
Ground Data Sys

1
00:00:23,850 --> 00:00:20,820
hello everyone I'm gay hill and I am in

2
00:00:26,580 --> 00:00:23,860
Grail Mission Control we are with the

3
00:00:30,330 --> 00:00:26,590
team for its last half hour with the

4
00:00:33,810 --> 00:00:30,340
spacecraft and ebb and flow are now out

5
00:00:36,090 --> 00:00:33,820
of fuel and they are on a delivered

6
00:00:38,549 --> 00:00:36,100
collision course with the moon and they

7
00:00:43,200 --> 00:00:38,559
will impact the moon at approximately

8
00:00:47,009 --> 00:00:43,210
3,800 miles per hour for ebb the impact

9
00:00:50,310 --> 00:00:47,019
will take place at approximately 220 846

10
00:00:55,170 --> 00:00:50,320
pacific time and then for flow about 20

11
00:00:57,840 --> 00:00:55,180
to 30 seconds later at about 20 to 29 14

12
00:01:00,390 --> 00:00:57,850
give or take a few seconds we're going

13
00:01:03,180 --> 00:01:00,400

to spend the next half hour talking two

14
00:01:05,460 --> 00:01:03,190
team members about this project and what

15
00:01:07,980 --> 00:01:05,470
has been like beginning with David

16
00:01:10,830 --> 00:01:07,990
layman he is the project manager of

17
00:01:13,410 --> 00:01:10,840
Grail first of all let's talk about the

18
00:01:17,039 --> 00:01:13,420
last big event the burn and that

19
00:01:20,250 --> 00:01:17,049
happened about 20 odd minutes ago what

20
00:01:22,020 --> 00:01:20,260
happened at that time well about 20

21
00:01:24,360 --> 00:01:22,030
minutes ago as you said we just finished

22
00:01:28,020 --> 00:01:24,370
the burn to depletion on both spacecraft

23
00:01:30,060 --> 00:01:28,030
both ebb and flow and you can see the

24
00:01:32,730 --> 00:01:30,070
display up there you which is the

25
00:01:36,060 --> 00:01:32,740
Doppler signal and it shows that on the

26
00:01:38,400 --> 00:01:36,070
edge spacecraft the amount of fuel

27
00:01:42,240 --> 00:01:38,410
remaining was equal to approximately 20

28
00:01:45,210 --> 00:01:42,250
meters per second and then on flow the

29
00:01:47,100 --> 00:01:45,220
remaining fuel was Aklavik to 25 meters

30
00:01:50,250 --> 00:01:47,110
per second you know why was it necessary

31
00:01:53,040 --> 00:01:50,260
to do this experiment this exercise you

32
00:01:55,170 --> 00:01:53,050
wanted to gain information right down to

33
00:01:58,430 --> 00:01:55,180
the very last right right what we wanted

34
00:02:01,440 --> 00:01:58,440
to do is we're going to use this data to

35
00:02:04,110 --> 00:02:01,450
compare with estimates of what the fuel

36
00:02:05,910 --> 00:02:04,120
remaining is and so it's a very rare for

37
00:02:07,950 --> 00:02:05,920
a mission to be able to do a burn to

38
00:02:09,690 --> 00:02:07,960

depletion that tells you exactly how

39
00:02:12,089 --> 00:02:09,700
much fuel is remaining we're gonna use

40
00:02:13,860 --> 00:02:12,099
that data to compare to the estimates

41
00:02:16,380 --> 00:02:13,870
the engineers have and then we can use

42
00:02:18,930 --> 00:02:16,390
that to better manage future missions to

43
00:02:21,809 --> 00:02:18,940
help other missions blow tell me why we

44
00:02:23,940 --> 00:02:21,819
decided to end the mission this way why

45
00:02:29,430 --> 00:02:23,950
not just let the fuel

46
00:02:32,040 --> 00:02:29,440
be done and land wherever well on the

47
00:02:34,380 --> 00:02:32,050
moon there are about 23 heritage

48
00:02:37,619 --> 00:02:34,390
historical sites and these are sites

49
00:02:42,030 --> 00:02:37,629
where either the US or the Russians have

50
00:02:43,979 --> 00:02:42,040
a soft Lander and the NASA policy is to

51
00:02:46,199 --> 00:02:43,989
not to disturb those sites to stay

52
00:02:48,509 --> 00:02:46,209
within to say outside of two kilometers

53
00:02:50,059 --> 00:02:48,519
so we wanted to miss those sites the

54
00:02:52,890 --> 00:02:50,069
other thing is we wanted to know exactly

55
00:02:55,530 --> 00:02:52,900
where we landed or where we're going to

56
00:02:58,500 --> 00:02:55,540
crash and so we're coming up from the

57
00:03:02,130 --> 00:02:58,510
south and we want to get good tracking

58
00:03:04,140 --> 00:03:02,140
data of the final moments and then we're

59
00:03:06,449 --> 00:03:04,150
going to crash on the North the northern

60
00:03:08,759 --> 00:03:06,459
hemisphere of the moon so we wanted lots

61
00:03:11,130 --> 00:03:08,769
of data tracking data to know where we

62
00:03:14,670 --> 00:03:11,140
actually crash now we have visuals and

63
00:03:17,490 --> 00:03:14,680

animation showing exactly the trajectory

64
00:03:20,430 --> 00:03:17,500
of the two spacecraft walk us through

65
00:03:22,979 --> 00:03:20,440
what will be happening and we can

66
00:03:26,309 --> 00:03:22,989
actually see that animation and we can

67
00:03:32,160 --> 00:03:26,319
go ahead and take a look at it it will

68
00:03:34,830 --> 00:03:32,170
start on a globe view here we go all

69
00:03:37,460 --> 00:03:34,840
right so this is Evan flow I one leads

70
00:03:39,720 --> 00:03:37,470
the other by about 20 seconds and

71
00:03:42,210 --> 00:03:39,730
they're going to be coming up from from

72
00:03:43,500 --> 00:03:42,220
the southern hemisphere and they're

73
00:03:48,780 --> 00:03:43,510
already about half way there right now

74
00:03:51,500 --> 00:03:48,790
and about to 28 p.m. but we're actually

75
00:03:57,470 --> 00:03:51,510
going to do the the impact on the moon

76
00:04:00,870 --> 00:03:57,480
and there you have it and tell me why

77
00:04:02,789 --> 00:04:00,880
took this location that it's going to be

78
00:04:04,890 --> 00:04:02,799
in darkness we won't be able to see

79
00:04:07,170 --> 00:04:04,900
anything will we we won't be able to see

80
00:04:10,349 --> 00:04:07,180
anything because it is dark right now on

81
00:04:12,780 --> 00:04:10,359
the moon but we picked a site to make

82
