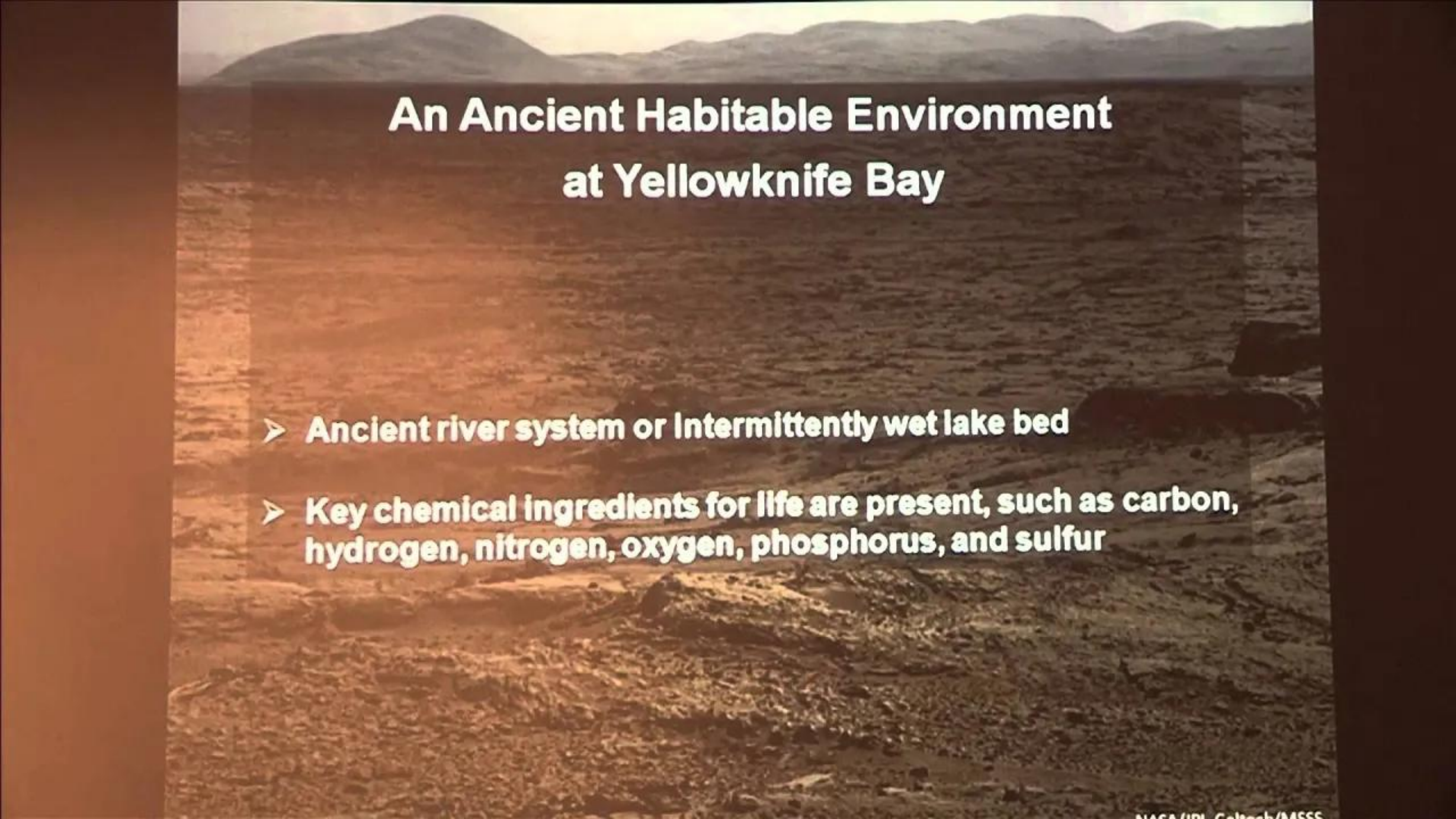
An Ancient Habitable Environment
at Yellowknife Bay
Ancient river system or intermittently wet lake bed
Key chemical ingredients for life are present, such as carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur

