:12:25,120
we'll turn to colin

312
00:12:29,190 --> 00:12:26,880
thanks alfred uh

313
00:12:31,269 --> 00:12:29,200

i'm going to talk a bit about martian

314
00:12:32,870 --> 00:12:31,279
gullies and their activity and how they

315
00:12:34,629 --> 00:12:32,880
compare with these dark flows that we're

316
00:12:37,990 --> 00:12:34,639
talking about today

317
00:12:40,230 --> 00:12:38,000
i if i could have the first slide

318
00:12:43,030 --> 00:12:40,240
gullies have been discussed frequently

319
00:12:45,190 --> 00:12:43,040
as evidence for water on mars

320
00:12:47,590 --> 00:12:45,200
this is an image of a crater in the

321
00:12:49,670 --> 00:12:47,600
southern mid-latitudes where you can see

322
00:12:51,430 --> 00:12:49,680
a number of gullies on the

323
00:12:52,790 --> 00:12:51,440
near the top of the image on the pole

324
00:12:54,790 --> 00:12:52,800
facing slope

325
00:12:56,310 --> 00:12:54,800
and the upper arrow is indicating one

326
00:12:57,269 --> 00:12:56,320
gully that i'll talk about a bit more

327
00:12:58,790 --> 00:12:57,279
later

328
00:13:00,710 --> 00:12:58,800
this is also a site where we've seen

329
00:13:02,629 --> 00:13:00,720
these dark flows the lower arrow

330
00:13:04,470 --> 00:13:02,639
indicates a site that i'll talk about

331
00:13:06,389 --> 00:13:04,480
where those are present

332
00:13:08,470 --> 00:13:06,399
so gullies have been discussed quite a

333
00:13:10,629 --> 00:13:08,480
bit as evidence for water on mars if i

334
00:13:13,430 --> 00:13:10,639
could have the next slide

335
00:13:15,590 --> 00:13:13,440
uh these tend to uh consist of an upper

336
00:13:17,670 --> 00:13:15,600
alcove feeding into a channel and then

337
00:13:20,230 --> 00:13:17,680
ultimately an apron and they look very

338
00:13:21,829 --> 00:13:20,240

much like water carved features on earth

339
00:13:23,509 --> 00:13:21,839
and these were first reported about 10

340
00:13:25,430 --> 00:13:23,519
years ago and since then there's been

341
00:13:27,030 --> 00:13:25,440
quite a bit of discussion about

342
00:13:28,470 --> 00:13:27,040
various processes that might have been

343
00:13:30,629 --> 00:13:28,480
involved in forming these but mostly

344
00:13:32,629 --> 00:13:30,639
centered around liquid water

345
00:13:34,790 --> 00:13:32,639
with highrise we've been very interested

346
00:13:37,190 --> 00:13:34,800
to learn more about these and we've been

347
00:13:38,949 --> 00:13:37,200
monitoring a number of gully sites as

348
00:13:40,790 --> 00:13:38,959
the context camera

349
00:13:42,310 --> 00:13:40,800
looking for changes

350
00:13:44,150 --> 00:13:42,320
uh we've

351
00:13:45,350 --> 00:13:44,160
i've seen a number of gullies that have

352
00:13:48,470 --> 00:13:45,360
been active

353
00:13:50,389 --> 00:13:48,480
and if i could have the next slide

354
00:13:52,550 --> 00:13:50,399
this is an example comparing this in the

355
00:13:54,230 --> 00:13:52,560
next image if you look at the lower left

356
00:13:56,389 --> 00:13:54,240
you'll see near the toe of a gully

357
00:13:58,310 --> 00:13:56,399
channel a dark deposit forms

358
00:14:00,310 --> 00:13:58,320
and we've seen a range of different

359
00:14:01,269 --> 00:14:00,320
activity in gullies

360
00:14:03,509 --> 00:14:01,279
but

361
00:14:06,150 --> 00:14:03,519
we've also seen a tendency uh given the

362
00:14:07,990 --> 00:14:06,160
timing constraints for this activity uh

363
00:14:09,910 --> 00:14:08,000

to occur in the colder times of year in

364
00:14:11,990 --> 00:14:09,920
fact for some of the best constrained

365
00:14:14,230 --> 00:14:12,000
events it tends to be in the winter

366
00:14:16,230 --> 00:14:14,240
and gullies in the martian mid-latitudes

367
00:14:18,069 --> 00:14:16,240
tend to be on pole facing slopes which

368
00:14:21,189 --> 00:14:18,079
are cold and especially cold in the

369
00:14:24,389 --> 00:14:21,199
winter when carbon dioxide frost forms

370
00:14:26,790 --> 00:14:24,399
so these gully activity is quite

371
00:14:28,389 --> 00:14:26,800
distinct from what we see in this slope

372
00:14:30,389 --> 00:14:28,399
linear

373
00:14:32,870 --> 00:14:30,399
if i could have the next slide

374
00:14:34,710 --> 00:14:32,880
uh this is again the same site that

375
00:14:37,110 --> 00:14:34,720
alfred showed in his third movie uh this

376
00:14:38,949 --> 00:14:37,120
is an example of slope linear in the

377
00:14:41,110 --> 00:14:38,959
same crater uh where

378
00:14:42,629 --> 00:14:41,120
that active gully that i just showed is

379
00:14:44,710 --> 00:14:42,639
present

380
00:14:46,389 --> 00:14:44,720
the activity is uh quite distinct the

381
00:14:48,150 --> 00:14:46,399
gullies are tend to be on the pole

382
00:14:51,509 --> 00:14:48,160
facing slopes tend to be active in the

383
00:14:53,509 --> 00:14:51,519
winter and tend to be single events uh

384
00:14:55,750 --> 00:14:53,519
but sometimes at a much larger scale

385
00:14:57,670 --> 00:14:55,760
than what we observe with these flows

386
00:15:00,790 --> 00:14:57,680
uh the scale of gullies can be a

387
00:15:02,389 --> 00:15:00,800
kilometer scale and we see in some cases

388
00:15:03,509 --> 00:15:02,399

quite significant

389
00:15:06,790 --> 00:15:03,519
changes

390
00:15:08,389 --> 00:15:06,800
uh whereas with these smaller dark flows

391
00:15:10,949 --> 00:15:08,399
these tend to be on equator facing

392
00:15:12,870 --> 00:15:10,959
warmer slopes active in the summer

393
00:15:13,829 --> 00:15:12,880
and they tend the individual

394
00:15:15,509 --> 00:15:13,839
flows

395
00:15:18,230 --> 00:15:15,519
tend to be much smaller

396
00:15:20,949 --> 00:15:18,240
and they're so far not associated with

397
00:15:22,389 --> 00:15:20,959
any visible changes to the topography as

398
00:15:23,910 --> 00:15:22,399
you go from year to year things look

399
00:15:25,509 --> 00:15:23,920
about the same

400
00:15:26,949 --> 00:15:25,519
these are sometimes associated with

401
00:15:29,590 --> 00:15:26,959
small channels

402
00:15:31,110 --> 00:15:29,600
uh but not with in most cases not with

403
00:15:33,350 --> 00:15:31,120
the larger gullies that have been talked

404
00:15:34,550 --> 00:15:33,360
about quite a bit previously

405
00:15:36,389 --> 00:15:34,560
so we've got

406
00:15:37,990 --> 00:15:36,399
two interesting and different types of

407
00:15:40,550 --> 00:15:38,000
activity here but these dark flows that

408
00:15:42,389 --> 00:15:40,560
we're talking about today are fairly

409
00:15:43,509 --> 00:15:42,399
distinct from the larger scale gully

410
00:15:46,710 --> 00:15:43,519
activity

411
00:15:48,389 --> 00:15:46,720
that in the previously reported gullies

412
00:15:50,710 --> 00:15:48,399
so with that i'll pass things along to

413
00:15:52,389 --> 00:15:50,720

phil christensen for a larger scale view

414
00:15:55,269 --> 00:15:52,399
of these results

415
00:15:58,069 --> 00:15:55,279
thanks colin uh in the last 15 years

416
00:15:59,749 --> 00:15:58,079
we've certainly discovered that mars has

417
00:16:02,310 --> 00:15:59,759
a lot of water

418
00:16:03,749 --> 00:16:02,320
much of that water is in the form of ice

419
00:16:05,189 --> 00:16:03,759
in the polar regions or the high

420
00:16:06,710 --> 00:16:05,199
latitudes

421
00:16:08,230 --> 00:16:06,720
and at those places

422
00:16:10,949 --> 00:16:08,240
that water is going to be frozen

423
00:16:12,870 --> 00:16:10,959
throughout the year it's just too cold

424
00:16:15,749 --> 00:16:12,880
to ever form a liquid

425
00:16:18,790 --> 00:16:15,759
what makes these new observations so

426
00:16:20,389 --> 00:16:18,800
interesting is that they occur at much

427
00:16:22,470 --> 00:16:20,399
lower latitudes where the temperatures

428
00:16:25,189 --> 00:16:22,480
are much warmer and where it's actually

429
00:16:27,110 --> 00:16:25,199
possible for liquid water

430
00:16:28,790 --> 00:16:27,120
to exist

431
00:16:30,389 --> 00:16:28,800
so to put this in a little bit of a

432
00:16:32,389 --> 00:16:30,399
perspective if we could take a look at

433
00:16:36,710 --> 00:16:32,399
the first slide

434
00:16:38,790 --> 00:16:36,720
what this shows is a global map of mars

435
00:16:41,670 --> 00:16:38,800
from pole to pole

436
00:16:44,550 --> 00:16:41,680
of the mars odyssey neutron spectrometer

437
00:16:46,870 --> 00:16:44,560
