



1
00:00:09,009 --> 00:00:17,201
>>> NASA'S JET PROPULSION
LABORATORY SCIENCE ENGINEERS WHO

2
00:00:17,201 --> 00:00:20,137
ARE EXPLORING OUR PRODUCT, OUR
SOLAR SYSTEM AND ALL THAT LIES

3
00:00:20,137 --> 00:00:28,262
BEYOND.

4
00:00:28,262 --> 00:00:30,314
>> HEY, FOLKS.

5
00:00:30,314 --> 00:00:31,281
HOW IS EVERYONE DOING TONIGHT?

6
00:00:31,281 --> 00:00:33,166
GOOD.

7
00:00:33,166 --> 00:00:37,070
WELL, THANKS FOR COMING OUT TO
JOIN US ON THIS KIND OF RATHER

8
00:00:37,070 --> 00:00:39,089
UNSEASONABLY WARM OCTOBER.

9
00:00:39,089 --> 00:00:42,376
BUT WE CERTAINLY APPRECIATE YOU
COMING OUT.

10
00:00:42,376 --> 00:00:47,447
PRIOR TO THE DODD'S SPACECRAFT
ARRIVAL, DISCOVERED IN 1801, IT

11
00:00:47,447 --> 00:00:51,318
WAS THE FIRST OBJECT IDENTIFIED
AT A TIME WHEN MANY WERE

12
00:00:51,318 --> 00:00:56,390
SEARCHING FOR A MISSING PLANET
BETWEEN MARS AND JUPITER.

13
00:00:56,390 --> 00:00:59,243
INITIALLY, SERIES WAS BELIEVED
TO BE THIS MISSING PLANET.

14
00:00:59,243 --> 00:01:03,163
BUT ONCE IT WAS DETERMINED THAT
THERE WERE MANY OBJECTS FORMING

15
00:01:03,163 --> 00:01:07,384
A BELT, SERIES WAS DEMOTED FROM
PLANET, TO MINOR PLANET TO

16
00:01:07,384 --> 00:01:10,220
ASTEROID.

17
00:01:10,220 --> 00:01:15,342
FINALLY, RECLASSIFIED AS A DWARF
PLANET IN 2006.

18
00:01:15,342 --> 00:01:18,145
REGARDLESS OF ITS
CLASSIFICATION, IT IS AN

19
00:01:18,145 --> 00:01:23,233
INTRIGUING FORMATION IN OUR
SOLAR SYSTEM AND STRADDLES THE

20
00:01:23,233 --> 00:01:28,422
BOUNDARY BETWEEN THE ROCKY INNER
SOLAR SYSTEM AND ICE AND RICH

21
00:01:28,422 --> 00:01:32,259
MOON OF THE OUTER SOLAR SYSTEM.

22
00:01:32,259 --> 00:01:36,063

HAVING COMPLETED ITS
COMPREHENSIVE INVESTIGATION OF

23
00:01:36,063 --> 00:01:43,220
PROTOPLANET VESPA IN 2012, THE
DAWN SPACECRAFT REACHED IT EARLY

24
00:01:43,220 --> 00:01:49,977
IN 2015 TO FINALLY PULL BACK THE
VAIL ON THIS MYSTERIOUS WORLD.

25
00:01:49,977 --> 00:01:55,916
TONIGHT'S GUEST JOINED JPO IN
1990 FRESH FROM RECEIVING A PH D

26
00:01:55,916 --> 00:01:58,035
THE PRIOR YEAR.

27
00:01:58,035 --> 00:02:03,156
IN 2002, SHE RECEIVED HER
CURRENT ROLE ON THE DAWN

28
00:02:03,156 --> 00:02:05,158
DISCOVERY MISSION.

29
00:02:05,158 --> 00:02:09,296
HER RESEARCH HAS FOLLOWED A LONG
ARC FROM THE EARTH'S OCEAN FLOOR

30
00:02:09,296 --> 00:02:14,351
FROM AN ARCTICA TO MARS TO THE
ASTEROID BELT.

31
00:02:14,351 --> 00:02:18,205
SHE SPENT HER EARLY CAREER AT
SEA.

32
00:02:18,205 --> 00:02:24,928
BUT, CURRENTLY, SHE SPENDS HER
TIME STUDYING THE FASCINATING

33
00:02:24,928 --> 00:02:28,115
DAWN AT VESPA WHILE MANAGING THE
SCIENCE TEAM.

34
00:02:28,115 --> 00:02:32,969
SHE HAS MORE THAN 120
PUBLICATIONS ON EARTH TECH

35
00:02:32,969 --> 00:02:39,042
TONICS, MAGNETIC FIELDS ON MARS,
RANGE OF MISSION TYPES AND THE

36
00:02:39,042 --> 00:02:54,107
CHARACTER EVOLUTION OF VESTA AND
THEORIES.

37
00:02:54,107 --> 00:02:57,027
ADDITIONAL, THE ASTEROID WAS
NAMED TO RECOGNIZE HER WORK ON

38
00:02:57,027 --> 00:02:59,096
THE DAWN MISSION.

39
00:02:59,096 --> 00:03:01,298
LADIES AND GENTLEMEN, PLEASE
HELP ME WELCOME DR. CAROL

40
00:03:01,298 --> 00:03:06,103
RAYMOND.

41
00:03:06,103 --> 00:03:14,010
[APPLAUSE]
>> THANK YOU, MARK.

42
00:03:14,010 --> 00:03:16,079
WELCOME, EVERYBODY.

43
00:03:16,079 --> 00:03:20,000

I'M SO GLAD TO SEE SO MANY
PEOPLE HERE.

44

00:03:20,000 --> 00:03:23,120
GETTING A MEDAL FROM NASA IS
PRETTY COOL, BUT GETTING AN

45

00:03:23,120 --> 00:03:24,354
ASTEROID IS REALLY COOL.

46

00:03:24,354 --> 00:03:26,273
SO I WAS REALLY PLEASED WITH
THAT.

47

00:03:26,273 --> 00:03:28,408
>>> SO LET'S GET UNDERWAY.

48

00:03:28,408 --> 00:03:32,262
JUST TO GIVE YOU A COUPLE OF
POINTERS ALONG THE WAY, WE'RE

49

00:03:32,262 --> 00:03:35,966
GOING TO TAKE A JOURNEY THROUGH
THE ASTEROID BELT.

50

00:03:35,966 --> 00:03:40,137
AND ON MY TITLE SLIDE HERE, YOU
SEE IN THE FOREGROUND HERE IS A

51

00:03:40,137 --> 00:03:43,173
VIEW OF VESTA.

52

00:03:43,173 --> 00:03:45,208
OBTAINED WHEN WE WERE THERE IN
2012.

53

00:03:45,208 --> 00:03:49,196
AND THEN THIS WAS SOME ARTIST'S
RENDITION OF WHAT SERIES MIGHT

54
00:03:49,196 --> 00:03:51,064
LOOK LIKEMENT AND WE'LL SEE THAT
IT WASN'T QUITE RIGHT.

55
00:03:51,064 --> 00:03:53,133
>>> OKAY.

56
00:03:53,133 --> 00:03:58,955
SO THE DAWN MISSION IS REALLY A
JOURNEY IN SPACE BACK IN TIME TO

57
00:03:58,955 --> 00:04:02,325
INVESTIGATE CONDITIONS AND
PROCESSES THAT WERE OCCURRING

58
00:04:02,325 --> 00:04:05,028
WHEN THE SOLAR SYSTEM WAS
FORMING.

59
00:04:05,028 --> 00:04:07,264
LITERALLY, THE DAWN OF THE SOLAR
SYSTEM, WHICH IS WHY THE MISSION

60
00:04:07,264 --> 00:04:09,166
IS NAMED DAWN.

61
00:04:09,166 --> 00:04:15,372
AND DAWN'S TARGETS ARE VESTA IN
SERIES AND THESE ARE THE TWO

62
00:04:15,372 --> 00:04:18,175
MAIN OBJECTS IN THE ASTEROID
BELT.

63
00:04:18,175 --> 00:04:23,013
SO DAWN WAS SELECTED IN 2001 AS
THE NINTH MISSION IN THE

64
00:04:23,013 --> 00:04:24,364

LOW-COST RECOVERY PROGRAM.

65

00:04:24,364 --> 00:04:26,349

IT WAS A REPEATED PROGRAM.

66

00:04:26,349 --> 00:04:30,120

AND THEY SELECTED THE DAWN
PROJECT UNDER THE LEADERSHIP OF

67

00:04:30,120 --> 00:04:34,407

PROFESSOR CHRIS RUSSEL AT UCLA
TO BE THEIR NINTH MISSION.

68

00:04:34,407 --> 00:04:38,328

NOW DAWN IS A COLLABORATION OF
MANY PARTNERS THAT BUILT,

69

00:04:38,328 --> 00:04:42,098

LAUNCHED AND OPERATED THE
SPACECRAFT AND THE INSTRUMENT.

70

00:04:42,098 --> 00:04:46,953

AND ITS RICH RETURN IS REALLY A
RESULT OF ALL OF THE HARDWORK OF

71

00:04:46,953 --> 00:04:49,139

MANY, MANY PEOPLE WITHIN THE
SCIENCE TEAM WITHIN THE

72

00:04:49,139 --> 00:04:52,275

OPERATIONS TEAM AT JPL AND ALL
OF OUR PARTNERED INSTITUTIONS.

73

00:04:52,275 --> 00:04:56,980

SO I JUST WANT TO GIVE A SHOUT
OUT TO THESE HARD-WORKING TEAMS.

74

00:04:56,980 --> 00:05:01,968

AND IN OUR LOGO BAR, YOU CAN
SEE, OF COURSE, WE HAD NASA AND

75

00:05:01,968 --> 00:05:11,027

JPL AND UCLA, THE ORBITAL
SCIENCE COMPANIES BUILT THE

76

00:05:11,027 --> 00:05:14,164

SPACECRAFT, FUNDED ONE OF OUR
INSTRUMENTS WHICH WAS BUILT BY

77

00:05:14,164 --> 00:05:18,935

THE NATIONAL ASTROPHYSICAL
INSTITUTION IN ROME AND JERMAN

78

00:05:18,935 --> 00:05:21,288

AEROSPACE AGENCY FUNDED OUR
CAMERAS.

