



# Mars News Briefing

Jan. 23, 2014

2 p.m. ET / 11 a.m. PT / 1900 UTC



Jet Propulsion Laboratory  
California Institute of Technology

1  
00:08:10,809 --> 00:08:08,059  
welcome to NASA's Jet Propulsion

2  
00:08:14,950 --> 00:08:10,819  
Laboratory JPL in Pasadena California

3  
00:08:20,210 --> 00:08:14,960  
I'm guy Webster with the JPL News team

4  
00:08:22,010 --> 00:08:20,220  
11 years ago NASA's twin Mars

5  
00:08:24,320 --> 00:08:22,020  
exploration Rovers didn't yet have the

6  
00:08:26,510 --> 00:08:24,330  
name Spirit and Opportunity they were

7  
00:08:29,510 --> 00:08:26,520  
right here two buildings east of this

8  
00:08:33,320 --> 00:08:29,520  
auditorium and that in JPL's spacecraft

9  
00:08:35,959 --> 00:08:33,330  
assembly facility exactly 10 years ago

10  
00:08:39,769 --> 00:08:35,969  
tomorrow evening two buildings north of

11  
00:08:42,159 --> 00:08:39,779  
here the control room team celebrated

12  
00:08:45,190 --> 00:08:42,169  
boisterously on getting the signal that

13  
00:08:47,360 --> 00:08:45,200

opportunity had landed safely on Mars

14

00:08:49,820 --> 00:08:47,370

spirit had been working for three weeks

15

00:08:55,250 --> 00:08:49,830

already at that point and opportunity

16

00:08:57,100 --> 00:08:55,260

was ready to begin a mission that was

17

00:08:59,690 --> 00:08:57,110

scheduled to last for just three months

18

00:09:02,449 --> 00:08:59,700

spirit Byul lasted six years kept

19

00:09:05,389 --> 00:09:02,459

working for six years in 2012 NASA sent

20

00:09:07,910 --> 00:09:05,399

a bigger Mars rover Curiosity which

21

00:09:10,400 --> 00:09:07,920

reached Mars ten years after

22

00:09:13,420 --> 00:09:10,410

opportunity's landing opportunity is

23

00:09:15,710 --> 00:09:13,430

still working on Mars very productively

24

00:09:17,720 --> 00:09:15,720

I'm going to introduce you to four

25

00:09:20,090 --> 00:09:17,730

panelists who will be telling you about

26

00:09:21,829 --> 00:09:20,100

a decade of roving on Mars and in

27

00:09:23,720 --> 00:09:21,839

particular some important new results

28

00:09:27,560 --> 00:09:23,730

being published in the journal Science

29

00:09:33,110 --> 00:09:27,570

tomorrow to two of the presenters are

30

00:09:35,360 --> 00:09:33,120

here at JPL Ray Arvidsson of Washington

31

00:09:36,829 --> 00:09:35,370

University in st. Louis is the deputy

32

00:09:38,420 --> 00:09:36,839

principal investigator for the Mars

33

00:09:40,360 --> 00:09:38,430

exploration Rovers Spirit and

34

00:09:43,370 --> 00:09:40,370

Opportunity

35

00:09:45,190 --> 00:09:43,380

he's also the lead author for the

36

00:09:49,220 --> 00:09:45,200

research report that you'll hear about

37

00:09:52,780 --> 00:09:49,230

John Kallis of JPL is the project

38

00:09:54,920 --> 00:09:52,790

manager for the Mars exploration Rovers

39

00:09:56,510 --> 00:09:54,930

and two of today's presenters are

40

00:09:58,610 --> 00:09:56,520

joining us from the television studio at

41

00:10:01,579 --> 00:09:58,620

NASA's Goddard Space Flight Center in

42

00:10:03,199 --> 00:10:01,589

Greenbelt Maryland they will be the

43

00:10:05,360 --> 00:10:03,209

first and the last and the order of

44

00:10:07,880 --> 00:10:05,370

presentation and you will hear from

45

00:10:10,009 --> 00:10:07,890

Michael Meyer of NASA's headquarters in

46

00:10:12,109 --> 00:10:10,019

Washington DC he's the lead

47

00:10:14,600 --> 00:10:12,119

scientist for NASA's Mars exploration

48

00:10:18,889 --> 00:10:14,610

program which includes several missions

49

00:10:21,559 --> 00:10:18,899

at Mars and in development Steve Squyres

50

00:10:23,809 --> 00:10:21,569

of Cornell University in Ithaca New York

51  
00:10:26,689 --> 00:10:23,819  
is the principal investigator for the

52  
00:10:28,009 --> 00:10:26,699  
Mars exploration Rovers after all for

53  
00:10:30,619 --> 00:10:28,019  
presentations we'll have plenty of time

54  
00:10:32,479 --> 00:10:30,629  
for questions and answers so let's stay

55  
00:10:37,910 --> 00:10:32,489  
at Goddard Space Flight Center and hear

56  
00:10:39,949 --> 00:10:37,920  
from Michael Mayer well thank you guy it

57  
00:10:41,239 --> 00:10:39,959  
will be ten years ago tomorrow that the

58  
00:10:43,999 --> 00:10:41,249  
mars exploration rover Opportunity

59  
00:10:45,739 --> 00:10:44,009  
landed on the surface of Mars and to

60  
00:10:49,639 --> 00:10:45,749  
kind of relive that excitement we have a

61  
00:10:53,329 --> 00:10:49,649  
video showing the rover going to the

62  
00:10:56,389 --> 00:10:53,339  
surface so if we roll that video we can

63  
00:11:01,999 --> 00:10:56,399

see the capsule entering the Mars

64

00:11:04,850 --> 00:11:02,009

atmosphere it will slowly unpack deploy

65

00:11:06,949 --> 00:11:04,860

airbags and then bounce several times on

66

00:11:10,669 --> 00:11:06,959

the surface before actually coming to a

67

00:11:13,609 --> 00:11:10,679

halt and landing but the real payoff

68

00:11:17,480 --> 00:11:13,619

from this mission is started on the day

69

00:11:19,660 --> 00:11:17,490

that opportunity landed it began science

70

00:11:23,119 --> 00:11:19,670

operations that lasted over ten years

71

00:11:26,210 --> 00:11:23,129

nine point seven five years beyond the

72

00:11:28,100 --> 00:11:26,220

rover's warranty we are here to

73

00:11:29,929 --> 00:11:28,110

celebrate the 10th anniversary but more

74

00:11:32,780 --> 00:11:29,939

importantly 10 years of groundbreaking

75

00:11:34,460 --> 00:11:32,790

research that has exemplified in the

76

00:11:36,609 --> 00:11:34,470

paper that is the public published

77

00:11:40,039 --> 00:11:36,619

coming out this week in science magazine

78

00:11:44,859 --> 00:11:40,049

the bottom line is we have discovered

79

00:11:48,739 --> 00:11:44,869

discovered another place on Mars that

80

00:11:54,199 --> 00:11:48,749

shows could have provided a habitat for

81

00:11:56,329 --> 00:11:54,209

life in a more ancient time this paper

82

00:11:58,519 --> 00:11:56,339

also highlights the importance of the

83

00:12:00,499 --> 00:11:58,529

Mars program in sweet land which in

84

00:12:02,299 --> 00:12:00,509

which we have landed assets and orbital

85

00:12:05,239 --> 00:12:02,309

assets on Mars that have played an

86

00:12:07,789 --> 00:12:05,249

important synergistic role for instance

87

00:12:10,939 --> 00:12:07,799

for opportunity Mars Global Surveyor and

88

00:12:13,879 --> 00:12:10,949

Mars Odyssey identified opportunities

89

00:12:16,280 --> 00:12:13,889

landing site finding hematite which is

90

00:12:19,400 --> 00:12:16,290

an aqueous mineral which became known as

91

00:12:20,600 --> 00:12:19,410

blueberries both Odyssey and the Mars

92

00:12:23,030 --> 00:12:20,610

Reconnaissance Orbiter provide

93

00:12:26,480 --> 00:12:23,040

telecommunications between law

94

00:12:28,280 --> 00:12:26,490

in earth the high-resolution camera on

95

00:12:30,470 --> 00:12:28,290

the Mars Reconnaissance Orbiter provided

96

00:12:32,990 --> 00:12:30,480

strategic navigation information for the

97

00:12:35,180 --> 00:12:33,000

extended mission and the infrared

98

00:12:37,460 --> 00:12:35,190

spectral imaging on the Mars

99

00:12:40,010 --> 00:12:37,470

Reconnaissance Orbiter prism has

100

00:12:41,420 --> 00:12:40,020

identified the clay minerals that were

101  
00:12:43,580 --> 00:12:41,430  
studied by opportunity that are

102  
00:12:47,210 --> 00:12:43,590  
published in this issue of science it

103  
00:12:49,400 --> 00:12:47,220  
has been this Mars program the logical

104  
00:12:52,160 --> 00:12:49,410  
sequence of missions that have brought

105  
00:12:54,560 --> 00:12:52,170  
us to this point by standing on the

106  
00:12:57,140 --> 00:12:54,570  
shoulders of on the solar panels of

107  
00:12:59,240 --> 00:12:57,150  
Spirit and Opportunity we see the future

108  
00:13:01,640 --> 00:12:59,250  
of Mars exploration that has progressed

109  
00:13:04,250 --> 00:13:01,650  
to the point of looking for

110  
00:13:07,340 --> 00:13:04,260  
biosignatures the ability to catch

111  
00:13:11,000 --> 00:13:07,350  
samples for sample return and planning

112  
00:13:12,830 --> 00:13:11,010  
for future humans to Mars to tell us

113  
00:13:14,960 --> 00:13:12,840

more about the latest science results

114

00:13:17,180 --> 00:13:14,970

I'll turn the microphone over to the

115

00:13:22,730 --> 00:13:17,190

lead author of the science paper Ray

116

00:13:25,310 --> 00:13:22,740

artisan rates something that Michael

117

00:13:27,050 --> 00:13:25,320

said and our science results to be

118

00:13:28,790 --> 00:13:27,060

published tomorrow could not have been

119

00:13:31,370 --> 00:13:28,800

accomplished without the joint use of

120

00:13:33,560 --> 00:13:31,380

orbital atlanta tassets and in

121

00:13:36,200 --> 00:13:33,570

particular the first slide step will be

122

00:13:39,440 --> 00:13:36,210

a view from orbit it shows high rise

123

00:13:42,380 --> 00:13:39,450

which is a exquisite color imager and in

124

00:13:44,450 --> 00:13:42,390

addition to using high rise we also used

125

00:13:46,310 --> 00:13:44,460

chris that's the hyper spectral

126

00:13:47,840 --> 00:13:46,320

infrared spectrometer that Michael

127

00:13:51,410 --> 00:13:47,850

mentioned but we used it in a special

128

00:13:53,030 --> 00:13:51,420

way and we over sampled the acquisition

129

00:13:55,370 --> 00:13:53,040

of data in the long track direction

130

00:13:57,680 --> 00:13:55,380

that's a form of super resolution and it

131

00:13:59,240 --> 00:13:57,690

allowed us to detect outcrops with these

132

00:14:01,490 --> 00:13:59,250

clay minerals signatures that we

133

00:14:04,010 --> 00:14:01,500

couldn't do heretofore that's what we're

134

00:14:06,440 --> 00:14:04,020

seeing in the lower left that little red

135

00:14:08,240 --> 00:14:06,450

splotch are there very few pixels where

136

00:14:10,550 --> 00:14:08,250

we see this clay mineral called an iron

137

00:14:12,320 --> 00:14:10,560

Smith type doesn't mean much to many

138

00:14:14,510 --> 00:14:12,330

people but to geologists it's pretty

139

00:14:16,340 --> 00:14:14,520

exciting because it's a clay mineral

140

00:14:18,530 --> 00:14:16,350

that forms in a particular aqueous

141

00:14:21,340 --> 00:14:18,540

environment or water environment and

142

00:14:23,720 --> 00:14:21,350

it's much less acidic and much less

143

00:14:26,330 --> 00:14:23,730

oxidizing than the Burns formation

144

00:14:29,000 --> 00:14:26,340

sandstones the sulfate rich sand stones

145

00:14:32,480 --> 00:14:29,010

that opportunity explored for most of

146

00:14:34,820 --> 00:14:32,490

its mission until August 2011 when a

147

00:14:36,500 --> 00:14:34,830

drove on to Cape York which is an

148

00:14:39,010 --> 00:14:36,510

isolated rim segment of this

149

00:14:42,170 --> 00:14:39,020

very very old crater called endeavour

150

00:14:44,690 --> 00:14:42,180

22,000 meters across and the white lines

151  
00:14:46,700 --> 00:14:44,700  
that you see drawn on the on the central

152  
00:14:49,160 --> 00:14:46,710  
image those are locations that we

153  
00:14:51,770 --> 00:14:49,170  
visited with opportunity and made

154  
00:14:53,630 --> 00:14:51,780  
measurements to really understand kind

155  
00:14:55,640 --> 00:14:53,640  
of getting down in the dirt and in the

156  
00:14:58,190 --> 00:14:55,650  
rocks to understand the geologic setting

157  
00:15:00,230 --> 00:14:58,200  
and the details of these these

158  
00:15:02,930 --> 00:15:00,240  
occurrences the presence of this iron

159  
00:15:06,020 --> 00:15:02,940  
clay when will call a smectite so we are

160  
00:15:08,300 --> 00:15:06,030  
the next slide step this is really a

161  
00:15:10,250 --> 00:15:08,310  
neat area because it's very small

162  
00:15:11,900 --> 00:15:10,260  