1
00:00:04,820 --> 00:00:03,169
thanks Selena and thank you for allowing

2
00:00:07,579 --> 00:00:04,830
me the opportunity to come here and talk

3
00:00:09,589 --> 00:00:07,589
about my favorite subject I am Doug Ming

4
00:00:12,980 --> 00:00:09,599
I'm the chief scientist for the ash

5
00:00:14,629 --> 00:00:12,990
materials exploration and research Rex

6
00:00:16,730 --> 00:00:14,639
parade s materials research and

7
00:00:19,429 --> 00:00:16,740
expiration science division here at the

8
00:00:21,349 --> 00:00:19,439
Johnson Space Center and yes I am a

9
00:00:24,290 --> 00:00:21,359
scientist I have a doctor's degree in

10
00:00:26,000 --> 00:00:24,300
mineralogy and I have been working here

11
00:00:28,939 --> 00:00:26,010
at Johnson Space Center for just about

12
00:00:30,380 --> 00:00:28,949
30 years when I first came here I got

13
00:00:32,479 --> 00:00:30,390

heavily involved in the band's life

14
00:00:34,160 --> 00:00:32,489
support program and so for about 15

15
00:00:36,080 --> 00:00:34,170
years I worked really hard on that

16
00:00:37,850 --> 00:00:36,090
particular effort of how we could

17
00:00:39,920 --> 00:00:37,860
develop life support systems for

18
00:00:42,290 --> 00:00:39,930
long-duration missions on the moon and

19
00:00:44,180 --> 00:00:42,300
on Mars about 15 years ago I had the

20
00:00:45,950 --> 00:00:44,190
really unique opportunity to get more

21
00:00:48,410 --> 00:00:45,960
into this back into the science that I

22
00:00:51,110 --> 00:00:48,420
was trained in I had the opportunity to

23
00:00:53,330 --> 00:00:51,120
get involved in a marsh land admission

24
00:00:56,689 --> 00:00:53,340
since that time I've been very fortunate

25
00:00:58,880 --> 00:00:56,699
to be actively involved in five landed

26
00:01:03,139 --> 00:00:58,890
missions to the surface of Mars on the

27
00:01:06,020 --> 00:01:03,149
science and the operation teams so when

28
00:01:08,990 --> 00:01:06,030
people ask me what I do I tell them i

29
00:01:11,359 --> 00:01:09,000
say i go to work on Mars every day now I

30
00:01:13,370 --> 00:01:11,369
don't put my boots on the surface but

31
00:01:17,210 --> 00:01:13,380
through the eyes of these robotic

32
00:01:20,060 --> 00:01:17,220
missions I am able to do research almost

33
00:01:22,460 --> 00:01:20,070
real time on the surface so it's great

34
00:01:25,370 --> 00:01:22,470
that I get up and say I'm going to work

35
00:01:27,499 --> 00:01:25,380
on Mars today now i am evolved in two

36
00:01:30,289 --> 00:01:27,509
missions right now i'm involved in the

37
00:01:32,359 --> 00:01:30,299
mars exploration rover Opportunity and

38
00:01:34,999 --> 00:01:32,369

i'm also on the science and operation

39
00:01:39,319 --> 00:01:35,009
teams for the Mars Science Laboratory

40
00:01:40,850 --> 00:01:39,329
Curiosity I have a job that I do for the

41
00:01:42,560 --> 00:01:40,860
curiosity mission I am what they call

42
00:01:45,499 --> 00:01:42,570
the science operation working group

43
00:01:48,410 --> 00:01:45,509
chair and what that is is I am the one

44
00:01:49,999 --> 00:01:48,420
that leads the science team in defining

45
00:01:52,069 --> 00:01:50,009
what the rover is going to do for that

46
00:01:53,600 --> 00:01:52,079
particular day on Mars are we going to

47
00:01:55,069 --> 00:01:53,610
drive over there are we going to look at

48
00:01:59,240 --> 00:01:55,079
that rock are we going to drill this

49
00:02:01,219 --> 00:01:59,250
rock what are we going to do so I've

50
00:02:03,020 --> 00:02:01,229
been heavily involved in leading those

51
00:02:06,190 --> 00:02:03,030
tactical operations and it's been a

52
00:02:09,650 --> 00:02:06,200
really honor to be in that position now

53
00:02:11,570 --> 00:02:09,660
we all know here in Texas everything is

54
00:02:13,390 --> 00:02:11,580