79

00:05:21,288 --> 00:05:27,344

AND THEY WERE BUILT BY THE DLR
IN SOCIETY.

80

00:05:27,344 --> 00:05:36,269

SO THE -- THE CONTRIBUTIONS THAT
WE GOT FROM THESE EUROPEAN

81

00:05:36,269 --> 00:05:43,193

PARTNERS HELPED TO MAKE DAWN A
POSSIBILITY IN A REMARKABLY LOW

82

00:05:43,193 --> 00:05:44,394

COST.

83

00:05:44,394 --> 00:05:48,381

>>> SO WE ARE PROBING DEEP INTO
THE ASTEROID BELT.

84

00:05:48,381 --> 00:05:51,985

LET'S START AT THE BEGINNING.

85

00:05:51,985 --> 00:05:56,973

SO OUR SUN, WHEN IT WAS BORN,
WAS BORN FROM A SHOCK WAVE,

86

00:05:56,973 --> 00:06:03,897

WHICH COMPRESSED A COLD CLOUD OF
GAS AND DUST AND THAT LED TO THE

87

00:06:03,897 --> 00:06:05,966

CONDENSATION THAT FORMED OUR
STAR.

88

00:06:05,966 --> 00:06:10,003

AND THAT SHOCK IS THOUGHT TO
HAVE BEEN RELATED TO A NEARBY

89

00:06:10,003 --> 00:06:12,305

SUPERNOVA EXPLOSION.

90

00:06:12,305 --> 00:06:26,286

ONCE THE SUN FORMS, THIS NEBULA
BEGINS TO ECRETE INTO

91

00:06:26,286 --> 00:06:30,206

PLANETECIMALS AND THEN
EVENTUALLY YOU HAVE PLANETARY

92

00:06:30,206 --> 00:06:33,209

EMBRYOS AND ALL OF THESE THINGS
ARE EMERGING UNTIL YOU HAVE

93

00:06:33,209 --> 00:06:36,129

PLANETS BORN.

94

00:06:36,129 --> 00:06:55,282

AND THIS WHOLE NEBRASKA NEBULAR
DISK GETS ECRETED OUT.

95

00:06:55,282 --> 00:07:01,354

AT THE DAWN OF THE SOLAR SYSTEM,

THIS NEBULA WAS RICH IN SHORT

96

00:07:01,354 --> 00:07:03,256

WAVE RADIOACTIVE LOTS.

97

00:07:03,256 --> 00:07:05,308

AND THAT ADDED A PLOT OF HEAT

THIS THE FIRST FEW MILLION

98

00:07:05,308 --> 00:07:08,244

YEARS.

99

00:07:08,244 --> 00:07:13,033

SO ANYTHING THAT WAS CLUMPING

TOGETHER AT THAT TIME, THESE

100

00:07:13,033 --> 00:07:17,337

BODIES THAT WERE FORMING AT THAT

TIME, INCORPORATED THIS

101

00:07:17,337 --> 00:07:21,074

RADIOACTIVE MATERIAL.

102

00:07:21,074 --> 00:07:25,145

BEING RADIOACTIVE, THEY WERE

ABLE TO MET, THE MATERIAL COULD

103

00:07:25,145 --> 00:07:29,149

GO TO THE CENTER AND YOU COULD

BOIL OFF A LOT OF THE LIGHT

104

00:07:29,149 --> 00:07:31,351

ELEMENTS, THE SULFUR, THE

SODIUM, THE CALCIUM AND,

105

00:07:31,351 --> 00:07:33,987

IMPORTANTLY, THE WATER.

106

00:07:33,987 --> 00:07:37,974

SO WHAT WE'RE REALLY TRYING TO
FIGURE OUT IS WHAT RESULTED IN

107

00:07:37,974 --> 00:07:42,262

THE DIVERSITY OF OBJECTS THAT WE
SEE TODAY WHERE THERE IS NAMELY

108

00:07:42,262 --> 00:07:49,853

THE RESULT OF CHEMICAL
VARIATIONS IN THAT NEBULAR DISK

109

00:07:49,853 --> 00:07:53,206

AND THE TIME IN WHICH THE BODY
FORMED THE RELATIVE HEAT TO THAT

110

00:07:53,206 --> 00:08:02,265

DISK.

111

00:08:02,265 --> 00:08:06,920

WHAT PROCESSES MIXED ALL OF THAT
STUFF UP?

112

00:08:06,920 --> 00:08:08,321

>> SO THESE PERTAIN TO SOME BIG
QUESTIONS.

113

00:08:08,321 --> 00:08:12,108

THE ANSWERS TO THESE QUESTIONS
PERTAIN TO THINGS LIKE HOW EWE

114

00:08:12,108 --> 00:08:15,962

NEEBLG IS OUR WATER RICH PLANET.

115

00:08:15,962 --> 00:08:18,164

AND WHERE DID IT GET US WATER.

116

00:08:18,164 --> 00:08:22,369

AND, IMPORTANTLY, WHERE AND WHEN
IN THE FORMATION OF THE SOLAR

117

00:08:22,369 --> 00:08:25,038

SYSTEM WERE THEIR BODIES WHERE
THE CONDITIONS FOR LIFE WERE

118

00:08:25,038 --> 00:08:28,942

MET.

119

00:08:28,942 --> 00:08:31,995

WE DO THINK THAT LIFE PROBABLY
FORMED IN MANY PLACES IN THE

120

00:08:31,995 --> 00:08:33,129

SOLAR SYSTEM.

121

00:08:33,129 --> 00:08:52,082

AND MAYBE IT'S STILL THERE NOW
AND WE'RE LOOKING BACK IN TIME

122

00:08:52,082 --> 00:08:54,918

IN BODIES THAT WERE
WATERER-RICH.

123

00:08:54,918 --> 00:08:58,188

THAT GIVES US A CLUE TO WHERE
LIFE MAY HAVE BEEN EXISTING IN

124

00:08:58,188 --> 00:09:00,206

THE EARL LE SOLAR SYSTEM.

125

00:09:00,206 --> 00:09:05,195

SO NOW WE'RE THROUGH WITH OUR
SORT OF OLD TESTAMENT.

126

00:09:05,195 --> 00:09:22,028

NOW WE'RE GOING TO GO TO A
GEOGRAPHY LESSON.

127

00:09:22,028 --> 00:09:25,014

THESE TWO OBJECTEDS REPRESENT

BUILDING BLOCKS OF TERRESTRIAL

128

00:09:25,014 --> 00:09:27,217

PLANETS.

129

00:09:27,217 --> 00:09:29,335

AND, AS SUCH, THEY'RE BASICALLY
FOSSILS.

130

00:09:29,335 --> 00:09:31,137

THEY DIDN'T GET INCORPORATED.

131

00:09:31,137 --> 00:09:36,359

THEY DIDN'T GET SMASHED TO
SMITHORINES.

132

00:09:36,359 --> 00:09:40,113

SO BY GOING THERE AND
INTERROGATING THESE WITNESSES,

133

00:09:40,113 --> 00:09:42,048

WE CAN LEARN A LOT ABOUT WHAT
WAS GOING ON AT THAT TIME.

134

00:09:42,048 --> 00:09:46,920

>>> SO THIS IS WHAT SERIES AND
VESTA LOOKED LIKE BEFORE DAWN

135

00:09:46,920 --> 00:09:48,905

GOT THERE.

136

00:09:48,905 --> 00:09:52,108

THESE ARE IMAGES FROM THE HUB
SPACE TELESCOPE.

137

00:09:52,108 --> 00:09:56,179

THESE ARE THE BEST DATA
AVAILABLE BEFORE DAWN.

138

00:09:56,179 --> 00:09:58,948
AND, AS YOU CAN SEE, THERE'S
SOME TANT LIEZING BIT OF

139
00:09:58,948 --> 00:10:01,301
INFORMATION IN THERE.

140
00:10:01,301 --> 00:10:05,305
SOME COLOR VARIATIONS AND
INTERESTING CAVITY AT THE SOUTH

141
00:10:05,305 --> 00:10:09,259
POLE OF VESTA, WHICH YOU CAN SEE
RIGHT HERE.

142
00:10:09,259 --> 00:10:14,998
BUT CLEARLY YOU CAN'T DO A WHOLE
LOT MORE WITH THESE IMAGES.

143
00:10:14,998 --> 00:10:19,986
NOW, YOU MAY ALSO, THE
INTRODUCTION TOLD YOU ABOUT

144
00:10:19,986 --> 00:10:22,205
SERIES AS THE DWARF PLANET.

145
00:10:22,205 --> 00:10:26,075
IT IS ONE OF A FAMILY OF DWARF
PLANETS SHOWN HERE WHICH

146
00:10:26,075 --> 00:10:28,194
INCLUDES PLUTO.

147
00:10:28,194 --> 00:10:32,115
INTERESTINGLY, IF YOU LOOK ON
THE BOTTOM HERE, YOU SEE THE

148
00:10:32,115 --> 00:10:35,034
DIFFERENCE FROM THE SUN IN
ASTRONOMICAL UNITS.

149

00:10:35,034 --> 00:10:38,071

AN ASTRONOMICAL UNIT IS THE
DISTANCE BETWEEN THE SUN AND THE

150

00:10:38,071 --> 00:10:39,389

EARTH.

151

00:10:39,389 --> 00:10:42,308

SO SERIES IS ROUGHLY THREE TIMES
THE DISTANCE BETWEEN THE EARTH

152

00:10:42,308 --> 00:10:45,295

AND THE SUN, OUT IN THE ASTEROID
BELT.

153

00:10:45,295 --> 00:10:49,983

AND ALL OF NEEDS OTHER PLANETS,
INCLUDING PLUTO, ARE WAY OUT

154

00:10:49,983 --> 00:10:53,186

THERE IN WHAT WE CALL THE QUAKER
BELT.

155

00:10:53,186 --> 00:10:56,322

AND IT'S FULL OF REALLY
INTERESTING OBJECTS WHICH WE'RE

156

00:10:56,322 --> 00:11:01,311

ONLY STARTING TO UNDERSTAND OR
FIND AND LEARN ABOUT.

157

00:11:01,311 --> 00:11:05,181

BUT SERIES IS THE ONLY OBJECT IN
THE INNER SOLAR SYSTEM THAT IS

158

00:11:05,181 --> 00:11:07,233

IN THIS CLASS OF OBJECT.