we couldn't have identified it otherwise

163  
00:15:15,080 --> 00:15:11,910

than using the super resolution

164

00:15:17,390 --> 00:15:15,090

technique and importantly these are the

165

00:15:19,820 --> 00:15:17,400

oldest rocks we've seen because it's

166

00:15:22,610 --> 00:15:19,830

that tan kind of corridor that runs from

167

00:15:24,200 --> 00:15:22,620

left to right in the image and these

168

00:15:26,390 --> 00:15:24,210

rocks are actually older than the

169

00:15:29,090 --> 00:15:26,400

Endeavour impact event because the

170

00:15:31,880 --> 00:15:29,100

ejecta sits on top of them copper cliff

171

00:15:33,920 --> 00:15:31,890

which you can see now is impact material

172

00:15:36,770 --> 00:15:33,930

from Endeavour so we're looking at rocks

173

00:15:38,510 --> 00:15:36,780

that in fact are older and those things

174

00:15:41,240 --> 00:15:38,520

called the dark veneers that Maps

175

00:15:43,580 --> 00:15:41,250

one-to-one with where chris is seeing

176

00:15:46,040 --> 00:15:43,590

the iron clay mineral smectite these

177

00:15:48,290 --> 00:15:46,050

probably formed in fractures bedding for

178

00:15:50,990 --> 00:15:48,300

plane fractures probably formed as

179

00:15:53,450 --> 00:15:51,000

ferrous smectite oxidized later to

180

00:15:55,970 --> 00:15:53,460

ferric smectite and the point is these

181

00:15:58,220 --> 00:15:55,980

waters couldn't be too acidic and they

182

00:15:59,810 --> 00:15:58,230

could be too oxidizing or we wouldn't

183

00:16:02,630 --> 00:15:59,820

have produced these materials that we

184

00:16:04,610 --> 00:16:02,640

seed but it gets better because we also

185

00:16:07,430 --> 00:16:04,620

saw fractures cutting through these

186

00:16:09,170 --> 00:16:07,440

finely layered rocks and esperance is

187

00:16:11,150 --> 00:16:09,180

one of those fractures it's kind of

188

00:16:13,340 --> 00:16:11,160

bright relative to the surroundings and

189

00:16:15,710 --> 00:16:13,350

it really is a place in which the

190

00:16:19,040 --> 00:16:15,720

composition suggests even more

191

00:16:21,680 --> 00:16:19,050

alteration what you're looking at now on

192

00:16:23,960 --> 00:16:21,690

the next step slide step is some of the

193

00:16:26,930 --> 00:16:23,970

veneers these dark veneers probably

194

00:16:29,660 --> 00:16:26,940

bedding plain deposits carrying the the

195

00:16:31,670 --> 00:16:29,670

iron smectite this iron clay mineral a

196

00:16:34,070 --> 00:16:31,680

little bit of alteration a little bit of

197

00:16:35,930 --> 00:16:34,080

water a little bit of salt mild

198

00:16:38,210 --> 00:16:35,940

conditions in terms of the water

199

00:16:40,700 --> 00:16:38,220

chemistry rather different than the

200

00:16:43,220 --> 00:16:40,710

younger burns formation very acidic very

201  
00:16:45,260 --> 00:16:43,230  
oxidizing conditions the older you look

202  
00:16:47,900 --> 00:16:45,270  
the better it gets in terms of

203  
00:16:49,790 --> 00:16:47,910  
habitability at this location we go to

204  
00:16:50,420 --> 00:16:49,800  
the next slide step now we're looking

205  
00:16:52,760 --> 00:16:50,430  
close

206  
00:16:53,840 --> 00:16:52,770  
up at this fracture system we couldn't

207  
00:16:55,070 --> 00:16:53,850  
see this from prison it's two

208  
00:16:57,290 --> 00:16:55,080  
centimeters across

209  
00:16:59,660 --> 00:16:57,300  
and even with super super resolution we

210  
00:17:02,450 --> 00:16:59,670  
couldn't get down to that resolution so

211  
00:17:04,520 --> 00:17:02,460  
we went up to this outcrop this this

212  
00:17:07,280 --> 00:17:04,530  
fracture and ground into it with a

213  
00:17:10,040 --> 00:17:07,290

little bit of grinding pads left on a

214

00:17:11,630 --> 00:17:10,050

rock abrasion tool and if you go to the

215

00:17:14,960 --> 00:17:11,640

next slide it's a triangular diagram

216

00:17:17,689 --> 00:17:14,970

it's a geochemist diagram and it's a way

217

00:17:20,390 --> 00:17:17,699

to get at the types of materials present

218

00:17:22,730 --> 00:17:20,400

here's the punchline if you look at the

219

00:17:24,799 --> 00:17:22,740

art average Martian crust which is it's

220

00:17:26,390 --> 00:17:24,809

kind of like the overall material we

221

00:17:28,580 --> 00:17:26,400

were looking at and then you look at

222

00:17:31,280 --> 00:17:28,590

those yellow dots those represents

223

00:17:33,740 --> 00:17:31,290

compositions for the material as we

224

00:17:36,799 --> 00:17:33,750

ground deeper and deeper into this

225

00:17:39,350 --> 00:17:36,809

fracture all the way toward an aluminous

226

00:17:41,240 --> 00:17:39,360

clay an alumina smectite called a ma

227

00:17:44,240 --> 00:17:41,250

true and that indicates significant

228

00:17:46,400 --> 00:17:44,250

leaching and removing of iron and other

229

00:17:49,520 --> 00:17:46,410

materials and had to be done

230

00:17:52,190 --> 00:17:49,530

under at best mildly acidic conditions

231

00:17:54,890 --> 00:17:52,200

and reducing not oxidizing conditions

232

00:17:56,840 --> 00:17:54,900

you know if I were there back when this

233

00:17:58,940 --> 00:17:56,850

material was being emplaced and altered

234

00:18:00,980 --> 00:17:58,950

and I had my summer house this is where

235

00:18:03,230 --> 00:18:00,990

I would drill to get good drinking water

236

00:18:05,720 --> 00:18:03,240

so the older you look the better it gets

237

00:18:07,940 --> 00:18:05,730

you know opportunity is still exploring

238

00:18:10,070 --> 00:18:07,950

and Steve will tell you a lot in a few

239

00:18:11,780 --> 00:18:10,080

minutes about what's coming up but in

240

00:18:13,940 --> 00:18:11,790

the meantime I'll turn it over to John

241

00:18:15,590 --> 00:18:13,950

Kallis the project manager to give a

242

00:18:18,520 --> 00:18:15,600

little bit of the engineering history

243

00:18:21,919 --> 00:18:18,530

and what's coming up for opportunity

244

00:18:24,770 --> 00:18:21,929

thanks very much ray no one ever

245

00:18:26,840 --> 00:18:24,780

expected this that after ten years a

246

00:18:29,120 --> 00:18:26,850

Mars Exploration Rover would continues

247

00:18:31,640 --> 00:18:29,130

to operate and operate productively on

248

00:18:34,210 --> 00:18:31,650

the surface of Mars so let's remind

249

00:18:36,650 --> 00:18:34,220

ourselves where opportunity has driven

250

00:18:38,840 --> 00:18:36,660

remember that the rover was designed for

251  
00:18:41,150 --> 00:18:38,850  
only one kilometre of odometry that's

252  
00:18:45,200 --> 00:18:41,160  
like six tenths of a mile so may have

253  
00:18:47,900 --> 00:18:45,210  
the the traverse' pan so we landed an

254  
00:18:50,120 --> 00:18:47,910  
eagle crater and then drove a few

255  
00:18:52,640 --> 00:18:50,130  
hundred meters over to endurance crater

256  
00:18:54,140 --> 00:18:52,650  
and after exploring endurance crater we

257  
00:18:56,330 --> 00:18:54,150  
headed south and we drove several

258  
00:18:59,240 --> 00:18:56,340  
kilometers to the 1/2 mile diameter

259  
00:19:02,750 --> 00:18:59,250  
Victoria crater and we spent almost a

260  
00:19:03,860 --> 00:19:02,760  
year exploring Victoria crater and then

261  
00:19:06,260 --> 00:19:03,870  
we decided well

262  
00:19:08,930 --> 00:19:06,270  
where do we go next so we decided to

263  
00:19:10,760 --> 00:19:08,940

more than double the already tremendous

264

00:19:13,850 --> 00:19:10,770

odometry on this vehicle and head to the

265

00:19:15,970 --> 00:19:13,860

very distant with giant endeavour crater

266

00:19:19,100 --> 00:19:15,980

and that's what you see here in the this

267

00:19:21,470 --> 00:19:19,110

animation and we are now exploring the

268

00:19:25,670 --> 00:19:21,480

rim of that crater and that's where we

269

00:19:30,610 --> 00:19:25,680

are today but after 10 years you know

270

00:19:33,230 --> 00:19:30,620

opportunity has driven 38.7 kilometers

271

00:19:36,110 --> 00:19:33,240

than the the one kilometer requirement

272

00:19:39,440 --> 00:19:36,120

that's about 24 miles we've survived

273

00:19:41,000 --> 00:19:39,450

more than 3,500 Martian days on the

274

00:19:44,240 --> 00:19:41,010

surface and we've collected over a

275

00:19:45,890 --> 00:19:44,250

hundred and seventy thousand images but

276

00:19:48,410 --> 00:19:45,900

you know it's not how long the rover is

277

00:19:51,350 --> 00:19:48,420

lasted or even how far it is driven but

278

00:19:53,210 --> 00:19:51,360

the amount of scientific exploration and

279

00:19:56,990 --> 00:19:53,220

discovery that's been accomplished in

280

00:19:59,630 --> 00:19:57,000

that time so after 10 years opportunity

281

00:20:01,070 --> 00:19:59,640

is still in very good health and it's

282

00:20:01,930 --> 00:20:01,080

still of course very scientifically

283

00:20:04,130 --> 00:20:01,940

productive

284

00:20:06,680 --> 00:20:04,140

although the rover has some degraded

285

00:20:09,350 --> 00:20:06,690

components the right front steering

286

00:20:11,510 --> 00:20:09,360

actuator is jammed and no longer steers

287

00:20:14,540 --> 00:20:11,520

the right front wheel the same wheel

288

00:20:17,150 --> 00:20:14,550

also shows elevated wheel currents the

289

00:20:19,070 --> 00:20:17,160

robotic arm has some arthritis to it and

290

00:20:22,040 --> 00:20:19,080

two of the scientific instruments no

291

00:20:24,380 --> 00:20:22,050

longer function but in the past year

292

00:20:26,270 --> 00:20:24,390

almost nothing has changed in terms of

293

00:20:28,760 --> 00:20:26,280

the health and status of the rover it's

294

00:20:30,910 --> 00:20:28,770

been very stable there is one recent

295

00:20:34,490 --> 00:20:30,920

issue that were keeping an eye on

296

00:20:37,250 --> 00:20:34,500

opportunity had a senior moment now we

297

00:20:39,200 --> 00:20:37,260

call this a an amnesia event this has to

298

00:20:40,580 --> 00:20:39,210

do with the flash file system on the

299

00:20:43,220 --> 00:20:40,590

rover this is the non-volatile memory

300

00:20:45,110 --> 00:20:43,230

inside the rover right now it's not a

301  
00:20:47,000 --> 00:20:45,120  
health or safety issue it's just an

302  
00:20:49,100 --> 00:20:47,010  
operational annoyance but if it gets

303  
00:20:51,140 --> 00:20:49,110  
precipitously were worse there are some

304  
00:20:54,680 --> 00:20:51,150  
corrective actions that we can take to

305  
00:20:56,630 --> 00:20:54,690  
remedy this as we approach the winter

306  
00:20:58,280 --> 00:20:56,640  
the winter solstice which is just three

307  
00:21:01,040 --> 00:20:58,290  
weeks away the energy levels have

308  
00:21:03,770 --> 00:21:01,050  
improved on the rover air fall dust

309  
00:21:05,330 --> 00:21:03,780  
accumulates on the solar rays and that

310  
00:21:08,210 --> 00:21:05,340  
was what we originally thought would

311  
00:21:12,340 --> 00:21:08,220  
limit the life of this mission to 90

312  
00:21:15,230 --> 00:21:12,350  
days if I could have the the next image

313  
00:21:16,920 --> 00:21:15,240

opportunity has recently taken a selfie

314

00:21:19,650 --> 00:21:16,930

if you will

315

00:21:22,170 --> 00:21:19,660

portrait using the cameras up here on

316

00:21:24,330 --> 00:21:22,180

the mast looking down we've collected a

317

00:21:26,670 --> 00:21:24,340

color mosaic of several hundred frames

318

00:21:28,470 --> 00:21:26,680

Senate you see that here and you can see

319

00:21:31,050 --> 00:21:28,480

the dust on the solar arrays and you can

320

00:21:33,800 --> 00:21:31,060

see how the rover is almost perfectly

321

00:21:37,410 --> 00:21:33,810

camouflaged against its environment a

322

00:21:39,510 --> 00:21:37,420

few weeks ago the dust factor the the

323

00:21:42,090 --> 00:21:39,520

performance of the solar arrays was only

324

00:21:43,860 --> 00:21:42,100

