
NASA

1
00:00:09,110 --> 00:00:06,680
after doing everyone this is our

2
00:00:12,740 --> 00:00:09,120
briefing to help us answer the question

3
00:00:15,259 --> 00:00:12,750
what do we know about Mars and here to

4
00:00:18,010 --> 00:00:15,269
help answer that question is Michael

5
00:00:22,810 --> 00:00:18,020
Meyer the lead scientist for the Mars

6
00:00:24,800 --> 00:00:22,820
exploration program Bethany Elmen

7
00:00:27,259 --> 00:00:24,810
scientists from the Jet Propulsion

8
00:00:29,410 --> 00:00:27,269
Laboratory assistant professor at the

9
00:00:32,630 --> 00:00:29,420
California Institute of Technology

10
00:00:34,340 --> 00:00:32,640
and John grotzinger the project

11
00:00:37,370 --> 00:00:34,350
scientists from Mars laboratory at the

12
00:00:39,110 --> 00:00:37,380
California Institute of Technology and

13
00:00:41,540 --> 00:00:39,120

we'll begin first with Michael Meyer

14
00:00:43,430 --> 00:00:41,550
Michael thank you George

15
00:00:45,260 --> 00:00:43,440
for millennia humans have been wondering

16
00:00:47,240 --> 00:00:45,270
about the red planet and studying it and

17
00:00:50,779 --> 00:00:47,250
it's only recently that we've actually

18
00:00:52,340 --> 00:00:50,789
be able to go there and look in 1976 we

19
00:00:54,439 --> 00:00:52,350
sent two missions there the Viking

20
00:00:56,660 --> 00:00:54,449
missions both were orbiter and Lander

21
00:00:59,740 --> 00:00:56,670
and we set them to the Red Planet if I

22
00:01:03,860 --> 00:00:59,750
can have the first slide please

23
00:01:09,280 --> 00:01:03,870
so Viking landed and this is from Viking

24
00:01:13,160 --> 00:01:09,290
2 and it shows a cold barren dry

25
00:01:15,020 --> 00:01:13,170
apparently dead planet and as you might

26
00:01:18,789 --> 00:01:15,030
imagine the enthusiasm for Mars

27
00:01:21,530 --> 00:01:18,799
exploration and kind of took a plummet

28
00:01:24,560 --> 00:01:21,540
but interestingly enough during the same

29
00:01:29,510 --> 00:01:24,570
period of time we found in the

30
00:01:33,050 --> 00:01:29,520
subsurface ocean life in scalding hot

31
00:01:34,670 --> 00:01:33,060
hydrothermal vents and that started a

32
00:01:36,620 --> 00:01:34,680
whole line of study looking at life in

33
00:01:38,990 --> 00:01:36,630
extreme environments and through that

34
00:01:41,420 --> 00:01:39,000
study we came to learn that life is

35
00:01:43,700 --> 00:01:41,430
capable of adapting to all sorts of

36
00:01:45,830 --> 00:01:43,710
environments where it seemed like the

37
00:01:48,830 --> 00:01:45,840
only real necessary ingredient would be

38
00:01:50,210 --> 00:01:48,840

liquid water this was encouraging to the

39
00:01:52,550 --> 00:01:50,220
broad scientific community and

40
00:01:54,649 --> 00:01:52,560
understanding that there may be more

41
00:01:55,840 --> 00:01:54,659
places where life is possible than we

42
00:01:59,840 --> 00:01:55,850
originally thought

43
00:02:02,209 --> 00:01:59,850
so we began the error a modern era of

44
00:02:05,030 --> 00:02:02,219
Mars exploration so in nineteen two

45
00:02:07,399 --> 00:02:05,040
decades later in 1996 we sent the Mars

46
00:02:12,199 --> 00:02:07,409
Global Surveyor could I show the next

47
00:02:13,730 --> 00:02:12,209
slide and what this slide shows is the

48
00:02:16,340 --> 00:02:13,740
missions that we've had

49
00:02:18,560 --> 00:02:16,350
to Mars since Mars Global Surveyor and

50
00:02:21,800 --> 00:02:18,570
with that we've had orbiters and Landers

51
00:02:23,840 --> 00:02:21,810
and with each successive mission we've

52
00:02:26,150 --> 00:02:23,850
been all to increase the spectral and

53
00:02:27,890 --> 00:02:26,160
spatial resolution of art look at the

54
00:02:30,050 --> 00:02:27,900
Red Planet and we learned so much more

55
00:02:31,910 --> 00:02:30,060
we've learned that Mars is a dynamic

56
00:02:35,390 --> 00:02:31,920
planet we've learned that it has a

57
00:02:37,100 --> 00:02:35,400
history where it was warm and wet at the

58
00:02:39,500 --> 00:02:37,110
same time that life started here on

59
00:02:41,990 --> 00:02:39,510
earth and we know that it's gone through

60
00:02:45,080 --> 00:02:42,000
a massive transition from that more

61
00:02:48,140 --> 00:02:45,090
benign planet of early on to what it is

62
00:02:50,570 --> 00:02:48,150
today and so we're actually here to give

63
00:02:53,300 --> 00:02:50,580

you a rundown on some of the things that

64
00:02:55,670 --> 00:02:53,310
we've learned in the last 10-15 years

65
00:02:58,100 --> 00:02:55,680
about the red planet that encouraged us

66
00:03:00,590 --> 00:02:58,110
to think that Mars is worth exploring

67
00:03:02,840 --> 00:03:00,600
for many different reasons including the

68
00:03:04,210 --> 00:03:02,850
potential of having been habitable at

69
00:03:07,130 --> 00:03:04,220
least in its past

70
00:03:09,830 --> 00:03:07,140
George thank you Michael and now to

71
00:03:11,720 --> 00:03:09,840
Bethany Elmen the scientists from the

72
00:03:13,310 --> 00:03:11,730
Jet Propulsion Laboratory and assistant

73
00:03:14,390 --> 00:03:13,320
professor from the California Institute

74
00:03:18,290 --> 00:03:14,400
of Technology

75
00:03:19,520 --> 00:03:18,300
Bethany so so I have the privilege of

76
00:03:21,800 --> 00:03:19,530
talking to you about some of the

77
00:03:24,110 --> 00:03:21,810
discoveries from this flotilla of

78
00:03:26,360 --> 00:03:24,120
missions that we've sent to Mars over

79
00:03:27,830 --> 00:03:26,370
the past decade and if we can start with

80
00:03:29,690 --> 00:03:27,840
the first graphic I mean I'm gonna begin

81
00:03:33,080 --> 00:03:29,700
the story with what we know about Mars

82
00:03:34,400 --> 00:03:33,090
as it is today so these are these are

83
00:03:37,670 --> 00:03:34,410
the top highlights of what we know about

84
00:03:39,770 --> 00:03:37,680
Mars today and so Mars today on this

85
00:03:43,280 --> 00:03:39,780