00:04:16,589 --> 00:04:12,790
sure that we did not hit the historic

83
00:04:18,839 --> 00:04:16,599
sites the Heritage historic sites and we

84
00:04:20,789 --> 00:04:18,849
wanted to get good tracking data before

85
00:04:24,270 --> 00:04:20,799
we impacted and so it turns out that

86
00:04:26,550 --> 00:04:24,280
this mountain and then 75 degrees north

87
00:04:28,500 --> 00:04:26,560
latitude is is where it fell out when

88
00:04:30,870 --> 00:04:28,510

we're going to hit perhaps we will be

89
00:04:33,839 --> 00:04:30,880
able to see it right now but LRO is

90
00:04:35,040 --> 00:04:33,849
orbiting the moon will we be able to get

91
00:04:38,070 --> 00:04:35,050
information

92
00:04:40,469 --> 00:04:38,080
later on yes LRO has already imaged this

93
00:04:42,240 --> 00:04:40,479
site in detail we have lots of data on

94
00:04:44,100 --> 00:04:42,250
where we're going to impact and then in

95
00:04:46,260 --> 00:04:44,110
a couple weeks lrl will fly over it

96
00:04:48,240 --> 00:04:46,270
again the lunar reconnaissance orbiter

97
00:04:50,640 --> 00:04:48,250
and we'll get more data on what we'll

98
00:04:53,219 --> 00:04:50,650
see well would just be looking at it

99
00:04:55,499 --> 00:04:53,229
with optical sort of instruments or

100
00:04:57,119 --> 00:04:55,509
we'll be looking at it in infrared was

101
00:04:59,430 --> 00:04:57,129
sort of interesting had a full spectrum

102
00:05:01,800 --> 00:04:59,440
of instruments so all kinds of spectrum

103
00:05:04,589 --> 00:05:01,810
they'll be able to image well overall

104
00:05:06,659 --> 00:05:04,599
looking back at this mission you said

105
00:05:09,240 --> 00:05:06,669
yourself that you would have mixed

106
00:05:12,029 --> 00:05:09,250
feelings today why is that well we've

107
00:05:14,399 --> 00:05:12,039
been we launched 15 months ago the

108
00:05:15,869 --> 00:05:14,409
spacecraft were very well behaved what

109
00:05:17,369 --> 00:05:15,879
I'd like to do is continue on for

110
00:05:20,100 --> 00:05:17,379
another six months but that's not going

111
00:05:21,959 --> 00:05:20,110
to happen so it's pretty much a sad day

112
00:05:23,309 --> 00:05:21,969
for me in fact I'm wearing usually I

113
00:05:24,869 --> 00:05:23,319

don't have handkerchiefs with me but

114
00:05:26,640 --> 00:05:24,879
today I brought my handkerchief just in

115
00:05:28,350 --> 00:05:26,650
case you're gonna be ready but this

116
00:05:31,589 --> 00:05:28,360
mission has surprised a lot of people

117
00:05:34,350 --> 00:05:31,599
it's gone well beyond what everyone's

118
00:05:36,450 --> 00:05:34,360
expectations were having not yes we've

119
00:05:38,939 --> 00:05:36,460
all all of the data we hope to have

120
00:05:40,800 --> 00:05:38,949
gotten scientifically we've gotten over

121
00:05:43,559 --> 00:05:40,810
ninety-nine point nine nine percent of

122
00:05:46,740 --> 00:05:43,569
the data available we have and the

123
00:05:49,170 --> 00:05:46,750
team's done a great job and we did it on

124
00:05:51,480 --> 00:05:49,180
schedule and under budget alright so

125
00:05:54,510 --> 00:05:51,490
we're not too far off in the big moment

126
00:05:57,300 --> 00:05:54,520
thanks for helping us out Dave right now

127
00:06:00,600 --> 00:05:57,310
let's we're less than 25 minutes away

128
00:06:02,670 --> 00:06:00,610
from Impact again the time is 228

129
00:06:05,519 --> 00:06:02,680
pacific time five to twenty eight

130
00:06:07,830 --> 00:06:05,529
eastern time and since the very

131
00:06:10,490 --> 00:06:07,840
beginning this mission has always been

132
00:06:13,070 --> 00:06:10,500
all about the science now the

133
00:06:16,230 --> 00:06:13,080
spacecraft's were flying at about 55

134
00:06:19,050 --> 00:06:16,240
kilometers over the surface and be they

135
00:06:22,830 --> 00:06:19,060
were able to return the best gravity map

136
00:06:25,469 --> 00:06:22,840
ever of any celestial body and then for

137
00:06:28,050 --> 00:06:25,479
an encore the twins went ahead and went

138
00:06:34,029 --> 00:06:28,060

even lower here's a look at some of the

139
00:06:38,029 --> 00:06:34,039
accomplishments of this mission 32

140
00:06:41,050 --> 00:06:38,039
zero and liftoff of the Delta 2 with

141
00:06:43,999 --> 00:06:41,060
grail Jerry to the center of the boat

142
00:06:45,680 --> 00:06:44,009
when gray launched at that point I was

143
00:06:47,839 --> 00:06:45,690
hoping we would get those two spacecraft

144
00:06:50,570 --> 00:06:47,849
interpreter on the moon we have

145
00:06:54,159 --> 00:06:50,580
grayleigh breakwire and separation good

146
00:06:56,809 --> 00:06:54,169
separation grill a now flying on its own

147
00:07:00,589 --> 00:06:56,819
ok I'll stations Grilli systems on grill

148
00:07:02,800 --> 00:07:00,599
a court at this time the reconfiguration

149
00:07:15,200 --> 00:07:02,810
of the spacecraft for the post LOI

150
00:07:18,080 --> 00:07:15,210
configuration has begun we look like

151
00:07:20,150 --> 00:07:18,090
they're in a very nominal orbit things

152
00:07:22,760 --> 00:07:20,160
have gone as as well as they could

153
00:07:24,800 --> 00:07:22,770
possibly have gone neither spacecraft

154
00:07:27,350 --> 00:07:24,810
has had an upset that has caused it to

155
00:07:29,899 --> 00:07:27,360
go into safe mode we have not lost any

156
00:07:33,499 --> 00:07:29,909
data we have essentially collected more

157
00:07:35,809 --> 00:07:33,509
than ninety-nine point nine nine percent

158
00:07:38,510 --> 00:07:35,819
of the data so in both the quantity and

159
00:07:40,339 --> 00:07:38,520
the quality and the spatial resolution

160
00:07:42,620 --> 00:07:40,349
of the data and the amount of data

161
00:07:45,770 --> 00:07:42,630
everything has exceeded the expectations

162
00:07:48,320 --> 00:07:45,780
that we had for the mission one of the

163
00:07:52,310 --> 00:07:48,330