bigger in Texas we've all heard that how

55
00:02:17,069 --> 00:02:13,400
many times

56
00:02:19,360 --> 00:02:17,079
well folks Mars has really big features

57
00:02:21,520 --> 00:02:19,370
Valley Marineris stretches all the way

58
00:02:23,110 --> 00:02:21,530
from the eastern to the western coast of

59
00:02:26,860 --> 00:02:23,120
the United States boobs here on earth

60
00:02:29,350 --> 00:02:26,870
and Olympus Mons is the highest volcano

61
00:02:32,110 --> 00:02:29,360
in the solar system it's three times

62
00:02:34,960 --> 00:02:32,120
higher than the highest volcano on earth

63
00:02:37,809 --> 00:02:34,970

which is Mon Aloha out in Hawaii and

64
00:02:40,240 --> 00:02:37,819
that's from the base down in the in the

65
00:02:42,759 --> 00:02:40,250
ocean all the way to its top now we

66
00:02:48,039 --> 00:02:42,769
landed in Gale Crater with curiosity and

67
00:02:52,589 --> 00:02:48,049
things are also big in for curiosity and

68
00:02:56,649 --> 00:02:52,599
Gale Crater it's 150 5 kilometer wide

69
00:02:58,479 --> 00:02:56,659
diameter crater then has this mound in

70
00:03:00,399 --> 00:02:58,489
the middle no as I said mound but to us

71
00:03:03,940 --> 00:03:00,409
here on earth that is a mountain it's

72
00:03:06,789 --> 00:03:03,950
over 16,000 feet high from the floor of

73
00:03:08,770 --> 00:03:06,799
the crater itself and you can see Mount

74
00:03:10,119 --> 00:03:08,780
Rainier is only about fourteen thousand

75
00:03:12,729 --> 00:03:10,129
four hundred feet and so if you're

76
00:03:15,039 --> 00:03:12,739
standing in Seattle Tacoma looking off

77
00:03:17,259 --> 00:03:15,049
at Mount Rainier that is an incredible

78
00:03:20,199 --> 00:03:17,269
view well you can well imagine the view

79
00:03:24,099 --> 00:03:20,209
that it is for our rover curiosity on

80
00:03:27,759 --> 00:03:24,109
Mars right now so the prime goals of the

81
00:03:30,819 --> 00:03:27,769
mission are to characterize and assess

82
00:03:33,970 --> 00:03:30,829
the past habitability at the landing

83
00:03:36,520 --> 00:03:33,980
site both present and past could life

84
00:03:38,080 --> 00:03:36,530
have evolved and could it have persisted

85
00:03:40,270 --> 00:03:38,090
there we're doing that by living to

86
00:03:42,640 --> 00:03:40,280
biological potential what are the

87
00:03:45,189 --> 00:03:42,650
elements for life are they there that

88
00:03:47,439 --> 00:03:45,199

are necessary characterizing the geology

89
00:03:49,449 --> 00:03:47,449
and geochemistry looking for water water

90
00:03:52,390 --> 00:03:49,459
is important for life right and then

91
00:03:54,250 --> 00:03:52,400
also looking at the record in the rocks

92
00:03:57,009 --> 00:03:54,260
themselves the mineralogy to look at

93
00:03:58,809 --> 00:03:57,019
what past climates on Mars might have

94
00:04:01,509 --> 00:03:58,819
looked like we also have it pay on the

95
00:04:04,330 --> 00:04:01,519
payload and the capability to do

96
00:04:08,259 --> 00:04:04,340
radiation assessment we launched

97
00:04:11,409 --> 00:04:08,269
November 26 2011 we landed august six

98
00:04:13,689 --> 00:04:11,419
2012 and this is an incredible image

99
00:04:16,029 --> 00:04:13,699
caught by our hi-rise camera on the Mars

100
00:04:19,719 --> 00:04:16,039
Reconnaissance Orbiter as the parachute

101
00:04:23,740 --> 00:04:19,729
was an spacecraft were going into entry

102
00:04:25,250 --> 00:04:23,750
descent and landing now edl this was six

103
00:04:27,770 --> 00:04:25,260
to seven minutes of terror

104
00:04:29,270 --> 00:04:27,780
error they called it and there was a lot

105
00:04:31,400 --> 00:04:29,280
of things that happened parachutes

106
00:04:33,650 --> 00:04:31,410
deploying slowing down the spacecraft

107
00:04:36,820 --> 00:04:33,660
breaking away from that parachute and