159

00:11:07,233 --> 00:11:10,236
IT'S BIG ENOUGH AND IT HAS THE
SAME KIND OF CHARACTERISTICS.

160
00:11:10,236 --> 00:11:13,406
SO IT IS A PRETTY EXCITING
OBJECT JUST FROM THAT

161
00:11:13,406 --> 00:11:16,926
STANDPOINT.

162
00:11:16,926 --> 00:11:21,347
NOW, ITS PEER GROUP INCLUDES ICY
MOONS OF THE SOLAR SYSTEM.

163
00:11:21,347 --> 00:11:27,053
AND, OF COURSE, YOU KNOW, PLUTO,
THE OTHER DWARF PLANET AND TWO

164
00:11:27,053 --> 00:11:33,192
THAT I FEATURED HERE ARE
ANCELIBOUS, HALF THE SIZE, HALF

165
00:11:33,192 --> 00:11:35,111
THE DIAMETER OF SERIES.

166
00:11:35,111 --> 00:11:39,065
AND THEN DIONE, ANOTHER MOON OF
SAT EARN WHICH IS ABOUT THE SAME

167
00:11:39,065 --> 00:11:41,100
RADIUS AS SERIES.

168
00:11:41,100 --> 00:11:45,405
AND THESE BODIES ARE VERY,
AGAIN, IT'S VERY ICY.

169
00:11:45,405 --> 00:12:11,931
WE KNOW THAT IT'S INACTIVE AND
PLOOMS.

170

00:12:11,931 --> 00:12:20,073

THE DAUNTING LEARNED A LOT ABOUT
AT OUR TEAM MEETING.

171

00:12:20,073 --> 00:12:41,311

POLERMO IS IN SICILY.

172

00:12:41,311 --> 00:12:47,083

THEY NOETSDSED THAT YOU COULD
ADD THIS FACTOR TO -- TO

173

00:12:47,083 --> 00:12:49,268

MERCURY'S DISTANCE AND YOU'D
FIND THIS MATHEMATICAL

174

00:12:49,268 --> 00:12:54,190

PROGRESSION OF, YOU KNOW, TWICE
THE LAST FACTOR AND SO FORTH.

175

00:12:54,190 --> 00:12:59,963

AND THIS ALL MADE SENSE EXCEPT
THAT THERE'S SOMETHING MISSING.

176

00:12:59,963 --> 00:13:03,032

THE PLUS 24 WAS MIZING.

177

00:13:03,032 --> 00:13:07,370

AND THEN URANUS WAS DISCOVERED
AND IT FOLLOWED THE SAME RULE, I

178

00:13:07,370 --> 00:13:24,003

THINK, IS GOING TO COME NEXT.

179

00:13:24,003 --> 00:13:29,993

SO IT'S NOW GENERALLY CALLED THE
BODE LAW, EVEN THOUGH NOBODY CAN

180

00:13:29,993 --> 00:13:33,262

FIND ANY SIGNIFICANCE TO THE
MATHEMATICAL PROGRESSION.

181

00:13:33,262 --> 00:13:34,197
MAYBE IT'S QUINCE DENTAL.

182

00:13:34,197 --> 00:13:36,332
WHO KNOWS.

183

00:13:36,332 --> 00:13:39,352
>>> SO, ANYWAY, THESE GUYS WERE
OFF LOOKING FOR A MISSING

184

00:13:39,352 --> 00:13:40,953
PLANET.

185

00:13:40,953 --> 00:13:43,122
THERE WAS ACTUALLY KIND OF AN
INTERNATIONAL SURVEY THAT WAS

186

00:13:43,122 --> 00:13:44,240
ORGANIZED.

187

00:13:44,240 --> 00:13:48,161
AND THEY CALLED THEMSELVES THE
CELESTIAL POLICE.

188

00:13:48,161 --> 00:13:53,199
HERE'S THIS GUY, PIAZZI, WHO
STARTED WORKING WITH THE

189

00:13:53,199 --> 00:13:54,984
OBSERVATORY IN POLERMO.

190

00:13:54,984 --> 00:13:57,270
HE'S A MATHEMATICIAN.

191

00:13:57,270 --> 00:13:59,205
HE WASN'T EVEN AN ASTRONOMER.

192

00:13:59,205 --> 00:14:02,241

HE JUST DID A LOT OF THE RIGHT
THINGS AND HE ENDED UP FINDING

193

00:14:02,241 --> 00:14:02,909

SERIES.

194

00:14:02,909 --> 00:14:09,349

AND THEN, SHORTLY, HE WAS IN
CLOSE CONTACT WITH ALBERS IN

195

00:14:09,349 --> 00:14:11,234

GERMANY.

196

00:14:11,234 --> 00:14:17,223

HE ACTUALLY REDISCOVERED SERIES
WHEN PIAZZI LOST IT.

197

00:14:17,223 --> 00:14:22,011

IT'S HARD EVEN WHEN YOU FIND AN
OBJECT THAT YOU KNOW IS

198

00:14:22,011 --> 00:14:24,247

SOMETHING LIKE AN ASTEROID, A
MINOR PLANET, YOU KNOW, THEN YOU

199

00:14:24,247 --> 00:14:26,132

LOSE IT.

200

00:14:26,132 --> 00:14:28,217

AND YOU HAVE TO FIND IT COMING
BACK AROUND AGAIN.

201

00:14:28,217 --> 00:14:30,136

IT CAN BE VERY EASY TO LOSE.

202

00:14:30,136 --> 00:14:40,012

SO IT WAS A COMBINATION OF

MATHEMATICS AND FIGURING OUT HOW

203

00:14:40,012 --> 00:14:43,116

TO CALCULATE FROM THE SERIES
ORBIT.

204

00:14:43,116 --> 00:14:47,019

SO THIS WAS REALLY A BIG DEAL.

205

00:14:47,019 --> 00:14:50,990

THIS IS A LITHOGRAPH THAT HANGS
IN THE OBSERVATORY.

206

00:14:50,990 --> 00:14:54,894

AND IT SHOWS THIS BEAUTIFUL
ASTRONOMICAL INSTRUMENT, WHICH

207

00:14:54,894 --> 00:15:00,900

IS THE ACTUAL TELESCOPE THAT
PIAZZI USED TO FIND SERIES.

208

00:15:00,900 --> 00:15:04,253

AND IT WAS REVOLUTIONARY AT THE
TIME BECAUSE IT COULD MOVE IN

209

00:15:04,253 --> 00:15:06,956

AZMUTH AND IN LATITUDE.

210

00:15:06,956 --> 00:15:09,275

AND SO IT WAS CALLED THE CIRCLE.

211

00:15:09,275 --> 00:15:13,379

AND IT ALSO HAD SOME OF THE BEST
GLASS AROUND.

212

00:15:13,379 --> 00:15:17,166

SO IT WAS REVERED IN ALL OF
EUROPE FOR ITS BEING ONE OF THE

213

00:15:17,166 --> 00:15:19,085
BEST INSTRUMENTS.

214
00:15:19,085 --> 00:15:21,287
AND HERE IT IS IN POLERMO.

215
00:15:21,287 --> 00:15:24,941
AND HE TOOK VERY, VERY CAREFUL
DATA AND HE FOUND SERIES.

216
00:15:24,941 --> 00:15:29,061
SO THIS IS SERIES, THE GODDESS
OF AGRICULTURE.

217
00:15:29,061 --> 00:15:31,347
AND HERE ON HER HEAD IS THE
SHINING STAR, WHICH IS OUR

218
00:15:31,347 --> 00:15:34,133
SIRIS.

219
00:15:34,133 --> 00:15:37,970
AND THEN YOU SEE THE ANGELS HERE
AROUND THE TELESCOPE.

220
00:15:37,970 --> 00:15:55,354
SO IT'S ALL VERY POETIC.

221
00:15:55,354 --> 00:16:01,194
>>> SO 200 YEARS AFTER THAT,
DAWN LAUNCHED.

222
00:16:01,194 --> 00:16:07,250
EVENTUALLY, THEY BECAME PART OF
A LARGE COLLECTION WHICH WE NOW

223
00:16:07,250 --> 00:16:11,037
CALL THE ASTEROID BELT.

224

00:16:11,037 --> 00:16:13,239
HERE WE ARE TO GO TAKE A LOOK AT
THEM KNOWING THAT THESE ARE

225
00:16:13,239 --> 00:16:14,891
IMPORTANT OBJECTS.

226
00:16:14,891 --> 00:16:22,081
AND WE LAUNCHED AT DAWN, WHICH
IS ANOTHER VERY POETIC THICK.

227
00:16:22,081 --> 00:16:25,935
SO OFF WE GO, THERE WAS MANY,
MANY PROBLEMS WITH THE LAUNCH.

228
00:16:25,935 --> 00:16:29,138
IT WAS ON, IT WAS OFF, THERE
WERE SPRING STORMS, THERE WERE

229
00:16:29,138 --> 00:16:31,140
BOATS THAT BROKE DOWN, THE
ROCKET BROKE DOWN, SO MANY

230
00:16:31,140 --> 00:16:32,208
THINGS BROKE DOWN.

231
00:16:32,208 --> 00:16:35,061
BUT WE FINALLY GOT OFF.

232
00:16:35,061 --> 00:16:37,997
AND THEN ONE OF THE THINGS
THAT'S REALLY UNIQUE ABOUT DAWN

233
00:16:37,997 --> 00:16:40,116
IS ITS ION ENGINES.

234
00:16:40,116 --> 00:16:45,188
AND, SO, WE USE THESE ION
ENGINES TO ALLOW US TO GET TO

235

00:16:45,188 --> 00:16:49,075

NOT ONE BUT TWO DESTINATIONS IN
THE SOLAR SYSTEM.

236

00:16:49,075 --> 00:16:51,143

THIS IS A FIRST.

237

00:16:51,143 --> 00:17:04,056

DAWN IS A FIRST MISSION TO GO TO
AN ASTEROID.

238

00:17:04,056 --> 00:17:07,176

AND THIS IS ALL, AGAIN, IN A
LOW-COST MISSION.

239

00:17:07,176 --> 00:17:10,029

SO THIS IS REALLY A REMARKABLE
FEAT.