data which measures water or hydrogen in

438
00:16:48,870 --> 00:16:46,880

the upper meter of the surface

439
00:16:50,949 --> 00:16:48,880
what that experiment showed was that at

440
00:16:52,790 --> 00:16:50,959
the high latitudes near the poles and

441
00:16:54,230 --> 00:16:52,800
these in this image these blue colors

442
00:16:57,670 --> 00:16:54,240
represent places where there's a

443
00:16:58,949 --> 00:16:57,680
significant amount 70 80 90

444
00:17:00,710 --> 00:16:58,959
of the surface

445
00:17:02,230 --> 00:17:00,720
being ice

446
00:17:03,829 --> 00:17:02,240
so there was never there hasn't been a

447
00:17:07,270 --> 00:17:03,839
question for some time now that there's

448
00:17:08,949 --> 00:17:07,280
ice on mars but it's uh it's a typically

449
00:17:11,029 --> 00:17:08,959
very high latitudes

450
00:17:14,309 --> 00:17:11,039
the next piece of the story came the

451
00:17:16,710 --> 00:17:14,319
next slide shows some

452
00:17:19,270 --> 00:17:16,720
small impacts where nature has helped us

453
00:17:21,350 --> 00:17:19,280
out to probe a little bit deeper these

454
00:17:23,510 --> 00:17:21,360
are small craters where the impact is

455
00:17:24,470 --> 00:17:23,520
actually exposed water ice onto the

456
00:17:27,669 --> 00:17:24,480
surface

457
00:17:29,909 --> 00:17:27,679
and this extends toward the equator the

458
00:17:32,870 --> 00:17:29,919
regions where we know

459
00:17:34,789 --> 00:17:32,880
ice is present but again these are

460
00:17:36,470 --> 00:17:34,799
fairly high latitudes up you know

461
00:17:38,470 --> 00:17:36,480
northern canada

462
00:17:40,710 --> 00:17:38,480
type of locations

463
00:17:41,750 --> 00:17:40,720

the next slide shows the locations of

464
00:17:43,830 --> 00:17:41,760
these

465
00:17:45,350 --> 00:17:43,840
slope flows that alfred and his team

466
00:17:47,110 --> 00:17:45,360
have discovered

467
00:17:48,870 --> 00:17:47,120
and what we see is these are much closer

468
00:17:50,710 --> 00:17:48,880
to the equator

469
00:17:52,470 --> 00:17:50,720
they're in regions as alfred mentioned

470
00:17:54,070 --> 00:17:52,480
where the surface temperatures are much

471
00:17:56,549 --> 00:17:54,080
warmer

472
00:17:59,669 --> 00:17:56,559
so this is providing even more evidence

473
00:18:02,230 --> 00:17:59,679
that water is closer to the equator than

474
00:18:03,430 --> 00:18:02,240
we thought before and now it's in a zone

475
00:18:04,630 --> 00:18:03,440
where the temperatures are going to

476
00:18:06,150 --> 00:18:04,640
allow that

477
00:18:09,270 --> 00:18:06,160
water to

478
00:18:10,950 --> 00:18:09,280
potentially be uh be liquid at various

479
00:18:13,350 --> 00:18:10,960
times throughout the year

480
00:18:15,190 --> 00:18:13,360
now these mid-latitudes are i think

481
00:18:17,590 --> 00:18:15,200
extremely interesting there's in

482
00:18:19,190 --> 00:18:17,600
addition to these flows and the gullies

483
00:18:21,029 --> 00:18:19,200
we've seen evidence of materials that

484
00:18:23,750 --> 00:18:21,039
looks like it's pasted onto the surface

485
00:18:25,669 --> 00:18:23,760
as if it was a snow or ice deposit

486
00:18:28,070 --> 00:18:25,679
knobby mantle terrains throughout this

487
00:18:29,909 --> 00:18:28,080
region that might be ice that's being uh

488
00:18:32,150 --> 00:18:29,919

that's evaporating

489
00:18:34,630 --> 00:18:32,160
so these mid-latitudes uh are

490
00:18:37,350 --> 00:18:34,640
i think a very interesting place on mars

491
00:18:39,430 --> 00:18:37,360
uh the final slide shows uh mineral

492
00:18:41,430 --> 00:18:39,440
evidence uh alfred mentioned the

493
00:18:44,070 --> 00:18:41,440
possibility that these were salty or

494
00:18:45,510 --> 00:18:44,080
briny flows the red dots there show

495
00:18:47,669 --> 00:18:45,520
places where we

496
00:18:50,390 --> 00:18:47,679
think we have evidence mineral evidence

497
00:18:52,230 --> 00:18:50,400
for actual salt deposits on mars and you

498
00:18:53,909 --> 00:18:52,240
can see there's a very nice correlation

499
00:18:56,470 --> 00:18:53,919
between where these salt deposits are

500
00:18:58,070 --> 00:18:56,480
occurring and where these potentially

501
00:19:00,230 --> 00:18:58,080
briny

502
00:19:01,669 --> 00:19:00,240
surface flows or near surface flows are

503
00:19:04,230 --> 00:19:01,679
occurring

504
00:19:06,070 --> 00:19:04,240
so again a very nice correlation

505
00:19:07,590 --> 00:19:06,080
so in conclusion i would i would argue

506
00:19:09,270 --> 00:19:07,600
that the mid-latitudes really are

507
00:19:11,350 --> 00:19:09,280
turning out to be the place on mars

508
00:19:13,590 --> 00:19:11,360
where a lot of the action is

509
00:19:15,590 --> 00:19:13,600
there are high enough latitudes and cold

510
00:19:17,830 --> 00:19:15,600
enough at times where snow and ice can

511
00:19:20,390 --> 00:19:17,840
accumulate and yet

512
00:19:23,270 --> 00:19:20,400
importantly they're warm enough

513
00:19:24,710 --> 00:19:23,280

at times where liquid water can actually

514
00:19:26,870 --> 00:19:24,720
exist

515
00:19:28,630 --> 00:19:26,880
so for me this is sort of the beginning

516
00:19:31,990 --> 00:19:28,640
of a process the beginning of a

517
00:19:34,070 --> 00:19:32,000
scientific process where

518
00:19:35,430 --> 00:19:34,080
we've just started as alfred mentioned

519
00:19:37,270 --> 00:19:35,440
there's questions regarding these

520
00:19:39,590 --> 00:19:37,280
observations but now the scientific

521
00:19:41,830 --> 00:19:39,600
community can really turn to them and

522
00:19:43,430 --> 00:19:41,840
really begin to probe the details of of

523
00:19:45,750 --> 00:19:43,440
what these observations are telling us

524
00:19:47,270 --> 00:19:45,760
about water on mars

525
00:19:49,990 --> 00:19:47,280
one of the reasons we're interested in

526
00:19:52,950 --> 00:19:50,000
water of course is the potential

527
00:19:55,190 --> 00:19:52,960
relationship to life and here to talk a

528
00:19:56,310 --> 00:19:55,200
little bit more about that is lisa pratt

529
00:19:58,470 --> 00:19:56,320
thanks phil

530
00:20:00,870 --> 00:19:58,480
i am really very pleased to be here

531
00:20:03,990 --> 00:20:00,880
today to comment on this report because

532
00:20:06,070 --> 00:20:04,000
i think this is an eye-opening discovery

533
00:20:08,230 --> 00:20:06,080
that'll really help us begin the

534
00:20:09,669 --> 00:20:08,240
planning process for future missions

535
00:20:12,230 --> 00:20:09,679
specifically

536
00:20:13,350 --> 00:20:12,240
looking for signs of life on present day

537
00:20:15,669 --> 00:20:13,360
mars

538
00:20:18,630 --> 00:20:15,679

we've waited a long time as a community

539
00:20:21,750 --> 00:20:18,640
for a place where we could monitor

540
00:20:24,149 --> 00:20:21,760
processes before during and after some

541
00:20:27,110 --> 00:20:24,159
type of recurrent event that suggested

542
00:20:29,510 --> 00:20:27,120
you might have a brine close enough to

543
00:20:32,230 --> 00:20:29,520
the surface that you might

544
00:20:35,270 --> 00:20:32,240
be able to see evidence of some kind of

545
00:20:37,430 --> 00:20:35,280
a biological process and again the the

546
00:20:39,750 --> 00:20:37,440
difficulty has been that mars is simply

547
00:20:41,990 --> 00:20:39,760
too large a planet to keep an eye on

548
00:20:43,669 --> 00:20:42,000
every place at all times and we've we've

549
00:20:45,510 --> 00:20:43,679
needed a way to really focus our

550
00:20:48,230 --> 00:20:45,520
instruments and think about the

551
00:20:51,510 --> 00:20:48,240
engineering um decisions that need to be

552
00:20:53,510 --> 00:20:51,520
made for future land admissions or for

553
00:20:55,750 --> 00:20:53,520
future orbiting missions and i i really

554
00:20:58,230 --> 00:20:55,760
think we now have it

555
00:21:00,230 --> 00:20:58,240
if we then start to talk about well what

556
00:21:02,549 --> 00:21:00,240
do we know about analog environments on

557
00:21:03,990 --> 00:21:02,559
earth i think we can bring up the last

558
00:21:06,149 --> 00:21:04,000
image here

559
00:21:09,029 --> 00:21:06,159
probably the best analog environments on

560
00:21:11,510 --> 00:21:09,039
earth where we have looked at

561
00:21:14,149 --> 00:21:11,520
the habitability and the specific forms

562