108
00:04:40,580 --> 00:04:36,830
then descending to the surface with a

109
00:04:43,190 --> 00:04:40,590
controlled descent Lander in the form of

110
00:04:45,500 --> 00:04:43,200
a sky crane and on a tether we rolled

111
00:04:47,540 --> 00:04:45,510
out the rover when it hit the ground the

112
00:04:49,700 --> 00:04:47,550
wheels were deployed we were ready to

113
00:04:53,630 --> 00:04:49,710

roll the sky crane was released and flew

114
00:04:56,330 --> 00:04:53,640
away this image is a high-rise image on

115
00:04:58,880 --> 00:04:56,340
the left side are the burn marks from

116
00:05:02,090 --> 00:04:58,890
that decent Lander you can see and then

117
00:05:04,430 --> 00:05:02,100
we made tracks over to the east about a

118
00:05:06,920 --> 00:05:04,440
kilometre mile and you can see the rover

119
00:05:09,350 --> 00:05:06,930
tracks of curiosity here to an area

120
00:05:11,780 --> 00:05:09,360
called Yellowknife Bay this is a low and

121
00:05:14,300 --> 00:05:11,790
this in these lows is where you would

122
00:05:16,130 --> 00:05:14,310
expect what water to accumulate so our

123
00:05:20,090 --> 00:05:16,140
theory was this was an area where water

124
00:05:21,560 --> 00:05:20,100
might have actually a pundit on our way

125
00:05:24,050 --> 00:05:21,570
down there we stopped at this wind

126
00:05:26,060 --> 00:05:24,060
blowing deposit called rocknest and here

127
00:05:28,430 --> 00:05:26,070
you can see rocknest that in front the

128
00:05:30,770 --> 00:05:28,440
rover we used the scoop to scoop up some

129
00:05:33,380 --> 00:05:30,780
of this material this image was taken

130
00:05:35,450 --> 00:05:33,390
with our geologic Hamlin's the Molly

131
00:05:37,580 --> 00:05:35,460
that was out on the end of the arm and

132
00:05:40,700 --> 00:05:37,590
back off in the distance you see that

133
00:05:42,500 --> 00:05:40,710
monsters looming Mount sharp now he took

134
00:05:44,690 --> 00:05:42,510
some of this material and we deliver it

135
00:05:46,340 --> 00:05:44,700
to our instruments we also looked at the

136
00:05:47,960 --> 00:05:46,350
physical chemical mineralogical

137
00:05:49,700 --> 00:05:47,970
properties of this material and you can

138
00:05:51,770 --> 00:05:49,710

imagine how important this is not only

139
00:05:53,900 --> 00:05:51,780
for science but to understand these

140
00:05:56,300 --> 00:05:53,910
materials on how they will interact with

141
00:05:58,270 --> 00:05:56,310
our humans and machines when they're on

142
00:06:02,060 --> 00:05:58,280
Mars how will the effect our spacecraft

143
00:06:03,710 --> 00:06:02,070
suits airlocks and the humans themselves

144
00:06:06,020 --> 00:06:03,720
all important questions that are being

145
00:06:09,170 --> 00:06:06,030
answered by the datasets being returned

146
00:06:10,550 --> 00:06:09,180
by curiosity now we deliver some this

147
00:06:12,650 --> 00:06:10,560
material to one of our estimates on

148
00:06:14,450 --> 00:06:12,660
board the spacecraft this instrument of

149
00:06:16,550 --> 00:06:14,460
the sample analysis of Mars or the Sam

150
00:06:19,070 --> 00:06:16,560
instrument and what this does it heats

151
00:06:21,590 --> 00:06:19,080
the sample up and it sniffs the gases

152
00:06:24,980 --> 00:06:21,600
that are driven off with a gas analyzer

153
00:06:26,570 --> 00:06:24,990
we found water about two-way percent of

154
00:06:29,480 --> 00:06:26,580
the material here with water could this

155
00:06:31,310 --> 00:06:29,490
be used for propulsion systems could it

156
00:06:33,290 --> 00:06:31,320
be used for life support systems this is

157
00:06:37,280 --> 00:06:33,300
something we need to consider we also

158
00:06:38,600 --> 00:06:37,290
saw oxygen hydrochloric acid along with

159
00:06:40,369 --> 00:06:38,610
some hi Courtney

160
00:06:43,730 --> 00:06:40,379