about 47% but recently we've had some

325

00:21:45,900 --> 00:21:43,870

wind events that have cleaned some of

326

00:21:48,840 --> 00:21:45,910

the dust off the arrays and so the

327

00:21:50,970 --> 00:21:48,850

performance is now at about 60% this is

328

00:21:53,220 --> 00:21:50,980

higher that it has been for the last two

329

00:21:55,530 --> 00:21:53,230

Martian winters this is good news it

330

00:21:57,540 --> 00:21:55,540

means that we have ample power through

331

00:22:00,300 --> 00:21:57,550

the winter and that the rover can remain

332

00:22:02,100 --> 00:22:00,310

active and that we can drive pretty much

333

00:22:03,990 --> 00:22:02,110

almost every day and continue the

334

00:22:06,780 --> 00:22:04,000

exploration throughout the the winter

335

00:22:10,020 --> 00:22:06,790

season so with the arrival at endeavor

336

00:22:14,070 --> 00:22:10,030

crater opportunity has gone back in time

337

00:22:16,860 --> 00:22:14,080

back to the oldest epoch on Mars this

338

00:22:18,540 --> 00:22:16,870

creates some of the most scientific most

339

00:22:20,910 --> 00:22:18,550

scientifically interesting opportunities

340

00:22:23,900 --> 00:22:20,920

of the entire mission considering that

341

00:22:26,370 --> 00:22:23,910

you know we're 3500 days on the surface

342

00:22:28,980 --> 00:22:26,380

but in addition to these tremendous

343

00:22:31,680 --> 00:22:28,990

scientific achievements and discoveries

344

00:22:33,540 --> 00:22:31,690

of the past decade these Rovers both

345

00:22:36,300 --> 00:22:33,550

Spirit and Opportunity have given us a

346

00:22:39,240 --> 00:22:36,310

great intangible something different

347

00:22:42,090 --> 00:22:39,250

something special over the past decade

348

00:22:44,190 --> 00:22:42,100

through these Rovers our species have

349

00:22:45,930 --> 00:22:44,200

gone to work on Mars and now a

350

00:22:48,180 --> 00:22:45,940

generation has grown up with these

351

00:22:50,790 --> 00:22:48,190

Rovers and have been inspired by them

352

00:22:53,090 --> 00:22:50,800

and some of those people are working on

353

00:22:55,320 --> 00:22:53,100

this mission today are working on Mars

354

00:22:57,450 --> 00:22:55,330

so in addition to being earthlings

355

00:23:01,890 --> 00:22:57,460

because of these Rovers we have become

356

00:23:04,020 --> 00:23:01,900

Martians to dual citizens if you will we

357

00:23:06,930 --> 00:23:04,030

now live in a larger world a world that

358

00:23:08,670 --> 00:23:06,940

extends beyond our own home planet the

359

00:23:11,490 --> 00:23:08,680

these Rovers have made Mars our

360

00:23:13,890 --> 00:23:11,500

neighborhood in our backyard and this is

361

00:23:15,690 --> 00:23:13,900

something truly remarkable so let me

362

00:23:16,770 --> 00:23:15,700

hand it over to Steve Squyres who'll

363

00:23:20,600 --> 00:23:16,780

tell us something about the current

364

00:23:24,320 --> 00:23:20,610

science and the future science Steve

365

00:23:27,690 --> 00:23:24,330

thank you John well at a time like this

366

00:23:29,220 --> 00:23:27,700

ten years in you start to think a lot

367

00:23:30,779 --> 00:23:29,230

about the legacy of the mission and john

368

00:23:33,089 --> 00:23:30,789

has already talked a little bit about

369

00:23:34,799 --> 00:23:33,099

the cultural legacy let me say a few

370

00:23:36,419 --> 00:23:34,809

quick words about the scientific legacy

371

00:23:39,299 --> 00:23:36,429

and I'd like to start with our first

372

00:23:40,560 --> 00:23:39,309

picture with the other over our blue

373

00:23:43,139 --> 00:23:40,570

collared Rover if you will the

374

00:23:45,659 --> 00:23:43,149

hard-working spirit rover spirit landed

375

00:23:47,879 --> 00:23:45,669

on what turned out to be a vast plain of

376

00:23:50,459 --> 00:23:47,889

basaltic lava that was not what we went

377

00:23:53,039 --> 00:23:50,469

to Mars defined but over a period of

378

00:23:55,739 --> 00:23:53,049

hundreds of Martian days we climbed with

379

00:23:57,419 --> 00:23:55,749

spirit to the summit of a hill we named

380

00:23:58,979 --> 00:23:57,429

it husband Hill brick husband was the

381

00:23:59,399 --> 00:23:58,989

commander of the Columbia when it went

382

00:24:02,909 --> 00:23:59,409

down

383

00:24:05,039 --> 00:24:02,919

and we named it to honor him and from

384

00:24:07,739 --> 00:24:05,049

the summit of husband Hill in the

385

00:24:10,409 --> 00:24:07,749

picture that that you just saw you can

386

00:24:12,779 --> 00:24:10,419

look to the south and you can look to

387

00:24:14,999 --> 00:24:12,789

the region where spirit made two of its

388

00:24:17,549 --> 00:24:15,009

most important discoveries as we

389

00:24:19,589 --> 00:24:17,559

descended down husband Hill we

390

00:24:20,789 --> 00:24:19,599

encountered a suite of outcrops that

391

00:24:21,599 --> 00:24:20,799

sort of looked different from the other

392

00:24:23,969 --> 00:24:21,609

stuff we'd seen before

393

00:24:25,559 --> 00:24:23,979

and what we discovered after we analyzed

394

00:24:28,169 --> 00:24:25,569

the data from these outcrops which we

395

00:24:30,359 --> 00:24:28,179

named Comanche in detail was that they

396

00:24:32,389 --> 00:24:30,369

were made largely of carbonate rocks

397

00:24:35,430 --> 00:24:32,399

there were about 30 plus percent

398

00:24:36,719 --> 00:24:35,440

magnesium and iron carbonates one of the

399

00:24:38,969 --> 00:24:36,729

big mysteries on Mars has always been

400

00:24:40,649 --> 00:24:38,979

what happened we know it was warmer

401  
00:24:43,049 --> 00:24:40,659  
wetter in the past but it's cold and dry

402  
00:24:44,519 --> 00:24:43,059  
today and something changed and one of

403  
00:24:46,680 --> 00:24:44,529  
the ways that you can make the climate

404  
00:24:48,899 --> 00:24:46,690  
of Mars change is if you had a dense

405  
00:24:50,249 --> 00:24:48,909  
atmosphere of carbon dioxide in the past

406  
00:24:52,049 --> 00:24:50,259  
a greenhouse effect and then the

407  
00:24:54,779 --> 00:24:52,059  
atmosphere goes away some of that

408  
00:24:56,489 --> 00:24:54,789  
atmosphere was surely lost to space but

409  
00:24:57,689 --> 00:24:56,499  
we've always sort of suspected that some

410  
00:24:59,159 --> 00:24:57,699  
of them may have been locked up in

411  
00:25:00,659 --> 00:24:59,169  
carbonate rocks on the surface because

412  
00:25:02,909 --> 00:25:00,669  
you can take carbon dioxide from the

413  
00:25:05,909 --> 00:25:02,919

atmosphere and you can sequester it you

414

00:25:07,680 --> 00:25:05,919

can hide it if you will at the surface

415

00:25:09,989 --> 00:25:07,690

in carbonate rocks and so finding

416

00:25:12,899 --> 00:25:09,999

massive carbonates was a was a really

417

00:25:15,059 --> 00:25:12,909

major part of that story then as we

418

00:25:16,499 --> 00:25:15,069

proceeded south from Comanche we went to

419

00:25:18,509 --> 00:25:16,509

a place where we ended up spending

420

00:25:21,449 --> 00:25:18,519

several years of spirit there we named

421

00:25:22,859 --> 00:25:21,459

home plate and home plate had many

422

00:25:24,449 --> 00:25:22,869

interesting characteristics but one of

423

00:25:26,729 --> 00:25:24,459

the most fascinating was we found very

424

00:25:29,849 --> 00:25:26,739

very high concentrations more than

425

00:25:32,059 --> 00:25:29,859

ninety percent pure silica this is not

426

00:25:35,699 --> 00:25:32,069

quartz this is not beach sand this was

427

00:25:36,869 --> 00:25:35,709

opal like the gemstone kind of and these

428

00:25:39,269 --> 00:25:36,879

are the kind of deposits that you

429

00:25:41,849 --> 00:25:39,279

typically find on earth in hydrothermal

430

00:25:44,290 --> 00:25:41,859

systems hot springs or volcanic steam

431

00:25:46,180 --> 00:25:44,300

vents and so this was evidence of a

432

00:25:48,280 --> 00:25:46,190

of a hydrothermal system which would

433

00:25:50,380 --> 00:25:48,290

have been a habitable environment on

434

00:25:53,049 --> 00:25:50,390

Mars at one point in the past the next

435

00:25:54,669 --> 00:25:53,059

graphic shows some of the wonderful

436

00:25:56,860 --> 00:25:54,679

rocks that we looked at with the

437

00:25:58,660 --> 00:25:56,870

opportunity Rover this is at Victoria

438

00:26:01,510 --> 00:25:58,670

crater which John Kallis mentioned and

439

00:26:03,820 --> 00:26:01,520

it shows this stack of layered set of me

440

00:26:06,070 --> 00:26:03,830

or sedimentary rocks when we land with

441

00:26:07,960 --> 00:26:06,080

opportunity nobody had ever seen layered

442

00:26:10,030 --> 00:26:07,970

sedimentary sedimentary rocks up close

443

00:26:13,500 --> 00:26:10,040

on Mars before we were able to

444

00:26:15,549 --> 00:26:13,510

investigate these in detail we found

445

00:26:17,470 --> 00:26:15,559

compelling evidence that they were made

446

00:26:19,120 --> 00:26:17,480

largely of sulfate salts the kind of

447

00:26:23,230 --> 00:26:19,130

thing that would have that would form if

448

00:26:24,730 --> 00:26:23,240

if sulfate rich fluid water evaporated

449

00:26:26,560 --> 00:26:24,740

away and of course the famous

450

00:26:28,120 --> 00:26:26,570

blueberries Michael Meyer mentioned that

451

00:26:30,790 --> 00:26:28,130

we found hematite deposits and the

452

00:26:33,190 --> 00:26:30,800

formerly little realm nodules in the

453

00:26:35,260 --> 00:26:33,200

rock that formed when when the haematite

454

00:26:37,810 --> 00:26:35,270

precipitated from liquid water so again

455

00:26:39,220 --> 00:26:37,820

telling a compelling story of water and

456

00:26:42,310 --> 00:26:39,230

habitability at this site and then of

457

00:26:44,680 --> 00:26:42,320

course we got to Endeavour crater we

458

00:26:46,930 --> 00:26:44,690

found the marvelous results at esperance

459

00:26:49,000 --> 00:26:46,940

the clay minerals that ray arvid's had

460

00:26:50,530 --> 00:26:49,010

talked about now I'd like to go onto the

461

00:26:51,820 --> 00:26:50,540

next graphic and let's linger on this

462

00:26:54,640 --> 00:26:51,830

one a moment because this is worth

463

00:26:57,130 --> 00:26:54,650

looking at this is a very strange pair

464

00:26:59,110 --> 00:26:57,140

of images these are two images they were

465

00:27:00,700 --> 00:26:59,120

taken 12 days apart and this just

466

00:27:02,440 --> 00:27:00,710

happened I mean this is going on right

467

00:27:05,140 --> 00:27:02,450

now this is where opportunity has

468

00:27:09,310 --> 00:27:05,150

currently parked and you can see 12 days

469

00:27:11,290 --> 00:27:09,320

apart a rock just simply appeared in

470

00:27:13,299 --> 00:27:11,300

front of us in fact we've we've narrowed

471

00:27:17,530 --> 00:27:13,309

down the date of its appearance to about

472

00:27:18,940 --> 00:27:17,540

a four day period this is strange now we

473

00:27:21,070 --> 00:27:18,950

don't think that anything particularly

474

00:27:25,419 --> 00:27:21,080

exotic happened here the most likely

475

00:27:27,640 --> 00:27:25,429

scenario just uphill from this location

476

00:27:29,290 --> 00:27:27,650

as we were driving on some bedrock the

477

00:27:31,090 --> 00:27:29,300

opportunity to Rover did a kind of a

478

00:27:34,240 --> 00:27:31,100

pirouette we call it a turn in place but

479

00:27:36,430 --> 00:27:34,250

but drove in such a fashion that it

480

00:27:39,490 --> 00:27:36,440

would drag the right front wheel kind of

481

00:27:41,710 --> 00:27:39,500

shattering across the ground and we

482

00:27:43,330 --> 00:27:41,720

think that in the process of that wheel

483

00:27:45,250 --> 00:27:43,340

moving across the ground again this is

484

00:27:47,230 --> 00:27:45,260

speculation at this point that we kind

485

00:27:49,240 --> 00:27:47,240

of flicked it kind of totally winked it

486

00:27:51,820 --> 00:27:49,250