graphic is is what you see in the top

86
00:03:46,940 --> 00:03:43,290
left of this picture Mars like Earth is

87
00:03:48,980 --> 00:03:46,950
tilted on its axis and as it's spinning

88
00:03:51,050 --> 00:03:48,990

like a top so as Mars has seasons you

89
00:03:55,250 --> 00:03:51,060
can see the two polar ice caps at the

90
00:03:58,040 --> 00:03:55,260
north and south of Mars but Mars unlike

91
00:03:59,750 --> 00:03:58,050
Earth is not stable around around it

92
00:04:03,350 --> 00:03:59,760
spinning axis so what happens is that

93
00:04:05,000 --> 00:04:03,360
Mars is axis tilts okay and what we

94
00:04:06,530 --> 00:04:05,010
found through a combination of modeling

95
00:04:08,570 --> 00:04:06,540
and observations of the surface is that

96
00:04:10,910 --> 00:04:08,580
this results in in ice ages on

97
00:04:12,830 --> 00:04:10,920
modern-day Mars you can see that when

98
00:04:13,160 --> 00:04:12,840
Mars is tilted more extremely than it is

99
00:04:15,380 --> 00:04:13,170
today

100
00:04:17,479 --> 00:04:15,390
ice builds up around the equator when

101
00:04:20,630 --> 00:04:17,489
Mars sort of straightens out along its

102
00:04:22,490 --> 00:04:20,640
axis the poles grow in size so the this

103
00:04:24,200 --> 00:04:22,500
changing distribution of ice is one of

104
00:04:25,700 --> 00:04:24,210
the emerging stories that's come out of

105
00:04:27,290 --> 00:04:25,710
come out of the work of the recent

106
00:04:30,110 --> 00:04:27,300
decades and if we go to the next

107
00:04:31,520 --> 00:04:30,120
slide we see evidence of this the

108
00:04:33,110 --> 00:04:31,530
high-rise camera on the Mars

109
00:04:34,369 --> 00:04:33,120
Reconnaissance Orbiter it's able to

110
00:04:36,649 --> 00:04:34,379
examine the surface at very high

111
00:04:38,749 --> 00:04:36,659
resolution what we found is that that

112
00:04:42,290 --> 00:04:38,759
impact craters that impact into the mid

113
00:04:44,659 --> 00:04:42,300

latitudes of Mars have excavated ice

114
00:04:45,980 --> 00:04:44,669
from beneath the surface and that's what

115
00:04:48,320 --> 00:04:45,990
you see in this image here ice

116
00:04:50,270 --> 00:04:48,330
associated with these small craters now

117
00:04:52,640 --> 00:04:50,280
this ice isn't isn't stable at the

118
00:04:55,070 --> 00:04:52,650
surface it's a relict of these of these

119
00:04:57,020 --> 00:04:55,080
paths tilts and changes in Mars as

120
00:04:58,520 --> 00:04:57,030
obliquity and so if we look back at this

121
00:05:00,170 --> 00:04:58,530
on the order of a few weeks in a few

122
00:05:03,290 --> 00:05:00,180
months at the same spot the ice is gone

123
00:05:05,930 --> 00:05:03,300
but it but it's a hint at past climate

124
00:05:08,930 --> 00:05:05,940
change if we head to the next graphic

125
00:05:11,839 --> 00:05:08,940
the other hint of this changing dynamic

126
00:05:14,180 --> 00:05:11,849
modern Mars is is in this recent

127
00:05:18,529 --> 00:05:14,190
discovery where you can see from right

128
00:05:21,439 --> 00:05:18,539
to left these dark streaks emanating

129
00:05:25,100 --> 00:05:21,449
from the walls of a crater these these

130
00:05:27,140 --> 00:05:25,110
streaks were recently in a recent paper

131
00:05:28,909 --> 00:05:27,150
by Alfred McEwen at all the best

132
00:05:31,809 --> 00:05:28,919
hypothesis we have to explain those

133
00:05:34,519 --> 00:05:31,819
streaks is that they're formed by

134
00:05:36,680 --> 00:05:34,529
short-term discharge of briny waters

135
00:05:39,409 --> 00:05:36,690
when when modern-day mars heats up

136
00:05:41,180 --> 00:05:39,419
during the summer for a brief period in

137
00:05:43,610 --> 00:05:41,190
time is ephemeral quick period of time

138
00:05:46,010 --> 00:05:43,620

we may in fact have salty waters on Mars

139
00:05:48,019 --> 00:05:46,020
so if we go to the next graphic I've

140
00:05:51,320 --> 00:05:48,029
talked to you about modern Mars the

141
00:05:53,809 --> 00:05:51,330
story of ice very very very short term

142
00:05:56,330 --> 00:05:53,819
rare water but if we look at ancient

143
00:05:58,850 --> 00:05:56,340
Mars this is a topographic map where red

144
00:06:00,350 --> 00:05:58,860
is high elevations blue is low

145
00:06:02,330 --> 00:06:00,360
elevations we're looking at the Mars

146
00:06:04,820 --> 00:06:02,340
globe and I've oriented it so that you

147
00:06:07,779 --> 00:06:04,830
can see Mars has these enormous outflow

148
00:06:10,999 --> 00:06:07,789
channels and valleys that that flow out

149
00:06:12,830 --> 00:06:11,009
where water previously flowed out into

150
00:06:15,950 --> 00:06:12,840
the northern lowlands that's that blue

151
00:06:18,800 --> 00:06:15,960
low depression toward the toward the

152
00:06:23,510 --> 00:06:18,810
left-hand side of the screen so liquid

153
00:06:26,240 --> 00:06:23,520
water was not short-term in the past we

154
00:06:28,279 --> 00:06:26,250
know that it carved had had a role in

155
00:06:30,619 --> 00:06:28,289
carving out these large channels if we

156
00:06:33,230 --> 00:06:30,629
head to the next graphic it also had a

157
00:06:35,689 --> 00:06:33,240
role in depositing sediments within

158
00:06:37,339 --> 00:06:35,699
craters now this isn't this is a an

159
00:06:38,510 --> 00:06:37,349
image that's a combination of some of

160
00:06:40,130 --> 00:06:38,520
the datasets from the Mars

161
00:06:41,870 --> 00:06:40,140
Reconnaissance Orbiter

162
00:06:44,030 --> 00:06:41,880
the high-resolution camera the context

163
00:06:46,250 --> 00:06:44,040

imager and an overlay nur our colors

164
00:06:48,770 --> 00:06:46,260
from the from the chrism infrared

165
00:06:52,370 --> 00:06:48,780
spectrometer and these colors along with

166
00:06:54,650 --> 00:06:52,380
the the spectra from pixels in this

167
00:06:57,020 --> 00:06:54,660
image allow us to get at the composition

168
00:06:59,690 --> 00:06:57,030