240

00:17:10,029 --> 00:17:17,253

AND IT'S ALL ENABLED BY ION
PROPULSION, A REALLY

241

00:17:17,253 --> 00:17:20,306

REVOLUTIONARY FORM OF
PROPULSION.

242

00:17:20,306 --> 00:17:24,944

I WANTED TO HIGHLIGHT THE
STRUCHLT.

243

00:17:24,944 --> 00:17:27,046

ONE THING THAT YOU'LL NOTICE IS
THAT THEY ALL LOOK PRETTY

244

00:17:30,149 --> 00:17:28,147

COMPLICATED.

245

00:17:30,149 --> 00:17:33,319

AND THEY'RE VERY WELL BUILT AND
THEY'RE STILL WORKING TODAY.

246

00:17:33,319 --> 00:17:36,339

YOU KNOW, TEN YEARS AFTER THEY
WERE DELIVERED TO THE PROJECT.

247

00:17:36,339 --> 00:17:40,092

SO WE HAVE CAMERAS THAT TAKE
IMAGES IN CLEAR AND COLOR

248

00:17:40,092 --> 00:17:43,262

FILTERS.

249

00:17:43,262 --> 00:17:48,050

WE HAVE GAMMA RAY LOOKING AT THE
ELEMENTS ON THE SURFACE BASED

250

00:17:48,050 --> 00:17:51,070

ON THE GAMMA RAY EMISSIONS AND
THE NEUTRONS THAT ARE COMING

251

00:17:51,070 --> 00:17:52,855

FROM THE SURFACE.

252

00:17:52,855 --> 00:18:03,049

AND THEN INVISIBLE INFRARED
MAPPING SPECTROMETER TELLING US

253

00:18:03,049 --> 00:18:12,258

ABOUT THE MINERALS AND COMP SIX
OF THE SURFACE.

254

00:18:12,258 --> 00:18:18,881

WE KEPT PUSHING OUT UNTIL WE GOT
TWO VESTA IN 2011.

255

00:18:18,881 --> 00:18:23,085

WE STAYED FOR 14 MONTHS AND
TURNED ON THE ENGINES AND PUSHED

256

00:18:23,085 --> 00:18:25,955

OUT TO SIRIS.

257

00:18:25,955 --> 00:18:29,292

WE GOT THERE IN MARCH AND WILL
BE HERE UNTIL FOREVER.

258

00:18:29,292 --> 00:18:34,063

ONCE WE GET INTO OUR LITTLE
ALTITUDE ORBIT, WHEN WE RUN OUT

259

00:18:34,063 --> 00:18:38,351

OF FUEL, THE SPACECRAFT WILL NO
LODGER TALK TO IT.

260

00:18:38,351 --> 00:18:41,988

BUT IT WON'T LEAVE THE ORBIT
THAT IT'S IN.

261

00:18:41,988 --> 00:18:45,274

IT'S GOING TO BECOME A NATURAL
SATELLITE OF SERIES.

262

00:18:45,274 --> 00:19:07,330

HERE, YOU CAN SEE IT IN MOTION.

263

00:19:07,330 --> 00:19:10,049

SO WE GET O THERE.

264

00:19:10,049 --> 00:19:16,956

WE CATCH UP WITH VESTA AND THEN
WE BEGIN OUR OBSERVATIONS.

265

00:19:16,956 --> 00:19:23,295

AND WE G FOR ABOUT A FOURTH OF
VESTA YEAR TAKING OBSERVATIONS

266

00:19:23,295 --> 00:19:26,098

AND FIRE BACK UP.

267

00:19:26,098 --> 00:19:29,068

YOU SEE HOW CLOSE THEY ARE
RELATIVE TO EACH OTHER IN THE

268

00:19:29,068 --> 00:19:31,003

CLIPTIC PLANE HERE.

269

00:19:31,003 --> 00:19:35,291

AND THAT IS THE REASON WE CAN DO
THIS DUAL ASTEROID MIX.

270

00:19:35,291 --> 00:19:39,145

SO, NOW, HERE WE ARE AT SIRIS.

271

00:19:39,145 --> 00:19:48,270

YOU CAN SEE SIRIS, IS IS A
LITTLE MORE INCLINED THAN VESTA.

272

00:19:48,270 --> 00:19:51,107

SO, EACH OF THESE BODIES, WE'RE
GETTING A LOT OF SCIENTIFIC

273

00:19:51,107 --> 00:19:53,042

DATA.

274

00:19:53,042 --> 00:19:57,196

WE'RE MAKING A TOPOGRAPHIC MAP
FROM ALL DIFFERENT DIRECTIONS AT

275

00:19:57,196 --> 00:20:00,383

THE SURFACE.

276

00:20:00,383 --> 00:20:06,238

WE'RE MAPPING THE LIMITS OF THE
HYDROGEN, THE NITROGEN, THE

277

00:20:06,238 --> 00:20:09,158

MAGNESIUM, THE IRON, ALL THE
THINGS THAT MAKE UP THE MINERALS

278

00:20:09,158 --> 00:20:13,279

AND ITS VARIATION ON THE
SURFACE.

279

00:20:13,279 --> 00:20:16,365

AND THEN WE'RE MEASURING THE
FWRAVITY FIELD.

280

00:20:16,365 --> 00:20:19,034

AND, ALSO, WE'RE SEARCHING
AROUND THEM TO SEE IF WE HAVE

281

00:20:19,034 --> 00:20:22,204

ANY MOONS.

282

00:20:22,204 --> 00:20:39,321

IT WILL TELL US SOMETHING ABOUT
THEIR HISTORY.

283

00:20:39,321 --> 00:20:55,121

IT REMINDS ME OF THE TV SHOW.

284

00:20:55,121 --> 00:20:59,041

YOU CAN ACTUALLY SEE IT AT
CERTAIN TIMES OF ITS ORBIT.

285

00:20:59,041 --> 00:21:01,043

IT HAS AN IRON CORE.

286

00:21:01,043 --> 00:21:04,096

IT HAS A MANTLE AND A CRUST,
SIMILAR TO THE EARTH.

287

00:21:04,096 --> 00:21:06,265

THE CRUST IS LIKE THE OCEAN
CRUST ON THE EARTH, IT'S WITH

288

00:21:06,265 --> 00:21:18,077

SALT.

289

00:21:18,077 --> 00:21:21,330

SIRIS IS ICY, WET AND DARK.

290

00:21:21,330 --> 00:21:26,135

IT'S GOT A MANTLE FULL OF ICE
AND A DUSTY CHA SURFACE, WHICH

291

00:21:26,135 --> 00:21:28,053

MAKES IT VERY DARK.

292

00:21:28,053 --> 00:21:30,406

SO, AGAIN, WHY ARE THESE TWO
THINGS DIFFERENT.

293

00:21:30,406 --> 00:21:34,994

WAS IT THE CHEMICAL GRADE I
CAN'TS?

294

00:21:34,994 --> 00:21:37,196

DID THEY FORM SOMEWHERE
EDUCATIONAL AND ONLY ACHIEVE

295

00:21:37,196 --> 00:21:39,064

THEIR CURRENT POSITION BASED ON
FORCES?

296

00:21:39,064 --> 00:21:40,966

OR WAS IT THE FORMATION TIME.

297

00:21:40,966 --> 00:21:44,253

WE'RE TRYING TO GET AT THOSE
QUESTIONS SO THEY CAN BETTER

298

00:21:44,253 --> 00:21:48,107

UNDERSTAND THE WHOLE CONTEXT IN
WHICH THEY WERE FORMING.

299

00:21:48,107 --> 00:21:52,978

SO THINKING OF CONTEXT, THIS WAS
A REALLY NICE COMPARISON OF ALL

300

00:21:52,978 --> 00:21:58,050

OF THE ASTEROIDS THAT HAVE BEEN
VISITED BY SPACECRAFT OVER, YOU

301

00:21:58,050 --> 00:22:00,186

KNOW, BY NASA.

302

00:22:00,186 --> 00:22:13,165

THE LARGEST ONE, BESIDE VESTA
AND SIR ZIRKS WAS LOTISHIA.

303

00:22:13,165 --> 00:22:17,086

YOU CAN'T EVEN SEE SOME OF THEM.

304

00:22:17,086 --> 00:22:20,072

SO WE LIKE TO SAY VESTA IS NOT
AN ASTEROID.

305

00:22:20,072 --> 00:22:22,074

IT IS A PROTOPLANET.

306

00:22:22,074 --> 00:22:27,346

IT IS REALLY A DIFFERENT THING
THAN ASTEROIDS WHICH GENERALLY

307

00:22:27,346 --> 00:22:34,253

ARE KIND OF DARK AND HOMOGENEOUS
AND MADE OF FRAGMENTEDS,

308

00:22:34,253 --> 00:22:39,975

PROBABLY, OF BIGGER BODIES THAT
GOT DISRUPTED.

309

00:22:39,975 --> 00:22:43,112

BUT VESTA IS AN INTACT BODY.

310

00:22:43,112 --> 00:22:46,131

IT'S FORMED AND EVOLVED AND
GENERALLY STILL IN THE SAME

311

00:22:46,131 --> 00:22:56,125

CONDITION IT WAS WHEN IT FORMED.

312

00:22:56,125 --> 00:23:08,387

>> I THINK YOU'LL AGREE WITH ME,
SIRIS IS DIFFERENT.

313

00:23:08,387 --> 00:23:16,161

THESE WERE ALL LUMPED TOGETHER
AS ASTEROIDS.

314

00:23:16,161 --> 00:23:19,148

SO AT THE TIME THEY WERE
DISCOVERED, THEY LOOKED LIKE

315

00:23:19,148 --> 00:23:19,315

STARS.

316

00:23:19,315 --> 00:23:32,995

THEY WERE JUST DIFFERENT.

317

00:23:32,995 --> 00:23:41,320

A WHOLE DIFFERENT CLASS OF
OBJECTS.

318

00:23:41,320 --> 00:23:46,191

SO SIRIS IS NAMED AFTER THE
LARGEST ROMAN GOD OF

319

00:23:46,191 --> 00:23:53,198

AGRICULTURE.

320

00:23:53,198 --> 00:23:58,253

IT'S THE ONLY DWARF PLANET IN
THE INNER SOLAR SYSTEM.