out of the ground and that it moved to

487

00:27:55,450 --> 00:27:51,830

the location that where we see it we

488

00:27:58,080 --> 00:27:55,460

have not found the divot the hole from

489

00:27:59,700 --> 00:27:58,090

which this thing popped out

490

00:28:01,350 --> 00:27:59,710

the reason for that we think is because

491

00:28:03,090 --> 00:28:01,360

the place where we believe it came from

492

00:28:04,980 --> 00:28:03,100

is currently blocked by the solar arrays

493

00:28:06,330 --> 00:28:04,990

we can't actually see that spot so soon

494

00:28:08,129 --> 00:28:06,340

we're gonna maneuver so we can go

495

00:28:09,779 --> 00:28:08,139

searching for that spot but what's

496

00:28:12,419 --> 00:28:09,789

interesting about this rock is a couple

497

00:28:15,269 --> 00:28:12,429

of things it appears that it may have

498

00:28:17,129 --> 00:28:15,279

flipped itself upside down and if that's

499

00:28:20,009 --> 00:28:17,139

the case what we're seeing is we're

500

00:28:21,810 --> 00:28:20,019

seeing a surface the underside of the

501  
00:28:23,639 --> 00:28:21,820  
rock and its original configuration that

502  
00:28:25,440 --> 00:28:23,649  
hasn't seen the Martian atmosphere for

503  
00:28:27,299 --> 00:28:25,450  
perhaps billions of years and so we're

504  
00:28:31,590 --> 00:28:27,309  
seeing stuff that we don't normally get

505  
00:28:33,870 --> 00:28:31,600  
to see the rock is small it is sort of

506  
00:28:35,940 --> 00:28:33,880  
white around the edge outside and it's

507  
00:28:39,690 --> 00:28:35,950  
got kind of a weird deep red color not a

508  
00:28:42,360 --> 00:28:39,700  
Martian kind of red but but more a deep

509  
00:28:43,860 --> 00:28:42,370  
deep red color in the interior looks

510  
00:28:45,570 --> 00:28:43,870  
like a jelly doughnut white around the

511  
00:28:47,310 --> 00:28:45,580  
outside red in the middle we've looked

512  
00:28:49,490 --> 00:28:47,320  
at it with our microscope it's clearly a

513  
00:28:51,360 --> 00:28:49,500

rock we've looked at it with our

514

00:28:53,490 --> 00:28:51,370

compositional spectrometer and we're

515

00:28:54,659 --> 00:28:53,500

seeing a strange composition different

516

00:28:56,850 --> 00:28:54,669

from anything we've seen before there's

517

00:28:58,320 --> 00:28:56,860

a lot of sulfur in it suggesting a lot

518

00:29:00,090 --> 00:28:58,330

of sulfate salts which might have

519

00:29:02,580 --> 00:29:00,100

precipitated out beneath the surface and

520

00:29:04,620 --> 00:29:02,590

in very high concentrations of manganese

521

00:29:06,240 --> 00:29:04,630

more manganese than we've ever seen in a

522

00:29:07,830 --> 00:29:06,250

Martian Rock high concentration of

523

00:29:09,509 --> 00:29:07,840

magnesium we're still working this out

524

00:29:12,180 --> 00:29:09,519

we're making measurements right now

525

00:29:14,940 --> 00:29:12,190

so this is an ongoing story of discovery

526  
00:29:16,710 --> 00:29:14,950  
as I said Mars keeps throwing new stuff

527  
00:29:18,629 --> 00:29:16,720  
at us and it's it's these kind of

528  
00:29:20,879 --> 00:29:18,639  
unexpected discoveries that make this

529  
00:29:23,279 --> 00:29:20,889  
mission continue to be the exciting fun

530  
00:29:25,200 --> 00:29:23,289  
thing that it is the final picture that

531  
00:29:27,029 --> 00:29:25,210  
I'd like to show is one that we took a

532  
00:29:29,840 --> 00:29:27,039  
little while ago but it shows where

533  
00:29:31,980 --> 00:29:29,850  
we're going next we are currently as

534  
00:29:34,830 --> 00:29:31,990  
some of the other presenters described

535  
00:29:36,810 --> 00:29:34,840  
on the rim of Endeavour crater and what

536  
00:29:38,549 --> 00:29:36,820  
we're doing is we're climbing the ridge

537  
00:29:40,560 --> 00:29:38,559  
that you see in front of us this is

538  
00:29:42,360 --> 00:29:40,570

called Murray Ridge that's named after

539

00:29:45,090 --> 00:29:42,370

the late Bruce Murray former director of

540

00:29:47,519 --> 00:29:45,100

the Jet Propulsion Laboratory and we are

541

00:29:48,960 --> 00:29:47,529

going to ascend this Ridge we hope all

542

00:29:50,430 --> 00:29:48,970

the way to its summit all the way the

543

00:29:53,460 --> 00:29:50,440

highest point a place called Cape

544

00:29:57,299 --> 00:29:53,470

Tribulation ray Arvidsson mentioned how

545

00:29:59,990 --> 00:29:57,309

data from orbit showed us at Mattia

546

00:30:02,370 --> 00:30:00,000

Vachel where we found esperance a

547

00:30:03,840 --> 00:30:02,380

signature of clay minerals that you

548

00:30:07,230 --> 00:30:03,850

could kind of see from orbit but it was

549

00:30:09,000 --> 00:30:07,240

weak you could barely see it Cape

550

00:30:11,130 --> 00:30:09,010

Tribulation to the south of where we are

551  
00:30:12,540 --> 00:30:11,140  
that's where the the mother lode appears

552  
00:30:14,700 --> 00:30:12,550  
to be as we call it there are much

553  
00:30:16,680 --> 00:30:14,710  
higher concentrations much larger

554  
00:30:19,320 --> 00:30:16,690  
expanse of these clay minerals and what

555  
00:30:21,870 --> 00:30:19,330  
we're gonna see we don't know we'll find

556  
00:30:24,000 --> 00:30:21,880  
out when we get there so we have an

557  
00:30:25,620 --> 00:30:24,010  
excited peering exciting period of

558  
00:30:27,630 --> 00:30:25,630  
discoveries ahead of us maybe some of

559  
00:30:29,550 --> 00:30:27,640  
the best science you have to come and as

560  
00:30:31,770 --> 00:30:29,560  
long as the Rover keeps going we'll keep

561  
00:30:36,720 --> 00:30:31,780  
going and with that I will turn it back

562  
00:30:38,670 --> 00:30:36,730  
to guy Webster thanks Steve for so we'll

563  
00:30:41,730 --> 00:30:38,680

have time for some questions and answers

564

00:30:43,560 --> 00:30:41,740

and for reporters in the room we'll have

565

00:30:45,840 --> 00:30:43,570

a question please wait till you get the

566

00:30:48,450 --> 00:30:45,850

microphone to you and identify yourself

567

00:30:49,710 --> 00:30:48,460

and your news organization and on the

568

00:30:51,900 --> 00:30:49,720

phone reporters listening on the phone

569

00:30:55,500 --> 00:30:51,910

if you would like to ask a question hit

570

00:30:57,420 --> 00:30:55,510

star 1 on your phone and the operator

571

00:30:59,160 --> 00:30:57,430

will put you in the queue we have

572

00:31:03,150 --> 00:30:59,170

several reporters listening around the

573

00:31:05,190 --> 00:31:03,160

country and further so first I'll check

574

00:31:06,390 --> 00:31:05,200

if there's any questions in the room

575

00:31:12,540 --> 00:31:06,400

from reporters

576

00:31:14,610 --> 00:31:12,550

we're also and well instead we'll go to

577

00:31:19,290 --> 00:31:14,620

a question on the phone from the New

578

00:31:22,530 --> 00:31:19,300

York Times oh hi thank you taking my

579

00:31:24,510 --> 00:31:22,540

question I guess like one question is

580

00:31:27,870 --> 00:31:24,520

how long is it going to take to get to

581

00:31:29,070 --> 00:31:27,880

the top of Murray Bridge and secondly at

582

00:31:32,100 --> 00:31:29,080

this point what's this going to happen

583

00:31:37,970 --> 00:31:32,110

first that opportunity will break down

584

00:31:42,120 --> 00:31:40,230

can I'll try that to answer the first

585

00:31:43,680 --> 00:31:42,130

part then I'll let my my colleague from

586

00:31:45,990 --> 00:31:43,690

NASA headquarters answer in the second

587

00:31:47,460 --> 00:31:46,000

part I learned a long time ago not to

588

00:31:49,830 --> 00:31:47,470

try to predict how long it's gonna take

589

00:31:51,450 --> 00:31:49,840

to do almost anything with these Rovers

590

00:31:53,880 --> 00:31:51,460

because you have unexpected stuff along

591

00:31:55,620 --> 00:31:53,890

the way the jelly donut Rock we call it

592

00:31:57,270 --> 00:31:55,630

pinnacle Island that popped up in front

593

00:31:58,860 --> 00:31:57,280

of us unexpectedly it's a real

594

00:32:01,020 --> 00:31:58,870

opportunity and so we're taking our time

595

00:32:02,550 --> 00:32:01,030

to look at it so I don't know but the

596

00:32:05,940 --> 00:32:02,560

kind of distance that we need to

597

00:32:08,160 --> 00:32:05,950

traverse to get to the summit of Cape

598

00:32:09,810 --> 00:32:08,170

Tribulation is comparable to the

599

00:32:12,600 --> 00:32:09,820

distance that we needed to traverse to

600

00:32:15,360 --> 00:32:12,610

climb husband Hill with spirit that took

601  
00:32:16,920 --> 00:32:15,370  
us four or 500 Martian days so you know

602  
00:32:22,049 --> 00:32:16,930  
it's going to keep us busy I would say

603  
00:32:28,240 --> 00:32:25,060  
in concerning whether or not the rubber

604  
00:32:31,389 --> 00:32:28,250  
would be turned off as you know we have

605  
00:32:33,580 --> 00:32:31,399  
a process in planetary sciences where as

606  
00:32:35,169 --> 00:32:33,590  
you go into extended missions they cost

607  
00:32:38,230 --> 00:32:35,179  
a certain amount of money and you have

608  
00:32:39,789 --> 00:32:38,240  
to decide whether or not it's worth the

609  
00:32:41,440 --> 00:32:39,799  
money for the extended mission or

610  
00:32:44,049 --> 00:32:41,450  
whether or not it should be applied to a

611  
00:32:45,580 --> 00:32:44,059  
new mission in the case of Mars we have

612  
00:32:48,880 --> 00:32:45,590  
several missions that are still ongoing

613  
00:32:50,620 --> 00:32:48,890

that are in the extended mission and we

614

00:32:52,630 --> 00:32:50,630

have to weigh how much money we have

615

00:32:55,120 --> 00:32:52,640

versus what missions are being most

616

00:32:57,190 --> 00:32:55,130

productive so what will happen is this

617

00:32:58,930 --> 00:32:57,200

spring there'll be what's called a

618

00:33:01,480 --> 00:32:58,940

senior review in which all the missions

619

00:33:04,480 --> 00:33:01,490

and planetary science are reviewed to

620

00:33:06,279 --> 00:33:04,490

see which missions are worth the dollars

621

00:33:09,519 --> 00:33:06,289

that you have to spend on them to extend

622

00:33:11,320 --> 00:33:09,529

them and so it's the process of the

623

00:33:13,180 --> 00:33:11,330

senior review that makes any

624

00:33:15,310 --> 00:33:13,190

recommendation in terms of which mission

625

00:33:17,710 --> 00:33:15,320

should go forward and which mission may

626

00:33:19,210 --> 00:33:17,720

get turned off and frankly from all the

627

00:33:21,820 --> 00:33:19,220

missions that we have are they're very

628

00:33:23,710 --> 00:33:21,830

productive and be a shame not to have

629

00:33:25,930 --> 00:33:23,720

enough to afford the continuation of

630

00:33:27,580 --> 00:33:25,940

those missions but we'll see how that

631

00:33:30,669 --> 00:33:27,590

turns out when we get to the senior

632

00:33:35,919 --> 00:33:30,679

review thanks Michael we have a question

633

00:33:38,799 --> 00:33:35,929

from Alan Boyle with MSNBC hi thank you

634

00:33:40,629 --> 00:33:38,809

for taking the question I follow up on

635

00:33:42,759 --> 00:33:40,639

that is could you provide the latest

636

00:33:45,009 --> 00:33:42,769

estimate on how much it is costing to

637

00:33:48,100 --> 00:33:45,019

keep the opportunity mission going a

638

00:33:50,139 --> 00:33:48,110

year and I wondered if the panel had any

639

00:33:51,879 --> 00:33:50,149

thoughts I know you could probably take

640

00:33:53,620 --> 00:33:51,889

all day to talk about the highlights of

641

00:33:56,799 --> 00:33:53,630

the last 10 years but if there's one

642

00:33:59,230 --> 00:33:56,809

thing that you feel either is on the top

643

00:34:03,009 --> 00:33:59,240

of your list or really needed needs to

644

00:34:04,690 --> 00:34:03,019

have more attention paid to it I thought

645

00:34:08,200 --> 00:34:04,700

I'd give you the opportunity to do that

646