of these sedimentary materials that were

169
00:07:02,390 --> 00:06:59,700
carried by the water and now the key the

170
00:07:04,640 --> 00:07:02,400
key color here is the green because the

171
00:07:07,040 --> 00:07:04,650
green materials have been identified as

172
00:07:10,550 --> 00:07:07,050
clays and carbonates now these are

173
00:07:12,740 --> 00:07:10,560
minerals that form in the presence of

174
00:07:16,160 --> 00:07:12,750
liquid water in the clays in particular

175
00:07:18,470 --> 00:07:16,170
indicate the long-term presence of water

176
00:07:20,810 --> 00:07:18,480
interacting with the rocks causing

177
00:07:23,830 --> 00:07:20,820
alteration of minerals clay minerals

178
00:07:27,230 --> 00:07:23,840
also have water in their structure and

179
00:07:29,470 --> 00:07:27,240
if we go to the next graphic we see

180
00:07:32,030 --> 00:07:29,480
these clay minerals and and other

181
00:07:35,150 --> 00:07:32,040
hydrated minerals so minerals with water

182
00:07:36,680 --> 00:07:35,160
in the structure in different geological

183
00:07:38,960 --> 00:07:36,690
settings throughout the planet this is

184
00:07:40,610 --> 00:07:38,970
just another example that we're able to

185
00:07:42,170 --> 00:07:40,620
get at now with this high spatial and

186
00:07:45,050 --> 00:07:42,180
spectral resolution of Mars where we can

187
00:07:46,400 --> 00:07:45,060
pick out in in the walls of this crater

188
00:07:48,440 --> 00:07:46,410

kind of like that the pages in a book

189
00:07:50,900 --> 00:07:48,450
two different pages in Mars history

190
00:07:53,360 --> 00:07:50,910
where we're early in Mars history we had

191
00:07:55,370 --> 00:07:53,370
an alteration that process that formed

192
00:07:57,560 --> 00:07:55,380
iron magnesium clays maybe not so much

193
00:07:59,180 --> 00:07:57,570
water flushing through possibly in the

194
00:08:02,030 --> 00:07:59,190
subsurface but on the top we have this

195
00:08:03,740 --> 00:08:02,040
this this this unit with a higher degree

196
00:08:06,260 --> 00:08:03,750
of leaching forming aluminium cave

197
00:08:08,510 --> 00:08:06,270
aluminum clay so two distinct periods in

198
00:08:10,640 --> 00:08:08,520
Mars history recorded in these strata if

199
00:08:13,280 --> 00:08:10,650
we go to the next I'm just gonna provide

200
00:08:16,040 --> 00:08:13,290
another example because here we go from

201
00:08:18,560 --> 00:08:16,050
clay minerals clay minerals formed from

202
00:08:21,740 --> 00:08:18,570
long-term chemical interaction of water

203
00:08:25,550 --> 00:08:21,750
with rock and there the green color now

204
00:08:28,190 --> 00:08:25,560
the pink color is our sulfate minerals I

205
00:08:30,680 --> 00:08:28,200
did again salt minerals identified

206
00:08:33,910 --> 00:08:30,690
through spectroscopy now so this is just

207
00:08:38,210 --> 00:08:33,920
a subset a small snapshot from from a

208
00:08:40,490 --> 00:08:38,220
crater that's over a hundred miles in in

209
00:08:42,740 --> 00:08:40,500
diameter and what we see when we look

210
00:08:45,950 --> 00:08:42,750
around that crater is this bathtub ring

211
00:08:48,530 --> 00:08:45,960
of salts so in this crater it was once

212
00:08:50,870 --> 00:08:48,540
filled with water and upon evaporation

213
00:08:53,270 --> 00:08:50,880

deposited these sulfates sort of ringing

214
00:08:53,510 --> 00:08:53,280
around afterwards what does this all

215
00:08:54,020 --> 00:08:53,520
mean

216
00:08:56,090 --> 00:08:54,030
so if you

217
00:08:58,430 --> 00:08:56,100
the next graphic what we think this

218
00:09:01,700 --> 00:08:58,440
means is that we we can trace a

219
00:09:05,770 --> 00:09:01,710
progression in Mars history through both

220
00:09:08,090 --> 00:09:05,780
minerals and by careful examination of

221
00:09:10,940 --> 00:09:08,100
rock strata and a few key locations

222
00:09:14,180 --> 00:09:10,950
across the planet now on the bottom our

223
00:09:15,530 --> 00:09:14,190
new okyun Hesperian Amazonian they'll

224
00:09:17,060 --> 00:09:15,540
name their names you'll hear over the

225
00:09:18,980 --> 00:09:17,070
course of other press briefings which

226
00:09:20,810 --> 00:09:18,990
are the traditional divisions in Mars

227
00:09:23,500 --> 00:09:20,820
time what we think we see as we move

228
00:09:25,850 --> 00:09:23,510
toward from the noachian is this clay

229
00:09:28,220 --> 00:09:25,860
you're aware there was abundant water

230
00:09:29,840 --> 00:09:28,230
chemically interacting with rocks we

231
00:09:32,420 --> 00:09:29,850
move that and then into a drying period

232
00:09:35,210 --> 00:09:32,430
where you get sulfate salts deposited as

233
00:09:38,000 --> 00:09:35,220
the water begins to go away at the

234
00:09:40,400 --> 00:09:38,010
surface and then you're in cold modern

235
00:09:41,810 --> 00:09:40,410
Mars where ice is the story not liquid

236
00:09:44,180 --> 00:09:41,820
water so there's this fundamental

237
00:09:46,520 --> 00:09:44,190
transition between the noachian and the

238
00:09:48,830 --> 00:09:46,530

Amazonian between the area of era of

239
00:09:51,140 --> 00:09:48,840
clays to the area of sulfates to the

240
00:09:52,790 --> 00:09:51,150
area era of anhydrous minerals where

241
00:09:54,830 --> 00:09:52,800
water doesn't appear to play a role and

242
00:09:56,720 --> 00:09:54,840
it's that critical period that's spanned

243
00:09:59,000 --> 00:09:56,730
by the by the sediments at Gale Crater

244
00:10:03,320 --> 00:09:59,010
we want to understand those transitions

245
00:10:07,120 --> 00:10:03,330
so that's why we're headed there thank

246
00:10:09,650 --> 00:10:07,130
you very much and our next briefer is

247
00:10:11,420 --> 00:10:09,660
John grotzinger the project scientist

248
00:10:14,440 --> 00:10:11,430
for Mars Science Laboratory from the

249
00:10:17,450 --> 00:10:14,450
California Institute of Technology John

250
00:10:20,450 --> 00:10:17,460