00:21:16,630 --> 00:21:14,159
of life in these permafrost environments

563
00:21:17,830 --> 00:21:16,640

would be the siberian permafrost

564
00:21:20,230 --> 00:21:17,840
we take what we know about that

565
00:21:21,990 --> 00:21:20,240
environment and try to then layer it on

566
00:21:24,950 --> 00:21:22,000
to what we infer about the subsurface of

567
00:21:26,870 --> 00:21:24,960
mars we get this simple cartoon

568
00:21:29,270 --> 00:21:26,880
we think that there might be two ways in

569
00:21:31,270 --> 00:21:29,280
which water could reside

570
00:21:34,470 --> 00:21:31,280
water or brines deeper in the crust

571
00:21:36,230 --> 00:21:34,480
either in a a connected fracture network

572
00:21:37,990 --> 00:21:36,240
like the one you see here on the left in

573
00:21:40,070 --> 00:21:38,000
this image that would

574
00:21:42,390 --> 00:21:40,080
penetrate below the permafrost

575
00:21:44,470 --> 00:21:42,400
potentially into a deep subpermafrost

576
00:21:48,149 --> 00:21:44,480
brine but on the right we can also

577
00:21:51,270 --> 00:21:48,159
imagine that as a result of pockets and

578
00:21:53,590 --> 00:21:51,280
patches of snow and ice we might have

579
00:21:55,830 --> 00:21:53,600
lenses or pockets

580
00:21:58,630 --> 00:21:55,840
in this diagram labeled cryopegs

581
00:22:01,029 --> 00:21:58,640
cryopegs on earth actually refer to

582
00:22:03,350 --> 00:22:01,039
bodies of water that are very cold and

583
00:22:04,870 --> 00:22:03,360
salty and because of their salt content

584
00:22:07,350 --> 00:22:04,880
they remain liquid even though the

585
00:22:10,230 --> 00:22:07,360
surrounding permafrost can be very very

586
00:22:12,390 --> 00:22:10,240
cold you also see in this diagram

587
00:22:15,110 --> 00:22:12,400
conceptually that there there might be a

588
00:22:17,510 --> 00:22:15,120

very thin layer at the top of mars where

589
00:22:19,590 --> 00:22:17,520
if there was seasonally available briny

590
00:22:21,750 --> 00:22:19,600
water you could have some sort of

591
00:22:24,149 --> 00:22:21,760
biological activity in a photic zone you

592
00:22:26,870 --> 00:22:24,159
might actually allow organisms to take

593
00:22:29,590 --> 00:22:26,880
advantage of the energy from sunlight

594
00:22:31,669 --> 00:22:29,600
and below that a slightly thicker active

595
00:22:34,230 --> 00:22:31,679
zone meaning the layer that seasonally

596
00:22:37,190 --> 00:22:34,240
warms up enough to

597
00:22:38,630 --> 00:22:37,200
to melt melt snow or ice and again have

598
00:22:40,950 --> 00:22:38,640
some sort of a brine and then an

599
00:22:45,430 --> 00:22:40,960
underlying permafrost and again very

600
00:22:48,149 --> 00:22:45,440
importantly a deeper subpermafrost brine

601
00:22:50,950 --> 00:22:48,159
so the next big question is to try to

602
00:22:53,430 --> 00:22:50,960
understand the origin and source

603
00:22:55,990 --> 00:22:53,440
of these of these flows that alfred and

604
00:22:57,909 --> 00:22:56,000
his team have inferred on mars to think

605
00:23:00,630 --> 00:22:57,919
about them in terms of whether or not

606
00:23:03,190 --> 00:23:00,640
they might provide a conduit or a

607
00:23:05,430 --> 00:23:03,200
connectivity to a larger deeper brine

608
00:23:07,669 --> 00:23:05,440
pool or if in fact these

609
00:23:09,190 --> 00:23:07,679
these fluids are just isolated patches

610
00:23:11,190 --> 00:23:09,200
and pockets

611
00:23:12,710 --> 00:23:11,200
no matter which it is

612
00:23:14,630 --> 00:23:12,720
as i mentioned before

613
00:23:18,070 --> 00:23:14,640

this is an enormous opportunity for the

614
00:23:20,310 --> 00:23:18,080
scientific community to really begin to

615
00:23:23,029 --> 00:23:20,320
focus on the specific changes that

616
00:23:25,029 --> 00:23:23,039
create the uh the the darkening that's

617
00:23:27,750 --> 00:23:25,039
been reported to try to determine if

618
00:23:29,990 --> 00:23:27,760
that's mineralogical it could be a

619
00:23:32,390 --> 00:23:30,000
hydration it could also be an oxidation

620
00:23:34,310 --> 00:23:32,400
or a reduction it also gives us the

621
00:23:36,070 --> 00:23:34,320
opportunity to focus

622
00:23:39,029 --> 00:23:36,080
future orbiting instruments where we

623
00:23:40,950 --> 00:23:39,039
could look upwind and downwind of those

624
00:23:43,430 --> 00:23:40,960
individual features or that band of

625
00:23:46,230 --> 00:23:43,440
features and look for the possibility of

626
00:23:48,630 --> 00:23:46,240
anomalous releases of either chemically

627
00:23:51,029 --> 00:23:48,640
reduced gases like methane and hydrogen

628
00:23:53,190 --> 00:23:51,039
sulfide or even with the possibility

629
00:23:54,950 --> 00:23:53,200
that this gets a habitable zone up into

630
00:23:57,350 --> 00:23:54,960
the photic region

631
00:23:59,029 --> 00:23:57,360
possibly the release of of an oxidized

632
00:24:01,430 --> 00:23:59,039
gas like oxygen

633
00:24:03,909 --> 00:24:01,440
i really think that this is a very

634
00:24:05,350 --> 00:24:03,919
exciting discovery because it is our

635
00:24:06,710 --> 00:24:05,360
first chance

636
00:24:09,590 --> 00:24:06,720
to see

637
00:24:11,269 --> 00:24:09,600
an environment on mars that might allow

638
00:24:14,149 --> 00:24:11,279

for the expression of an active

639
00:24:16,549 --> 00:24:14,159
biological process if there is present

640
00:24:19,590 --> 00:24:16,559
day life on mars and with that i'll turn

641
00:24:21,669 --> 00:24:19,600
it back to steve okay thank you lisa and

642
00:24:22,789 --> 00:24:21,679
now we'll take questions from the press

643
00:24:24,950 --> 00:24:22,799
we have

644
00:24:26,870 --> 00:24:24,960
questions to begin with at two of our

645
00:24:28,870 --> 00:24:26,880
nasa centers in california starting with

646
00:24:34,789 --> 00:24:28,880
the jet propulsion laboratory please go

647
00:24:38,870 --> 00:24:37,350
yes i know that you mentioned that uh

648
00:24:40,630 --> 00:24:38,880
now the work begins in terms of

649
00:24:43,029 --> 00:24:40,640
identifying the source

650
00:24:45,909 --> 00:24:43,039
of the water but are there any working

651
00:24:49,590 --> 00:24:45,919
theories as to what could possibly be a

652
00:24:51,110 --> 00:24:49,600
source for this uh theoretical water

653
00:24:54,070 --> 00:24:51,120
uh yes

654
00:24:56,149 --> 00:24:54,080
we have too many theories maybe uh

655
00:25:00,149 --> 00:24:56,159
this is a tough question

656
00:25:02,149 --> 00:25:00,159
it could be from carried by gas salts

657
00:25:05,430 --> 00:25:02,159
have this uh interesting property of

658
00:25:07,510 --> 00:25:05,440
actually absorbing moisture from the air

659
00:25:09,750 --> 00:25:07,520
and it could be subsurface

660
00:25:11,909 --> 00:25:09,760
gas flow as well from sublimating ice

661
00:25:14,230 --> 00:25:11,919
bodies for example

662
00:25:15,909 --> 00:25:14,240
the other possibility is that uh similar

663
00:25:17,830 --> 00:25:15,919

to what lisa showed there are actually

664
00:25:20,710 --> 00:25:17,840
pockets of brine

665
00:25:23,269 --> 00:25:20,720
uh in the crust and you know if there

666
00:25:25,350 --> 00:25:23,279
were very concentrated brines associated

667
00:25:27,990 --> 00:25:25,360
even with the those chloride deposits

668
00:25:30,149 --> 00:25:28,000
that phil showed that were quite ancient

669
00:25:32,070 --> 00:25:30,159
that briny water is cold enough to be

670
00:25:34,549 --> 00:25:32,080
stable over geologic time so then you

671
00:25:36,950 --> 00:25:34,559
need some process by which it is is

672
00:25:37,990 --> 00:25:36,960
brought and released to the surface

673
00:25:38,950 --> 00:25:38,000
these

674
00:25:40,789 --> 00:25:38,960
may be

675
00:25:42,630 --> 00:25:40,799
you know low probability sorts of

676
00:25:43,990 --> 00:25:42,640
scenarios but these are also rare

677
00:25:45,590 --> 00:25:44,000
features so

678
00:25:47,830 --> 00:25:45,600
that's where we are now and trying to

679
00:25:49,350 --> 00:25:47,840
understand this

680
00:25:51,350 --> 00:25:49,360
okay thank you uh we have another

681
00:25:54,070 --> 00:25:51,360
question from jpl uh would you please

682
00:25:56,630 --> 00:25:54,080
state your name and affiliation

683
00:26:01,430 --> 00:25:56,640
and go ahead

684
00:26:06,470 --> 00:26:04,310
uh my question is uh how is the mars