00:34:10,419 --> 00:34:08,210

thank you I'll take the first part of

647

00:34:12,399 --> 00:34:10,429

your question and that it cost

648

00:34:16,300 --> 00:34:12,409

approximately fourteen million dollars

649

00:34:18,550 --> 00:34:16,310

per year to maintain the team in the and

650

00:34:25,230 --> 00:34:18,560

the pace of activity that we have on

651

00:34:25,240 --> 00:34:29,750

you know greatest hits

652

00:34:33,620 --> 00:34:31,430

you know raised probably a little too

653

00:34:36,560 --> 00:34:33,630

modest to to mention it but I think the

654

00:34:37,970 --> 00:34:36,570

the paper on which he's lead author the

655

00:34:40,160 --> 00:34:37,980

discoverer of those clay deposits

656

00:34:42,020 --> 00:34:40,170

Esperanza's got a rank right near at the

657

00:34:43,940 --> 00:34:42,030

top and that's what motivates us so

658

00:34:46,910 --> 00:34:43,950

strongly to continue this search for

659

00:34:49,550 --> 00:34:46,920

clay minerals esperance was invisible

660

00:34:52,220 --> 00:34:49,560

from orbit and yet following the clay

661

00:34:53,930 --> 00:34:52,230

signature took us to that if we follow

662

00:34:55,400 --> 00:34:53,940

the much stronger clay signature the

663

00:34:57,320 --> 00:34:55,410

lies to the south we think that there

664

00:34:59,240 --> 00:34:57,330

are fantastic discoveries that that may

665

00:35:02,060 --> 00:34:59,250

lie there and so if you ask what merits

666

00:35:03,920 --> 00:35:02,070

more attention I think it's that to tell

667

00:35:05,990 --> 00:35:03,930

you about some other small locations

668

00:35:10,760 --> 00:35:06,000

along the way that we just recently

669

00:35:16,070 --> 00:35:10,770

found yep well what do those two rayar

670

00:35:17,720 --> 00:35:16,080

promise I should mention to report if

671

00:35:20,600 --> 00:35:17,730

you can direct your question to a

672

00:35:21,710 --> 00:35:20,610

specific panelist settled that'll help

673

00:35:24,080 --> 00:35:21,720

us since we're dealing with two

674

00:35:25,760 --> 00:35:24,090

locations here and we have a question

675

00:35:26,920 --> 00:35:25,770

from Ken Kramer I believe with you

676

00:35:29,240 --> 00:35:26,930

Universe Today

677

00:35:32,480 --> 00:35:29,250

alright thanks for taking my question

678

00:35:34,400 --> 00:35:32,490

and congratulations on ten years I have

679

00:35:36,080 --> 00:35:34,410

a question for Ray and Steve I wonder if

680

00:35:38,630 --> 00:35:36,090

you could talk a little bit more about

681

00:35:40,400 --> 00:35:38,640

the area where you are right now you got

682

00:35:43,370 --> 00:35:40,410

the Chrysler measurements to direct you

683

00:35:45,410 --> 00:35:43,380

to the spot where you are because of the

684

00:35:48,110 --> 00:35:45,420

phyllosilicates I believe so could you

685

00:35:50,180 --> 00:35:48,120

talk about what you have found there

686

00:35:53,870 --> 00:35:50,190

with regard to the phyllosilicates and

687

00:35:56,150 --> 00:35:53,880

what you're planning to do and also with

688

00:35:58,370 --> 00:35:56,160

regard to tribulation d do you have to

689

00:36:00,380 --> 00:35:58,380

climb back down in order to get there or

690

00:36:00,920 --> 00:36:00,390

you just follow the richer or how do you

691

00:36:02,990 --> 00:36:00,930

get there

692

00:36:06,500 --> 00:36:03,000

thanks Steve you want me to start on

693

00:36:08,840 --> 00:36:06,510

this go ahead right so we have super

694

00:36:10,760 --> 00:36:08,850

resolution prism data thanks to the

695

00:36:14,630 --> 00:36:10,770

chrim team and the Mars Reconnaissance

696

00:36:17,480 --> 00:36:14,640

Orbiter all the way from Cape York to

697

00:36:19,070 --> 00:36:17,490

Murray Ridge to the beginning of Cape

698

00:36:21,110 --> 00:36:19,080

Tribulation and we expect to get

699

00:36:23,860 --> 00:36:21,120

additional data to cover Cape

700

00:36:28,340 --> 00:36:23,870

Tribulation and we're seeing these small

701

00:36:30,980 --> 00:36:28,350

outcrops of aluminous and iron clays

702

00:36:32,870 --> 00:36:30,990

these smectite s-- all along where

703

00:36:34,940 --> 00:36:32,880

they're in the sun facing side and

704

00:36:37,850 --> 00:36:34,950

they're large enough and large only

705

00:36:39,950 --> 00:36:37,860

means a few tens of meters across so we

706

00:36:40,700 --> 00:36:39,960

stopped at one location called morton

707

00:36:42,920 --> 00:36:40,710

island

708

00:36:45,740 --> 00:36:42,930

which I like very much a very pretty

709

00:36:48,620 --> 00:36:45,750

area on Murray Ridge and it's an impact

710

00:36:50,480 --> 00:36:48,630

Retta but with a lot of matrix a lot of

711

00:36:52,940 --> 00:36:50,490

very bright matrix and we think that's

712

00:36:54,410 --> 00:36:52,950

probably the carrier of the aluminous

713

00:36:56,630 --> 00:36:54,420

clay mineral that's still

714

00:36:59,120 --> 00:36:56,640

work-in-progress but we had to get to

715

00:37:02,059 --> 00:36:59,130

North facing slopes so we're in an area

716

00:37:03,530 --> 00:37:02,069

called Cooke Haven and after James Cook

717

00:37:06,589 --> 00:37:03,540

who was the captain of the endeavour

718

00:37:08,210 --> 00:37:06,599

ship and we're in the process of

719

00:37:09,530 --> 00:37:08,220

beginning the winter campaign but as

720

00:37:13,190 --> 00:37:09,540

John mentioned there's enough solar

721

00:37:15,920 --> 00:37:13,200

energy to examine the strata in Cooke

722

00:37:17,750 --> 00:37:15,930

Haven and I suspect that's mainly impact

723

00:37:19,730 --> 00:37:17,760

breccia although we might go down

724

00:37:21,380 --> 00:37:19,740

stratigraphically low enough to see

725

00:37:23,450 --> 00:37:21,390

these preexisting rocks but we haven't

726

00:37:25,760 --> 00:37:23,460

gotten there yet so Ken it's very much

727

00:37:27,440 --> 00:37:25,770

work in progress and as we kind of

728

00:37:29,809 --> 00:37:27,450

Traverse south when the spring season

729

00:37:32,120 --> 00:37:29,819

comes about there are lots as I just

730

00:37:33,799 --> 00:37:32,130

told Steve there are lots of small areas

731

00:37:36,049 --> 00:37:33,809

where I'm going to suggest we stop and

732

00:37:38,630 --> 00:37:36,059

look around but it's very much detective

733

00:37:41,000 --> 00:37:38,640

work and we're using chiasm as the way

734

00:37:42,650 --> 00:37:41,010

to get at the mineralogy and then kind

735

00:37:45,650 --> 00:37:42,660

of boots on the ground or wheels on the

736

00:37:47,750 --> 00:37:45,660

ground in terms of getting into the dirt

737

00:37:50,960 --> 00:37:47,760

grinding in the rocks and putting

738

00:37:53,660 --> 00:37:50,970

together that the whole kind of story

739

00:37:58,069 --> 00:37:53,670

that that makes them the best sense so

740

00:38:00,260 --> 00:37:58,079

Ken it's it's work in progress and Ken

741

00:38:02,000 --> 00:38:00,270

with respect to your second question and

742

00:38:04,069 --> 00:38:02,010

the route going forward you know I think

743

00:38:05,510 --> 00:38:04,079

Cape Tribulation is well-named we expect

744

00:38:07,400 --> 00:38:05,520

some pretty significant trials and

745

00:38:09,799 --> 00:38:07,410

tribulations as we work our way up it

746

00:38:11,720 --> 00:38:09,809

it's steep it's extremely rugged we

747

00:38:13,700 --> 00:38:11,730

haven't chosen the route yet and we

748

00:38:15,380 --> 00:38:13,710

could descend and then come at it from a

749

00:38:18,589 --> 00:38:15,390

different direction or we could just

750

00:38:20,030 --> 00:38:18,599

work our way up that Ridge and that's

751  
00:38:21,950 --> 00:38:20,040  
the decision that we're gonna make going

752  
00:38:25,640 --> 00:38:21,960  
forward because it's driven not just by

753  
00:38:27,589 --> 00:38:25,650  
finding the best route to get up Murray

754  
00:38:30,920 --> 00:38:27,599  
Ridge and cape tribulation it's also as

755  
00:38:32,480 --> 00:38:30,930  
Ray's reminded us driven by the science

756  
00:38:36,289 --> 00:38:32,490  
that we can do along the way so we're

757  
00:38:38,539 --> 00:38:36,299  
still working that thanks Steve

758  
00:38:39,650 --> 00:38:38,549  
we have a question from a reporter if I

759  
00:38:42,430 --> 00:38:39,660  
remember right might have been here on

760  
00:38:46,010 --> 00:38:42,440  
landing night leo in right from Irish TV

761  
00:38:48,620 --> 00:38:46,020  
yes the big guy 10 years ago it seems

762  
00:38:50,680 --> 00:38:48,630  
like a long time but if I may put a

763  
00:38:54,430 --> 00:38:50,690

question to Ray and also

764

00:38:56,170 --> 00:38:54,440

perhaps to Steve about the it used to be

765

00:38:59,650 --> 00:38:56,180

follow the water it now seems to be

766

00:39:02,020 --> 00:38:59,660

follow the phyllosilicates so I'm

767

00:39:04,090 --> 00:39:02,030

wondering from Ray whether he really

768

00:39:07,030 --> 00:39:04,100

thinks now that this is almost a new

769

00:39:09,580 --> 00:39:07,040

mission and whether all the focus now is

770

00:39:12,880 --> 00:39:09,590

on these Philo silicates and if I could

771

00:39:14,770 --> 00:39:12,890

also ask Steve for a broader picture I

772

00:39:18,220 --> 00:39:14,780

mean what you had tremendous success

773

00:39:20,680 --> 00:39:18,230

with remote sensing as Mike Meyers said

774

00:39:22,540 --> 00:39:20,690

so I'm just wondering what what lessons

775

00:39:25,480 --> 00:39:22,550

are we learn now by the Europeans and

776

00:39:28,090 --> 00:39:25,490

the Americans who are both planning new

777

00:39:29,500 --> 00:39:28,100

missions are there places now that you

778

00:39:32,230 --> 00:39:29,510

say they should go

779

00:39:34,510 --> 00:39:32,240

that's very political well Larry let me

780

00:39:36,460 --> 00:39:34,520

take the first part so the Byrnes

781

00:39:37,800 --> 00:39:36,470

formation which which you know about

782

00:39:40,600 --> 00:39:37,810

because you were here at the get-go

783

00:39:43,270 --> 00:39:40,610

sulfates and stones so they they

784

00:39:46,030 --> 00:39:43,280

probably formed when more or less

785

00:39:48,580 --> 00:39:46,040

neutral waters came up with ferrous iron

786

00:39:51,340 --> 00:39:48,590

and saw an oxidizing environment it

787

00:39:54,310 --> 00:39:51,350

makes Fe plus 2 ferric iron and then

788

00:39:56,400 --> 00:39:54,320

actually produces acid as soon as you

789

00:39:59,280 --> 00:39:56,410

begin to make sulfates so it was a very

790

00:40:01,360 --> 00:39:59,290

oxidizing very acidic environment

791

00:40:03,910 --> 00:40:01,370

phyllosilicates on the other hand and

792

00:40:06,520 --> 00:40:03,920

minerals are kind of keys to past

793

00:40:10,030 --> 00:40:06,530

geochemical conditions in terms of the

794

00:40:13,840 --> 00:40:10,040

waters the phyllosilicates have to form

795

00:40:15,730 --> 00:40:13,850

in less extreme environments so that

796

00:40:17,410 --> 00:40:15,740

these minerals called smectite s-- the

797

00:40:19,720 --> 00:40:17,420

particular type of phyllosilicates

798

00:40:21,370 --> 00:40:19,730

they're the types of phyllosilicates

799

00:40:24,370 --> 00:40:21,380

that you get when you weather basalt but

800

00:40:26,620 --> 00:40:24,380

it can't be done in highly acidic highly

801

00:40:28,960 --> 00:40:26,630

oxidizing conditions or you get other

802

00:40:31,030 --> 00:40:28,970

kinds of minerals that we don't see so

803

00:40:34,150 --> 00:40:31,040

these are indicators of where you want

804

00:40:36,910 --> 00:40:34,160

to go for a mild aqueous condition still

805

00:40:39,510 --> 00:40:36,920

corrosive but nothing like the you know

806

00:40:42,670 --> 00:40:39,520

the very low pH high highly oxidizing

807

00:40:45,100 --> 00:40:42,680

stuff that we found in terms of

808

00:40:47,350 --> 00:40:45,110

formation on the byrds formation so yeah

809