hydrocarbons being released and we have

161
00:06:46,100 --> 00:06:43,740
attribute this to a compound called epic

162
00:06:48,350 --> 00:06:46,110
Laurie chlorate salt is this stuff

163
00:06:51,529 --> 00:06:48,360

useful or is it dangerous something we

164
00:06:53,270 --> 00:06:51,539
need to understand so we headed down

165
00:06:55,790 --> 00:06:53,280
into this low this depression our

166
00:06:59,899 --> 00:06:55,800
hypothesis of this lake deposit of

167
00:07:03,379 --> 00:06:59,909
Yellowknife Bay and we came to this area

168
00:07:05,570 --> 00:07:03,389
that we call the John Klein area and if

169
00:07:07,790 --> 00:07:05,580
you look at this and it's been a really

170
00:07:09,740 --> 00:07:07,800
dry year here in houston we got lots of

171
00:07:11,839 --> 00:07:09,750
clay all of us know what clay is here in

172
00:07:14,269 --> 00:07:11,849
the houston area and this material is

173
00:07:16,339 --> 00:07:14,279
wet it's ponded it dries out it cracks

174
00:07:18,110 --> 00:07:16,349
these are mud cracks now these aren't

175
00:07:21,050 --> 00:07:18,120
exactly like the ones here in the

176
00:07:22,550 --> 00:07:21,060
Houston area but these materials have a

177
00:07:23,839 --> 00:07:22,560
lot of the same properties they're a

178
00:07:26,179 --> 00:07:23,849
little more resistant there's a little

179
00:07:27,830 --> 00:07:26,189
bit more fractures in this but there are

180
00:07:30,800 --> 00:07:27,840
larger fractures that we think could be

181
00:07:35,029 --> 00:07:30,810
to desiccation of potentially clay type

182
00:07:36,800 --> 00:07:35,039
materials we drill the hole we had a

183
00:07:38,869 --> 00:07:36,810
drill on the end of we have a drill on

184
00:07:41,179 --> 00:07:38,879
the end of our arm we were able to drill

185
00:07:44,570 --> 00:07:41,189
this material out and put it in one of

186
00:07:45,950 --> 00:07:44,580
our instruments on the rover and in this

187
00:07:48,140 --> 00:07:45,960
case we put it in the chemistry and

188
00:07:50,510 --> 00:07:48,150

mineralogy the chemin instrument and

189
00:07:52,999 --> 00:07:50,520
this instrument detects the mineralogy

190
00:07:55,850 --> 00:07:53,009
now there are two images on this

191
00:07:58,879 --> 00:07:55,860
particular slide on the left is this

192
00:08:01,040 --> 00:07:58,889
image of this sand deposit this wind

193
00:08:03,439 --> 00:08:01,050
blowing deposited rocknest that I just

194
00:08:05,809 --> 00:08:03,449
talked about and on the right is the one

195
00:08:07,490 --> 00:08:05,819
from this kind of we call it a mudstone

196
00:08:09,499 --> 00:08:07,500
this really fine grain material that we

197
00:08:12,679 --> 00:08:09,509
drilled out of this myth the sediment

198
00:08:14,029 --> 00:08:12,689
and near the bottom of this diagram on

199
00:08:16,760 --> 00:08:14,039
the right there's this really bright

200
00:08:19,399 --> 00:08:16,770
bright region and this is due to the

201
00:08:21,499 --> 00:08:19,409
diffraction of x-rays that's what's

202
00:08:23,869 --> 00:08:21,509
using this instrument to diffract off of

203
00:08:26,420 --> 00:08:23,879
the mineral and then this case it's a

204
00:08:28,159 --> 00:08:26,430
clay mineral called phyllosilicate so we

205
00:08:30,170 --> 00:08:28,169
discovered that yes this stuff is like

206
00:08:32,240 --> 00:08:30,180
stuff around Houston this is these are

207
00:08:35,089 --> 00:08:32,250
clay minerals and we had about 20 weight

208
00:08:38,000 --> 00:08:35,099
percent of these materials in our sample

209
00:08:40,670 --> 00:08:38,010
so our conclusion here in this brief

210
00:08:43,310 --> 00:08:40,680
jaunt over to Yellowknife Bay was that

211
00:08:46,699 --> 00:08:43,320
this was a intermittent river system

212
00:08:49,160 --> 00:08:46,709
with probably shallow lake deposits now