321

00:23:58,253 --> 00:24:04,109

THIS IS WHAT WE THINK IS GOING
ON INSIDE OF SIRIS.

322

00:24:04,109 --> 00:24:10,165

THE VERY CORE OF SERIS, BECAUSE
SIRIS IS LARGE, THERE'S SOME

323

00:24:10,165 --> 00:24:24,229

GRAVITY, THIS'S COMPRESSION AND
THAT CAN CAUSE DEHYDRATION.

324

00:24:24,229 --> 00:24:27,266

AND THEN SURROUNDING THAT, WE
HAVE A LAYER OF HEEL DRATED

325

00:24:27,266 --> 00:24:31,070

SILICAS.

326

00:24:31,070 --> 00:24:33,238

THAT'S LIKE CLAY.

327

00:24:33,238 --> 00:24:39,128

BASICALLY, WHEN YOU ADD WATER TO
ROCKY MATERIAL, YOU GET THINGS

328

00:24:39,128 --> 00:24:39,361

LIKE CLAY.

329

00:24:39,361 --> 00:24:41,981

OR MUD.

330

00:24:41,981 --> 00:24:57,980

THAT'S WHAT WE THINK IS FORMING
THE BULK OF SIRIS.

331

00:24:57,980 --> 00:25:07,189
IF YOU GO THROUGH A MODEL, THE
HEAT HAD TO GET OUT.

332
00:25:07,189 --> 00:25:09,324
IT WOULD HAVE RELEASED A LOT OF
WATER.

333
00:25:09,324 --> 00:25:14,096
YOU WOULD HAVE HAD A LAYER OF
LIQUID WATERER OF SUB SURFACE

334
00:25:14,096 --> 00:25:17,950
OCEAN DURING SOME PORTION OF
SIRIS'S HES RI.

335
00:25:17,950 --> 00:25:20,152
NOT TODAY BECAUSE IT'S NOW TOO
COLD.

336
00:25:20,152 --> 00:25:22,971
ALL OF THAT OCEAN WOULD HAVE
FROZEN OUT AND INTO THIS ICE

337
00:25:22,971 --> 00:25:24,306
LAYER AT THE SURFACE.

338
00:25:24,306 --> 00:25:28,077
SO WHAT WE THINK IS WE'VE GOT
THIS ICE, WHICH IS REALLY MIXED

339
00:25:28,077 --> 00:25:31,380
IN WITH ROCK AND, OF COURSE,
THERE'S SAULT BECAUSE OUR OCEAN

340
00:25:31,380 --> 00:25:44,259
HAS SALT.

341
00:25:44,259 --> 00:25:47,312
AND THEN COVERED BY THIS DUSTY

LAYER OF STUFF.

342

00:25:47,312 --> 00:25:50,215

SO YOU GET THIS DRIED, DUSTY
LAYER AT THE SURFACE.

343

00:25:50,215 --> 00:25:57,990

>>> SO THIS IS KIND OF WHAT WE
THINK SIRIS LOOKED LIKE.

344

00:25:57,990 --> 00:26:00,909

WHY IS IT IMPORTANT THAT WE HAVE
THIS FROZEN OCEAN OR THAT WE HAD

345

00:26:00,909 --> 00:26:09,034

A SUB SURFACE OCEAN IN THE PAST.

346

00:26:09,034 --> 00:26:13,071

>> WHAT WE'RE REALLY CURIOUS
ABOUT IS WHAT WERE THE PROCESSES

347

00:26:13,071 --> 00:26:27,219

GOING ON AT THAT OCEAN FLOOR.

348

00:26:27,219 --> 00:26:39,314

AND THAT'S WHERE THE ENVIRONMENT
FOR LIFE IS MOST CONDUCIVE.

349

00:26:39,314 --> 00:26:42,100

WE'RE REALLY INTERESTED TO KNOW
MORE ABOUT THAT ENVIRONMENT IN

350

00:26:42,100 --> 00:26:44,403

THE PAST.

351

00:26:44,403 --> 00:26:46,972

WE'RE NOT GOING ANYWHERE.

352

00:26:46,972 --> 00:26:49,291

BUT WE'RE LOOKING FOR WHAT'S ON
THE SURFACE, THE TELLTALE SIGNS

353

00:26:49,291 --> 00:27:03,188
OF WHAT WAS HAPPENING.

354

00:27:03,188 --> 00:27:09,895
WE'RE LOOKING FOR WHAT MINERALS
SURFACED.

355

00:27:09,895 --> 00:27:12,898
IS THERE OTHER MATERIAL BROUGHT
IN BY IMPACTERS?

356

00:27:12,898 --> 00:27:18,320
WE'RE TRYING TO FIGURE OUT HOW
MUCH WATER IS BEING RELEASED

357

00:27:18,320 --> 00:27:20,155
OVER TIME AND IDENTIFYING
WHATEVER THE ENERGY SOURCE FOR

358

00:27:20,155 --> 00:27:21,240
THAT 1.

359

00:27:21,240 --> 00:27:24,092
WE WANT TO KNOW MORE ABOUT THAT
ICE SHELL COMPETITION.

360

00:27:24,092 --> 00:27:26,078
THAT TELLS US MORE ABOUT THE
EVOLUTION OF THE BODY AS A

361

00:27:26,078 --> 00:27:35,070
WHOLE.

362

00:27:35,070 --> 00:27:51,086
WE TO THAT BY LOOKING AT THE
KRATER SHAPES.

363

00:27:51,086 --> 00:27:54,006

>>> NOW, WE CAN GET A LITTLE BIT
OF THE INTERIOR STRUCTURE WITH

364

00:27:54,006 --> 00:27:55,207

THE GRAVITY.

365

00:27:55,207 --> 00:27:59,945

AND THAT'S TO MAP THE DENSITY OF
THE BODY AS A WHOLE AND THE

366

00:27:59,945 --> 00:28:04,933

SHAPE OF THAT ROCKY CORE.

367

00:28:04,933 --> 00:28:10,072

SO HERE IS A COMPARISON OF SCALE
AT EUROPA.

368

00:28:10,072 --> 00:28:17,913

EUROPA BEING THE MOON OF JUPITER
FOR ONE OF NASA'S UPCOMING

369

00:28:17,913 --> 00:28:19,898

MISSIONS.

370

00:28:19,898 --> 00:28:24,169

WE'RE GOING TO EUROPA BECAUSE WE
THINK IT'S PROBABLY ONE OF THE

371

00:28:24,169 --> 00:28:27,339

HIGHEST POTENTIAL ENVIRONMENTS
FOR LIFE OUTSIDE OF THE EARTH

372

00:28:27,339 --> 00:28:29,291

AND OUR SOLAR SYSTEM.

373

00:28:29,291 --> 00:28:37,349

AND IF YOU COMPARE EUROPA AND
LITERALLY THESE PLUMES SHOOTING

374

00:28:37,349 --> 00:28:41,987

OUT IN THE SOUTH BECAUSE OF
CRACKS BECAUSE WE ALSO KNOW THAT

375

00:28:41,987 --> 00:28:49,945

THERE'S SOME HYPOTHERMAL
ACTIVITY.

376

00:28:49,945 --> 00:28:55,017

THE ONLY DIFFERENT THING THAT
THESE GUYS HAVE A LOT OF HITLES.

377

00:28:55,017 --> 00:28:57,853

THEY'RE ORBITING THESE GIANT
PLANETS AND THE TITLE FORCES

378

00:28:57,853 --> 00:29:00,138

CAUSE A LOT OF FRICTION.

379

00:29:00,138 --> 00:29:02,190

AND THAT FRICTION METS THE
INTERIOR.

380

00:29:02,190 --> 00:29:06,345

AND SO AT THE PRESENT DAY, THEY
HAVE LIQUID OCEANS.

381

00:29:06,345 --> 00:29:10,048

SIRIS DIDS IN THE PAST, BUT
MAINLY BECAUSE IT WAS SO MUCH

382

00:29:10,048 --> 00:29:12,985

CLOSER TO THE SUN THAT IT HAD A
LOT OF SOLAR ENERGY.

383

00:29:12,985 --> 00:29:14,970

THAT WOULD KEEP IT WARM.

384

00:29:14,970 --> 00:29:20,042
AND, SO, FOR SOME BILLIONS OF
YEARS THAT HAVE PASSED, THEY

385
00:29:20,042 --> 00:29:22,177
LIKELY HAVE LIQUID WATERER.

386
00:29:22,177 --> 00:29:26,949
SO THESE THREE OBJECTS ALL HAD
THE ESSENTIAL INGREDIENTS.

387
00:29:26,949 --> 00:29:30,068
THE LIQUID WATER, THE CHEMICAL
INGREED YEBTS AND AN ENERGY

388
00:29:30,068 --> 00:29:31,303
SOURCE.

389
00:29:31,303 --> 00:29:34,256
SO THAT'S WHY WE'RE REALLY
INTERESTED IN LEARNING MORE

390
00:29:34,256 --> 00:29:37,960
ABOUT WHAT SIRIS WAS LIKE BACK
THEN IN A MORE DEFINITIVE SENSE.

391
00:29:37,960 --> 00:29:45,283
OKAY.

392
00:29:45,283 --> 00:29:50,272
SO NOW THIS IS A REALLY COOL
MOVIE WHICH IS SHOWING YOU THE

393
00:29:50,272 --> 00:30:06,955
SPACECRAFT WITH ITS BLUE ION
BEAM.

394
00:30:06,955 --> 00:30:10,375
A AND THEN THERE WILL BE A
SERIES OF EMAGES.

395

00:30:10,375 --> 00:30:11,376
EVERYBODY IS IT'S EXCITED.

396

00:30:18,283 --> 00:30:13,945
WE'RE GETTING THERE.

397

00:30:18,283 --> 00:30:36,184
AND IT STARTS TO GLOW IN OUR
VIEW.

398

00:30:36,184 --> 00:30:38,970
AND THEN WE GOT OUR FIRST
ROTATION MOVIE.

399

00:30:38,970 --> 00:30:44,109
AND THEN WE SAW IT IN ALL OF ITS
GLORY IN A FULL ROTATION AND

400

00:30:44,109 --> 00:30:49,181
FOUND THOSE INCREDIBLY BRIGHT
SPOTS, WHICH ARE STILL PUZZLING

401

00:30:49,181 --> 00:30:55,253
THE TEAM TO THIS DAY.