biggest surprises that we've found so

164
00:07:55,670 --> 00:07:52,320
far is evidence for very long dykes or

165
00:07:58,180 --> 00:07:55,680
intrusive features within the crust that

166
00:08:00,730 --> 00:07:58,190
are not observed at the surface

167
00:08:04,250 --> 00:08:00,740
whatsoever

168
00:08:06,950 --> 00:08:04,260
heated up enough to expand and that this

169
00:08:10,730 --> 00:08:06,960
occurred extremely early after the moon

170
00:08:14,270 --> 00:08:10,740
formed we now see evidence for this we

171
00:08:17,510 --> 00:08:14,280
have found with the Grail data that the

172
00:08:19,610 --> 00:08:17,520
crust of the womb is even thinner than

173
00:08:22,700 --> 00:08:19,620
it was believed to be and so this

174
00:08:26,240 --> 00:08:22,710
provides us with information about how

175
00:08:28,280 --> 00:08:26,250
much early melting of the lunar exterior

176
00:08:30,260 --> 00:08:28,290
occurred and how much of the outside of

177
00:08:32,719 --> 00:08:30,270
the moon melted so it tells us something

178
00:08:35,839 --> 00:08:32,729
about the thermal history but it also

179
00:08:38,570 --> 00:08:35,849
tells us about how this melting was

180
00:08:41,540 --> 00:08:38,580
distributed over the surface of the Moon

181
00:08:44,480 --> 00:08:41,550
and we've been able to map this out the

182
00:08:47,660 --> 00:08:44,490
idea that one can map a planet from

183
00:08:49,610 --> 00:08:47,670
orbit at the height you know similar to

184
00:08:52,910 --> 00:08:49,620
what a commercial airplane flies around

185
00:08:56,420 --> 00:08:52,920
earth just opens up huge possibilities

186
00:08:59,450 --> 00:08:56,430
of really studying the shallow structure

187
00:09:01,790 --> 00:08:59,460
of the moon our team is absolutely

188
00:09:04,730 --> 00:09:01,800

delighted that we now have the data set

189
00:09:07,010 --> 00:09:04,740
that is going to allow scientists to

190
00:09:09,920 --> 00:09:07,020
study these fascinating questions for

191
00:09:13,010 --> 00:09:09,930
years to come ok we have scooched over

192
00:09:15,770 --> 00:09:13,020
to Maria Zuber spot she is the principal

193
00:09:18,260 --> 00:09:15,780
investigator she's standing by watching

194
00:09:21,050 --> 00:09:18,270
all this information come in you

195
00:09:24,890 --> 00:09:21,060
yourself said in that video piece that

196
00:09:27,130 --> 00:09:24,900
it exceeded all your expectations this

197
00:09:31,040 --> 00:09:27,140
has gone as well as it possibly have

198
00:09:33,140 --> 00:09:31,050
good of God it's it's actually hard for

199
00:09:36,470 --> 00:09:33,150
me to envision what more could have

200
00:09:39,680 --> 00:09:36,480
happened then then has happened we

201
00:09:41,840 --> 00:09:39,690
wanted to fly low we flew low and we

202
00:09:44,240 --> 00:09:41,850
learned enough by flying low that it was

203
00:09:47,630 --> 00:09:44,250
possible to challenge the team to fly

204
00:09:49,090 --> 00:09:47,640
lower and and then lower yet let's go

205
00:09:51,050 --> 00:09:49,100
over some of the scientific

206
00:09:55,340 --> 00:09:51,060
accomplishments of its prime mission

207
00:09:57,860 --> 00:09:55,350
what did you discover ok so the analysis

208
00:10:00,260 --> 00:09:57,870
of gravity is very complicated and and

209
00:10:04,310 --> 00:10:00,270
so the initial results have only just

210
00:10:08,540 --> 00:10:04,320
come out but but the first results have

211
00:10:10,910 --> 00:10:08,550
shown that the moon was heavily

212
00:10:12,890 --> 00:10:10,920
fractured in the exterior well now we

213
00:10:14,000 --> 00:10:12,900

knew from the bombardment in the early

214
00:10:16,520 --> 00:10:14,010
solar system that

215
00:10:17,810 --> 00:10:16,530
fracturing of the outside of planets has

216
00:10:19,940 --> 00:10:17,820
occurred this is something that we call

217
00:10:21,290 --> 00:10:19,950
the planetary regolith but what we've

218
00:10:24,430 --> 00:10:21,300
been able to show is that this

219
00:10:27,680 --> 00:10:24,440
fracturing is much more intensive and

220
00:10:30,770 --> 00:10:27,690
extends much deeper into the crust than

221
00:10:32,840 --> 00:10:30,780
we had ever thought of before and and in

222
00:10:33,950 --> 00:10:32,850
fact that this kind of fracturing must

223
00:10:37,100 --> 00:10:33,960
have occurred on other terrestrial

224
00:10:40,940 --> 00:10:37,110
planets as well so because fractures

225
00:10:42,770 --> 00:10:40,950
provide a pathway for volatile this is

226
00:10:45,350 --> 00:10:42,780
going to tell us things about the

227
00:10:47,180 --> 00:10:45,360
formation of early atmospheres as well

228
00:10:49,240 --> 00:10:47,190
as the possible transport of volatiles

229
00:10:53,510 --> 00:10:49,250
between the surface and the interior

230
00:10:57,350 --> 00:10:53,520
we've also learned things about the

231
00:11:00,650 --> 00:10:57,360
early expansion of the moon by the

232
00:11:03,050 --> 00:11:00,660
determination of large dikes that have

233
00:11:05,600 --> 00:11:03,060
not been visible at the surface they

234
00:11:06,620 --> 00:11:05,610
were predicted by models but any record

235
00:11:09,560 --> 00:11:06,630
that might have been at the surface

236
00:11:11,150 --> 00:11:09,570
would have been wiped out we've

237
00:11:13,340 --> 00:11:11,160
determined the thickness of the lunar

238
00:11:16,190 --> 00:11:13,350

crust finally we have crustal thickness

239
00:11:18,470 --> 00:11:16,200
model of the moon globally that matches

240
00:11:21,500 --> 00:11:18,480
the point measurements that have come

241
00:11:23,390 --> 00:11:21,510
from Apollo seismics and and this shows

242
00:11:25,430 --> 00:11:23,400
us that the moon's crust is actually

243
00:11:29,300 --> 00:11:25,440
much thinner than we thought before we

244
00:11:31,400 --> 00:11:29,310
have that show image of the animation of