213
00:08:50,569 --> 00:08:49,170

one thing also we found we got the water

214
00:08:52,340 --> 00:08:50,579
we have an environment that could have

215
00:08:55,040 --> 00:08:52,350
been supportive of

216
00:08:57,740 --> 00:08:55,050
biological systems what about the key

217
00:09:00,920 --> 00:08:57,750
ingredients we did discover carbon

218
00:09:03,650 --> 00:09:00,930
hydrogen nitrogen oxygen phosphorus and

219
00:09:05,990 --> 00:09:03,660
sulfur all key for human for living

220
00:09:08,420 --> 00:09:06,000
systems so we did find what we call a

221
00:09:11,030 --> 00:09:08,430
habitable environment now we left this

222
00:09:12,950 --> 00:09:11,040
little jaunt over to Yellowknife Bay and

223
00:09:15,260 --> 00:09:12,960
we travel nine kilometers down to a

224
00:09:16,460 --> 00:09:15,270
place called the Pahrump Hills now along

225
00:09:18,830 --> 00:09:16,470
the way of course we did a lot of

226
00:09:20,810 --> 00:09:18,840
science and one of those I love this

227
00:09:22,700 --> 00:09:20,820
picture by the way and I was actually

228
00:09:25,850 --> 00:09:22,710
leading tactical operations this day and

229
00:09:27,350 --> 00:09:25,860
I said since I got the final word I was

230
00:09:28,460 --> 00:09:27,360
able to get this in I said I would

231
00:09:31,820 --> 00:09:28,470
really like to drive over this

232
00:09:34,370 --> 00:09:31,830
particular this the positive wind

233
00:09:37,610 --> 00:09:34,380
blowing materials stop the rover take

234
00:09:40,340 --> 00:09:37,620
our eyes turn around take a shot of this

235
00:09:44,810 --> 00:09:40,350
and this was a shot we that we acquired

236
00:09:46,550 --> 00:09:44,820
now this is great for you know it's a

237
00:09:48,560 --> 00:09:46,560
beautiful picture number one number two

238
00:09:50,390 --> 00:09:48,570

it provides us with some science input

239
00:09:53,480 --> 00:09:50,400
but it really helps with us looking for

240
00:09:55,070 --> 00:09:53,490
for humans how will our if we have a

241
00:09:56,810 --> 00:09:55,080
rover or wheels interact with these

242
00:09:58,820 --> 00:09:56,820
kinds of materials how far do we sink

243
00:10:00,710 --> 00:09:58,830
these are really key things that we are

244
00:10:03,650 --> 00:10:00,720
looking at that will feed forward to

245
00:10:05,570 --> 00:10:03,660
human missions we also notice that all

246
00:10:07,520 --> 00:10:05,580
of the sedimentary deposits these

247
00:10:10,100 --> 00:10:07,530
layered deposits of sediment were

248
00:10:11,750 --> 00:10:10,110
tilting towards Mount sharp what that

249
00:10:16,190 --> 00:10:11,760
told us is that these were probably

250
00:10:19,550 --> 00:10:16,200
transported by water systems lakes maybe

251
00:10:21,980 --> 00:10:19,560
and fall off into a delta into a from a

252
00:10:24,350 --> 00:10:21,990
river system and they were all tilting

253
00:10:25,940 --> 00:10:24,360
and depositing towards the mount Sharp's

254
00:10:27,440 --> 00:10:25,950
suggesting that this at one time had

255
00:10:29,390 --> 00:10:27,450
quite a bit of water here we had a lot

256
00:10:32,450 --> 00:10:29,400
of water inside this crater probably

257
00:10:34,760 --> 00:10:32,460
around three plus billion years ago we

258
00:10:37,700 --> 00:10:34,770
also discovered not all the time but

259
00:10:40,580 --> 00:10:37,710
once in a while with our sniffer the

260
00:10:44,030 --> 00:10:40,590
atmospheric sniffer on the the rover

261
00:10:45,320 --> 00:10:44,040
that we discovered methane and we didn't

262
00:10:47,360 --> 00:10:45,330
see it all the time just once in a while

263
00:10:49,520 --> 00:10:47,370

we would get a signal of methane now we

264
00:10:51,260 --> 00:10:49,530
didn't get a lot just a few parts per

265
00:10:52,610 --> 00:10:51,270
billion but this is pretty significant