00:40:49,360 --> 00:40:47,360

we are hunting for phyllosilicates form

810

00:40:52,540 --> 00:40:49,370

orbit using the super resolution

811

00:40:54,580 --> 00:40:52,550

technique and then what really is the

812

00:40:58,510 --> 00:40:54,590

payoff is getting opportunity to those

813

00:41:00,400 --> 00:40:58,520

sites to do the details for example on

814

00:41:02,680 --> 00:41:00,410

Mattia veg hill and the mattias

815

00:41:03,660 --> 00:41:02,690

formation that's the topic of tomorrow's

816

00:41:06,329 --> 00:41:03,670

science paper

817

00:41:08,880 --> 00:41:06,339

it was such a small outcrop and so

818

00:41:10,740 --> 00:41:08,890

poorly exposed vertically that we don't

819

00:41:12,660 --> 00:41:10,750

know the environment of deposition so

820

00:41:15,180 --> 00:41:12,670

we're carrying maybe they were lake beds

821

00:41:18,030 --> 00:41:15,190

maybe they were volcanic ash deposits

822

00:41:20,160 --> 00:41:18,040

maybe they represent ancient ejecta

823

00:41:22,680 --> 00:41:20,170

prior to endeavor but we didn't have

824

00:41:24,809 --> 00:41:22,690

enough exposure to really kind of get in

825

00:41:28,200 --> 00:41:24,819

and do what a a geologist would do in

826

00:41:30,359 --> 00:41:28,210

the field look for cross bedding for mud

827

00:41:32,579 --> 00:41:30,369

cracks and other features that together

828

00:41:34,319 --> 00:41:32,589

with the chemistry and mineralogy would

829

00:41:34,740 --> 00:41:34,329

allow you to kind of back out the full

830

00:41:37,410 --> 00:41:34,750

story

831

00:41:39,630 --> 00:41:37,420

there are outcrops when we go south that

832

00:41:42,059 --> 00:41:39,640

are large enough and also file a

833

00:41:44,520 --> 00:41:42,069

silicate or smectite bearing where we

834

00:41:46,200 --> 00:41:44,530

hope to kind of catch up to what what

835

00:41:48,510 --> 00:41:46,210

curiosity has been able to do in

836

00:41:50,549 --> 00:41:48,520

Yellowknife Bay where you could have the

837

00:41:52,650 --> 00:41:50,559

strata exposed and where you can really

838

00:41:55,039 --> 00:41:52,660

back out the environment a deposition in

839

00:41:58,020 --> 00:41:55,049

addition to the geochemical conditions

840

00:42:02,280 --> 00:41:58,030

that led to formation of the minerals

841

00:42:03,720 --> 00:42:02,290

that were detecting and and just to

842

00:42:05,220 --> 00:42:03,730

answer your second question briefly you

843

00:42:07,289 --> 00:42:05,230

know I think the key takeaway message

844

00:42:10,319 --> 00:42:07,299

here is the incredible power of having

845

00:42:12,480 --> 00:42:10,329

orbital assets and mobile surface assets

846

00:42:14,670 --> 00:42:12,490

working at the same time the science

847

00:42:17,460 --> 00:42:14,680

that we're getting from the orbiters is

848

00:42:18,870 --> 00:42:17,470

dramatically enhanced by the rover's the

849

00:42:20,520 --> 00:42:18,880

science and the Rovers is dramatically

850

00:42:23,720 --> 00:42:20,530

enhanced by the orbiters and so working

851  
00:42:25,710 --> 00:42:23,730  
those two together is very very valuable

852  
00:42:27,390 --> 00:42:25,720  
thanks Dave we are getting some

853  
00:42:29,220 --> 00:42:27,400  
questions in from social media and I

854  
00:42:31,829 --> 00:42:29,230  
think this one is probably directed to

855  
00:42:34,289 --> 00:42:31,839  
John has the surface radiation

856  
00:42:37,620 --> 00:42:34,299  
environment on Mars affected the rover

857  
00:42:39,750 --> 00:42:37,630  
in any way no not really the rover's

858  
00:42:40,920 --> 00:42:39,760  
were designed for the environment for

859  
00:42:44,039 --> 00:42:40,930  
the radiation environment that they're

860  
00:42:46,620 --> 00:42:44,049  
finding and so what we haven't had any

861  
00:42:50,130 --> 00:42:46,630  
issues of radiation damage or radiation

862  
00:42:52,950 --> 00:42:50,140  
related effects we do have we can see in

863  
00:42:54,990 --> 00:42:52,960

the electronics and in the cameras some

864

00:42:57,210 --> 00:42:55,000

effects of cosmic rays or solar wind

865

00:43:01,220 --> 00:42:57,220

particles but they're not a health issue

866

00:43:05,099 --> 00:43:01,230

for the vehicle and another from

867

00:43:07,650 --> 00:43:05,109

followers on Ustream on the chat how is

868

00:43:09,359 --> 00:43:07,660

opportunities filesystem holding up are

869

00:43:11,010 --> 00:43:09,369

the energy and are the energy levels

870

00:43:13,710 --> 00:43:11,020

okay I guess that's two different

871

00:43:15,930 --> 00:43:13,720

questions the filesystem they referring

872

00:43:16,690 --> 00:43:15,940

to our flash memory you just take a

873

00:43:21,310 --> 00:43:16,700

moment

874

00:43:24,069 --> 00:43:21,320

a little explanation here we use the

875

00:43:26,829 --> 00:43:24,079

same kind of non-volatile storage that

876

00:43:28,359 --> 00:43:26,839

your camera or your smartphone uses that

877

00:43:31,030 --> 00:43:28,369

it retains the information after the

878

00:43:34,630 --> 00:43:31,040

power has been turned off those flash

879

00:43:36,730 --> 00:43:34,640

file or flash memory chips have a finite

880

00:43:39,220 --> 00:43:36,740

number of read/write cycles to them you

881

00:43:41,410 --> 00:43:39,230

can actually wear them out but they're

882

00:43:42,910 --> 00:43:41,420

designed such that you don't continually

883

00:43:44,260 --> 00:43:42,920

read/write in the same location to kind

884

00:43:48,640 --> 00:43:44,270

of spread things out or what they call

885

00:43:51,490 --> 00:43:48,650

duty cycle our load leveling the use but

886

00:43:53,980 --> 00:43:51,500

it is possible that in time that you do

887

00:43:56,140 --> 00:43:53,990

wear out a particular location and we

888

00:43:58,480 --> 00:43:56,150

may be seeing that we think we saw this

889

00:44:01,630 --> 00:43:58,490

with spirit we were able to correct it

890

00:44:02,589 --> 00:44:01,640

on spirit by reformatting and some of

891

00:44:04,810 --> 00:44:02,599

you have may have had to do this

892

00:44:06,760 --> 00:44:04,820

yourselves with your the flash card in

893

00:44:08,980 --> 00:44:06,770

your camera is no it's not working

894

00:44:10,720 --> 00:44:08,990

properly and you reformat the flash

895

00:44:12,609 --> 00:44:10,730

memory card and things are fine from

896

00:44:13,540 --> 00:44:12,619

there so we might have to do something

897

00:44:15,880 --> 00:44:13,550

like that

898

00:44:18,310 --> 00:44:15,890

for opportunity but we'll wait and see

899

00:44:20,020 --> 00:44:18,320

it's it's as I mentioned earlier it's

900

00:44:23,230 --> 00:44:20,030

only an occasional annoyance right now

901  
00:44:24,609 --> 00:44:23,240  
it's not a major issue yet and then the

902  
00:44:28,390 --> 00:44:24,619  
other question was about the energy

903  
00:44:30,400 --> 00:44:28,400  
levels well the good news is that we've

904  
00:44:31,839 --> 00:44:30,410  
had some dust cleaning events and that

905  
00:44:33,700 --> 00:44:31,849  
the amount of dust on the solar arrays

906  
00:44:36,760 --> 00:44:33,710  
is less than it has been for the past

907  
00:44:38,650 --> 00:44:36,770  
couple of winters and three weeks we'll

908  
00:44:40,780 --> 00:44:38,660  
get through the winter solstice and so

909  
00:44:42,940 --> 00:44:40,790  
the Sun will be higher in the sky so the

910  
00:44:45,339 --> 00:44:42,950  
energy level should be increasing as you

911  
00:44:47,200 --> 00:44:45,349  
would expect as you move into a spring

912  
00:44:49,690 --> 00:44:47,210  
and summer so our expectation is that

913  
00:44:51,490 --> 00:44:49,700

we'll have robust power levels you know

914

00:44:53,950 --> 00:44:51,500

through the next seasonal cycles for

915

00:44:56,349 --> 00:44:53,960

exploration thanks John

916

00:44:58,030 --> 00:44:56,359

we have maybe one or two more on the

917

00:44:59,670 --> 00:44:58,040

social media reminder if any any

918

00:45:01,720 --> 00:44:59,680

reporters in the room have a question

919

00:45:02,950 --> 00:45:01,730

we'll bring the mic to you please

920

00:45:07,270 --> 00:45:02,960

identify yourself and your news

921

00:45:12,420 --> 00:45:07,280

organization guy if skales Dale

922

00:45:14,770 --> 00:45:12,430

expressway Charlie were so Poland also

923

00:45:17,079 --> 00:45:14,780

entrepreneur an investor who started

924

00:45:20,710 --> 00:45:17,089

collaboration with the city of Lombok

925

00:45:25,329 --> 00:45:20,720

own creation of a California space

926  
00:45:27,550 --> 00:45:25,339  
center and my question is of interest to

927  
00:45:30,279 --> 00:45:27,560  
our readers who like to look toward the

928  
00:45:33,370 --> 00:45:30,289  
future and very much value you

929  
00:45:37,719 --> 00:45:33,380  
gentleman's accomplishments mister Elon

930  
00:45:40,929 --> 00:45:37,729  
Musk and his SpaceX ultimate goal as he

931  
00:45:45,400 --> 00:45:40,939  
shared with us recently is to deploy us

932  
00:45:47,439 --> 00:45:45,410  
human beings to be present on Mars what

933  
00:45:50,349 --> 00:45:47,449  
you are doing here it creates a

934  
00:45:53,859 --> 00:45:50,359  
incredible vehicle which potentially can

935  
00:45:58,239 --> 00:45:53,869  
be used for making transportation

936  
00:46:02,979 --> 00:45:58,249  
possible should the mission to Mars be

937  
00:46:06,339 --> 00:46:02,989  
achievable so if I may ask for your

938  
00:46:09,519 --> 00:46:06,349

response to convey to our non-technical

939

00:46:12,519 --> 00:46:09,529

readers about how would you like your

940

00:46:15,519 --> 00:46:12,529

accomplishments your vehicle technology

941

00:46:17,319 --> 00:46:15,529

to potentially be harnessed in let's say

942

00:46:20,979 --> 00:46:17,329

five years from now for this type of a

943

00:46:22,569 --> 00:46:20,989

purpose thanks for your question and I I

944

00:46:27,269 --> 00:46:22,579

think I'll toss that one to Michael if

945

00:46:32,169 --> 00:46:27,279

he wants to or anybody else who wants to

946

00:46:35,559 --> 00:46:32,179

well certainly NASA has the ultimate

947

00:46:39,099 --> 00:46:35,569

goal of having humans to Mars and in

948

00:46:42,609 --> 00:46:39,109

fact our missions now when going to Mars

949

00:46:44,799 --> 00:46:42,619

10 will have on board something that

950

00:46:46,839 --> 00:46:44,809

will help further our knowledge that

951  
00:46:50,259 --> 00:46:46,849  
will help future human exploration and

952  
00:46:52,059 --> 00:46:50,269  
good examples of that are on the rover

953  
00:46:53,919 --> 00:46:52,069  
Curiosity we have an instrument called

954  
00:46:56,289 --> 00:46:53,929  
rad which is measuring the radiation

955  
00:46:59,949 --> 00:46:56,299  
environment on the surface of Mars so we

956  
00:47:02,289 --> 00:46:59,959  
know what the astronauts will have to

957  
00:47:05,339 --> 00:47:02,299  
guard against when they go exploring the

958  
00:47:08,469 --> 00:47:05,349  
surface and we just finished a call of

959  
00:47:11,859 --> 00:47:08,479  
instruments for the 2020 Rover in fact

960  
00:47:13,959 --> 00:47:11,869  
asking for ideas technologies that will

961  
00:47:17,769 --> 00:47:13,969  
help future human exploration so

962  
00:47:19,539 --> 00:47:17,779  
certainly any mission going to Mars we

963  
00:47:21,969 --> 00:47:19,549

would love to be able to have NASA

964

00:47:25,209 --> 00:47:21,979

assets involved in furthering human

965

00:47:27,130 --> 00:47:25,219

exploration and it's in many ways it's

966

00:47:29,289 --> 00:47:27,140

not very important whether or not is

967

00:47:33,249 --> 00:47:29,299

from commercial space or it's from a

968

00:47:36,849 --> 00:47:33,259

NASA headed mission itself so I think

969

00:47:41,720 --> 00:47:41,029

anymore in the room here we have Adam

970

00:47:46,309 --> 00:47:41,730

here in the front

971