402

00:30:55,253 --> 00:31:01,243
THIS IS A QUICK ANIMATION
SHOWING HOW DAWN GOT IN.

403

00:31:01,243 --> 00:31:02,210
THE SPACECRAFT SAVED BACK HERE.

404

00:31:02,210 --> 00:31:04,179
IT SHUT ITSELF DOWN.

405

00:31:04,179 --> 00:31:08,016
SO IT WASN'T ON ITS REGULAR
PLANNED TRAJECTORY TO GO INTO

406
00:31:08,016 --> 00:31:10,302
ORBIT.

407
00:31:10,302 --> 00:31:16,942
IT WAS SCREAMING PASSED SIRIS
TOO FAST.

408
00:31:16,942 --> 00:31:24,933
SO THE TEAM BASICALLY FIGURED
OUT HOW TO MAKE A YOU TURN, COME

409
00:31:24,933 --> 00:31:27,285
BACK AND DID IT IN A MATTER OF
WEEKS.

410
00:31:27,285 --> 00:31:30,055
IT'S A HUGE MATHEMATICAL PROBLEM
SOLVED.

411
00:31:30,055 --> 00:31:32,124
SO THAT WAS ANOTHER -- YOU KNOW,
THEY RESCUED THE MISSION.

412
00:31:32,124 --> 00:31:33,275
IT WAS REALLY IMPRESSIVE.

413
00:31:33,275 --> 00:31:39,264
SO ANOTHER THING.

414
00:31:39,264 --> 00:31:43,335
I WANT TO MENTION HOW WONDERFUL
IT IS TO WORK WITH SUCH

415
00:31:43,335 --> 00:31:46,371
INCREDIBLY SMART AND CREATIVE
PEOPLE BECAUSE THIS IS NOT LIKE

416
00:31:46,371 --> 00:31:50,926

WROTE STUFF.

417

00:31:50,926 --> 00:31:53,061

THIS IS REALLY FIRST-TIME
ACTIVITIES ALMOST ALL OF THE

418

00:31:53,061 --> 00:31:55,330

TIME.

419

00:31:55,330 --> 00:32:01,970

SO THEN WE GET A LITTLE CLOSER
UP AND THIS IS WHAT WE FOUND.

420

00:32:01,970 --> 00:32:15,233

YOU CAN SEE THOSE BRIGHT SPOTS
IN THE CRATER HERE.

421

00:32:15,233 --> 00:32:17,953

OVERALL, THE SURFACE IS VERY
DARK.

422

00:32:17,953 --> 00:32:23,358

AND THERE WAS CRATERERS
EVERYWHERE.

423

00:32:23,358 --> 00:32:28,079

THAT WAS A LITTLE PUZZLING.

424

00:32:28,079 --> 00:32:34,986

IT BASICALLY DOESN'T HAVE
STRENGTH.

425

00:32:34,986 --> 00:32:37,055

IT BASICALLY WILL FLOW BACK.

426

00:32:37,055 --> 00:32:51,153

BUT, CLEARLY, THERE ARE CRATERS.

427

00:32:51,153 --> 00:33:29,007

AND THEN YOU KNOW, ICE BEING THE
MOST REFLECTIVE MATERIAL THAT

428

00:33:29,007 --> 00:33:33,278

YOU COULD HAVE, SALT BEING
HIGHLY REFLECTIVE, BUT NOT AS

429

00:33:33,278 --> 00:33:54,983

REFLECTIVE AS ICE.

430

00:33:54,983 --> 00:34:07,262

SO SATURDAY IS A GOOD GOING IN
HYPOTHESIS.

431

00:34:07,262 --> 00:34:13,385

BUT MANY WOULD LIKE TO SEE AN
ALIEN CIVILIZATION AS WELL.

432

00:34:13,385 --> 00:34:20,108

SO WE'RE KEEPING OUR EYES OUT
FOR THAT.

433

00:34:20,108 --> 00:34:24,362

AS YOU MAY KNOW, ANYTHING THAT'S
EXPOSED TO SOLAR WIND, TO THE

434

00:34:24,362 --> 00:34:29,000

RADIATION OF SPACE WILL USUALLY
DARKEN OVERTIME.

435

00:34:29,000 --> 00:34:33,138

SO WE'RE WONDERING IF THEY COULD
BE RELATED TO WATER VAPOR

436

00:34:33,138 --> 00:34:41,046

EMISSIONS THAT WAS PROTECTED BY
THE OBSERVATORY A FEW YEARS AGO

437

00:34:41,046 --> 00:34:45,984

WHEN SERIES WAS GOING THROUGH

ITS PASSING CLOSEST TO THE ZUN

438

00:34:45,984 --> 00:34:53,074

AND THEN THEY DETEKTED BY A VERY SENSITIVE SPECK TROM MATERIAL

439

00:34:53,074 --> 00:34:59,064

THAT TLFGS WATER VAPOR IN THE SIRIS ENVIRONMENT.

440

00:34:59,064 --> 00:35:04,102

SO THIS KIND OF ADDS TO THE WHOLE MIGS MYSTERY OF WHAT IS

441

00:35:04,102 --> 00:35:15,096

GOING ON AT SIRIS.

442

00:35:15,096 --> 00:35:32,147

A COUPLE OF LOOKS OF RESOLVED DATA.

443

00:35:32,147 --> 00:35:35,200

AND THIS ONE, CALLED HILONI.

444

00:35:35,200 --> 00:35:40,055

SO THIS IS SHOWING YOU IN GREAT SCALE THE SHAPE AND BRIGHTNESS.

445

00:35:40,055 --> 00:35:44,359

AND THEN IF WE COLOR THE TOPOGRAPHY, YOU CAN SEE THE

446

00:35:44,359 --> 00:35:51,082

CRATER OUTLINES.

447

00:35:51,082 --> 00:36:01,926

IT'S PART OF THAT SMOOTH TERRAIN AND THEN ANOTHER HIGH AREA.

448

00:36:01,926 --> 00:36:08,199
AND THEN, YOU KNOW, IN THESE
ROUGH, SMOOTH TERRAINS WHICH

449
00:36:08,199 --> 00:36:33,291
DON'T NECESSARILY RELATE TO
THE DIFFERENCES IN TOPOGRAPHY.

450
00:36:33,291 --> 00:36:36,344
LOTS OF STUFF THAT WE CAN USE TO
SEE WHAT'S GOING ON.

451
00:36:36,344 --> 00:36:42,067
>>> AND THEN RECENTLY, OUR
NAMING THEME IS AGRICULTURAL

452
00:36:42,067 --> 00:36:45,203
DEITIES.

453
00:36:45,203 --> 00:36:48,356
AND WE COLLECTED NAMES OF
AGRICULTURAL DEITIES FROM AROUND

454
00:36:48,356 --> 00:36:51,860
THE WORLD.

455
00:36:51,860 --> 00:36:56,214
SO THIS IS ONE OF THE BODIES
WHERE INSTEAD OF BEING ALL ROMAN

456
00:36:56,214 --> 00:37:01,920
MYTHOLOGY OR A LOT OF MORE
EUROPEAN CENTRIC NAMES, WE HAVE

457
00:37:01,920 --> 00:37:05,140
SOME REALLY INTERESTING NAMES
FROM ALL OVER THE WORLD.

458
00:37:05,140 --> 00:37:11,045
AND THE COUPLE PLACES THAT I'LL

BE SHOWING YOU CLOSE UP ARE

459

00:37:11,045 --> 00:37:41,993

OCOTTER CRATER.

460

00:37:41,993 --> 00:38:00,278

I'M NOT SURE WHY THAT SLIDE IS
NOT SHOWING UP.

461

00:38:00,278 --> 00:38:02,280

SO HERE IT IS CLOSE UP.

462

00:38:02,280 --> 00:38:05,333

YOU SEE IT'S GOT KIND OF SOME
VARIATIONS IN THE TOPOGRAPHY

463

00:38:05,333 --> 00:38:08,987

WITHIN IT.

464

00:38:08,987 --> 00:38:10,972

IT GIVES YOU THE IMPRESSION THAT
STUFF IS SORT OF RISING UNDER

465

00:38:10,972 --> 00:38:15,260

IT.

466

00:38:15,260 --> 00:38:21,249

THE CRATER RIM IS NOT DEFINED
AND NOT VERY SHARP.

467

00:38:21,249 --> 00:38:42,987

ING THE LOCATED IN THE REGION OF
SMOOTHER TOPOGRAPHY.

468

00:38:42,987 --> 00:38:46,925

AND SO THE MATERIAL WAS ABLE TO
FLOW.

469

00:38:46,925 --> 00:38:48,877

SO WE'RE DOING MODELLING RIGHT
NOW.

470

00:38:48,877 --> 00:38:52,881

WE'RE TRYING TO GET TO THE
BOTTOM OF WHAT CAUSES THE

471

00:38:52,881 --> 00:39:04,926

DIFFERENT TYPES OF CRATER
SHAPES.

472

00:39:04,926 --> 00:39:31,236

YOU HAVE THE DEEP CENTER AND THE
SHALLOW BASIN.

473

00:39:31,236 --> 00:39:33,154

IT'S MUCH ROUGHER.

474

00:39:33,154 --> 00:39:36,140

AND THEN YOU'LL NOTICE RIGHT IN
THE CENTER IS VERY SMOOTH.

475

00:39:36,140 --> 00:39:43,214

AND WE'RE THINKING THAT THESE
ARE SOME SORT OF DISCUSS METS.

476

00:39:43,214 --> 00:39:47,352

SOMETHING THAT'S FLOWING IN THE
BOTTOM OF THESE CRATERS.

477

00:39:47,352 --> 00:39:50,221

THE TEAM IS JUST TRYING TO
FIGURE OUT WHAT THAT IS AND WHEN

478

00:39:50,221 --> 00:40:06,170

IT HAPPENS.

479

00:40:06,170 --> 00:40:11,242

BUT ONE THING THAT'S CONCLUDED
IS THE STRENGTH OF THE CRUST.

480

00:40:11,242 --> 00:40:17,949

AND HERE'S A BEAUTIFUL PICTURE
THAT WE GOT EARLY ON.