thanks George so what I'd like to do is

251
00:10:23,780 --> 00:10:20,460
take you back again to a few decades ago

252
00:10:25,310 --> 00:10:23,790
and if we can have the first graphic one

253
00:10:27,500 --> 00:10:25,320
of the reasons one of the motivating

254
00:10:29,900 --> 00:10:27,510
reasons for the Viking mission to land

255
00:10:32,570 --> 00:10:29,910
and look for evidence of life on the

256
00:10:34,640 --> 00:10:32,580
surface of Mars was the discovery of the

257
00:10:36,770 --> 00:10:34,650
the channel network systems that you see

258
00:10:39,290 --> 00:10:36,780
here these have been studied for decades

259
00:10:41,690 --> 00:10:39,300
now I think it's safe to say that that

260
00:10:43,220 --> 00:10:41,700
that virtually the vast majority of the

261
00:10:45,340 --> 00:10:43,230
science community believes that these

262
00:10:48,380 --> 00:10:45,350
channels were cut by flowing water

263
00:10:50,660 --> 00:10:48,390

emerging from the surface subsurface may

264
00:10:52,490 --> 00:10:50,670
be flowing across the surface but it's

265
00:10:55,550 --> 00:10:52,500
these channel systems that originally

266
00:10:58,430 --> 00:10:55,560
attracted so much attention for Mars now

267
00:11:01,310 --> 00:10:58,440
and the more recent decade there have

268
00:11:02,960 --> 00:11:01,320
been some spectacular discoveries that

269
00:11:04,490 --> 00:11:02,970
sort of fill out the rest of the story

270
00:11:07,490 --> 00:11:04,500
because if you look at these channels

271
00:11:10,190 --> 00:11:07,500
it's natural to ask if if

272
00:11:12,980 --> 00:11:10,200
was flowing where would it take all the

273
00:11:16,430 --> 00:11:12,990
materials that were eroded away to to

274
00:11:19,100 --> 00:11:16,440
create the canyons so if you go to the

275
00:11:21,170 --> 00:11:19,110
next display item what we see here is a

276
00:11:22,940 --> 00:11:21,180
Delta called a bruise wall Delta it was

277
00:11:26,420 --> 00:11:22,950
one of the potential landing sites for

278
00:11:28,580 --> 00:11:26,430
the mission and and it's at the end of

279
00:11:30,830 --> 00:11:28,590
one of these channel networks and so we

280
00:11:33,620 --> 00:11:30,840
see all the material that got eroded by

281
00:11:35,570 --> 00:11:33,630
water here being deposited in water as a

282
00:11:38,870 --> 00:11:35,580
delta that almost everybody can

283
00:11:41,120 --> 00:11:38,880
recognize and and this is really amazing

284
00:11:43,010 --> 00:11:41,130
because in addition to this there was

285
00:11:45,500 --> 00:11:43,020
also the discovery of clay minerals here

286
00:11:48,170 --> 00:11:45,510
so we're beginning to see a more

287
00:11:50,810 --> 00:11:48,180
balanced picture of Mars one where you

288
00:11:53,930 --> 00:11:50,820

have source areas that represent the

289
00:11:56,000 --> 00:11:53,940
interaction of water with rock to

290
00:11:58,160 --> 00:11:56,010
produce sedimentary materials that

291
00:12:00,620 --> 00:11:58,170
contain alteration products like clays

292
00:12:03,020 --> 00:12:00,630
and then they get transported down river

293
00:12:05,330 --> 00:12:03,030
systems to form things like Delta's that

294
00:12:06,650 --> 00:12:05,340
would have accumulated in bodies of

295
00:12:08,870 --> 00:12:06,660
standing water and this is very

296
00:12:11,420 --> 00:12:08,880
attractive from a habitability point of

297
00:12:13,640 --> 00:12:11,430
view and it creates the basis then for

298
00:12:17,300 --> 00:12:13,650
Mars Science Laboratory to have had a

299
00:12:20,240 --> 00:12:17,310
very exciting landing site selection

300
00:12:21,530 --> 00:12:20,250
process so if we go to the next one now

301
00:12:24,530 --> 00:12:21,540
we're going to jump up here more

302
00:12:27,200 --> 00:12:24,540
recently within the last seven years the

303
00:12:29,329 --> 00:12:27,210
discoveries by the rover Opportunity in

304
00:12:31,880 --> 00:12:29,339
the Mars Exploration Rover mission and

305
00:12:34,100 --> 00:12:31,890
here we see a number of very important

306
00:12:36,860 --> 00:12:34,110
aspects that that take us into our

307
00:12:39,620 --> 00:12:36,870
understanding of modern Mars one is is

308
00:12:43,070 --> 00:12:39,630
that we see layered rock sedimentary

309
00:12:45,110 --> 00:12:43,080
rock and the sedimentary rock on Mars we

310
00:12:47,390 --> 00:12:45,120
view in an analogous way to sedimentary

311
00:12:50,660 --> 00:12:47,400
rocks on earth which are the principal

312
00:12:54,170 --> 00:12:50,670
repository for all the the records of

313
00:12:56,300 --> 00:12:54,180

life on Earth and while Mars Science

314
00:12:58,579 --> 00:12:56,310
Laboratory is not a life detection

315
00:13:01,130 --> 00:12:58,589
mission we are on a mission to to

316
00:13:03,650 --> 00:13:01,140
investigate the building blocks of life

317
00:13:06,350 --> 00:13:03,660
important chemical elements and also

318
00:13:09,470 --> 00:13:06,360
potentially look for organic compounds

319
00:13:11,630 --> 00:13:09,480
and when you have what a geologist calls

320
00:13:13,730 --> 00:13:11,640
a model like this where you can look at

321
00:13:16,460 --> 00:13:13,740
the rocks and see that you had ancient

322
00:13:18,490 --> 00:13:16,470
sand dunes environments where there was

323
00:13:20,300 --> 00:13:18,500
ancient groundwater and then

324
00:13:20,900 --> 00:13:20,310
environments where you had ancient

325
00:13:22,880 --> 00:13:20,910
streams

326
00:13:25,460 --> 00:13:22,890
this gives you a whole diversity of

327
00:13:27,410 --> 00:13:25,470
potentially different habitats this is

328
00:13:29,000 --> 00:13:27,420
just one example on Mars you can go back

329
00:13:31,370 --> 00:13:29,010
to the locations that Bethany was

330
00:13:33,500 --> 00:13:31,380
talking about very ancient Mars and you

331
00:13:36,400 --> 00:13:33,510
see a different type of geological

332
00:13:39,260 --> 00:13:36,410