266
00:10:55,400 --> 00:10:52,620
we're seeing methane what does that mean

267
00:10:58,760 --> 00:10:55,410
could mean a lot of things but these

268
00:11:00,710 --> 00:10:58,770
periodic of discoveries of methane

269
00:11:03,620 --> 00:11:00,720
suggest that there's some kind of a

270
00:11:05,250 --> 00:11:03,630
local hot spot now it could be that dust

271
00:11:08,970 --> 00:11:05,260
is raining down organic

272
00:11:10,830 --> 00:11:08,980
terial from out there in the cosmos UV

273
00:11:12,930 --> 00:11:10,840
light is interacting with it and

274
00:11:15,270 --> 00:11:12,940
degrading it to form methane more likely

275
00:11:18,540 --> 00:11:15,280
there's a geologic source underneath us

276
00:11:20,940 --> 00:11:18,550
that is spewing out methane into the

277
00:11:22,620 --> 00:11:20,950
atmosphere however we cannot rule out

278
00:11:24,570 --> 00:11:22,630
the possibility if we were on earth

279
00:11:27,420 --> 00:11:24,580
we've probably attribute that methane to

280
00:11:29,100 --> 00:11:27,430
what to living systems that is one of

281
00:11:31,200 --> 00:11:29,110
the by-products methane so it could be

282
00:11:34,470 --> 00:11:31,210
something dealing with life but more

283
00:11:39,030 --> 00:11:34,480
likely it's a geologic explanation now

284
00:11:43,350 --> 00:11:39,040
our friends at headquarters heo heo md

285
00:11:45,090 --> 00:11:43,360
as we all know was a very important

286
00:11:47,160 --> 00:11:45,100
contributor to this payload they

287
00:11:50,010 --> 00:11:47,170
provided a instrument called the

288
00:11:51,600 --> 00:11:50,020

radiation assessment detector rad to

289
00:11:53,700 --> 00:11:51,610
look at the radiation environment not

290
00:11:56,010 --> 00:11:53,710
only on the surface but during transit

291
00:11:58,770 --> 00:11:56,020
and what we found with this instrument

292
00:12:00,450 --> 00:11:58,780
is that if you were an astronaut going

293
00:12:03,060 --> 00:12:00,460
to Mars you're on the surface for five

294
00:12:05,280 --> 00:12:03,070
days you would basically get in transit

295
00:12:10,710 --> 00:12:05,290
and on the surface about 1,000

296
00:12:13,980 --> 00:12:10,720
millisieverts now station for six months

297
00:12:17,670 --> 00:12:13,990
75 million here in Houston for one year

298
00:12:18,840 --> 00:12:17,680
2 to 3 milli Siemens so radiation we

299
00:12:20,880 --> 00:12:18,850
know it's going to be a problem we're

300
00:12:23,880 --> 00:12:20,890
definitely going to have to address this

301
00:12:27,450 --> 00:12:23,890
with humans now we just finished about a

302
00:12:29,130 --> 00:12:27,460
six month campaign at the base of Mount

303
00:12:31,380 --> 00:12:29,140
sharp we're here what we call the

304
00:12:33,540 --> 00:12:31,390
foothills of Mount sharp we went up to

305
00:12:35,280 --> 00:12:33,550
this this this outcrop and we really did

306
00:12:36,720 --> 00:12:35,290
a detailed characterization here of the

307
00:12:38,520 --> 00:12:36,730
physical properties the mineralogical

308
00:12:41,430 --> 00:12:38,530
and chemical properties because this is

309
00:12:43,020 --> 00:12:41,440
probably the base of Mount sharp this is

310
00:12:45,150 --> 00:12:43,030
as low as we're going to get in the

311
00:12:46,800 --> 00:12:45,160
stratigraphic section because here we go

312
00:12:50,130 --> 00:12:46,810
up there going to be deposited after

313
00:12:52,110 --> 00:12:50,140

this material now this is a great image

314
00:12:54,480 --> 00:12:52,120
from high rise this is this prompt hills

315
00:12:56,310 --> 00:12:54,490
that i just showed in the previous slide

316
00:12:58,980 --> 00:12:56,320
and what you will notice here is that

317
00:13:01,350 --> 00:12:58,990
the rover is just leaving / hills and

318
00:13:05,850 --> 00:13:01,360