481

00:40:17,949 --> 00:40:22,320

IT GIVES YOU A LOT OF DEFINITION
OF TOPOGRAPHY BECAUSE OF THE

482

00:40:22,320 --> 00:40:24,072

SHADOWS.

483

00:40:24,072 --> 00:40:50,315

AND HERE YOU CAN SEE ALL OF THE
TERRACES AND THE FRACTURES.

484

00:40:50,315 --> 00:40:58,039

SO THESE ARE TWO THINGS SITTING
RIGHT NEXT TO EACH OTHER.

485

00:40:58,039 --> 00:41:04,312

HERE, AT THE SAME SCALE, A 49
CLEM XX CRATER ON RAOS, ONE OF

486

00:41:04,312 --> 00:41:26,951

THE MOONS OF SAT EARN.

487

00:41:26,951 --> 00:41:32,390

SO THAT'S GENERALLY BOWL-SHAPED.

488

00:41:32,390 --> 00:41:40,982

NOW, YOU GET THE SAME SORT OF
RIM TOPOGRAPHY.

489

00:41:40,982 --> 00:41:44,969

SO RAY IS A LOT COLDER THAN
SERIES.

490

00:41:44,969 --> 00:41:49,290

AND SO THIS IS A GOOD INDICATION
OR EXAMPLE OF HOW SIRIS WAS

491

00:41:49,290 --> 00:41:53,294

REALLY STRADDLING THE BOUNDARY
BETWEEN THESE DRY ROCKY BODIES

492

00:41:53,294 --> 00:41:58,132

AND THESE ICY MOONS.

493

00:41:58,132 --> 00:41:59,016

THESE ARE VERY COLD.

494

00:41:59,016 --> 00:42:15,099

THEY HAVE ABOUT THE SAME
TEMPERATURE.

495

00:42:15,099 --> 00:42:17,168

CLEARLY WHATEVER THE MATERIAL IS
IS DIFFERENT.

496

00:42:17,168 --> 00:42:23,374

>> AND EVENTUALLY, HOW DOES THAT
AFFECT THE WAY THE MATERIAL IS

497

00:42:23,374 --> 00:42:27,145

CON VEKTING IN THE INTERIOR AND
MIXING.

498

00:42:27,145 --> 00:42:30,131

NOW, THIS IS ANOTHER RESULT.

499

00:42:30,131 --> 00:42:32,283

IT WAS PUBLICIZED LAST WEEK.

500

00:42:32,283 --> 00:42:37,188

IT IS OUR FIRST COLOR MAP OF
SIRIS.

501

00:42:37,188 --> 00:43:04,182
AND IT LOOKS TECHNICOLOR AND
IT'S ALL BRIGHT AND EXCITING.

502
00:43:04,182 --> 00:43:11,038
THE COLOR VARIATIONS ARE REALLY
SLOW.

503
00:43:11,038 --> 00:43:14,091
HERE IS DONTU.

504
00:43:14,091 --> 00:43:25,002
IT'S ALSO QUIET BLUE.

505
00:43:25,002 --> 00:43:27,288
USUALLY NEF A SPECTRUM THAT GETS
HIGHER.

506
00:43:27,288 --> 00:43:33,344
BUT WHEN YOU HAVE A BLUER
SPECTRUM, IT'S FLATTER.

507
00:43:33,344 --> 00:43:42,403
SO IT'S REFLECTING AS MUCH BLUE
AS IT IS RED.

508
00:43:42,403 --> 00:43:51,929
THE UPSHOT HERE IS THERE'S
SOMETHING SPECIAL.

509
00:43:51,929 --> 00:44:13,034
AND THEN WE HAVE A COUPLE MOVIES
OF TWO OF THESE KRATERS.

510
00:44:13,034 --> 00:44:19,106
YOU CAN SEE IT'S VERY DISCREET
DEPOSITS.

511
00:44:19,106 --> 00:44:21,976
YOU ALSO NOTICE THE CRATER WALLS

LOOKS A LOT DIFFERENT THAN YOU

512

00:44:21,976 --> 00:44:29,333

MIGHT BE FAMILIAR WITH.

513

00:44:29,333 --> 00:44:33,070

IT ALMOST LOOKS LIKE FLOUR.

514

00:44:33,070 --> 00:44:37,141

THE VERY STEEP WALLS AND YOU CAN
SEE THINGS HAVE FLUNKED DOWN

515

00:44:37,141 --> 00:44:57,929

INTO THE CRATER.

516

00:44:57,929 --> 00:45:13,177

AGAIN, A LOT OF SLUMPING OVER
HERE ON THIS SIDE.

517

00:45:13,177 --> 00:45:40,021

AND THEN THESE VERY, VERY BRIGHT
AREAS.

518

00:45:40,021 --> 00:45:48,195

>> THIS IS THE SOURCE OF THE
VERY BRIGHTEST MATERIAL.

519

00:45:48,195 --> 00:45:56,070

YOU CAN SEE THAT THERE'S ALSO
DARK MATERIAL.

520

00:45:56,070 --> 00:46:03,277

AS YOU CAN SEE, THIS OTHER AREA
THAT HAS SOME DEFLECTION.

521

00:46:03,277 --> 00:46:07,999

SO WHATEVER THIS IS, IT SEEMS TO
BE RELATED TO A PIT IN THE

522

00:46:07,999 --> 00:46:32,023
MIDDLE OF THE CRATER.

523
00:46:32,023 --> 00:46:38,996
IT SEECHLS TO BE RELATED TO THE
FRARKTURES.

524
00:46:38,996 --> 00:46:41,265
OKAY, ANOTHER REALLY COOL
FEATURE THAT WE FOUND WAS DUBBED

525
00:46:41,265 --> 00:46:43,200
THE PYRAMID.

526
00:46:43,200 --> 00:46:47,271
YOU MAY HAVE SEEN IT IN SOME
PRESS RELEASES BECAUSE IT WAS

527
00:46:47,271 --> 00:47:08,275
BASICALLY JUST THIS THING
STICKING UP OUT OF THE SURFACE.

528
00:47:08,275 --> 00:47:10,127
THERE IS THIS LONELY MOUNTAIN.

529
00:47:10,127 --> 00:47:15,332
LET'S TAKE A CLOSER LOOK AT
THAT.

530
00:47:15,332 --> 00:47:17,318
SO NOW YOU'RE LOOKING DOWN ON
IT.

531
00:47:17,318 --> 00:47:45,346
THE TOP OF IT LOOKS A LOT REICH
LIKE THE SURROUNDING TERRAIN.

532
00:47:45,346 --> 00:47:47,348
OKAY, SO YOU'VE MADE IT THIS
FAR.

533

00:47:47,348 --> 00:47:53,871

A LITTLE MOVIE OF TONIGHT'S
MUSIC.

534

00:47:53,871 --> 00:47:56,006

YOU CAN GET UP AND STRETCH IF
YOU WANT.

535

00:47:56,006 --> 00:47:58,943

WE'RE GOING TO TAKE A LOOK AT
THIS AND THEN WE'RE GOING TO

536

00:47:58,943 --> 00:48:00,144

WRAP IT UP.

537

00:48:00,144 --> 00:48:03,214

BUT THIS MOVIE WAS MADE FROM OUR
HIGHEST ORBIT DATA.

538

00:48:03,214 --> 00:48:05,066

SO IT'S NOT THAT HIGH
RESOLUTION.

539

00:48:05,066 --> 00:48:08,919

BUT IT'S STILL A NICE OVERVIEW.

540

00:48:08,919 --> 00:48:15,059

BY OUR COLLEAGUES IN GERMANY, IN
DLR, AND THE GUY THAT MAKES THE

541

00:48:15,059 --> 00:48:16,994

MOVIES, HE ALSO WRITES THE
MUSIC.

542

00:48:16,994 --> 00:48:29,156

HE COMPOSES THIS ORIGINAL SCORE
FOR THE MOVIE.

543

00:48:29,156 --> 00:48:31,225
IT'S ALWAYS FUN TO WORK WITH
THESE CREATIVE PEOPLE.

544
00:48:31,225 --> 00:48:36,147
YOU CAN REALLY GET A SENSE OF
HOW BUMPY SIRIS IS BY LOOKING AT

545
00:48:36,147 --> 00:48:37,364
THIS MOVIE.

546
00:48:37,364 --> 00:48:54,165
IT'S JUST VERY LUMPY.

547
00:48:54,165 --> 00:49:01,005
OKAY, LET'S GIVE HIM THE CREDIT
THAT HE'S DUE SO WHAT ABOUT THAT

548
00:49:01,005 --> 00:49:01,155
STUFF?

549
00:49:01,155 --> 00:49:44,014
WE DIDN'T FORGET ABOUT HER.
>>> IN THE CASE OF VESTA, THESE

550
00:49:44,014 --> 00:49:55,993
COLORS ARE MUCH MORE PRONOUNCED.

551
00:49:55,993 --> 00:49:59,046
LOOK AT THIS ORANGE DEPOSIT
HERE.

552
00:49:59,046 --> 00:50:04,351
THIS PURPLE BLUE IS ANOTHER KIND
OF MORE BAA SALTIC TYPE OF

553
00:50:04,351 --> 00:50:16,096
LITOLOGY.

554

00:50:16,096 --> 00:50:19,166
SO WHAT YOU GET FROM LOOKING AT
THIS IS THERE'S SOME MORE

555
00:50:19,166 --> 00:50:23,387
GENERAL AREAS, BUT YOU'VE GOT A
LOT OF MIX GTS AND A LOT OF

556
00:50:23,387 --> 00:50:27,074
EXOTIC DEPOZ SITS.

557
00:50:27,074 --> 00:50:36,267
SO WE HAD A LOT OF FUN PICKING
ALL OF THAT APART.

558
00:50:36,267 --> 00:50:43,040
ONE OF THE REASONS THAT WE WENT,
WE HAD A LOT OF METEORITES.

559
00:50:43,040 --> 00:51:03,110
THEY'VE BEEN STUDYING FOR
DECADES.

560
00:51:03,110 --> 00:51:05,012
WHEN WE GOT THERE, WE WERE ABLE
TO CONFIRM THAT IT WAS THE

561
00:51:05,012 --> 00:51:15,239
SOURCE.

562
00:51:15,239 --> 00:51:17,374
WE DID LEARN A TREMENDOUS
AMOUNT.