685
00:26:08,230 --> 00:26:06,480
rover curiosity able to follow up on

686
00:26:10,870 --> 00:26:08,240
this new information when it when it's

687
00:26:13,510 --> 00:26:10,880
launched to mars

688
00:26:15,750 --> 00:26:13,520

uh well one experiment that has on board

689
00:26:18,470 --> 00:26:15,760
is the tunable laser spectrometer which

690
00:26:20,470 --> 00:26:18,480
can measure among other things methane

691
00:26:22,950 --> 00:26:20,480
so if there actually is methane being

692
00:26:24,710 --> 00:26:22,960
produced somewhere on the planet it has

693
00:26:26,070 --> 00:26:24,720
the sensitivity that it ought to be able

694
00:26:27,830 --> 00:26:26,080
to pick that up

695
00:26:29,029 --> 00:26:27,840
and if there's a seasonal component i'd

696
00:26:31,110 --> 00:26:29,039
be able to

697
00:26:33,590 --> 00:26:31,120
see that also since

698
00:26:35,510 --> 00:26:33,600
curiosity is expected to last at least

699
00:26:37,750 --> 00:26:35,520
one mars year

700
00:26:40,230 --> 00:26:37,760
other than that it can't follow it up it

701
00:26:41,430 --> 00:26:40,240
can't go to these

702
00:26:43,590 --> 00:26:41,440
sites that

703
00:26:46,470 --> 00:26:43,600
alfred just showed because they're too

704
00:26:49,190 --> 00:26:46,480
far of a southern latitude so that the

705
00:26:51,190 --> 00:26:49,200
rover hasn't been designed to do that

706
00:26:53,750 --> 00:26:51,200
but more importantly it's not designed

707
00:26:55,590 --> 00:26:53,760
to land on those steep slopes

708
00:26:57,830 --> 00:26:55,600
which that would be bad

709
00:27:00,310 --> 00:26:57,840
but then number three is there is a

710
00:27:03,669 --> 00:27:00,320
planetary protection concern that if

711
00:27:08,470 --> 00:27:03,679
these are features showing

712
00:27:12,470 --> 00:27:10,710
curiosity has not been

713
00:27:15,110 --> 00:27:12,480

fully sterilized so it wouldn't be

714
00:27:18,630 --> 00:27:15,120
allowed to go there for fear of actually

715
00:27:22,070 --> 00:27:18,640
contaminating the planet with earth life

716
00:27:25,190 --> 00:27:22,080
and so for those reasons uh curiosity

717
00:27:28,389 --> 00:27:25,200
can do some in helping uh explore these

718
00:27:30,870 --> 00:27:28,399
areas and and mars on a global scale but

719
00:27:32,830 --> 00:27:30,880
it can't go there specifically because

720
00:27:37,190 --> 00:27:32,840
you have to plan for those

721
00:27:41,750 --> 00:27:39,669
okay let's go to ames research center

722
00:27:46,549 --> 00:27:41,760
for the next question your name and

723
00:27:51,590 --> 00:27:49,110
it's john fowler i'm the science editor

724
00:27:55,190 --> 00:27:51,600
for ktvu television you say it's

725
00:27:57,430 --> 00:27:55,200
suggestive of liquid water what do you

726
00:27:58,789 --> 00:27:57,440
need to rule out

727
00:28:01,350 --> 00:27:58,799
to be

728
00:28:04,870 --> 00:28:01,360
certain and it looks like a duck quacks

729
00:28:07,190 --> 00:28:04,880
like a duck isn't it a duck

730
00:28:09,029 --> 00:28:07,200
right well it it looks like water to

731
00:28:10,070 --> 00:28:09,039
high rise but uh

732
00:28:11,909 --> 00:28:10,080
grissom

733
00:28:14,230 --> 00:28:11,919
which can actually detect the

734
00:28:15,750 --> 00:28:14,240
mineralogic signature of water has not

735
00:28:17,190 --> 00:28:15,760
been able to confirm this there are

736
00:28:18,630 --> 00:28:17,200
reasons for this

737
00:28:19,909 --> 00:28:18,640
we're going to keep trying with chrism

738
00:28:22,070 --> 00:28:19,919

by the way

739
00:28:24,149 --> 00:28:22,080
they have a super resolution mode that

740
00:28:25,830 --> 00:28:24,159
that increases the resolution at least

741
00:28:28,230 --> 00:28:25,840
in one dimension

742
00:28:29,830 --> 00:28:28,240
also by observing uh different seasons

743
00:28:31,750 --> 00:28:29,840
and differencing the specter that'd be

744
00:28:33,990 --> 00:28:31,760
another way to tease out some subtleties

745
00:28:37,750 --> 00:28:34,000
in the spectrum

746
00:28:39,590 --> 00:28:37,760
but uh as i said before uh i think it's

747
00:28:42,149 --> 00:28:39,600
going to be laboratory experiments on

748
00:28:44,789 --> 00:28:42,159
earth that really give us the the best

749
00:28:47,350 --> 00:28:44,799
confirmation or refutation

750
00:28:49,190 --> 00:28:47,360
if if we can show a mechanism of

751
00:28:51,350 --> 00:28:49,200
matching these observations with or

752
00:28:53,110 --> 00:28:51,360
without water in the lab

753
00:28:54,870 --> 00:28:53,120
that i think that would be very powerful

754
00:28:57,350 --> 00:28:54,880
i'm looking forward to

755
00:28:59,029 --> 00:28:57,360
the publication of these observations as

756
00:29:02,310 --> 00:28:59,039
motivation to those who do such

757
00:29:05,909 --> 00:29:04,149
all right and we have a question here at

758
00:29:08,630 --> 00:29:05,919
headquarters please go ahead

759
00:29:10,389 --> 00:29:08,640
maggie with cronkite news service um

760
00:29:11,909 --> 00:29:10,399
you guys mentioned the

761
00:29:13,510 --> 00:29:11,919
via tool

762
00:29:14,789 --> 00:29:13,520
i guess characteristics of what was

763
00:29:16,710 --> 00:29:14,799

found at the

764
00:29:19,830 --> 00:29:16,720
lower latitudes am i correct

765
00:29:21,830 --> 00:29:19,840
i'm in the brine water i

766
00:29:23,830 --> 00:29:21,840
an average reader i certainly don't

767
00:29:25,510 --> 00:29:23,840
necessarily get that so can you relate

768
00:29:26,710 --> 00:29:25,520
that to a substance that i would

769
00:29:28,630 --> 00:29:26,720
understand

770
00:29:30,070 --> 00:29:28,640
from a day-to-day use if

771
00:29:33,750 --> 00:29:30,080
pure water

772
00:29:36,470 --> 00:29:33,760
in this environment would boil what is

773
00:29:38,389 --> 00:29:36,480
what is what you found

774
00:29:40,549 --> 00:29:38,399
does that make sense right so

775
00:29:42,389 --> 00:29:40,559
on earth we we don't

776
00:29:44,470 --> 00:29:42,399
commonly encounter these highly

777
00:29:46,389 --> 00:29:44,480
concentrated brines because there's so

778
00:29:48,230 --> 00:29:46,399
much water this is the water world and

779
00:29:51,110 --> 00:29:48,240
it gets diluted by all the rainfall and

780
00:29:52,710 --> 00:29:51,120
so forth sea water is salty

781
00:29:54,710 --> 00:29:52,720
uh it actually only depresses the

782
00:29:57,029 --> 00:29:54,720
freezing point by about four degrees

783
00:29:59,110 --> 00:29:57,039
fahrenheit so it's not

784
00:30:00,630 --> 00:29:59,120
probably not as salty as the water we're

785
00:30:03,590 --> 00:30:00,640
talking about here

786
00:30:05,669 --> 00:30:03,600
it's if if we had more experience in the

787
00:30:06,950 --> 00:30:05,679
permafrost environment that lisa was

788
00:30:08,549 --> 00:30:06,960

describing that's the kind of

789
00:30:11,669 --> 00:30:08,559
environment where

790
00:30:14,549 --> 00:30:11,679
as you freeze water with some salt in it

791
00:30:16,870 --> 00:30:14,559
you first precipitate out pure ice

792
00:30:18,630 --> 00:30:16,880
and that then causes the residual liquid

793
00:30:20,870 --> 00:30:18,640
to have more concentrated water and so

794
00:30:24,630 --> 00:30:20,880
the last liquid to freeze if it freezes

795
00:30:26,149 --> 00:30:24,640
at all is highly concentrated in salt

796
00:30:28,389 --> 00:30:26,159
uh

797
00:30:30,389 --> 00:30:28,399
there must be

798
00:30:32,070 --> 00:30:30,399
some some common substance that we're

799
00:30:33,590 --> 00:30:32,080
all familiar with that has a high

800
00:30:36,310 --> 00:30:33,600
concentration of salt so it's not coming

801
00:30:38,149 --> 00:30:36,320
to me what you put salt on your walkway

802
00:30:40,070 --> 00:30:38,159
okay so like the slush that would be

803
00:30:42,310 --> 00:30:40,080
left over maybe i mean i'm thinking of

804
00:30:44,710 --> 00:30:42,320
like buttermilk with the equivalent to

805
00:30:47,430 --> 00:30:44,720
salt you know like yeah

806
00:30:49,750 --> 00:30:47,440
so that makes sense right so

807
00:30:51,590 --> 00:30:49,760
this very salty water can be very

808
00:30:53,590 --> 00:30:51,600
different from water in that it is a

809
00:30:56,389 --> 00:30:53,600
higher in density and higher in

810
00:30:58,950 --> 00:30:56,399
viscosity so it is more like a syrup

811
00:31:00,870 --> 00:30:58,960