we're starting up this dr called artists

319
00:13:08,790 --> 00:13:05,860
valley and today on Mars it is sold 971

320
00:13:10,830 --> 00:13:08,800
we've had 971 days mars days of

321
00:13:12,930 --> 00:13:10,840
operation we have gone over 10

322
00:13:15,150 --> 00:13:12,940
kilometers of roving and we right now

323
00:13:17,610 --> 00:13:15,160
are setting at a place called Logan's

324
00:13:18,920 --> 00:13:17,620
pass that's where the rover is as we

325
00:13:22,100 --> 00:13:18,930
speak

326
00:13:24,350 --> 00:13:22,110
so how is curiosity helping us to look

327
00:13:26,990 --> 00:13:24,360
forward to human missions what is it

328
00:13:29,090 --> 00:13:27,000
providing us resources what are the

329
00:13:30,920 --> 00:13:29,100
resources information that we're

330
00:13:32,780 --> 00:13:30,930
gathering well we know there's water how

331
00:13:34,700 --> 00:13:32,790
can that water be used can we extract it

332
00:13:36,139 --> 00:13:34,710
can we then split it and use it for

333
00:13:38,300 --> 00:13:36,149
propulsion systems coming as they use

334
00:13:39,740 --> 00:13:38,310
that life support systems what about

335
00:13:42,680 --> 00:13:39,750
these blue chlorate salts can they be

336
00:13:45,740 --> 00:13:42,690
used as a fuel as well both in the

337
00:13:48,829 --> 00:13:45,750
Rockets propulsion systems as well as in

338
00:13:51,110 --> 00:13:48,839

fuel cells co2 to the atmosphere we know

339
00:13:53,210 --> 00:13:51,120
we got an atmosphere that contains co2

340
00:13:56,750 --> 00:13:53,220
can that be extracted can that be

341
00:14:00,019 --> 00:13:56,760
utilized to potentially make oxygen for

342
00:14:01,760 --> 00:14:00,029
propulsion systems methane can we find a

343
00:14:03,820 --> 00:14:01,770
hot spot for methane you know we the

344
00:14:06,440 --> 00:14:03,830
methane is kind of a hot topic for

345
00:14:08,150 --> 00:14:06,450
propulsion systems around here at JSC is

346
00:14:10,579 --> 00:14:08,160
it a possibility we could use methane

347
00:14:13,280 --> 00:14:10,589
and then the hazards we've got to

348
00:14:15,590 --> 00:14:13,290
address the hazards as well dust that's

349
00:14:17,329 --> 00:14:15,600
always on everybody's mind what is going

350
00:14:19,760 --> 00:14:17,339
to happen when you must get dust in

351
00:14:20,690 --> 00:14:19,770
their lungs and then the radiation we

352
00:14:22,579 --> 00:14:20,700
got a pretty good idea about the

353
00:14:25,340 --> 00:14:22,589
radiation from this this mission and

354
00:14:27,230 --> 00:14:25,350
then this compound called perchlorates

355
00:14:30,620 --> 00:14:27,240
is it going to be toxic something we

356
00:14:32,720 --> 00:14:30,630
will have to address so our goal from

357
00:14:35,510 --> 00:14:32,730
here on is to continue exploring the

358
00:14:37,850 --> 00:14:35,520
lower reaches of Mount sharp and let me

359
00:14:40,160 --> 00:14:37,860
tell you what from the view right now of

360
00:14:43,400 --> 00:14:40,170
the rover it is absolutely incredible

361
00:14:47,269 --> 00:14:43,410
we've got these layers these sedimentary

362
00:14:48,800 --> 00:14:47,279
layers that contain iron oxide they

363
00:14:51,530 --> 00:14:48,810

contain clay minerals they can claim

364
00:14:53,360 --> 00:14:51,540
sulfates just a whole entourage of stuff

365
00:14:54,800 --> 00:14:53,370
and it's it the missions really just

366
00:14:57,050 --> 00:14:54,810
starting now because the stuff we're

367
00:14:58,970 --> 00:14:57,060
getting into is just absolutely stunning

368
00:15:02,510 --> 00:14:58,980
from orbit I can't wait to get there in

369
00:15:05,600 --> 00:15:02,520
real life so on to the slopes of Mount

370
00:15:08,060 --> 00:15:05,610
sharp and as we do this curiosity is

371
00:15:11,410 --> 00:15:08,070
trailblazing in my view the path for