245
00:11:33,350 --> 00:11:31,410
the gravity map and we can play that

246
00:11:36,410 --> 00:11:33,360
while I I talked to you a little bit

247
00:11:38,120 --> 00:11:36,420
more about this how are we going to use

248
00:11:40,520 --> 00:11:38,130
this information this is information

249
00:11:44,810 --> 00:11:40,530
that scientists have wanted for a long

250
00:11:49,150 --> 00:11:44,820
time well it's um yes I mean this will

251
00:11:51,920 --> 00:11:49,160
be used to study geophysics to get at

252
00:11:54,920 --> 00:11:51,930
the structure of the moon the early heat

253
00:11:58,100 --> 00:11:54,930
flow of the moon but but the state it

254
00:12:00,260 --> 00:11:58,110
will it will be a boon for geochemist

255
00:12:02,960 --> 00:12:00,270
petrology studying the composition of

256
00:12:07,430 --> 00:12:02,970
the moon which what's been very apparent

257
00:12:09,800 --> 00:12:07,440
so far is just what great interest this

258
00:12:12,140 --> 00:12:09,810
data is for people who study lunar

259
00:12:13,640 --> 00:12:12,150
samples so we continue to study the

260
00:12:16,640 --> 00:12:13,650
lunar samples we continue to learn

261
00:12:19,790 --> 00:12:16,650
things but what was what was actually

262
00:12:22,010 --> 00:12:19,800
very exciting was our density values for

263
00:12:24,470 --> 00:12:22,020

the moon and how the well those compared

264
00:12:26,000 --> 00:12:24,480
with the point values from lunar samples

265
00:12:27,040 --> 00:12:26,010
that were collected from the moon 40

266
00:12:28,509 --> 00:12:27,050
years ago and

267
00:12:30,460 --> 00:12:28,519
speaking about learning from this

268
00:12:33,570 --> 00:12:30,470
information and learning from the moon

269
00:12:37,389 --> 00:12:33,580
one of the aspects of this mission is

270
00:12:40,509 --> 00:12:37,399
outreach to middle school students to

271
00:12:42,250 --> 00:12:40,519
learn about science and to be excited

272
00:12:44,829 --> 00:12:42,260
about science talk to me a little bit

273
00:12:47,920 --> 00:12:44,839
about moon camp and we have footage from

274
00:12:51,190 --> 00:12:47,930
the moon cam cameras of a fly over the

275
00:12:53,410 --> 00:12:51,200
surface well we are extremely proud of

276
00:12:57,069 --> 00:12:53,420
the moon cam investigation which is the

277
00:13:00,310 --> 00:12:57,079
first time and imaging imaging device

278
00:13:03,280 --> 00:13:00,320
has actually flown on a NASA spacecraft

279
00:13:05,889 --> 00:13:03,290
and been totally to get dedicated to

280
00:13:10,110 --> 00:13:05,899
education and outreach so the moon camp

281
00:13:13,780 --> 00:13:10,120
program enlisted over 200,000 students

282
00:13:18,420 --> 00:13:13,790
over 3,600 classrooms from the US and

283
00:13:22,449 --> 00:13:18,430
actually 63 countries and students have

284
00:13:24,550 --> 00:13:22,459
targeted over a hundred thousand images

285
00:13:28,030 --> 00:13:24,560
of the lunar surface which are all

286
00:13:31,120 --> 00:13:28,040
posted online we've extended the funding

287
00:13:34,870 --> 00:13:31,130
of the moon cam investigation in order

288
00:13:37,540 --> 00:13:34,880

to develop more exercises to study the

289
00:13:39,790 --> 00:13:37,550
images so that these images can be used

290
00:13:43,300 --> 00:13:39,800
as a resource for years to come for

291
00:13:44,949 --> 00:13:43,310
teachers who are interested in teaching

292
00:13:46,420 --> 00:13:44,959
students about the moon something that

293
00:13:48,790 --> 00:13:46,430
goes beyond just learning what the

294
00:13:50,560 --> 00:13:48,800
phases of the war so it'll be archived

295
00:13:53,620 --> 00:13:50,570
there for future students to learn

296
00:13:55,690 --> 00:13:53,630
exactly alright Bria I know you're

297
00:13:57,940 --> 00:13:55,700
standing by thank you so much and we'll

298
00:13:59,860 --> 00:13:57,950
talk to you a little bit later meantime

299
00:14:02,860 --> 00:13:59,870
let's talk about some of the first

300
00:14:05,650 --> 00:14:02,870
students who ever used moon cam they

301
00:14:09,250 --> 00:14:05,660
were fourth graders from a school Emily

302
00:14:12,460 --> 00:14:09,260
Dickinson Elementary in Bozeman Montana

303
00:14:15,550 --> 00:14:12,470
they were the kids that named the two

304
00:14:18,550 --> 00:14:15,560
spacecraft they named them ebb and flow

305
00:14:20,500 --> 00:14:18,560
and remembering back that day when they

306
00:14:22,630 --> 00:14:20,510
made the announcement is one of the

307
00:14:29,470 --> 00:14:22,640
highlights of this mission take a look

308
00:14:32,350 --> 00:14:29,480
back we gave these two spacecraft names

309
00:14:36,010 --> 00:14:32,360
of a and B so we asked the youth of

310
00:14:37,720 --> 00:14:36,020
America to assist us in in getting

311
00:14:40,830 --> 00:14:37,730
slightly better names and we held a

312
00:14:43,830 --> 00:14:40,840
nationwide contest over 11

313
00:14:46,830 --> 00:14:43,840

thousand students wrote essays there was

314
00:14:49,560 --> 00:14:46,840
a very competitive competition Grail is

315
00:14:51,330 --> 00:14:49,570
the first spacecraft mission to carry

316
00:14:53,700 --> 00:14:51,340
instruments that are entirely dedicated

317
00:14:56,910 --> 00:14:53,710
to education cameras that will be

318
00:14:58,740 --> 00:14:56,920
operated by students and it's my

319
00:15:02,850 --> 00:14:58,750
pleasure to introduce fourth grade

320
00:15:04,830 --> 00:15:02,860
teachers Nina tomorrow class at Emily

321
00:15:08,190 --> 00:15:04,840
Dickinson school submitted the winning

322
00:15:40,190 --> 00:15:08,200
entry Nina congratulations we're so

323
00:15:44,490 --> 00:15:40,200
thrilled that our names were chosen and

324
00:15:47,280 --> 00:15:44,500
that was one of the very special moments

325
00:15:50,250 --> 00:15:47,290
of this mission with me right now is dr.