maybe in how it flows it could be

812
00:31:02,789 --> 00:31:00,880
we really don't know how salty this

813
00:31:03,509 --> 00:31:02,799

water is from these observations so this

814
00:31:07,990 --> 00:31:03,519
is

815
00:31:09,990 --> 00:31:08,000
different from pure water

816
00:31:11,509 --> 00:31:10,000
okay and i think the one personal

817
00:31:13,909 --> 00:31:11,519
experience you might have with this is

818
00:31:16,230 --> 00:31:13,919
when you're desperate to drink

819
00:31:19,029 --> 00:31:16,240
a liter bottle of soda but it's warm

820
00:31:21,190 --> 00:31:19,039
shove it in the freezer and it it you

821
00:31:23,830 --> 00:31:21,200
get a you get a block of ice in the

822
00:31:25,830 --> 00:31:23,840
middle of it and then this very sugar

823
00:31:28,149 --> 00:31:25,840
syrup around it where all the all the

824
00:31:30,070 --> 00:31:28,159
flavor and the goodies are

825
00:31:33,190 --> 00:31:30,080
that's because the water that freezes

826
00:31:34,950 --> 00:31:33,200
out is is quite pure ice and

827
00:31:36,710 --> 00:31:34,960
all of the other things the sugars and

828
00:31:38,470 --> 00:31:36,720
the salts are in the syrup and and we

829
00:31:40,149 --> 00:31:38,480
all know this from experience the whole

830
00:31:41,750 --> 00:31:40,159
thing doesn't freeze

831
00:31:44,950 --> 00:31:41,760
the ice freezes and then there's a

832
00:31:46,789 --> 00:31:44,960
remaining liquid brine in that

833
00:31:48,230 --> 00:31:46,799
in that plastic bottle and you just hope

834
00:31:49,750 --> 00:31:48,240
you didn't leave it there so long that

835
00:31:52,310 --> 00:31:49,760
the bottle

836
00:31:53,830 --> 00:31:52,320
expanded and blew up in your freezer and

837
00:31:57,110 --> 00:31:53,840
made a terrible mess

838
00:31:58,870 --> 00:31:57,120

okay so let's just imagine then that all

839
00:32:01,509 --> 00:31:58,880
of a sudden we can go to mars and live

840
00:32:03,190 --> 00:32:01,519
there like what do you do with what you

841
00:32:04,630 --> 00:32:03,200
have what i mean what do you do with

842
00:32:07,430 --> 00:32:04,640
this to make it

843
00:32:08,950 --> 00:32:07,440
usable is there an option is it is this

844
00:32:11,269 --> 00:32:08,960
something you do and you take samples

845
00:32:13,190 --> 00:32:11,279
back to the lab and go from there or and

846
00:32:14,630 --> 00:32:13,200
i don't really know

847
00:32:17,269 --> 00:32:14,640
how it goes from

848
00:32:19,509 --> 00:32:17,279
well we have plenty of pure water ice

849
00:32:21,990 --> 00:32:19,519
and that's that's water and it's more

850
00:32:23,350 --> 00:32:22,000
pure and the ice is easily accessible

851
00:32:25,029 --> 00:32:23,360
and uh

852
00:32:28,310 --> 00:32:25,039
you know that's that's very useful stuff

853
00:32:31,029 --> 00:32:28,320
so it might be that that's uh more

854
00:32:33,750 --> 00:32:31,039
usable than the brines for

855
00:32:36,710 --> 00:32:33,760
uh producing fuel and oxygen and

856
00:32:39,750 --> 00:32:36,720
drinking water and so forth

857
00:32:42,710 --> 00:32:39,760
but but i think the key here is

858
00:32:44,630 --> 00:32:42,720
we know mars has a lot of ice

859
00:32:46,789 --> 00:32:44,640
but this is the first

860
00:32:48,870 --> 00:32:46,799
time we've seen the potential

861
00:32:51,269 --> 00:32:48,880
for liquid

862
00:32:52,070 --> 00:32:51,279
water it might be salty water but it's

863
00:32:55,990 --> 00:32:52,080

still

864
00:32:58,149 --> 00:32:56,000
real the key here it's not that mars

865
00:32:59,110 --> 00:32:58,159
doesn't have a lot of ice but liquid

866
00:33:01,029 --> 00:32:59,120
water

867
00:33:04,149 --> 00:33:01,039
certainly to an organism

868
00:33:06,950 --> 00:33:04,159
is very very very different than ice and

869
00:33:09,430 --> 00:33:06,960
so that's i think the key

870
00:33:10,950 --> 00:33:09,440
right how people would use it that's a

871
00:33:12,950 --> 00:33:10,960
question i guess

872
00:33:14,710 --> 00:33:12,960
they might use it for their experiments

873
00:33:16,549 --> 00:33:14,720
yeah

874
00:33:18,389 --> 00:33:16,559
okay we have a questionnaire on the

875
00:33:30,310 --> 00:33:18,399
phone lines clara moskowitz from

876
00:33:32,870 --> 00:33:31,590
if not

877
00:33:34,710 --> 00:33:32,880
we'll see if we have another

878
00:33:37,430 --> 00:33:34,720
questionnaire come back to clara in a

879
00:33:40,950 --> 00:33:39,029
all right we're going to peter spots

880
00:33:51,350 --> 00:33:40,960
christian science monitor

881
00:33:51,360 --> 00:33:56,710
questions here in the auditorium

882
00:33:58,470 --> 00:33:57,509
no

883
00:34:01,669 --> 00:33:58,480
um

884
00:34:03,990 --> 00:34:01,679
well failing any other questions on the

885
00:34:06,630 --> 00:34:04,000
uh telephones uh did we have a follow-up

886
00:34:08,710 --> 00:34:06,640
oh we didn't have a follow-up all right

887
00:34:11,349 --> 00:34:08,720
since i have you all here um can someone

888
00:34:14,389 --> 00:34:11,359

just explain i guess in greater detail

889
00:34:19,349 --> 00:34:17,190
all right i can cover that one uh the

890
00:34:20,950 --> 00:34:19,359
gullies on mars are

891
00:34:22,310 --> 00:34:20,960
they were discovered a bit over 10 years

892
00:34:24,950 --> 00:34:22,320
ago they're

893
00:34:27,909 --> 00:34:24,960
these the classic form is an alcove

894
00:34:30,869 --> 00:34:27,919
channel and an apron of material

895
00:34:32,470 --> 00:34:30,879
somewhat similar to small alluvial fans

896
00:34:34,790 --> 00:34:32,480
on earth which are

897
00:34:37,990 --> 00:34:34,800
transported by water and so they've been

898
00:34:39,589 --> 00:34:38,000
uh taken as uh evidence for liquid water

899
00:34:40,310 --> 00:34:39,599
at some point there's been a lot of work

900
00:34:44,470 --> 00:34:40,320
in

901
00:34:46,869 --> 00:34:44,480
and how they might relate to possible

902
00:34:49,589 --> 00:34:46,879
snow deposits or variations in mars's

903
00:34:51,829 --> 00:34:49,599
orbit and the current activity we're

904
00:34:54,470 --> 00:34:51,839
seeing is in the winter when liquid

905
00:34:55,990 --> 00:34:54,480
water is less likely but

906
00:34:57,510 --> 00:34:56,000
exactly how that relates to the past

907
00:35:00,150 --> 00:34:57,520
history of gullies isn't completely

908
00:35:04,230 --> 00:35:02,069
okay thank you we have another question

909
00:35:05,750 --> 00:35:04,240
at ames research center in california

910
00:35:08,310 --> 00:35:05,760
please go ahead and identify yourself

911
00:35:08,320 --> 00:35:10,630
hey

912
00:35:14,870 --> 00:35:12,470
that's not the answer we wanted to uh

913
00:35:18,150 --> 00:35:14,880

the question we wanted to respond to

914
00:35:19,190 --> 00:35:18,160
um but let's see i guess if there are no

915
00:35:21,349 --> 00:35:19,200
other

916
00:35:23,589 --> 00:35:21,359
questions let me uh just remind

917
00:35:25,750 --> 00:35:23,599
everybody that all of this information

918
00:35:28,230 --> 00:35:25,760
about this and all the images are

919
00:35:32,230 --> 00:35:28,240
available on the nasa website at www

920
00:35:35,589 --> 00:35:34,069
mro

921
00:35:38,550 --> 00:35:35,599
we do have a question here in the

922
00:35:41,349 --> 00:35:38,560
auditorium in the back

923
00:35:43,190 --> 00:35:41,359
hi my name is jason callahan uh

924
00:35:44,550 --> 00:35:43,200
you mentioned that

925
00:35:46,310 --> 00:35:44,560
that a lot of study would need to be

926
00:35:48,630 --> 00:35:46,320
done to confirm or

927
00:35:52,310 --> 00:35:51,270
or uh rebut the the findings i was

928
00:35:54,069 --> 00:35:52,320
wondering

929
00:35:55,910 --> 00:35:54,079
what are the other plus

930
00:35:57,510 --> 00:35:55,920
possible or plausible explanations for

931
00:35:59,670 --> 00:35:57,520
what you're finding

932
00:36:01,670 --> 00:35:59,680
and what exactly would the process be

933
00:36:03,190 --> 00:36:01,680
how long do you think it would

934
00:36:04,710 --> 00:36:03,200
potentially take to to make this

935
00:36:06,470 --> 00:36:04,720
determination

936
00:36:07,910 --> 00:36:06,480
right so we've spent a lot of time the

937
00:36:10,950 --> 00:36:07,920
co-authors of this paper and trying to

938
00:36:13,990 --> 00:36:10,960

come up with alternate hypotheses

939
00:36:16,790 --> 00:36:14,000
it's clearly associated with uh warm