00:47:48,470 --> 00:47:46,319

Oh coming across hi Adam Palissy Los

972

00:47:50,390 --> 00:47:48,480

Angeles news group ray can you tell me

973

00:47:52,579 --> 00:47:50,400

again win these discoveries such as

974

00:47:54,650 --> 00:47:52,589

smectite swear made and how does

975

00:47:56,329 --> 00:47:54,660

something that is only meant to last a

976

00:47:58,400 --> 00:47:56,339

couple of months how exactly does it

977

00:48:00,950 --> 00:47:58,410

last 10 years and continue to make

978

00:48:05,740 --> 00:48:00,960

discoveries let me answer the second one

979

00:48:12,069 --> 00:48:09,019

do you mean when in calendar date we we

980

00:48:15,440 --> 00:48:12,079

did the discoveries so this began in

981

00:48:17,690 --> 00:48:15,450

2012 and was pretty well wrapped up by

982

00:48:20,089 --> 00:48:17,700

last spring and summer in terms of the

983

00:48:22,430 --> 00:48:20,099

observations and then we buttoned up and

984

00:48:24,680 --> 00:48:22,440

started driving across botany bay to get

985

00:48:27,109 --> 00:48:24,690

to Murray Ridge and we've been doing

986

00:48:28,819 --> 00:48:27,119

Murray Ridge for for quite a while but

987

00:48:31,220 --> 00:48:28,829

you know science is a difficult process

988

00:48:33,410 --> 00:48:31,230

and the data analysis the the

989

00:48:36,620 --> 00:48:33,420

super-resolution processing is very very

990

00:48:38,180 --> 00:48:36,630

tough because the way we operate chris

991

00:48:40,009 --> 00:48:38,190

you're putting pixels all over the

992

00:48:42,740 --> 00:48:40,019

surface and you have to reorganize them

993

00:48:45,499 --> 00:48:42,750

to regularize them so it took a while to

994

00:48:47,660 --> 00:48:45,509

put that together to be comfortable with

995

00:48:49,339 --> 00:48:47,670

what we were seeing to direct the rover

996

00:48:51,140 --> 00:48:49,349

to get there and then all the

997

00:48:53,269 --> 00:48:51,150

observations that we made during the

998

00:48:56,029 --> 00:48:53,279

walk about in and all the in situ

999

00:48:58,069 --> 00:48:56,039

observations took a long time to come to

1000

00:49:01,490 --> 00:48:58,079

grips with what it was telling us about

1001

00:49:04,039 --> 00:49:01,500

the history of Mars let me just add to

1002

00:49:05,870 --> 00:49:04,049

you the second part of your question is

1003

00:49:07,940 --> 00:49:05,880

do you know how was it that these Rovers

1004

00:49:09,440 --> 00:49:07,950

have lasted so long well they're

1005

00:49:11,240 --> 00:49:09,450

solar-powered mission and the only

1006

00:49:13,460 --> 00:49:11,250

previous solar-powered landed mission

1007

00:49:15,529 --> 00:49:13,470

experience we had was with Pathfinder

1008

00:49:17,450 --> 00:49:15,539

and so we knew about the air fall dust

1009

00:49:19,190 --> 00:49:17,460

and the expectation was the dust would

1010

00:49:21,319 --> 00:49:19,200

accumulate at a rate similar to

1011

00:49:23,539 --> 00:49:21,329

Pathfinder and so we sized the arrays to

1012

00:49:27,559 --> 00:49:23,549

give us enough power to last at least 90

1013

00:49:28,849 --> 00:49:27,569

days what we didn't expect was that the

1014

00:49:31,490 --> 00:49:28,859

wind would blow the dust off the arrays

1015

00:49:33,799 --> 00:49:31,500

in fact we thought that the dust

1016

00:49:35,299 --> 00:49:33,809

wouldn't blow the wind would not blow

1017

00:49:37,579 --> 00:49:35,309

the dust off the erase because a my

1018

00:49:39,859 --> 00:49:37,589

cling electrostatically to the surfaces

1019

00:49:41,779 --> 00:49:39,869

so this has been a tremendous benefit

1020

00:49:43,549 --> 00:49:41,789

that there's periodic cleaning we can't

1021

00:49:46,339 --> 00:49:43,559

predict it it seems to have some

1022

00:49:48,170 --> 00:49:46,349

seasonal relationship but it certainly

1023

00:49:48,490 --> 00:49:48,180

has enabled the Rovers to continue to

1024

00:49:50,680 --> 00:49:48,500

general

1025

00:49:53,410 --> 00:49:50,690

power and then the other aspect of this

1026  
00:49:55,810 --> 00:49:53,420  
is that we have an Operations team that

1027  
00:49:58,930 --> 00:49:55,820  
has been very innovative in figuring out

1028  
00:50:01,240 --> 00:49:58,940  
how to get these Rovers to survive the

1029  
00:50:03,850 --> 00:50:01,250  
the cold dark Martian winters how we can

1030  
00:50:05,920 --> 00:50:03,860  
preserve energy continue to be

1031  
00:50:08,380 --> 00:50:05,930  
productive but operate these vehicles at

1032  
00:50:11,590 --> 00:50:08,390  
much lower power levels than they were

1033  
00:50:13,480 --> 00:50:11,600  
originally designed and and Ray is right

1034  
00:50:15,760 --> 00:50:13,490  
these are magnificently built machines

1035  
00:50:17,350 --> 00:50:15,770  
the really wonderful project manager is

1036  
00:50:19,900 --> 00:50:17,360  
being humble these are excellent

1037  
00:50:22,360 --> 00:50:19,910  
machines they're they're well designed

1038  
00:50:25,240 --> 00:50:22,370

they're well built they're tested and

1039

00:50:27,820 --> 00:50:25,250

that that's why they're still working so

1040

00:50:29,980 --> 00:50:27,830

is this unique that something last this

1041

00:50:31,450 --> 00:50:29,990

long pass was expected or is this

1042

00:50:35,230 --> 00:50:31,460

something that NASA missions and I'd

1043

00:50:37,990 --> 00:50:35,240

ever see a lot you know that's it's very

1044

00:50:40,120 --> 00:50:38,000

difficult to to say you know it's you

1045

00:50:42,430 --> 00:50:40,130

know in the choice of being whether

1046

00:50:45,610 --> 00:50:42,440

you'd rather be good or be lucky choose

1047

00:50:50,530 --> 00:50:45,620

being lucky you know it's yes these are

1048

00:50:51,640 --> 00:50:50,540

well designed well built but you know we

1049

00:50:53,830 --> 00:50:51,650

don't know what the environment is like

1050

00:50:55,210 --> 00:50:53,840

I mean the amazing thing is if these

1051

00:50:57,460 --> 00:50:55,220

vehicles go through this deep

1052

00:50:58,720 --> 00:50:57,470

temperature cycle every single day you

1053

00:51:00,160 --> 00:50:58,730

know the temperature change from night

1054

00:51:02,260 --> 00:51:00,170

to day is greater than the temperature

1055

00:51:04,150 --> 00:51:02,270

change from summer to winter and so

1056

00:51:06,460 --> 00:51:04,160

they're they're constantly fatigued by

1057

00:51:08,230 --> 00:51:06,470

this this you know it's it's it's kind

1058

00:51:10,000 --> 00:51:08,240

of like going from the Sahara Desert to

1059

00:51:12,580 --> 00:51:10,010

Antarctica every single day without a

1060

00:51:14,110 --> 00:51:12,590

change of clothing in the fact that

1061

00:51:15,880 --> 00:51:14,120

they've lasted so long really speaks to

1062

00:51:18,460 --> 00:51:15,890

the the quality of the workmanship the

1063

00:51:22,480 --> 00:51:18,470

extensive testing that went into these

1064

00:51:23,950 --> 00:51:22,490

vehicles but is this a general trend are

1065

00:51:24,970 --> 00:51:23,960

all vehicles gonna last this long I

1066

00:51:30,460 --> 00:51:24,980

don't think you could make that

1067

00:51:32,440 --> 00:51:30,470

extrapolation a reminder to reporters on

1068

00:51:34,090 --> 00:51:32,450

the phone for a question hit star one

1069

00:51:35,650 --> 00:51:34,100

and you'll be in the queue and at the

1070

00:51:37,240 --> 00:51:35,660

top of the queue right now is Pete spots

1071

00:51:40,750 --> 00:51:37,250

with the Christian Science Monitor can

1072

00:51:43,150 --> 00:51:40,760

you hear us beep yes oh great great

1073

00:51:45,310 --> 00:51:43,160

thanks for doing this um this may be for

1074

00:51:50,020 --> 00:51:45,320

Ray or Steve kind of a big picture of

1075

00:51:53,170 --> 00:51:50,030

Mars question you know last let we have

1076

00:51:56,080 --> 00:51:53,180

the you know we had the latest from

1077

00:51:59,080 --> 00:51:56,090

curiosity and Gale Crater with you know

1078

00:52:00,790 --> 00:51:59,090

flowing water and streams and maybe a

1079

00:52:02,140 --> 00:52:00,800

lake and you know again but not

1080

00:52:05,440 --> 00:52:02,150

relatively benign

1081

00:52:08,260 --> 00:52:05,450

conditions of acidity and so forth and

1082

00:52:10,960 --> 00:52:08,270

now we have kind of a second similar

1083

00:52:14,140 --> 00:52:10,970

data point on what may be a half a

1084

00:52:15,970 --> 00:52:14,150

hemisphere or a hemisphere away but from

1085

00:52:21,579 --> 00:52:15,980

a different time period what what is

1086

00:52:25,000 --> 00:52:21,589

this this latest piece of research done

1087

00:52:26,890 --> 00:52:25,010

in terms of you know kind of either

1088

00:52:29,380 --> 00:52:26,900

confirming or building on or whatever

1089

00:52:31,480 --> 00:52:29,390

you know the dominant models you folks

1090

00:52:35,859 --> 00:52:31,490

have for the evolution of the climate in

1091

00:52:38,279 --> 00:52:35,869

the environment on the planet want me to

1092

00:52:43,269 --> 00:52:38,289

take a swing at that one you do it boss

1093

00:52:47,069 --> 00:52:43,279

yeah sure um there's an emerging picture

1094

00:52:50,589 --> 00:52:47,079

I think here that conditions on Mars

1095

00:52:53,740 --> 00:52:50,599

changed from the earliest epoch of

1096

00:52:57,190 --> 00:52:53,750

Martian history when you had warmer

1097

00:53:00,010 --> 00:52:57,200

conditions wetter conditions and a

1098

00:53:02,589 --> 00:53:00,020

chemistry that was mostly dominated the

1099

00:53:05,589 --> 00:53:02,599

water chemistry dominated by a neutral

1100

00:53:08,880 --> 00:53:05,599

pH and then you progress through a

1101  
00:53:12,279 --> 00:53:08,890  
period of diminishing water activity

1102  
00:53:13,630 --> 00:53:12,289  
increasing acidity so less water less

1103  
00:53:16,390 --> 00:53:13,640  
coming to the surface less flowing

1104  
00:53:20,140 --> 00:53:16,400  
across the ground what waters there was

1105  
00:53:23,170 --> 00:53:20,150  
there was was more acid and then for the

1106  
00:53:26,190 --> 00:53:23,180  
last three billion years plus very

1107  
00:53:28,900 --> 00:53:26,200  
little water activity at all most of the

1108  
00:53:31,180 --> 00:53:28,910  
activity on Mars in terms of

1109  
00:53:33,220 --> 00:53:31,190  
habitability and and water activity was

1110  
00:53:35,230 --> 00:53:33,230  
concentrated in the first billion or so

1111  
00:53:38,829 --> 00:53:35,240  
years and then after that it's been

1112  
00:53:40,329 --> 00:53:38,839  
pretty quiet since so it's this is one

1113  
00:53:43,269 --> 00:53:40,339

of these things where you piece together

1114

00:53:44,620 --> 00:53:43,279

the story bit by bit clue by clue over a

1115

00:53:48,339 --> 00:53:44,630

period of what's turning out to be

1116

00:53:50,289 --> 00:53:48,349

decades but I think the the rover data

1117

00:53:53,170 --> 00:53:50,299

that we've accumulated the rover data

1118

00:53:54,849 --> 00:53:53,180

from curiosity which is again looking

1119

00:53:58,410 --> 00:53:54,859

very distant very far into the Martian

1120

00:54:01,510 --> 00:53:58,420

past and then global datasets chris on

1121

00:54:03,130 --> 00:54:01,520

the Mars Reconnaissance Orbiter is one

1122

00:54:07,120 --> 00:54:03,140

example there was a marvelous system it

1123

00:54:10,089 --> 00:54:07,130

called Omega on the European Mars

1124

00:54:12,180 --> 00:54:10,099

Express that was one of the first to

1125

00:54:14,529 --> 00:54:12,190

really show this pattern of

1126

00:54:15,640 --> 00:54:14,539

phyllosilicates and clays in neutral pH

1127

00:54:18,010 --> 00:54:15,650

early and then

1128

00:54:20,320 --> 00:54:18,020

then more acidic conditions later on and

1129

00:54:24,010 --> 00:54:20,330

so it's it's a picture that continues to

1130

00:54:25,860 --> 00:54:24,020

evolve but I would say that general

1131

00:54:28,300 --> 00:54:25,870