326
00:15:52,670 --> 00:15:50,260
Charles elachi he is the director of the

327
00:15:56,010 --> 00:15:52,680
jet propulsion laboratory JPL manages

328
00:15:57,660 --> 00:15:56,020
the gray mission and tell me a little

329
00:15:59,970 --> 00:15:57,670
bit about your feelings about the

330
00:16:01,860 --> 00:15:59,980
success of this mission yeah me first no

331
00:16:04,620 --> 00:16:01,870
question we have mixed feeling about it

332
00:16:06,210 --> 00:16:04,630
in the sense of when you work these

333
00:16:08,100 --> 00:16:06,220
missions for so many years they become

334
00:16:11,100 --> 00:16:08,110
like part of the family so people do

335
00:16:13,050 --> 00:16:11,110
feel you know the angst but you know the

336
00:16:14,640 --> 00:16:13,060
end of the mission on the other hand it

337
00:16:17,490 --> 00:16:14,650
is a celebration because this mission

338
00:16:20,130 --> 00:16:17,500

have accomplished tremendous science it

339
00:16:21,840 --> 00:16:20,140
was superbly well managed it thanks for

340
00:16:24,660 --> 00:16:21,850
on schedule and well within the budget

341
00:16:26,280 --> 00:16:24,670
that was committed to NASA it's

342
00:16:28,770 --> 00:16:26,290
improving our knowledge of the moon

343
00:16:30,450 --> 00:16:28,780
literally by orders of magnitude and

344
00:16:32,760 --> 00:16:30,460
it's so clearly it was one of the

345
00:16:35,310 --> 00:16:32,770
greatest success that we have in space

346
00:16:37,800 --> 00:16:35,320
exploration and even from an engineering

347
00:16:40,110 --> 00:16:37,810
standpoint we're learning from this

348
00:16:42,180 --> 00:16:40,120
the burn to depletion will give us

349
00:16:44,940 --> 00:16:42,190
information that will help us for future

350
00:16:46,740 --> 00:16:44,950
mission absolutely and and I mean the

351
00:16:49,710 --> 00:16:46,750
team is using every possibility and

352
00:16:52,350 --> 00:16:49,720
every opportunity to improve our future

353
00:16:54,570 --> 00:16:52,360
prediction for future missions and the

354
00:16:57,870 --> 00:16:54,580
knowledge of them of the gravitational

355
00:16:59,670 --> 00:16:57,880
field is now so accurate that it will

356
00:17:02,730 --> 00:16:59,680
enable as in the future which lie

357
00:17:05,010 --> 00:17:02,740
mission be it NASA mission or possibly

358
00:17:06,510 --> 00:17:05,020
commercial missions in the future we

359
00:17:08,790 --> 00:17:06,520
will be able to navigate much more

360
00:17:10,829 --> 00:17:08,800
accurately about where do we land in how

361
00:17:13,770 --> 00:17:10,839
we fly over the moon that would also

362
00:17:16,860 --> 00:17:13,780
apply to manned missions as well having

363
00:17:18,870 --> 00:17:16,870

such a accurate map this way yeah

364
00:17:20,850 --> 00:17:18,880
absolutely i mean it's the same thing as

365
00:17:23,040 --> 00:17:20,860
here on earth that we have the GPS

366
00:17:25,410 --> 00:17:23,050
Network which allow us you know to land

367
00:17:27,390 --> 00:17:25,420
airplanes very accurately this one

368
00:17:29,490 --> 00:17:27,400
enable us not because of GPS but because

369
00:17:31,620 --> 00:17:29,500
of the knowledge of the gravity field it

370
00:17:33,840 --> 00:17:31,630
will allow us to navigate both human and

371
00:17:36,000 --> 00:17:33,850
robotic mission to land basically do

372
00:17:37,680 --> 00:17:36,010
pinpoint you know landing on the morning

373
00:17:40,110 --> 00:17:37,690
and for future exploration that will be

374
00:17:42,360 --> 00:17:40,120
very important so with this success

375
00:17:44,940 --> 00:17:42,370
behind us what do we look to the future

376
00:17:46,770 --> 00:17:44,950
for me well the future also looks very

377
00:17:48,330 --> 00:17:46,780
good i mean nasa is very committed for

378
00:17:50,600 --> 00:17:48,340
in our countries committed to keep

379
00:17:54,750 --> 00:17:50,610
leadership role in planetary exploration

380
00:17:57,390 --> 00:17:54,760
being the moon or the planets as you

381
00:17:59,280 --> 00:17:57,400
know after the landing of curiosity

382
00:18:01,290 --> 00:17:59,290
which attracted the 50 million people

383
00:18:03,600 --> 00:18:01,300
were watching that landing and NASA

384
00:18:06,060 --> 00:18:03,610
decided to lay out a new plan for Mars

385
00:18:07,800 --> 00:18:06,070
so we have the mission insight which

386
00:18:10,620 --> 00:18:07,810
will be landing in twenty sixteen to

387
00:18:12,300 --> 00:18:10,630
look at marsquakes and learn more about

388
00:18:15,270 --> 00:18:12,310

the internal structure of the moon and

389
00:18:17,940 --> 00:18:15,280
recently nasa announced a 2020 you know

390
00:18:20,070 --> 00:18:17,950
Mars rover mission that will take us the

391
00:18:21,870 --> 00:18:20,080
next step in exploration of Mars we have

392
00:18:23,910 --> 00:18:21,880
the Juno mission which is heading toward

393
00:18:25,830 --> 00:18:23,920
Jupiter which will give us insight about

394
00:18:28,230 --> 00:18:25,840
the internal structure you know of

395
00:18:30,750 --> 00:18:28,240
Jupiter and and there is a whole series

396
00:18:33,060 --> 00:18:30,760
of mission that our country will play

397
00:18:35,310 --> 00:18:33,070
the leadership lower in in planetary

398
00:18:37,530 --> 00:18:35,320
exploration so we're all excited you

399
00:18:40,020 --> 00:18:37,540
know about that combination of missions

400
00:18:42,720 --> 00:18:40,030
well dr. Elijah never a boring moment

401
00:18:45,820 --> 00:18:42,730
here at Jamie all right thank you for

402
00:18:48,279 --> 00:18:45,830
joining us well JPL is not

403
00:18:50,470 --> 00:18:48,289
alone in the operation of the Grail

404
00:18:53,649 --> 00:18:50,480
mission we are also partners with

405
00:18:56,470 --> 00:18:53,659
Lockheed Martin space systems in Denver

406
00:18:58,779 --> 00:18:56,480
Colorado and we spoke to some of the the

407
00:19:01,509 --> 00:18:58,789
team over there and like the folks here

408
00:19:10,090 --> 00:19:01,519
they're looking at this moment with

409
00:19:12,549 --> 00:19:10,100
mixed emotions operating the the two

410
00:19:14,919 --> 00:19:12,559
spacecraft here in the mission support

411
00:19:16,779 --> 00:19:14,929
air Lockheed Martin has been has been

412
00:19:18,659 --> 00:19:16,789
very exciting during the extended

413
00:19:21,490 --> 00:19:18,669

mission we've been doing maneuvers

414
00:19:23,590 --> 00:19:21,500
extraordinarily frequently a few

415
00:19:26,019 --> 00:19:23,600
maneuvers a week we're flying through

416
00:19:28,720 --> 00:19:26,029
space craft at the same time it adds

417
00:19:30,549 --> 00:19:28,730
some more complexity to attitude control