940
00:36:19,109 --> 00:36:16,800
temperatures from mars now just uh wrap

941
00:36:21,030 --> 00:36:19,119
end rapid temperature changes and and

942
00:36:23,670 --> 00:36:21,040
that can damage rock

943
00:36:26,230 --> 00:36:23,680
and cause bits of it to flake off

944
00:36:28,390 --> 00:36:26,240
but that's a slow process and why this

945
00:36:31,109 --> 00:36:28,400
occurs in only some places and not

946
00:36:33,190 --> 00:36:31,119
others is puzzling

947
00:36:36,310 --> 00:36:33,200
and certainly the incremental growth and

948
00:36:38,390 --> 00:36:36,320
so forth none of that quite makes sense

949
00:36:39,990 --> 00:36:38,400
another possibility is well there's dust

950
00:36:42,069 --> 00:36:40,000
over most of mars these are relatively

951
00:36:43,829 --> 00:36:42,079
dust free areas but there's some dust

952
00:36:47,270 --> 00:36:43,839
everywhere if you remove dust it gets

953
00:36:50,230 --> 00:36:47,280
darker and you add dust it gets brighter

954
00:36:52,230 --> 00:36:50,240
the problem with that is that we don't

955
00:36:53,510 --> 00:36:52,240
we don't we've seen dust avalanches

956
00:36:55,109 --> 00:36:53,520
elsewhere we know what they look like

957
00:36:57,510 --> 00:36:55,119
they don't share these characteristics

958
00:36:59,589 --> 00:36:57,520
they don't have seasonality

959
00:37:01,910 --> 00:36:59,599
it does cause a color change when you

960
00:37:03,829 --> 00:37:01,920
move dust from rocky ground we don't see

961
00:37:05,990 --> 00:37:03,839
that color change

962
00:37:07,910 --> 00:37:06,000
here we don't understand why would have

963
00:37:09,910 --> 00:37:07,920

this latitudinal distribution and

964
00:37:11,589 --> 00:37:09,920
seasonality and so forth if that was the

965
00:37:13,510 --> 00:37:11,599
case

966
00:37:16,550 --> 00:37:13,520
another idea that might be a little more

967
00:37:19,270 --> 00:37:16,560
promising is that maybe maybe this is

968
00:37:21,510 --> 00:37:19,280
activity induced by removing water it

969
00:37:23,510 --> 00:37:21,520
gets warm and you sub there's very thin

970
00:37:25,670 --> 00:37:23,520
films of water that can coat grains and

971
00:37:27,910 --> 00:37:25,680
it makes them sticky this was something

972
00:37:29,270 --> 00:37:27,920
that the phoenix mission people know

973
00:37:31,109 --> 00:37:29,280
about very well where they couldn't get

974
00:37:32,790 --> 00:37:31,119
their sample out of their scoop and into

975
00:37:33,990 --> 00:37:32,800
their instruments because it was so

976
00:37:36,310 --> 00:37:34,000
sticky

977
00:37:39,109 --> 00:37:36,320
so maybe when it warms up that removes

978
00:37:40,870 --> 00:37:39,119
that stickiness and then causes it to

979
00:37:42,630 --> 00:37:40,880
you know dry grains to tumble down the

980
00:37:43,829 --> 00:37:42,640
slope

981
00:37:46,230 --> 00:37:43,839
but again

982
00:37:48,470 --> 00:37:46,240
why do why are they only certain places

983
00:37:50,790 --> 00:37:48,480
why only the mid-latitudes

984
00:37:53,430 --> 00:37:50,800
why not the northern hemisphere

985
00:37:56,230 --> 00:37:53,440
uh you know these these these questions

986
00:37:57,910 --> 00:37:56,240
the whole story doesn't fit together but

987
00:37:59,750 --> 00:37:57,920
so we haven't been able to come up with

988
00:38:01,109 --> 00:37:59,760

an alternate that we believe but but

989
00:38:02,790 --> 00:38:01,119
there may be people out there that are

990
00:38:04,470 --> 00:38:02,800
more clever than us and and it's

991
00:38:05,349 --> 00:38:04,480
definitely worthwhile to keep thinking

992
00:38:09,589 --> 00:38:05,359
about

993
00:38:14,069 --> 00:38:12,390
okay we'll try the phone bridge again uh

994
00:38:15,990 --> 00:38:14,079
we have a caller from san francisco

995
00:38:17,589 --> 00:38:16,000
david perlman from the san francisco

996
00:38:20,630 --> 00:38:17,599
chronicle

997
00:38:24,390 --> 00:38:21,670
you know hi

998
00:38:25,349 --> 00:38:24,400
i have just a quick question

999
00:38:29,190 --> 00:38:25,359
in

1000
00:38:30,470 --> 00:38:29,200
comparison with the evidence from

1001
00:38:32,390 --> 00:38:30,480
phoenix

1002
00:38:35,349 --> 00:38:32,400
and the evidence from

1003
00:38:40,310 --> 00:38:35,359
uh mars global surveyor

1004
00:38:41,910 --> 00:38:40,320
how do you rate this uh as to

1005
00:38:44,630 --> 00:38:41,920
convincing

1006
00:38:46,390 --> 00:38:44,640
evidence of the possibility and i'll say

1007
00:38:49,430 --> 00:38:46,400
possibility of water

1008
00:38:51,670 --> 00:38:49,440
you've had a lot of uh observations of

1009
00:38:54,230 --> 00:38:51,680
water snow ice

1010
00:38:56,069 --> 00:38:54,240
from previous missions and how does this

1011
00:38:59,430 --> 00:38:56,079
stack up in terms of

1012
00:39:00,470 --> 00:38:59,440
it's uh improving the possibility of of

1013
00:39:02,870 --> 00:39:00,480

water

1014
00:39:05,589 --> 00:39:02,880
and i'd like to follow up with uh lisa

1015
00:39:07,430 --> 00:39:05,599
for a quick question if i may

1016
00:39:09,510 --> 00:39:07,440
okay let me just remind people quickly

1017
00:39:12,150 --> 00:39:09,520
of a phoenix mission result where there

1018
00:39:13,109 --> 00:39:12,160
were apparent droplets that formed on

1019
00:39:22,230 --> 00:39:13,119
the

1020
00:39:24,470 --> 00:39:22,240
particularly pick up salt that

1021
00:39:27,349 --> 00:39:24,480
absorbs water from the atmosphere and so

1022
00:39:29,349 --> 00:39:27,359
it a plausible explanation is that the

1023
00:39:30,950 --> 00:39:29,359
salt that was kicked up from landing on

1024
00:39:32,950 --> 00:39:30,960
the legs absorbed water from the

1025
00:39:34,870 --> 00:39:32,960
atmosphere and made droplets

1026
00:39:37,030 --> 00:39:34,880
and if that's the case there should be

1027
00:39:39,430 --> 00:39:37,040
you know droplets of water that form in

1028
00:39:41,270 --> 00:39:39,440
the regolith on the ground as well at

1029
00:39:43,589 --> 00:39:41,280
the phoenix site

1030
00:39:45,109 --> 00:39:43,599
so uh i don't know if that's more or

1031
00:39:47,510 --> 00:39:45,119
less plausible than what we're saying

1032
00:39:49,349 --> 00:39:47,520
but that's extremely cold water so what

1033
00:39:51,829 --> 00:39:49,359
we're seeing is at least warmer water

1034
00:39:53,109 --> 00:39:51,839
that's that's more friendly to possible

1035
00:39:55,829 --> 00:39:53,119
uh life

1036
00:39:57,349 --> 00:39:55,839
and it's flowing so it's different i'm

1037
00:39:59,589 --> 00:39:57,359
not going to rate which one is more

1038
00:40:01,589 --> 00:39:59,599

likely to be water

1039
00:40:03,349 --> 00:40:01,599
for mgs maybe

1040
00:40:05,109 --> 00:40:03,359
maybe phil would

1041
00:40:07,349 --> 00:40:05,119
talk about that

1042
00:40:09,670 --> 00:40:07,359
um again dave it's hard to it's hard to

1043
00:40:12,069 --> 00:40:09,680
rate these i i think for me

1044
00:40:13,030 --> 00:40:12,079
the story has been growing

1045
00:40:15,030 --> 00:40:13,040
uh

1046
00:40:17,829 --> 00:40:15,040
we've found water in increasing number

1047
00:40:20,950 --> 00:40:17,839
of places and increasing abundances

1048
00:40:23,190 --> 00:40:20,960
and and other than the the observations

1049
00:40:25,990 --> 00:40:23,200
that um alfred just referred to which

1050
00:40:27,829 --> 00:40:26,000
were extremely cold polar regions

1051
00:40:29,349 --> 00:40:27,839
i think this is the best evidence we

1052
00:40:33,990 --> 00:40:29,359
have to date

1053
00:40:37,430 --> 00:40:34,000
of a liquid water occurring today

1054
00:40:39,670 --> 00:40:37,440
on mars there's again evidence

1055
00:40:42,069 --> 00:40:39,680
these other features may have formed by

1056
00:40:45,829 --> 00:40:42,079
liquid water in the past but as far as

1057
00:40:47,990 --> 00:40:45,839
liquid water to liquid water today the

1058
00:40:49,430 --> 00:40:48,000
places where it's warm enough to stay

1059
00:40:52,470 --> 00:40:49,440
liquid for a while i think this is the

1060
00:40:54,069 --> 00:40:52,480
best evidence we have

1061
00:40:58,309 --> 00:40:54,079
okay david and your follow-up question

1062
00:41:03,670 --> 00:41:01,670
yeah i couldn't quite understand uh

1063
00:41:05,829 --> 00:41:03,680

about the

1064
00:41:09,270 --> 00:41:05,839
how an organism

1065
00:41:12,550 --> 00:41:09,280