history and a very different type of

333
00:13:41,390 --> 00:13:39,270
potentially habitable environments so

334
00:13:43,580 --> 00:13:41,400
we're just on the cusp of beginning to

335
00:13:45,620 --> 00:13:43,590
come up with a whole range of these

336
00:13:48,370 --> 00:13:45,630
possibilities for us to explore into the

337
00:13:52,010 --> 00:13:48,380
future okay so in the next one

338
00:13:53,450 --> 00:13:52,020

now we take us into as Bethany mentioned

339
00:13:55,640 --> 00:13:53,460
there were the three eras where you went

340
00:13:57,800 --> 00:13:55,650
from dominantly clays time when

341
00:14:00,260 --> 00:13:57,810
weathering alteration and water produced

342
00:14:02,720 --> 00:14:00,270
clays to a time when alteration of water

343
00:14:04,760 --> 00:14:02,730
produced a lot of sulfate minerals to a

344
00:14:07,430 --> 00:14:04,770
time when apparently there were not many

345
00:14:09,110 --> 00:14:07,440
hydrated minerals that were formed yet

346
00:14:11,570 --> 00:14:09,120
we still see the accumulation of

347
00:14:13,640 --> 00:14:11,580
sedimentary materials and you might ask

348
00:14:16,070 --> 00:14:13,650
what do you learn about Mars in the

349
00:14:19,130 --> 00:14:16,080
absence of water or in the absence of a

350
00:14:21,140 --> 00:14:19,140
potentially habitable environment for

351
00:14:23,390 --> 00:14:21,150
life if it had evolved on Mars and this

352
00:14:26,090 --> 00:14:23,400
beautiful example of that you see these

353
00:14:27,860 --> 00:14:26,100
very well-organized strata this is like

354
00:14:30,500 --> 00:14:27,870
a heartbeat except this is the heartbeat

355
00:14:32,120 --> 00:14:30,510
of the planets climate cycle so just

356
00:14:34,910 --> 00:14:32,130
like on earth we're very interested in

357
00:14:37,880 --> 00:14:34,920
climate change on Mars we see this very

358
00:14:40,940 --> 00:14:37,890
rhythmic alternation of layers that

359
00:14:43,070 --> 00:14:40,950
creates a really spectacular record of

360
00:14:45,260 --> 00:14:43,080
past climate change on Mars and then

361
00:14:46,640 --> 00:14:45,270
that takes us to the era that Bethany

362
00:14:49,100 --> 00:14:46,650
talked about first where Mars is

363
00:14:51,770 --> 00:14:49,110

dominated more by ice and a very cold

364
00:14:54,170 --> 00:14:51,780
climate and atmospheric processes and

365
00:14:56,840 --> 00:14:54,180
transport of sediments by wind rather

366
00:14:58,370 --> 00:14:56,850
than water so we see we can see in the

367
00:15:01,340 --> 00:14:58,380
rock record these these different

368
00:15:04,130 --> 00:15:01,350
histories ok so now if we go to the next

369
00:15:06,170 --> 00:15:04,140
one what we see here is our destination

370
00:15:09,200 --> 00:15:06,180
for Mars Science Laboratory this is Gale

371
00:15:11,290 --> 00:15:09,210
Crater you'll hear a lot about it

372
00:15:15,950 --> 00:15:11,300
tomorrow at the press briefing tomorrow

373
00:15:17,930 --> 00:15:15,960
there is a crater about 150 kilometers

374
00:15:20,090 --> 00:15:17,940
in diameter that's about as big as the

375
00:15:21,710 --> 00:15:20,100
Los Angeles basin surrounded by the

376
00:15:23,750 --> 00:15:21,720
mountains that ringed the Los Angeles

377
00:15:26,840 --> 00:15:23,760
basin and right there in the middle of

378
00:15:28,580 --> 00:15:26,850
it is a mountain about five kilometers

379
00:15:31,220 --> 00:15:28,590
high that's as high as Mount Whitney

380
00:15:34,210 --> 00:15:31,230
which is the tallest mountain and in the

381
00:15:35,950 --> 00:15:34,220
lower 48 states and if you go from the

382
00:15:37,960 --> 00:15:35,960
yellow dot which is in the center of our

383
00:15:40,150 --> 00:15:37,970
landing ellipse we have the ability to

384
00:15:44,500 --> 00:15:40,160
traverse in our mission through the

385
00:15:46,180 --> 00:15:44,510
first few hundred meters of strata that

386
00:15:48,130 --> 00:15:46,190
you see there and then eventually over

387
00:15:50,290 --> 00:15:48,140
an extended mission it might be possible

388
00:15:51,610 --> 00:15:50,300

to go to the top of that Mound but the

389
00:15:54,190 --> 00:15:51,620
important thing I wanted to say about

390
00:15:55,510 --> 00:15:54,200
the mound today to sort of walk in some

391
00:15:57,790 --> 00:15:55,520
of the points that we've been talking

392
00:16:00,400 --> 00:15:57,800
about at the base of the mound you see

393
00:16:03,250 --> 00:16:00,410
strata that are composed of clays and

394
00:16:05,320 --> 00:16:03,260
sulfates as you go farther up the mound

395
00:16:08,170 --> 00:16:05,330
you see strata that are composed of

396
00:16:11,590 --> 00:16:08,180
dominantly sulfates and then as you get

397
00:16:14,110 --> 00:16:11,600
above you know the first 500 meters or

398
00:16:15,910 --> 00:16:14,120
so you then go into strata that don't

399
00:16:17,980 --> 00:16:15,920
have hydrated minerals they seem to be

400
00:16:23,230 --> 00:16:17,990
composed of these rhythmites from the

401
00:16:25,330 --> 00:16:23,240
drier time of Mars so in one location we

402
00:16:27,010 --> 00:16:25,340
can drive the rover through all these

403
00:16:29,350 --> 00:16:27,020
successive different environments and

404
00:16:31,110 --> 00:16:29,360
sample these various periods in the

405
00:16:33,310 --> 00:16:31,120
history of Mars that we've talked about

406
00:16:35,560 --> 00:16:33,320
so I'll turn it back to George all right

407
00:16:37,900 --> 00:16:35,570
thanks very much we're ready now to take

408
00:16:39,760 --> 00:16:37,910
questions so please give your name and

409
00:16:41,260 --> 00:16:39,770
affiliation when the microphone comes to

410
00:16:45,400 --> 00:16:41,270
you and we'll start right here in the

411
00:16:48,430 --> 00:16:45,410
front hi Kent Cramer for Space Flight

412
00:16:49,870 --> 00:16:48,440
magazine for Bethany and anyone else who

413
00:16:51,910 --> 00:16:49,880