418
00:19:32,080 --> 00:19:30,559
the Grail extended mission well has been

419
00:19:33,850 --> 00:19:32,090
slightly different from the primary

420
00:19:35,769 --> 00:19:33,860
mission that it is a little bit more

421
00:19:39,610 --> 00:19:35,779
sporty we knew that going into it what

422
00:19:43,480 --> 00:19:39,620
we've been doing is flying over the moon

423
00:19:45,850 --> 00:19:43,490
surface solo and as we fly we've been

424
00:19:48,100 --> 00:19:45,860
going down into basins and then we have

425
00:19:51,100 --> 00:19:48,110
to do maneuvers to pop us up over the

426
00:19:54,519 --> 00:19:51,110
bridges that follow those bases and so

427
00:19:56,019 --> 00:19:54,529
it's been constantly these three

428
00:19:57,700 --> 00:19:56,029
maneuvers a week to keep us from

429
00:20:00,519 --> 00:19:57,710
crashing into the moon the two

430
00:20:02,470 --> 00:20:00,529
spacecraft have behaved remarkably so

431
00:20:05,200 --> 00:20:02,480
it's actually made our jobs a lot easier

432
00:20:06,430 --> 00:20:05,210
not having to constantly deal with

433
00:20:08,889 --> 00:20:06,440
anomalies

434
00:20:11,680 --> 00:20:08,899
investigate problems we've been flying

435
00:20:14,529 --> 00:20:11,690
low over the moon for this extended

436
00:20:17,440 --> 00:20:14,539
mission in order to get high precision

437
00:20:19,419 --> 00:20:17,450
gravity data and it's the most high

438
00:20:22,810 --> 00:20:19,429

precision gravity data that's been

439
00:20:24,310 --> 00:20:22,820
measured at the moon to date ending the

440
00:20:25,299 --> 00:20:24,320
grill mission coming to an end it's

441
00:20:28,450 --> 00:20:25,309
there's definitely a lot of mixed

442
00:20:30,669 --> 00:20:28,460
feelings personally I am excited but

443
00:20:33,039 --> 00:20:30,679
it's also kind of sad because it's it's

444
00:20:37,320 --> 00:20:33,049
been a huge part of my life and the

445
00:20:40,450 --> 00:20:37,330
entire team's life we've gotten to fly a

446
00:20:42,789 --> 00:20:40,460
complex mission and do things that no

447
00:20:45,369 --> 00:20:42,799
one has done before with this kind of

448
00:20:49,029 --> 00:20:45,379
spacecraft doing all these maneuvers in

449
00:20:51,610 --> 00:20:49,039
a week just avoiding the train by flying

450
00:20:53,590 --> 00:20:51,620
down its basins and up over ridges it's

451
00:20:57,760 --> 00:20:53,600
been a it's been an honor and it's been

452
00:21:03,410 --> 00:21:00,140
part of the team here that works

453
00:21:05,090 --> 00:21:03,420
hand-in-hand and works a lot with the

454
00:21:08,210 --> 00:21:05,100
team at Lockheed Martin is our

455
00:21:11,150 --> 00:21:08,220
navigation team and with me right now is

456
00:21:14,240 --> 00:21:11,160
Sarah hatch she's a trajectory analyst

457
00:21:16,160 --> 00:21:14,250
and you're a member of the navigation

458
00:21:18,230 --> 00:21:16,170
team which is right down the hall from

459
00:21:20,540 --> 00:21:18,240
us here yeah we've done the whole

460
00:21:22,640 --> 00:21:20,550
they're watching closely why don't you

461
00:21:24,740 --> 00:21:22,650
tell us exactly what the NAP team does

462
00:21:26,660 --> 00:21:24,750
well there's about 20 people on the

463
00:21:29,000 --> 00:21:26,670

Grail nav team over in the room down the

464
00:21:30,920 --> 00:21:29,010
hall and we have several different

465
00:21:32,390 --> 00:21:30,930
functions as my job as the trajectory

466
00:21:34,640 --> 00:21:32,400
analyst is to figure out where the

467
00:21:36,320 --> 00:21:34,650
spacecraft needs to go to satisfy all of

468
00:21:38,750 --> 00:21:36,330
its science requirements and

469
00:21:41,270 --> 00:21:38,760
communication requirements so we plan

470
00:21:43,190 --> 00:21:41,280
the path the other analyst Mark Wallace

471
00:21:44,930 --> 00:21:43,200
and I have planned out these 78

472
00:21:48,410 --> 00:21:44,940
maneuvers that Grail has gone through

473
00:21:50,450 --> 00:21:48,420
and we plan the path the other part of

474
00:21:52,610 --> 00:21:50,460
that is the orbit determination they

475
00:21:54,440 --> 00:21:52,620
figure out the data that comes in figure

476
00:21:57,020 --> 00:21:54,450
out where we are along that path most

477
00:21:58,910 --> 00:21:57,030
likely we're not exactly on it so what

478
00:22:01,640 --> 00:21:58,920
we do then is have the maneuver design

479
00:22:02,930 --> 00:22:01,650
team design the maneuvers so the to

480
00:22:04,580 --> 00:22:02,940
judge people say this is what the

481
00:22:05,960 --> 00:22:04,590
maneuver should do but since we're not

482
00:22:08,090 --> 00:22:05,970
on that path the maneuver is going to be

483
00:22:09,680 --> 00:22:08,100
different so they design the maneuver

484
00:22:11,240 --> 00:22:09,690
pass that off to the folks at Lockheed

485
00:22:12,740 --> 00:22:11,250
Martin to implement it on the spacecraft

486
00:22:14,300 --> 00:22:12,750
the spacecraft points in the right

487
00:22:16,310 --> 00:22:14,310
direction burns for the right amount of

488
00:22:18,830 --> 00:22:16,320

time to get the the change velocity we

489
00:22:20,630 --> 00:22:18,840
need speaking of the burn we're looking

490
00:22:23,060 --> 00:22:20,640
at the Doppler here can you walk us

491
00:22:25,190 --> 00:22:23,070
through what's transpired since the

492
00:22:27,290 --> 00:22:25,200
burnin and how did the burn go the

493
00:22:29,300 --> 00:22:27,300
burghley great we actually burned a

494
00:22:30,770 --> 00:22:29,310
little longer than we expected so we had

495
00:22:32,780 --> 00:22:30,780
a little bit more fuel in the tanks than

496
00:22:34,130 --> 00:22:32,790
we thought we had which is good news and

497
00:22:35,780 --> 00:22:34,140
it will help the Lockheed Martin folks a

498
00:22:37,850 --> 00:22:35,790
lot in determining how much fuel is on

499
00:22:40,910 --> 00:22:37,860
the next mission we burned for about

500
00:22:43,030 --> 00:22:40,920
four minutes on grill a ebb and just

501
00:22:46,130 --> 00:22:43,040
over five minutes on Grail be flow and

502
00:22:48,950 --> 00:22:46,140
as the Doppler came in we were kind of

503
00:22:52,010 --> 00:22:48,960
walking up that line there was a maximum

504
00:22:54,800 --> 00:22:52,020
possibility and way out their maximum

505
00:22:57,080 --> 00:22:54,810
possibility 55 meters per second grill a

506
00:22:59,690 --> 00:22:57,090
was just over 20 meters per second Grail

507
00:23:01,760 --> 00:22:59,700
be was just over 25 almost 26 meters per

508
00:23:04,370 --> 00:23:01,770
second so they went really really well

509
00:23:06,050 --> 00:23:04,380
the data is coming in and our team back

510