in a subsurface a sub uh

1066
00:41:14,950 --> 00:41:12,560
how did you phrase it i've forgotten now

1067
00:41:18,390 --> 00:41:14,960
beneath the permafrost where you might

1068
00:41:21,109 --> 00:41:18,400
have liquid water beneath permafrost uh

1069
00:41:24,390 --> 00:41:21,119
you indicated that there they the

1070
00:41:26,470 --> 00:41:24,400
organisms like that could uh proliferate

1071
00:41:28,710 --> 00:41:26,480
uh but if there's no

1072
00:41:31,270 --> 00:41:28,720
light of any kind i recognize of course

1073
00:41:33,270 --> 00:41:31,280
that extremophiles have been found with

1074
00:41:35,109 --> 00:41:33,280
no visible light apparent

1075
00:41:37,270 --> 00:41:35,119
but could you explain a little bit how

1076
00:41:38,390 --> 00:41:37,280
an organism might

1077
00:41:43,270 --> 00:41:38,400
grow

1078
00:41:45,109 --> 00:41:43,280
beneath a a solid surface of permafrost

1079
00:41:47,030 --> 00:41:45,119
i think we would assume it would grow in

1080
00:41:49,109 --> 00:41:47,040
the same way that that happens on earth

1081
00:41:51,270 --> 00:41:49,119
where we see life in the deep subsurface

1082
00:41:53,829 --> 00:41:51,280
that is utilizing some other source of

1083
00:41:55,670 --> 00:41:53,839
energy usually a chemical gradient where

1084
00:41:57,670 --> 00:41:55,680
the organism is either able to do an

1085
00:41:59,589 --> 00:41:57,680
oxidation or a reduction taking

1086
00:42:01,670 --> 00:41:59,599
advantage of

1087
00:42:04,150 --> 00:42:01,680
dissolved constituents in brines and

1088
00:42:05,829 --> 00:42:04,160

mineral surfaces certainly this

1089
00:42:06,950 --> 00:42:05,839
community of organisms that i've been

1090
00:42:08,950 --> 00:42:06,960
part of

1091
00:42:11,910 --> 00:42:08,960
discovering and looking at

1092
00:42:14,390 --> 00:42:11,920
in the deep groundwater in south africa

1093
00:42:18,069 --> 00:42:14,400
those are sulfate reducers sulfate

1094
00:42:20,710 --> 00:42:18,079
reduction is a common process in anoxic

1095
00:42:22,870 --> 00:42:20,720
parts of the surface ocean as well and

1096
00:42:25,430 --> 00:42:22,880
given the amount of sulfur and in

1097
00:42:27,589 --> 00:42:25,440
particular sulfate that we now know is

1098
00:42:30,309 --> 00:42:27,599
present on mars i think a sulfur-based

1099
00:42:32,630 --> 00:42:30,319
metabolism would be a very uh very

1100
00:42:34,309 --> 00:42:32,640
reasonable one to anticipate

1101
00:42:36,309 --> 00:42:34,319
the way in which it would communicate

1102
00:42:39,510 --> 00:42:36,319
with the surface environment and

1103
00:42:42,870 --> 00:42:39,520
possibly take advantage of

1104
00:42:45,910 --> 00:42:42,880
seasonal access to the surface world

1105
00:42:49,030 --> 00:42:45,920
would be if there was a fracture network

1106
00:42:50,950 --> 00:42:49,040
that created a conduit that extended

1107
00:42:54,470 --> 00:42:50,960
through the permafrost on earth we would

1108
00:42:56,309 --> 00:42:54,480
call that italic which means there are

1109
00:42:59,270 --> 00:42:56,319
are fluids that because of their

1110
00:43:02,309 --> 00:42:59,280
saltiness actually create a column of

1111
00:43:04,630 --> 00:43:02,319
unfrozen ground through the permafrost

1112
00:43:06,710 --> 00:43:04,640
now again we don't have any evidence for

1113
00:43:08,870 --> 00:43:06,720

that yet on mars but when we look at

1114
00:43:11,109 --> 00:43:08,880
analog environments with very cold very

1115
00:43:12,790 --> 00:43:11,119
thick permafrost on earth

1116
00:43:13,510 --> 00:43:12,800
those are the kind of features we see

1117
00:43:16,150 --> 00:43:13,520
and

1118
00:43:19,190 --> 00:43:16,160
if there were to have been

1119
00:43:22,309 --> 00:43:19,200
um life on mars and if it evolved and

1120
00:43:23,589 --> 00:43:22,319
adapted to this permafrost world i i

1121
00:43:25,349 --> 00:43:23,599
think those are

1122
00:43:27,589 --> 00:43:25,359
reasonable things that we could go look

1123
00:43:29,670 --> 00:43:27,599
for

1124
00:43:31,589 --> 00:43:29,680
all right we have another question on

1125
00:43:33,829 --> 00:43:31,599
the phone lines clara moskowitz from

1126
00:43:38,470 --> 00:43:33,839
space.com tried clara again please go

1127
00:43:43,109 --> 00:43:40,950
yes thanks very much um i understand

1128
00:43:45,589 --> 00:43:43,119
that if this water exists at all it only

1129
00:43:47,510 --> 00:43:45,599
exists seasonally so could you talk a

1130
00:43:49,670 --> 00:43:47,520
little bit more about what type of

1131
00:43:51,430 --> 00:43:49,680
organisms would be able to survive that

1132
00:43:53,510 --> 00:43:51,440
kind of change and what would happen to

1133
00:43:56,230 --> 00:43:53,520
the organisms when the water wasn't

1134
00:43:56,240 --> 00:43:59,270
you want me to take that one

1135
00:44:04,550 --> 00:44:02,550
again this is very speculative because

1136
00:44:06,790 --> 00:44:04,560
we really have no idea whether or not

1137
00:44:09,109 --> 00:44:06,800
there are extant organisms on mars or if

1138
00:44:11,270 --> 00:44:09,119

there ever was life on mars but what we

1139
00:44:14,390 --> 00:44:11,280
see on earth in that kind of a setting

1140
00:44:16,870 --> 00:44:14,400
is that if there are cryo pegs

1141
00:44:19,829 --> 00:44:16,880
cold salty waters that never freeze

1142
00:44:23,190 --> 00:44:19,839
despite the cold surrounding frozen

1143
00:44:25,910 --> 00:44:23,200
ground then they simply remain

1144
00:44:28,150 --> 00:44:25,920
active at all times although at lower

1145
00:44:30,790 --> 00:44:28,160
metabolic rates when uh when the coldest

1146
00:44:33,349 --> 00:44:30,800
temperatures occur if the if the

1147
00:44:35,109 --> 00:44:33,359
environment is one in which it's liquid

1148
00:44:37,670 --> 00:44:35,119
seasonally but

1149
00:44:39,430 --> 00:44:37,680
pretty much freezes up solid at other

1150
00:44:41,349 --> 00:44:39,440
times a year and that would have to be

1151
00:44:43,510 --> 00:44:41,359
an organism that could go into a dormant

1152
00:44:47,589 --> 00:44:43,520
state or could could go into a resting

1153
00:44:50,069 --> 00:44:47,599
state and just uh patiently hang out on

1154
00:44:51,589 --> 00:44:50,079
near the surface and until spring comes

1155
00:44:53,510 --> 00:44:51,599
around again

1156
00:44:55,589 --> 00:44:53,520
this is a strategy that we see many

1157
00:44:57,990 --> 00:44:55,599
organisms on earth using to get through

1158
00:45:00,470 --> 00:44:58,000
either long dry spells or to get through

1159
00:45:02,870 --> 00:45:00,480
long cold spells so if there were to be

1160
00:45:04,550 --> 00:45:02,880
evolving organisms on mars i don't see

1161
00:45:06,390 --> 00:45:04,560
any reason why they couldn't uh couldn't

1162
00:45:09,510 --> 00:45:06,400
adapt to that kind of

1163
00:45:10,870 --> 00:45:09,520

seasonally available very brief access

1164
00:45:13,349 --> 00:45:10,880
to resources

1165
00:45:17,670 --> 00:45:13,359
you you bloom quickly you do what you

1166
00:45:21,349 --> 00:45:19,109
all right we have another question uh

1167
00:45:25,910 --> 00:45:21,359
peter spots christian science monitor on

1168
00:45:29,030 --> 00:45:27,510
yeah thank you very much

1169
00:45:31,430 --> 00:45:29,040
actually i guess it's a trivia question

1170
00:45:33,030 --> 00:45:31,440
but since you were able to do this uh

1171
00:45:35,270 --> 00:45:33,040
observe these repeatedly are there any

1172
00:45:37,190 --> 00:45:35,280
even back of the envelope estimates

1173
00:45:40,069 --> 00:45:37,200
for let's say newton crater and the

1174
00:45:42,390 --> 00:45:40,079
amount of water uh that was flowing over

1175
00:45:44,150 --> 00:45:42,400
these periods uh particularly since it

1176
00:45:45,109 --> 00:45:44,160
seems over these long seasons it's not

1177
00:45:46,950 --> 00:45:45,119
you know these things are kind of

1178
00:45:48,790 --> 00:45:46,960
renewing and extending themselves you

1179
00:45:51,190 --> 00:45:48,800
have a kind of a sense for how much

1180
00:45:53,430 --> 00:45:51,200
water we're talking about how much fluid

1181
00:45:54,790 --> 00:45:53,440
uh yeah well i can you have to make

1182
00:45:56,710 --> 00:45:54,800
assumptions here we don't really know

1183
00:45:59,030 --> 00:45:56,720
the mechanism and in particular we don't

1184
00:46:01,349 --> 00:45:59,040