wants to answer please a couple of

414
00:16:55,000 --> 00:16:51,920
questions can you describe the Clay's

415
00:16:56,860 --> 00:16:55,010
how widespread they are on Mars or and

416
00:17:00,070 --> 00:16:56,870
the sulfates are they very narrow or

417
00:17:01,690 --> 00:17:00,080
they're pretty widespread right so so I

418
00:17:02,680 --> 00:17:01,700
should say that clays and sulfates are

419
00:17:06,880 --> 00:17:02,690
something that that weren't even

420
00:17:08,800 --> 00:17:06,890
discovered until until 2004 with the the

421
00:17:10,570 --> 00:17:08,810
Mars Express mission from Europe so

422
00:17:14,050 --> 00:17:10,580
they'd eluded detection so far and

423
00:17:16,540 --> 00:17:14,060
that's because the exposures where we're

424
00:17:17,710 --> 00:17:16,550
able to see them are very small and it

425
00:17:18,670 --> 00:17:17,720
makes sense if you think about the fact

426
00:17:19,900 --> 00:17:18,680
that they're ancient

427
00:17:23,140 --> 00:17:19,910
and because they're ancient they're

428
00:17:25,120 --> 00:17:23,150
buried by later materials so it's so

429
00:17:26,380 --> 00:17:25,130
with this high spatial resolution we're

430
00:17:29,410 --> 00:17:26,390
able to see them and where do we see

431
00:17:31,180 --> 00:17:29,420
them so clays to the extent that we are

432
00:17:35,260 --> 00:17:31,190
able to figure it out they seem to be

433
00:17:38,170 --> 00:17:35,270
globally widespread but frequently

434
00:17:41,230 --> 00:17:38,180
buried and the way they're exposed often

435
00:17:42,730 --> 00:17:41,240
is is in impact craters where again we

436
00:17:44,860 --> 00:17:42,740
punched through the surface and and

437
00:17:47,380 --> 00:17:44,870
these clays are thrown out for us to be

438
00:17:47,890 --> 00:17:47,390

able to see them we also have a few

439
00:17:49,960 --> 00:17:47,900
places

440
00:17:52,480 --> 00:17:49,970
where tectonic activity has exposed a

441
00:17:55,570 --> 00:17:52,490
nice thick stratigraphic section with

442
00:17:59,350 --> 00:17:55,580
the clays but they do appear to Clay's

443
00:18:05,380 --> 00:17:59,360
do appear to be global the sulfates also

444
00:18:07,060 --> 00:18:05,390
are regionally global if that makes

445
00:18:09,490 --> 00:18:07,070
sense there are a few regions scattered

446
00:18:13,390 --> 00:18:09,500
throughout the planet where we see

447
00:18:15,340 --> 00:18:13,400
sulfates it appears and that some work

448
00:18:17,950 --> 00:18:15,350
on hydrologic modeling modeling ground

449
00:18:19,660 --> 00:18:17,960
water flow through Mars and orbital

450
00:18:21,610 --> 00:18:19,670
detections of sulfates are starting to

451
00:18:23,860 --> 00:18:21,620
converge or it looks like where we see

452
00:18:25,600 --> 00:18:23,870
the sulfates are these zones it where

453
00:18:29,340 --> 00:18:25,610
it's predicted that ground waters would

454
00:18:34,480 --> 00:18:29,350
be upwelling and reaching the surface

455
00:18:37,000 --> 00:18:34,490
and for John could you tell me I think

456
00:18:40,420 --> 00:18:37,010
you said these channels you believe most

457
00:18:42,370 --> 00:18:40,430
are by water formed by water so you say

458
00:18:43,570 --> 00:18:42,380
that about Valles Marineris it's mostly

459
00:18:46,930 --> 00:18:43,580
water you don't think it's carbon

460
00:18:50,590 --> 00:18:46,940
dioxide and also how long is that

461
00:18:52,510 --> 00:18:50,600
distance from the yellow dot to the red

462
00:18:55,180 --> 00:18:52,520
dot how quickly could you drive the

463
00:18:57,730 --> 00:18:55,190

rover right a couple of questions there

464
00:18:59,410 --> 00:18:57,740
I think that you know for for a long

465
00:19:00,850 --> 00:18:59,420
time as long as people have seen the

466
00:19:03,130 --> 00:19:00,860
channels there's been a discussion about

467
00:19:06,610 --> 00:19:03,140
what the liquid was that it carved them

468
00:19:08,770 --> 00:19:06,620
out and and I as I said I think that

469
00:19:10,930 --> 00:19:08,780
this is now stabilized on water as being

470
00:19:12,640 --> 00:19:10,940
the most likely material and that's been

471
00:19:14,770 --> 00:19:12,650
bolster recently by the discovery of

472
00:19:16,960 --> 00:19:14,780
hydrated minerals that do occur as

473
00:19:19,810 --> 00:19:16,970
transport weathering products in these

474
00:19:21,730 --> 00:19:19,820
in these channels it's it's a it was a

475
00:19:23,560 --> 00:19:21,740
prediction of that model it was observed

476
00:19:25,270 --> 00:19:23,570
independently and I think it Shores the

477
00:19:26,710 --> 00:19:25,280
whole thing up

478
00:19:28,120 --> 00:19:26,720
the second question about Valles

479
00:19:29,920 --> 00:19:28,130
Marineris Valles Marineris is a

480
00:19:32,620 --> 00:19:29,930
different feature it's not produced by

481
00:19:34,570 --> 00:19:32,630
erosion it's dominantly produced by

482
00:19:36,940 --> 00:19:34,580
tectonic processes that involve big

483
00:19:40,000 --> 00:19:36,950
crustal motions that drop blocks down

484
00:19:42,640 --> 00:19:40,010
and at the base of Mount Valles

485
00:19:45,220 --> 00:19:42,650
Marineris you do get the successions of

486
00:19:47,530 --> 00:19:45,230
sulfates one of the attractions of Gale

487
00:19:50,050 --> 00:19:47,540
to us is that without being able to fly

488
00:19:51,550 --> 00:19:50,060

into Valles Marineris we capture a lot

489
00:19:53,500 --> 00:19:51,560
of the interest that you would get in

490
00:19:56,680 --> 00:19:53,510
going to Valles Marineris because the

491
00:19:58,960 --> 00:19:56,690
the bottom flares in Gale Crater are

492
00:20:01,300 --> 00:19:58,970
composed dominantly of sulfates and they

493
00:20:03,340 --> 00:20:01,310
sit in a very low topographic

494
00:20:05,920 --> 00:20:03,350
lower than the floor of Valles Marineris

495
00:20:07,960 --> 00:20:05,930
so it's not the same as Valles Marineris

496