00:23:08,540 --> 00:23:06,060
in the other room is analyzing that data

511
00:23:10,420 --> 00:23:08,550
and getting updated estimates on where

512
00:23:13,610 --> 00:23:10,430
we're going to impact on

513
00:23:15,770 --> 00:23:13,620

crater ridge quickly we have one of the

514
00:23:18,650 --> 00:23:15,780
displays that the team has come up with

515
00:23:21,320 --> 00:23:18,660
walk us through as to what we're seeing

516
00:23:24,710 --> 00:23:21,330
we're seeing a blue line and a red line

517
00:23:28,130 --> 00:23:24,720
that indicates Evan flow and where

518
00:23:30,290 --> 00:23:28,140
they're targeted yes if there were to be

519
00:23:32,270 --> 00:23:30,300
no burnet depletion maneuver we would

520
00:23:35,060 --> 00:23:32,280
have ended up on that kind of red

521
00:23:36,680 --> 00:23:35,070
contour there more to the right because

522
00:23:38,540 --> 00:23:36,690
we did those maneuvers we move to the

523
00:23:41,480 --> 00:23:38,550
left and we also moved down on that

524
00:23:43,700 --> 00:23:41,490
crater wall so you can see there on the

525
00:23:45,650 --> 00:23:43,710
the a line is or the red line it's Grail

526
00:23:47,570 --> 00:23:45,660
a.m. and the blue line is grilled beef

527
00:23:49,850 --> 00:23:47,580
lo there approximately going to hit

528
00:23:52,040 --> 00:23:49,860
about three kilometers apart and there

529
00:23:54,140 --> 00:23:52,050
I'm about 32 seconds apart and impact

530
00:23:56,000 --> 00:23:54,150
time and the impact terms are very close

531
00:23:57,710 --> 00:23:56,010
to what we expected them to be because

532
00:24:00,320 --> 00:23:57,720
our Delta bees weren't too far off from

533
00:24:01,670 --> 00:24:00,330
what we expected and so that's what

534
00:24:04,970 --> 00:24:01,680
they're going to impact on the mountain

535
00:24:06,890 --> 00:24:04,980
and as the data comes in there'll be a

536
00:24:09,140 --> 00:24:06,900
little dot that moves along to kind of

537
00:24:10,700 --> 00:24:09,150
show where the spacecraft are on the

538
00:24:12,550 --> 00:24:10,710

bottom part it's kind of a cross section

539
00:24:15,110 --> 00:24:12,560
of that mountain and some downstream

540
00:24:18,260 --> 00:24:15,120
topography and you can see there's kind

541
00:24:21,980 --> 00:24:18,270
of a little ridge south of our impact

542
00:24:24,950 --> 00:24:21,990
location that we design these maneuvers

543
00:24:27,650 --> 00:24:24,960
not to impact there and so we skip over

544
00:24:29,780 --> 00:24:27,660
that mountain and then impact the crater

545
00:24:31,100 --> 00:24:29,790
rock wall so it looks like we're clear

546
00:24:33,350 --> 00:24:31,110
over the wrist yeah looks like we're

547
00:24:35,990 --> 00:24:33,360
pretty we're right on target yep alright

548
00:24:38,990 --> 00:24:36,000
Sarah thank you so much I don't know if

549
00:24:41,060 --> 00:24:39,000
you heard but we hurt the call just a

550
00:24:43,520 --> 00:24:41,070
little while ago that we are five

551
00:24:45,320 --> 00:24:43,530
minutes away from impact and because

552
00:24:49,880 --> 00:24:45,330
with that where you are going to head

553
00:24:53,060 --> 00:24:49,890
over here to Glenn havens and Glenn is

554
00:24:56,450 --> 00:24:53,070
the deputy mission manager who is going

555
00:24:58,430 --> 00:24:56,460
to walk us through and tell us exactly

556
00:25:00,410 --> 00:24:58,440
what's happening with this impact a

557
00:25:02,810 --> 00:25:00,420
play-by-play tell us what's happening so

558
00:25:04,550 --> 00:25:02,820
far well we just crossed about the

559
00:25:07,610 --> 00:25:04,560
5-minute mark it was just called out on

560
00:25:09,350 --> 00:25:07,620
the on on the net so all the teams now

561
00:25:12,170 --> 00:25:09,360
are basically watching the Doppler

562
00:25:14,210 --> 00:25:12,180
display so the Doppler is two-way data

563
00:25:17,120 --> 00:25:14,220

that we're getting from each orbiter are

564
00:25:19,310 --> 00:25:17,130
on stations that are tracking here in

565
00:25:21,470 --> 00:25:19,320
this case from Goldstone California are

566
00:25:22,940 --> 00:25:21,480
sending signals we get those back and it

567
00:25:23,450 --> 00:25:22,950
basically shows us that the spacecraft

568
00:25:26,029 --> 00:25:23,460
are

569
00:25:28,250 --> 00:25:26,039
live and access our heartbeat right now

570
00:25:31,159 --> 00:25:28,260
so we're watching these signals watching

571
00:25:33,500 --> 00:25:31,169
this Green Line get closer to the time

572
00:25:35,090 --> 00:25:33,510
we expect the impact when it reaches

573
00:25:36,200 --> 00:25:35,100
that we expect that signal to go away

574
00:25:38,180 --> 00:25:36,210
and that's going to mean that the

575
00:25:41,450 --> 00:25:38,190
orbiters have impacted on the moon and

576
00:25:43,700 --> 00:25:41,460
give us the time now we are what so

577
00:25:45,889 --> 00:25:43,710
we're about three minutes and 17 seconds

578
00:25:48,169 --> 00:25:45,899
for a gray LA and then grill bees just

579
00:25:50,899 --> 00:25:48,179
about a half a minute later so what are

580
00:25:52,399 --> 00:25:50,909
you looking most closely at then well I

581
00:25:54,230 --> 00:25:52,409
am watching this Doppler data and

582
00:25:56,600 --> 00:25:54,240
watching a track and you can see the

583
00:25:58,880 --> 00:25:56,610
lines have appeared here on this cross

584
00:26:00,409 --> 00:25:58,890
section of the topography so one of the

585
00:26:01,970 --> 00:26:00,419
things we're waiting for is just to see

586
00:26:04,700 --> 00:26:01,980
that signal pass over that Ridge that

587
00:26:07,130 --> 00:26:04,710
Sarah just told you about that'll show

588
00:26:09,049 --> 00:26:07,140

that we cleared it which we expect to so

589
00:26:10,789 --> 00:26:09,059
we're right on trajectory and now it's

590
00:26:13,549 --> 00:26:10,799
just waiting all right so we'll be

591
00:26:22,770 --> 00:26:13,559
standing by and as soon as you hear the

592
00:26:35,049 --> 00:26:25,120
so about two and a half minutes for Gore

593
00:26:37,930 --> 00:26:35,059
LA ok you stand up for now can you stand

594
00:26:39,430 --> 00:26:37,940
up for now and then put that chair

595
00:26:47,350 --> 00:26:39,440
there's like a whip around if I me to

596
00:26:57,760 --> 00:26:47,360
thank you that makes sense no because

597
00:27:26,340 --> 00:27:00,590
okay so two minutes for a gray la until

598
00:27:38,000 --> 00:27:28,470
we can see the signal here approaching

599
00:27:49,750 --> 00:27:40,190
just about a minute and 20 seconds for a

600
00:27:55,000 --> 00:27:52,450
Gorillaz passing over the rotations this

601
00:27:58,840 --> 00:27:55,010
is Grail a systems we are now at one