trend is hanging together pretty well I

1132

00:54:29,950 --> 00:54:28,310

think that's true Steven and what we're

1133

00:54:32,530 --> 00:54:29,960

doing now is trying to take the

1134

00:54:34,840 --> 00:54:32,540

geochemical and the geological evidence

1135

00:54:36,490 --> 00:54:34,850

which continues to accumulate and then

1136

00:54:39,100 --> 00:54:36,500

bounce that against the folks who

1137

00:54:40,780 --> 00:54:39,110

actually model whole planets in terms of

1138

00:54:43,420 --> 00:54:40,790

the thermal evolution in the interior

1139

00:54:45,460 --> 00:54:43,430

volcanism and tectonics and also the

1140

00:54:47,470 --> 00:54:45,470

atmosphere greenhouse gases and those

1141

00:54:50,230 --> 00:54:47,480

kinds of things so we put together a

1142

00:54:52,780 --> 00:54:50,240

kind of a global view of the evolution

1143

00:54:54,490 --> 00:54:52,790

of this planet importantly a lot of the

1144

00:54:57,250 --> 00:54:54,500

rocks that we've been investigating are

1145

00:54:59,620 --> 00:54:57,260

very early in geologic time as we've

1146

00:55:02,230 --> 00:54:59,630

said and that records long for the most

1147

00:55:04,750 --> 00:55:02,240

part gone on earth so we're able to look

1148

00:55:06,670 --> 00:55:04,760

back through to very early in time for

1149

00:55:08,620 --> 00:55:06,680

with a very pretty extensive record

1150

00:55:12,390 --> 00:55:08,630

because the rate of erosion and turnover

1151  
00:55:15,580 --> 00:55:12,400  
of Mars's than a lot less than on earth

1152  
00:55:17,020 --> 00:55:15,590  
we have an interesting social media

1153  
00:55:20,230 --> 00:55:17,030  
question I think this one's for Steve

1154  
00:55:22,300 --> 00:55:20,240  
it's from William Shatner and he'd like

1155  
00:55:24,010 --> 00:55:22,310  
to know if you've ruled out Martian rock

1156  
00:55:28,270 --> 00:55:24,020  
throwers in the case of the jelly donut

1157  
00:55:30,190 --> 00:55:28,280  
I think Martian rock throwers are

1158  
00:55:33,100 --> 00:55:30,200  
unlikely though we'll keep our eyes open

1159  
00:55:34,660 --> 00:55:33,110  
for those we did actually have another

1160  
00:55:37,000 --> 00:55:34,670  
scenario which we're still thinking

1161  
00:55:39,250 --> 00:55:37,010  
about it's the the smoking hole in the

1162  
00:55:41,680 --> 00:55:39,260  
ground hypothesis as I've called it we

1163  
00:55:43,660 --> 00:55:41,690

cannot yet rule out the possibility with

1164

00:55:45,580 --> 00:55:43,670

certainty that there wasn't a freshly

1165

00:55:49,140 --> 00:55:45,590

formed impact crater nearby and this is

1166

00:55:52,390 --> 00:55:49,150

a piece of stuff that was thrown out by

1167

00:55:54,820 --> 00:55:52,400

by a small impact but we think the most

1168

00:55:56,470 --> 00:55:54,830

likely scenario is that that rock wasn't

1169

00:55:58,270 --> 00:55:56,480

thrown it wasn't kicked out of a crater

1170

00:56:00,130 --> 00:55:58,280

it was flicked out with one of our

1171

00:56:02,230 --> 00:56:00,140

wheels and we're gonna take a close look

1172

00:56:06,310 --> 00:56:02,240

at that hypothesis just in the coming

1173

00:56:08,230 --> 00:56:06,320

days one more from social media this is

1174

00:56:11,260 --> 00:56:08,240

about a comet called sighting spring

1175

00:56:13,420 --> 00:56:11,270

that will come near Mars later in 2014

1176  
00:56:16,570 --> 00:56:13,430  
and the question from social media from

1177  
00:56:18,850 --> 00:56:16,580  
epic cosmos on Twitter asked are there

1178  
00:56:22,570 --> 00:56:18,860  
plans to study comet siding spring when

1179  
00:56:24,100 --> 00:56:22,580  
it comes near Mars and maybe write a

1180  
00:56:25,780 --> 00:56:24,110  
question yeah I can take a quick swing

1181  
00:56:27,430 --> 00:56:25,790  
of that from the opportunity perspective

1182  
00:56:29,650 --> 00:56:27,440  
and then we can look at all let Michael

1183  
00:56:30,730 --> 00:56:29,660  
address the other missions as well

1184  
00:56:32,829 --> 00:56:30,740  
one of the things that we've learned

1185  
00:56:36,160 --> 00:56:32,839  
with opportunity and spirit over the

1186  
00:56:38,740 --> 00:56:36,170  
years is that we can see meteors

1187  
00:56:40,180 --> 00:56:38,750  
streaking across the Martian sky from

1188  
00:56:42,160 --> 00:56:40,190

time to time and so when sighting

1189

00:56:44,440 --> 00:56:42,170

Springs those come by if opportunity is

1190

00:56:47,049 --> 00:56:44,450

still alive and well if we have enough

1191

00:56:49,029 --> 00:56:47,059

power to take images during the daytime

1192

00:56:52,000 --> 00:56:49,039

one of the things that we'll look for is

1193

00:56:54,730 --> 00:56:52,010

meteors in the sky that might be the

1194

00:56:57,700 --> 00:56:54,740

track of debris that's been shed by the

1195

00:57:01,240 --> 00:56:57,710

comet as it is flown by Mars yeah

1196

00:57:04,599 --> 00:57:01,250

sighting spring poses a real interesting

1197

00:57:08,500 --> 00:57:04,609

situation it's closest approach to Mars

1198

00:57:11,260 --> 00:57:08,510

I think is October 19th and so there's

1199

00:57:13,240 --> 00:57:11,270

two aspects to it one is this comic is

1200

00:57:15,220 --> 00:57:13,250

going to produce material that will come

1201  
00:57:16,930 --> 00:57:15,230  
to the Martian atmosphere and we are

1202  
00:57:18,819 --> 00:57:16,940  
gonna have our Martian Allen assets

1203  
00:57:21,400 --> 00:57:18,829  
looking to see what's happening they

1204  
00:57:23,650 --> 00:57:21,410  
march in atmosphere and certainly we

1205  
00:57:25,599 --> 00:57:23,660  
even had a trial run of doing that with

1206  
00:57:29,319 --> 00:57:25,609  
the Mars Reconnaissance Orbiter highrise

1207  
00:57:31,210 --> 00:57:29,329  
looking at the comet ISON so that's

1208  
00:57:35,019 --> 00:57:31,220  
going to be very exciting having a

1209  
00:57:37,000 --> 00:57:35,029  
meteor shower on Mars we're also looking

1210  
00:57:38,920 --> 00:57:37,010  
at very hard because there's a little

1211  
00:57:40,809 --> 00:57:38,930  
bit of a concern that if there are

1212  
00:57:42,579 --> 00:57:40,819  
sufficient number of particles and large

1213  
00:57:46,539 --> 00:57:42,589

enough they actually may pose a hazard

1214

00:57:48,010 --> 00:57:46,549

to our orbiting spacecraft and so over

1215

00:57:51,220 --> 00:57:48,020

the next half a year we're going to be

1216

00:57:56,260 --> 00:57:51,230

doing some observations beforehand to

1217

00:57:58,539 --> 00:57:56,270

see how active this comet is going to be

1218

00:58:01,510 --> 00:57:58,549

and what the particle size distribution

1219

00:58:04,269 --> 00:58:01,520

is and what sort of spectacular show can

1220

00:58:07,539 --> 00:58:04,279

we expect at Mars from this comet and

1221

00:58:10,450 --> 00:58:07,549

also look to see what hazard there might

1222

00:58:11,920 --> 00:58:10,460

be presented by this comment thanks

1223

00:58:15,279 --> 00:58:11,930

Michael and one more quick question from

1224

00:58:17,319 --> 00:58:15,289

Tracy Watson of USA Today hi could you

1225

00:58:20,380 --> 00:58:17,329

talk a little bit about the hypotheses

1226  
00:58:22,059 --> 00:58:20,390  
to explain why Mars climate change so

1227  
00:58:24,730 --> 00:58:22,069  
much that the grades you just review

1228  
00:58:30,010 --> 00:58:24,740  
that a little bit things Oh Steve let me

1229  
00:58:31,690 --> 00:58:30,020  
take this okay this is the big question

1230  
00:58:34,000 --> 00:58:31,700  
and they don't have the answer kind of

1231  
00:58:36,400 --> 00:58:34,010  
fully quantified or even qualitatively

1232  
00:58:40,150 --> 00:58:36,410  
together but let me give you my working

1233  
00:58:43,000 --> 00:58:40,160  
hypothesis we for Mars and planets tend

1234  
00:58:45,910 --> 00:58:43,010  
to form hot because they accrete in that

1235  
00:58:48,640 --> 00:58:45,920  
energy gets changed to heat the core

1236  
00:58:51,580 --> 00:58:48,650  
forms and that gender generates even

1237  
00:58:54,099 --> 00:58:51,590  
more heat the the core is liquid it's

1238  
00:58:56,200 --> 00:58:54,109

rotating we have a magnetic field the

1239

00:58:58,120 --> 00:58:56,210

magnetic field shields the solar wind

1240

00:59:00,940 --> 00:58:58,130

from stripping the atmosphere as does

1241

00:59:03,280 --> 00:59:00,950

our magnetic field because it's hot it's

1242

00:59:05,380 --> 00:59:03,290

extensively degassing in terms of

1243

00:59:08,020 --> 00:59:05,390

volcanism those are the the right

1244

00:59:09,910 --> 00:59:08,030

conditions to have an atmosphere where

1245

00:59:12,460 --> 00:59:09,920

water can be sustained on the surface

1246

00:59:14,950 --> 00:59:12,470

and the shallow subsurface Mars is a

1247

00:59:17,200 --> 00:59:14,960

smaller planet than Earth so it's going

1248

00:59:19,750 --> 00:59:17,210

to cool down faster and one could

1249

00:59:21,870 --> 00:59:19,760

imagine that if the magnetic field was

1250

00:59:25,450 --> 00:59:21,880

kind of withering as the core froze as

1251  
00:59:27,700 --> 00:59:25,460  
volcanism was kind of on the wane we

1252  
00:59:30,430 --> 00:59:27,710  
moved from a pretty active planet in

1253  
00:59:32,740 --> 00:59:30,440  
terms of volcanic activity and water

1254  
00:59:34,540 --> 00:59:32,750  
being on the surface for some period of

1255  
00:59:37,180 --> 00:59:34,550  
time and certainly in the subsurface

1256  
00:59:40,030 --> 00:59:37,190  
shallow subsurface to the cold dry

1257  
00:59:41,920 --> 00:59:40,040  
conditions that Steve talked about a few

1258  
00:59:43,750 --> 00:59:41,930  
minutes ago and the transition is

1259  
00:59:45,870 --> 00:59:43,760  
interesting that might be the Bern's

1260  
00:59:48,670 --> 00:59:45,880  
formation these hydrated sulfates

1261  
00:59:51,220 --> 00:59:48,680  
because you can explain the the burns

1262  
00:59:53,500 --> 00:59:51,230  
formation by having more or less neutral

1263  
00:59:55,900 --> 00:59:53,510

water coming up to the top of the

1264

00:59:58,150 --> 00:59:55,910

atmosphere and interacting with an

1265

01:00:01,840 --> 00:59:58,160

oxidizing atmosphere or ultraviolet

1266

01:00:04,690 --> 01:00:01,850

radiation that turns ferrous ions into

1267

01:00:06,820 --> 01:00:04,700

ferric ions that creates hydrogen which

1268

01:00:08,349 --> 01:00:06,830

can it escape but it also makes sulfates

1269

01:00:11,230 --> 01:00:08,359

and when you make sulfates you release

1270

01:00:13,720 --> 01:00:11,240

protons acids and that's going to

1271

01:00:15,640 --> 01:00:13,730

produce this very acidic very oxidizing

1272

01:00:18,040 --> 01:00:15,650

set of conditions and if you don't have

1273

01:00:19,930 --> 01:00:18,050

a lot of liquid water and it really

1274

01:00:23,109 --> 01:00:19,940

makes acidic condition so that might be

1275

01:00:25,090 --> 01:00:23,119

the kind of last major gasp of kind of a

1276

01:00:25,570 --> 01:00:25,100

flu viola cussed Rand system for the

1277

01:00:27,790 --> 01:00:25,580

planet

1278

01:00:29,470 --> 01:00:27,800

now I made all this up alright because

1279

01:00:32,109 --> 01:00:29,480

it's a good story and it's a good

1280

01:00:33,700 --> 01:00:32,119

working hypothesis but in addition to

1281

01:00:36,040 --> 01:00:33,710

habitability in life we're trying to

1282

01:00:38,080 --> 01:00:36,050

understand the global system and how its

1283

01:00:40,359 --> 01:00:38,090

evolved over time and it's a good

1284

01:00:41,830 --> 01:00:40,369

working hypothesis that you know if you

1285

01:00:44,140 --> 01:00:41,840

invite us back a few years from now

1286

01:00:46,300 --> 01:00:44,150

we'll probably change it okay well

1287

01:00:48,670 --> 01:00:46,310

thanks very much for the reporters and

1288

01:00:50,470 --> 01:00:48,680

the others watching the briefing today