00:20:10,300 --> 00:20:07,970
but it's maybe as close as you can get

497
00:20:12,610 --> 00:20:10,310
and then the last question about the

498
00:20:15,520 --> 00:20:12,620
distance you know our landing ellipse is

499
00:20:17,350 --> 00:20:15,530
about 20 kilometers in diameter so we

500
00:20:19,510 --> 00:20:17,360
would drive outside of the landing

501
00:20:22,150 --> 00:20:19,520
ellipse on the order of about 12

502
00:20:24,220 --> 00:20:22,160
kilometers to get to the first

503
00:20:28,210 --> 00:20:24,230
well-developed sulphate deposits in

504
00:20:34,930 --> 00:20:28,220
clays we have a question here in the

505
00:20:36,790 --> 00:20:34,940
back did you have a question Chris

506
00:20:40,660 --> 00:20:36,800
Hebert United television network

507
00:20:45,460 --> 00:20:40,670
I was wondering with the the recent

508
00:20:47,590 --> 00:20:45,470
discovery of shifting the sand dunes are

509
00:20:50,170 --> 00:20:47,600
you planning on using curiosity if

510
00:20:52,000 --> 00:20:50,180
there's anything on board that you might

511
00:20:53,860 --> 00:20:52,010
be able to investigate further with the

512
00:20:59,380 --> 00:20:53,870
existing equipment that's already built

513
00:21:00,550 --> 00:20:59,390

into the Rover yeah that would be a good

514
00:21:01,930 --> 00:21:00,560
question to bring up again tomorrow

515
00:21:04,360 --> 00:21:01,940
because we'll have the principal

516
00:21:07,540 --> 00:21:04,370
investigator of the of the camera here

517
00:21:10,690 --> 00:21:07,550
and that's one of his his real interests

518
00:21:14,980 --> 00:21:10,700
and so we have the ability to to measure

519
00:21:16,690 --> 00:21:14,990
the wind speed on on curiosity what

520
00:21:19,540 --> 00:21:16,700
direction the wind is blowing in and

521
00:21:22,090 --> 00:21:19,550
then make measurements of the surface

522
00:21:23,770 --> 00:21:22,100
topography of the dunes and see if sand

523
00:21:28,330 --> 00:21:23,780
as is being transported we should be

524
00:21:30,300 --> 00:21:28,340
able to do that Marsha Associated Press

525
00:21:33,480 --> 00:21:30,310
probably for dr. Maier but I'm not sure

526
00:21:36,190 --> 00:21:33,490
of the previous Mars missions the

527
00:21:38,380 --> 00:21:36,200
several dozen that there have been how

528
00:21:40,600 --> 00:21:38,390
many besides this one have actually

529
00:21:43,630 --> 00:21:40,610
looked directly or indirectly at the

530
00:21:45,720 --> 00:21:43,640
life issue and what have what have you

531
00:21:48,670 --> 00:21:45,730
learned so far that this will build upon

532
00:21:51,340 --> 00:21:48,680
well I actually like to call cure on

533
00:21:54,010 --> 00:21:51,350
curiosity the first astrobiology mission

534
00:21:55,660 --> 00:21:54,020
since Viking and basically that's

535
00:21:58,150 --> 00:21:55,670
because we're sending a gas

536
00:22:00,220 --> 00:21:58,160
chromatograph mass spectrometer which

537
00:22:02,290 --> 00:22:00,230
can look at look for organics and

538
00:22:04,720 --> 00:22:02,300

characterize them and essentially it's

539
00:22:07,090 --> 00:22:04,730
similar much better but similar to the

540
00:22:08,890 --> 00:22:07,100
instrument that was sent on Viking here

541
00:22:10,930 --> 00:22:08,900
there are huge advantages that you can

542
00:22:13,410 --> 00:22:10,940
Rove to wherever you think is the best

543
00:22:16,900 --> 00:22:13,420
thing to measure

544
00:22:21,760 --> 00:22:16,910
there's been this gaps in essentially in

545
00:22:26,260 --> 00:22:21,770
your mind Phoenix had a gas Cremona gas

546
00:22:28,660 --> 00:22:26,270
chromatograph mass spec on it that was

547
00:22:30,720 --> 00:22:28,670
able could have measured organics if

548
00:22:33,790 --> 00:22:30,730
there was you know a sufficient amount

549
00:22:37,030 --> 00:22:33,800
but it couldn't move around and is also

550
00:22:41,200 --> 00:22:37,040
on a the northern Pollard layer terrain

551
00:22:43,240 --> 00:22:41,210
so in many ways it's it's goal was

552
00:22:47,890 --> 00:22:43,250
appointed more toward understanding the

553
00:22:51,340 --> 00:22:47,900
formation of the layer terrain and what

554
00:22:53,110 --> 00:22:51,350
the polar areas are like so curiosity I

555
00:22:56,230 --> 00:22:53,120
think is really the first one since

556
00:22:59,920 --> 00:22:56,240
biking to approach the life question now

557
00:23:04,390 --> 00:22:59,930
I should be clear that it doesn't have a

558
00:23:05,860 --> 00:23:04,400
life detection instrument on it in the

559
00:23:07,480 --> 00:23:05,870
sense that a camera is not a life

560
00:23:11,560 --> 00:23:07,490
detection instrument unless something

561
00:23:15,250 --> 00:23:11,570
hops in front of it so the capability of

562
00:23:17,110 --> 00:23:15,260
the of Sam the sample analysis at Mars

563
00:23:19,330 --> 00:23:17,120

which is the gas chromatograph mass spec

564
00:23:21,820 --> 00:23:19,340
is that it can look at organics and

565
00:23:24,250 --> 00:23:21,830
characterize them and make you more

566
00:23:28,330 --> 00:23:24,260
interested in Mars and what what secrets

567
00:23:29,950 --> 00:23:28,340
that might hold but unless you're

568
00:23:30,970 --> 00:23:29,960
extremely lucky it's not going to tell

569
00:23:36,160 --> 00:23:30,980
you whether or not you've found evidence

570
00:23:38,040 --> 00:23:36,170
of life ask another question um what is

571
00:23:40,090 --> 00:23:38,050
it about Morris it makes it so

572
00:23:42,970 --> 00:23:40,100
treacherous getting there so many

573
00:23:45,730 --> 00:23:42,980
missions have failed including one in

574
00:23:48,820 --> 00:23:45,740
Earth orbit right now what what what is

575
00:23:52,960 --> 00:23:48,830
it about Mars that makes it so tricky so

576
00:23:58,000 --> 00:23:52,970
difficult to get to one one one thirty

577
00:24:00,820 --> 00:23:58,010
is gremlins the other it's just I'm not

578
00:24:04,030 --> 00:24:00,830