602
00:28:01,210 --> 00:27:58,850
minute to impact systems is just

603
00:28:04,570 --> 00:28:01,220
announced over the web that it's one

604
00:28:09,370 --> 00:28:04,580
minute nap confirms Gore LA has made it

605
00:28:16,120 --> 00:28:11,860
now we can see Grail B is passing over

606
00:28:17,620 --> 00:28:16,130
the same Ridge so kind of waiting for

607
00:28:26,210 --> 00:28:17,630
the call from nav that says they've made

608
00:28:32,040 --> 00:28:29,640
system through a pencil and that's just

609
00:28:34,110 --> 00:28:32,050
reported that we successfully navigated

610
00:28:39,180 --> 00:28:34,120
Grail be over the ridge and now we're on

611
00:28:41,670 --> 00:28:39,190
target for our impact grell I impacting

612
00:28:43,440 --> 00:28:41,680
27 systems college and all stations

613
00:28:52,490 --> 00:28:43,450

grill these systems we are less than one

614
00:29:01,110 --> 00:28:57,210
system this is gray la systems impact in

615
00:29:03,840 --> 00:29:01,120
three two one zero so systems has just

616
00:29:12,620 --> 00:29:03,850
made to call from Denver that we at the

617
00:29:24,480 --> 00:29:16,290
so the DSN station is just reported that

618
00:29:29,340 --> 00:29:24,490
we've lost signal for LA Oasis mm we

619
00:29:31,650 --> 00:29:29,350
have lost in all stations girlby systems

620
00:29:36,450 --> 00:29:31,660
we have passed the point of impact where

621
00:29:37,800 --> 00:29:36,460
Lee is past its impact time okay and

622
00:29:39,690 --> 00:29:37,810
then we just have the report from the

623
00:29:44,040 --> 00:29:39,700
DSM that we've lost signal for Grail be

624
00:29:45,960 --> 00:29:44,050
as well so both both spacecraft of an

625
00:30:06,800 --> 00:29:45,970
operation of saudi telecom only a blonde

626
00:30:06,810 --> 00:30:25,310
I'm gonna make boyfriend is the same

627
00:30:30,120 --> 00:30:28,560
we've been acting for a joke yeah okay

628
00:30:32,190 --> 00:30:30,130
if you want to go stand next to Murray

629
00:30:41,690 --> 00:30:32,200
okay you'll be over here if your li

630
00:30:46,860 --> 00:30:44,460
le systems mission manager all right

631
00:30:49,500 --> 00:30:46,870
it's a moment of celebration here in

632
00:30:52,110 --> 00:30:49,510
Grail Mission Control let's go back to

633
00:30:55,260 --> 00:30:52,120
Maria Zuber and we have an announcement

634
00:30:58,050 --> 00:30:55,270
to make I understand yes we do well I'm

635
00:31:01,280 --> 00:30:58,060
extremely happy to announce that nASA

636
00:31:05,640 --> 00:31:01,290
has approved the Grail teams request to

637
00:31:09,630 --> 00:31:05,650
name the final resting place of ebb and

638
00:31:12,540 --> 00:31:09,640

flow after our teammate sally ride sally

639
00:31:15,870 --> 00:31:12,550
was a visionary the head of our moon cam

640
00:31:18,570 --> 00:31:15,880
investigation and and the team very much

641
00:31:21,750 --> 00:31:18,580
wanted to honor her contributions to

642
00:31:24,090 --> 00:31:21,760
education by naming the impact sites

643
00:31:27,960 --> 00:31:24,100
after her we know that nASA has plans

644
00:31:30,290 --> 00:31:27,970
for celebrating Sally's accomplishments

645
00:31:32,820 --> 00:31:30,300
in many different areas but her

646
00:31:35,820 --> 00:31:32,830
contributions to education in Grail and

647
00:31:38,310 --> 00:31:35,830
more generally to science technology and

648
00:31:40,440 --> 00:31:38,320
math education are very very special to

649
00:31:42,780 --> 00:31:40,450
our tune so we're very happy to be able

650
00:31:45,840 --> 00:31:42,790
to do this for her today and we'd love

651
00:31:48,900 --> 00:31:45,850
to get some reaction from Reverend bear

652
00:31:51,900 --> 00:31:48,910
ride sister of Sally Ride what are your

653
00:31:56,190 --> 00:31:51,910
feelings about things we were so so

654
00:31:59,400 --> 00:31:56,200
deeply appreciative and so thrilled you

655
00:32:02,940 --> 00:31:59,410
know speaking for the whole family we're

656
00:32:04,730 --> 00:32:02,950
so grateful to to Maria into the team

657
00:32:08,909 --> 00:32:04,740
for continuing this

658
00:32:11,279 --> 00:32:08,919
making it such a complete success you

659
00:32:14,310 --> 00:32:11,289
know Sally comes from the generation of

660
00:32:16,560 --> 00:32:14,320
kids that watch the Apollo and and got

661
00:32:19,519 --> 00:32:16,570
excited about science and that way and

662
00:32:22,499 --> 00:32:19,529
then after becoming you know an

663
00:32:25,049 --> 00:32:22,509

astronaut and actually having that

664
00:32:29,639 --> 00:32:25,059
thrilled herself she really gave herself

665
00:32:33,360 --> 00:32:29,649
to igniting the excitement to in

666
00:32:35,430 --> 00:32:33,370
curiosity science to middle school kids

667
00:32:37,049 --> 00:32:35,440
especially girls so it's really cool to

668
00:32:38,430 --> 00:32:37,059
know that when you look up now at the

669
00:32:40,680 --> 00:32:38,440
moon there's this little corner of the

670
00:32:43,200 --> 00:32:40,690
movements named after Sally and we hope

671
00:32:45,330 --> 00:32:43,210
that that kids will will really be

672
00:32:47,100 --> 00:32:45,340
inspired by that as well well bear thank

673
00:32:49,950 --> 00:32:47,110
you so much for being a part of this

674
00:32:54,600 --> 00:32:49,960
let's go back to Maria one last time to

675
00:32:57,629 --> 00:32:54,610
get your final thoughts well I guess I

676
00:33:00,360 --> 00:32:57,639
just like to close by saying that ebb

677
00:33:03,539 --> 00:33:00,370
and flow have removed a veil from the

678
00:33:06,060 --> 00:33:03,549
moon and and removing this veil will

679
00:33:08,129 --> 00:33:06,070
enable discoveries about the way the

680
00:33:11,460 --> 00:33:08,139
moon formed and evolved for many years

681
00:33:13,860 --> 00:33:11,470
to come well this has been so much part

682
00:33:15,690 --> 00:33:13,870
of your life and you'll still be working

683
00:33:18,240 --> 00:33:15,700
for quite some time with all that

684
00:33:20,369 --> 00:33:18,250
information trickling out all this time

685
00:33:23,190 --> 00:33:20,379
yes we will all right Thank You Maria

686
00:33:26,279 --> 00:33:23,200
well this is wrapping it up here from

687
00:33:30,180 --> 00:33:26,289
grail Mission Control we have impact

688
00:33:32,820 --> 00:33:30,190

both spacecraft and from now on not only

689
00:33:35,399 --> 00:33:32,830
will we see the resting spot for the two

690
00:33:39,720 --> 00:33:35,409
spacecraft but we will also see it as a

691
00:33:42,450 --> 00:33:39,730
memorial to Sally Ride America's first

692
00:33:44,820 --> 00:33:42,460
woman in space so that wraps it up here