know whether this is really a flow of

1185
00:46:02,790 --> 00:46:01,359
water for the most part or whether it's

1186
00:46:05,190 --> 00:46:02,800
just a matter of

1187
00:46:08,390 --> 00:46:05,200
wetting a boundary layer and you have a

1188
00:46:09,910 --> 00:46:08,400

debris flow flowing on a thin film of

1189
00:46:12,470 --> 00:46:09,920
water

1190
00:46:14,390 --> 00:46:12,480
so estimates could vary but if if it's a

1191
00:46:17,270 --> 00:46:14,400
flow of water there were some laboratory

1192
00:46:19,349 --> 00:46:17,280
experiments done in

1193
00:46:21,910 --> 00:46:19,359
in the united kingdom recently published

1194
00:46:23,910 --> 00:46:21,920
by conway at all in which they they

1195
00:46:25,990 --> 00:46:23,920
poured water on a slope

1196
00:46:27,670 --> 00:46:26,000
it mars atmospheric pressure and

1197
00:46:29,910 --> 00:46:27,680
temperature conditions pure water and

1198
00:46:31,190 --> 00:46:29,920
made features that look look somewhat

1199
00:46:33,349 --> 00:46:31,200
like these but

1200
00:46:35,670 --> 00:46:33,359
just scaling from that

1201
00:46:38,870 --> 00:46:35,680
we're talking about for a typical flow

1202
00:46:41,670 --> 00:46:38,880
something like 100 liters of water

1203
00:46:44,230 --> 00:46:41,680
so 25 gallons so that's a pretty modest

1204
00:46:47,589 --> 00:46:44,240
amount but if there's a thousand of them

1205
00:46:49,910 --> 00:46:47,599
uh then then that starts to amount to

1206
00:46:52,950 --> 00:46:49,920
multiple swimming pools worth of water

1207
00:46:55,109 --> 00:46:52,960
the sort of that that magnitude it's

1208
00:46:57,430 --> 00:46:55,119
this is a lot less water than than you

1209
00:47:00,309 --> 00:46:57,440
need to to explain the gullies if those

1210
00:47:02,069 --> 00:47:00,319
form by water for example and it's it's

1211
00:47:03,829 --> 00:47:02,079
a relatively small amount of water

1212
00:47:06,710 --> 00:47:03,839
relative to the total inventory that we

1213
00:47:08,230 --> 00:47:06,720

know of on the planet

1214
00:47:10,790 --> 00:47:08,240
all right the next question on the phone

1215
00:47:16,150 --> 00:47:10,800
lines anne ryman from the arizona

1216
00:47:19,750 --> 00:47:17,829
thank you i wondered if you could tell

1217
00:47:22,309 --> 00:47:19,760
us a little bit more about this newton

1218
00:47:24,870 --> 00:47:22,319
crater what it's like there and then how

1219
00:47:26,630 --> 00:47:24,880
close are any of the other landed

1220
00:47:29,910 --> 00:47:26,640
missions to this crater like the you

1221
00:47:33,109 --> 00:47:29,920
know the rovers or um when curiosity

1222
00:47:35,510 --> 00:47:33,119
lands how how far away would it be from

1223
00:47:37,349 --> 00:47:35,520
this newton crater site thank you okay

1224
00:47:38,870 --> 00:47:37,359
well the newton crater site is uh i

1225
00:47:40,630 --> 00:47:38,880
think the opposite side of mars but

1226
00:47:42,870 --> 00:47:40,640
there are multiple sites that the one

1227
00:47:43,829 --> 00:47:42,880
closest to gale crater is horowitz

1228
00:47:45,750 --> 00:47:43,839
crater

1229
00:47:47,910 --> 00:47:45,760
named after norman horowitz of the

1230
00:47:51,589 --> 00:47:47,920
viking biology experiment fame

1231
00:47:53,510 --> 00:47:51,599
appropriately that's at 32 south gale is

1232
00:47:56,390 --> 00:47:53,520
a few degrees south they're something

1233
00:47:58,710 --> 00:47:56,400
like 2 000 kilometers apart so

1234
00:48:00,549 --> 00:47:58,720
that's relatively close but still a long

1235
00:48:01,750 --> 00:48:00,559
ways away

1236
00:48:03,910 --> 00:48:01,760
uh

1237
00:48:07,349 --> 00:48:03,920
you asked what it's what it's like at

1238
00:48:09,829 --> 00:48:07,359

newton crater and

1239
00:48:11,270 --> 00:48:09,839
not quite sure what to say beyond what i

1240
00:48:17,190 --> 00:48:11,280
showed you previously could you clarify

1241
00:48:20,950 --> 00:48:18,870
i'm just curious like how much we know

1242
00:48:22,870 --> 00:48:20,960
about it um just if there's any sort of

1243
00:48:25,510 --> 00:48:22,880
description of it that people would find

1244
00:48:30,390 --> 00:48:28,470
well it's a relatively young crater it

1245
00:48:33,109 --> 00:48:30,400
doesn't have a name now we need to

1246
00:48:35,670 --> 00:48:33,119
submit to iu names for the the craters

1247
00:48:37,349 --> 00:48:35,680
that we're making famous here

1248
00:48:39,349 --> 00:48:37,359
but it's a relatively well preserved 10

1249
00:48:42,150 --> 00:48:39,359
kilometer diameter crater

1250
00:48:43,990 --> 00:48:42,160
uh the crater itself is is probably a

1251
00:48:47,589 --> 00:48:44,000
few hundred million years old just

1252
00:48:49,589 --> 00:48:47,599
judging from its state of preservation

1253
00:48:51,030 --> 00:48:49,599
it has steep crater walls because it's

1254
00:48:53,910 --> 00:48:51,040
relatively young

1255
00:48:56,870 --> 00:48:53,920
it's still well preserved and has steep

1256
00:48:58,230 --> 00:48:56,880
crater walls it exposed bedrock around

1257
00:49:00,790 --> 00:48:58,240
the rim

1258
00:49:03,270 --> 00:49:00,800
it's got gullies as colin showed on on

1259
00:49:04,950 --> 00:49:03,280
the north side and fine channels around

1260
00:49:06,069 --> 00:49:04,960
the rest of the crater that may or may

1261
00:49:08,630 --> 00:49:06,079
not be

1262
00:49:10,950 --> 00:49:08,640
related to these flow features

1263
00:49:13,109 --> 00:49:10,960

these flow features also seem to emanate

1264
00:49:16,309 --> 00:49:13,119
from bedrock which is eroded back into

1265
00:49:18,150 --> 00:49:16,319
sort of a sapping like morphology

1266
00:49:20,230 --> 00:49:18,160
so that that site

1267
00:49:21,990 --> 00:49:20,240
looks more like water for that reason

1268
00:49:23,829 --> 00:49:22,000
but again we don't really know cause and

1269
00:49:25,750 --> 00:49:23,839
effect here maybe that formed first

1270
00:49:27,829 --> 00:49:25,760
before these slope features started

1271
00:49:30,390 --> 00:49:27,839
forming

1272
00:49:32,069 --> 00:49:30,400
okay we have a question back at nasa's

1273
00:49:33,349 --> 00:49:32,079
ames research center in california

1274
00:49:37,109 --> 00:49:33,359
please go ahead state your name and

1275
00:49:42,710 --> 00:49:40,390
uh douglas messier from parabolicarc.com

1276
00:49:45,270 --> 00:49:42,720
i was wondering about the

1277
00:49:46,870 --> 00:49:45,280
mechanism is are the organisms that

1278
00:49:47,829 --> 00:49:46,880
might be

1279
00:49:50,069 --> 00:49:47,839
in

1280
00:49:51,750 --> 00:49:50,079
water under the soil protected from the

1281
00:49:53,829 --> 00:49:51,760
radiation and what happens if they

1282
00:49:55,670 --> 00:49:53,839
outflow and get exposed suddenly to

1283
00:49:58,230 --> 00:49:55,680
surface radiation

1284
00:50:00,230 --> 00:49:58,240
or the organisms

1285
00:50:03,030 --> 00:50:00,240
might they be adapted to dealing with

1286
00:50:05,030 --> 00:50:03,040
that level of radiation

1287
00:50:07,190 --> 00:50:05,040
i think we have to assume if they're if

1288
00:50:08,950 --> 00:50:07,200

there are organisms on mars that they're

1289
00:50:10,950 --> 00:50:08,960
highly adapted

1290
00:50:13,349 --> 00:50:10,960
and capable and one of the things they'd

1291
00:50:15,430 --> 00:50:13,359
have to be able to tolerate is is

1292
00:50:20,630 --> 00:50:15,440
exposure to

1293
00:50:23,349 --> 00:50:20,640
radiation environment and one of the

1294
00:50:25,430 --> 00:50:23,359
nice coincidences is of course that iron

1295
00:50:27,270 --> 00:50:25,440
oxides give are a pretty darn good

1296
00:50:29,030 --> 00:50:27,280
sunscreen so one

1297
00:50:31,190 --> 00:50:29,040
actually might envision that they've

1298
00:50:34,150 --> 00:50:31,200
they've found a way to be sticky enough

1299
00:50:36,549 --> 00:50:34,160
that the iron oxide in the surface dust

1300
00:50:38,790 --> 00:50:36,559
adheres to them and that puts them under

1301
00:50:42,230 --> 00:50:38,800
a little sunbrella and keeps them from

1302
00:50:46,950 --> 00:50:44,710
okay that's all the questions we have

1303
00:50:48,630 --> 00:50:46,960
again as a reminder all these images

1304
00:50:50,069 --> 00:50:48,640
you've seen today a lot more information

1305
00:50:55,030 --> 00:50:50,079
about mro

1306
00:50:57,990 --> 00:50:56,309
mro