sure why we've been that unlucky and it

579
00:24:07,150 --> 00:24:04,040
may be that early on in in planetary

580
00:24:11,770 --> 00:24:07,160
exploration Mars was a target such that

581
00:24:13,180 --> 00:24:11,780
as our space faring agencies we're

582
00:24:14,950 --> 00:24:13,190
coming up to speed to how to do

583
00:24:16,690 --> 00:24:14,960
planetary missions their first target

584
00:24:20,530 --> 00:24:16,700
was Mars so there's a lot of failures

585
00:24:22,900 --> 00:24:20,540
early on and just you know just with how

586
00:24:25,720 --> 00:24:22,910
two rockets work how do you get there

587
00:24:26,290 --> 00:24:25,730
so I think there was a big learning

588
00:24:29,770 --> 00:24:26,300

curve

589
00:24:32,020 --> 00:24:29,780
and now we're just running into Mars is

590
00:24:34,510 --> 00:24:32,030
difficult and so many things have to go

591
00:24:36,460 --> 00:24:34,520
right for a mission to work but we have

592
00:24:43,450 --> 00:24:36,470
a much better track record than we did

593
00:24:49,510 --> 00:24:43,460
in in the 70s dan dan billow from w e sh

594
00:24:51,490 --> 00:24:49,520
t v-- on the the time-lapse photo you

595
00:24:55,090 --> 00:24:51,500
had that looked so much like surface

596
00:24:58,330 --> 00:24:55,100
water give me a ballpark estimate if you

597
00:25:02,340 --> 00:24:58,340
can on how long that might persist hours

598
00:25:04,240 --> 00:25:02,350
or days and if you have any idea and

599
00:25:07,570 --> 00:25:04,250
would you discuss a little bit more

600
00:25:10,120 --> 00:25:07,580
about but to what extent the planet has

601
00:25:14,980 --> 00:25:10,130
kind of a subsurface layer of ice do you

602
00:25:18,100 --> 00:25:14,990
think that that's the case so water

603
00:25:21,190 --> 00:25:18,110
liquid water is not stable on the on the

604
00:25:22,780 --> 00:25:21,200
surface of Mars today so so as for how

605
00:25:24,310 --> 00:25:22,790
long it sticks around well it's how long

606
00:25:26,410 --> 00:25:24,320
it takes for it to evaporate so we're

607
00:25:29,200 --> 00:25:26,420
probably talking on the order of a few

608
00:25:30,760 --> 00:25:29,210
minutes but what happens when when that

609
00:25:33,220 --> 00:25:30,770
water is at the surface it causes all

610
00:25:34,810 --> 00:25:33,230
these noticeable geological changes that

611
00:25:38,490 --> 00:25:34,820
we that we can then track but we're

612
00:25:43,720 --> 00:25:38,500
talking really short periods of time but

613
00:25:45,610 --> 00:25:43,730

those features form and lengthen over a

614
00:25:47,350 --> 00:25:45,620
Mars it starts you know kind of in the

615
00:25:50,020 --> 00:25:47,360
spring goes for the summer and then they

616
00:25:52,110 --> 00:25:50,030
disappear in the fall and this happened

617
00:25:55,930 --> 00:25:52,120
on successive seasons

618
00:25:59,500 --> 00:25:55,940
so although liquid water at the surface

619
00:26:01,780 --> 00:25:59,510
may be very short time the moisture

620
00:26:06,160 --> 00:26:01,790
that's causing those features to form

621
00:26:08,440 --> 00:26:06,170
last over a whole season and at a

622
00:26:10,780 --> 00:26:08,450
subsurface layer of ice or water what

623
00:26:12,400 --> 00:26:10,790
are your thoughts on that yeah the

624
00:26:14,740 --> 00:26:12,410
thought is that it's it's a subsurface

625
00:26:18,400 --> 00:26:14,750
layer of ice it's probably the most

626
00:26:20,110 --> 00:26:18,410
likely source for this water and one of

627
00:26:22,270 --> 00:26:20,120
the things that may be causing it to

628
00:26:24,280 --> 00:26:22,280
melt periodically is the presence of

629
00:26:25,510 --> 00:26:24,290
salts which just like you you throw salt

630
00:26:27,520 --> 00:26:25,520
on the road in the winter to get the

631
00:26:28,540 --> 00:26:27,530
snow to melt in those areas where

632
00:26:30,400 --> 00:26:28,550
there's a particularly high

633
00:26:31,900 --> 00:26:30,410
concentration of chloride salts you you

634
00:26:33,340 --> 00:26:31,910
also those may be the areas were

635
00:26:34,990 --> 00:26:33,350
preferentially you get these slope

636
00:26:37,040 --> 00:26:35,000
streaks to form over the course of the

637
00:26:39,560 --> 00:26:37,050
season

638
00:26:42,590 --> 00:26:39,570

and just one more I'm trying to get an

639
00:26:43,910 --> 00:26:42,600
idea if you have an idea of what the

640
00:26:45,740 --> 00:26:43,920
extent of that might be is there a

641
00:26:49,850 --> 00:26:45,750
notion of that water or a little bit or

642
00:26:54,470 --> 00:26:49,860
a lot or what you know well if we're

643
00:26:58,550 --> 00:26:54,480
talking ice and we're we're considering

644
00:27:00,950 --> 00:26:58,560
the entire subsurface of Mars there's

645
00:27:05,360 --> 00:27:00,960
probably at least a shallow seas worth

646
00:27:06,800 --> 00:27:05,370
of water in ice form beneath the surface

647
00:27:08,990 --> 00:27:06,810
but when we're talking about how much is

648
00:27:11,690 --> 00:27:09,000
available in liquid form it's only these

649
00:27:13,160 --> 00:27:11,700
these ephemeral short-lived slope

650
00:27:17,420 --> 00:27:13,170
streaks that appear to be occurring over

651
00:27:22,610 --> 00:27:17,430
the course of the season anyone have any

652
00:27:24,440 --> 00:27:22,620
follow-ups all right in that event just

653
00:27:27,650 --> 00:27:24,450
a little bit of a programming note we

654
00:27:29,360 --> 00:27:27,660
have to Mars briefings tomorrow at one

655
00:27:31,370 --> 00:27:29,370
o'clock we'll have briefing on looking

656
00:27:34,130 --> 00:27:31,380
for signs of life in the universe and

657
00:27:36,170 --> 00:27:34,140
then following at two o'clock will be

658
00:27:38,000 --> 00:27:36,180
our Mars Science Laboratory science

659
00:27:41,420 --> 00:27:38,010
briefing so if you're joining us for

660
00:27:42,770 --> 00:27:41,430
those 1 & 2 p.m. Eastern Time and that