563
00:51:17,374 --> 00:51:21,412
>> WE KNEW FROM HUB THAT I
SHOWED YOU EARLY ON THAT TLFGS A

564
00:51:21,412 --> 00:51:33,207
CON CAVITY IN THE SOUTH.

565

00:51:33,207 --> 00:51:40,414

THERE WAS A SECOND BASIN
UNDERNEATH THAT.

566

00:51:40,414 --> 00:51:42,983

THIS IS THE CRATER.

567

00:51:42,983 --> 00:51:48,939

IT'S A WONDER IT DIDN'T SHATTER
THE WHOLE BODY.

568

00:51:48,939 --> 00:51:51,358

THIS IS THE LARGEST CRATER
RELATIVE IN SIZE TO THE SOLAR

569

00:51:51,358 --> 00:51:59,950

SYSTEM.

570

00:51:59,950 --> 00:52:01,969

SO PRETTY COOL STUFF.

571

00:52:01,969 --> 00:52:04,054

THE LOWEST POINT HERE, 14 MILES.

572

00:52:04,054 --> 00:52:06,323

THE HIGHEST POINT, 12 MILES.

573

00:52:06,323 --> 00:52:21,305

AND IT ALL OCCURS IN THAT IMPACT
BASIN.

574

00:52:21,305 --> 00:52:28,012

AND THEN YOU'VE GOT THIS GIANT
MOUNTAIN.

575

00:52:28,012 --> 00:52:55,072

NOT UNUSUAL TO HAVE AN UPLIFT IN
THE CENTER IT RIVALS FOR BEING

576

00:52:55,072 --> 00:52:55,989

THE HIGHEST.

577

00:52:55,989 --> 00:52:59,927

AND TWICE AS HIGH AS MT.
EVEREST.

578

00:52:59,927 --> 00:53:02,062

SO THIS IS A PRETTY INTERESTING
BODY.

579

00:53:02,062 --> 00:53:07,117

THOSE IMPACTS LEFT THESE SCARS
AROUND THE E KWATER OF VESTA.

580

00:53:07,117 --> 00:53:10,070

IT'S THE GLOBAL TECH TONIC
FEATURES FROM THE SHOCK THAT

581

00:53:10,070 --> 00:53:14,074

WENT THROUGH DURING THOSE
IMPACTS.

582

00:53:14,074 --> 00:53:20,964

VESTA IS REALLY EXPERIENCING A
LOT OF GEOLOGY AND A LOT OF

583

00:53:20,964 --> 00:53:24,168

MIXING PROCESSES FROM IMPACTS.

584

00:53:24,168 --> 00:53:36,213

THIS IS A WONDERFUL EXAMPLE OF
THIS LIGHT AND DARK MATERIAL.

585

00:53:36,213 --> 00:53:40,350

WHEN YOU LOOK AT THAT IN THE
REFLECTED LIGHT SPECTRUM THAT

586

00:53:40,350 --> 00:53:53,147
GIVES US MIN ROLG, THERE IS A
COMPOSITIONAL BOUNDARY.

587
00:53:53,147 --> 00:54:03,123
A LOT OF MIXING AND EXOTIC
MATERIALS.

588
00:54:03,123 --> 00:54:08,345
A BIG SURPRISE WAS THAT THE
GAMMA RAY DETECTOR FOUND THAT

589
00:54:08,345 --> 00:54:10,197
THERE'S MINERAL ON VESTA.

590
00:54:10,197 --> 00:54:12,332
WE THOUGHT IT WOULD BE BONE DRY.

591
00:54:12,332 --> 00:54:16,036
IT SHOULD BE DRIER THAN THE MOON
BECAUSE THE SOLAR WIND CAN'T

592
00:54:16,036 --> 00:54:22,376
REALLY GET THE HYDROGEN OUT
THERE AS EFFICIENTLY.

593
00:54:22,376 --> 00:54:25,262
BUT WHAT WE FOUND, HYDROGEN
LEVELS WERE FOUR TIMES AS

594
00:54:25,262 --> 00:54:39,276
EXPECTED.

595
00:54:39,276 --> 00:54:42,930
YOU SEE IT'S LOCALIZED, TOO.

596
00:54:42,930 --> 00:54:48,118
SO AFTER NOTICING THAT THE
HYDROGEN ANOMALY COINCIDED WITH

597

00:54:48,118 --> 00:54:52,940

PREPONDERANCE OF DARK MATERIAL,
WE TURN TO METEOR IT'S AND SAID

598

00:54:52,940 --> 00:54:55,008

WHAT CAN THIS BE.

599

00:54:55,008 --> 00:54:58,145

EVERYBODY WAS FOCUSING ON THESE
MINERAL CLASS.

600

00:54:58,145 --> 00:55:00,280

WHAT IS THAT AND WHAT IS THAT.

601

00:55:00,280 --> 00:55:02,916

THEY WOULD JUST IGNORE THESE
DARK THINGS.

602

00:55:02,916 --> 00:55:10,340

OH, YEAH, THAT'S THE CLAV THAT'S
A PIECE OF MATERIAL THAT'S

603

00:55:10,340 --> 00:55:14,127

ASSOCIATED WITH A PRIMITIVE BODY
FROM SOMEWHERE ELSE IN THE SOLAR

604

00:55:14,127 --> 00:55:18,332

SYSTEM THAT'S MUCH MORE
WATER-RICH.

605

00:55:18,332 --> 00:55:20,184

HERE IT IS MIXED IN WITH THE
OTHER MATERIALS.

606

00:55:20,184 --> 00:55:21,385

SO IT WAS LIKE A HA.

607

00:55:21,385 --> 00:55:30,093

THAT'S WHAT WE'RE SEEING.

608

00:55:30,093 --> 00:55:33,363

THIS IS A LARGE PERCENTAGE
THAT'S SHOWING UP IN THE DATA

609

00:55:33,363 --> 00:55:36,366

FROM OUR NEUTRON DETECTOR.

610

00:55:36,366 --> 00:55:42,239

SO, CLEARLY, IT WAS COMING TO
THE SURFACE AND BRINGING THE

611

00:55:42,239 --> 00:55:46,994

WATER WHICH WAS BOUND IN THOSE
MINERALS.

612

00:55:46,994 --> 00:55:49,913

SO THERE WAS A COUPLE OF REALLY
INTERESTING FEATURES THAT WE SAW

613

00:55:49,913 --> 00:55:52,015

ON THE SURFACE.

614

00:55:52,015 --> 00:55:54,034

AND THIS IS KIND OF LIKE A
POSTER CHILD FOR SOME OF THESE

615

00:55:54,034 --> 00:56:05,212

THINGS.

616

00:56:05,212 --> 00:56:07,281

SO YOU'LL SEE THERE'S THIS LIGHT
AND DARK MATERIAL.

617

00:56:07,281 --> 00:56:09,917

WE TOOK A LOOK AT THAT.

618

00:56:09,917 --> 00:56:14,187

AND HERE WE'RE GOING TO JUST FLY

AROUND IT A LITTLE BIT.

619

00:56:14,187 --> 00:56:17,124

AND YOU SEE THAT THERE'S KIND OF
A MORE ROCKY-LOOKING WALL OVER

620

00:56:17,124 --> 00:56:21,895

HERE.

621

00:56:21,895 --> 00:56:24,998

AND AS WE COME AROUND THE SIDE,
WE SEE THE SMOOTH BENCH, A VERY

622

00:56:24,998 --> 00:56:26,316

SMOOTH MATERIAL.

623

00:56:26,316 --> 00:56:29,169

IT KIND OF SEEMS TO HAVE FLOWED
DOWN TO THE BOTTOM OF THE

624

00:56:29,169 --> 00:56:35,926

CRATER.

625

00:56:35,926 --> 00:56:39,963

AND, IN GENERAL, WE COME AROUND
AND YOU'LL SEE THE VERY BRIGHT

626

00:56:39,963 --> 00:56:49,890

LAYER SHOWING UP OVER HERE.

627

00:56:49,890 --> 00:56:51,158

IT'S UNDER THE BRIGHT MATERIAL.

628

00:56:51,158 --> 00:56:59,149

IT'S ALSO SHOWING UP AS DISCREET
LAYERS.

629

00:56:59,149 --> 00:57:06,073

CLEARLY, IT'S NOT A COUPLE OF

IMPACTERS.

630

00:57:06,073 --> 00:57:08,992

THIS DARK MATERIAL HAS BEEN
DELIVERED TO THE SURFACE.

631

00:57:08,992 --> 00:57:12,245

WHAT WE'RE THINKING IS THAT
THESE PITS, DAY MAY NOT LOOK

632

00:57:12,245 --> 00:57:20,187

LIKE PITS TO YOU, BUT THEY ARE.

633

00:57:20,187 --> 00:57:26,326

WHAT THIS IS, WHAT'S LEFT BEHIND
WHEN BUBBLES OF GAS ARE BUBBLING

634

00:57:26,326 --> 00:57:28,312

TO THE SURFACE.

635

00:57:28,312 --> 00:57:51,234

IT'S KIND OF A SIMILAR PROCESS,
AT LEAST WE THINK.

636

00:57:51,234 --> 00:57:55,238

THERE'S CERTAINLY THE CENTRAL
STRUCTURE.

637

00:57:55,238 --> 00:57:58,241

SO IT COVERS OVER THE DARK
MATERIAL THAT'S STILL PROCESSING

638

00:57:58,241 --> 00:58:00,160

IMPACT HEAT.

639

00:58:00,160 --> 00:58:03,947

THE WATER IS BEING RELEASED FROM
THOSE WATER-RICH MINERALS AND

640

00:58:03,947 --> 00:58:12,339
THEN THE GASES ARE ESCAPING.

641
00:58:12,339 --> 00:58:15,976
HERE YOU CAN SEE THE DARK
MATERIAL.

642
00:58:15,976 --> 00:58:22,199
SO, BY ANALOGY TO MARS, WHERE
THEY'RE ATTRIBUTED TO WATER TO

643
00:58:22,199 --> 00:58:27,287
ESCAPE THE VAPOR FROM THE CRATER
FLOOR, WE MAKE A MUCH FORMER

644
00:58:27,287 --> 00:58:40,951
CONNECTION.

645
00:58:40,951 --> 00:58:44,938
THERE MAY ACTUALLY BE ICE IN THE
SUB SURFACE AS WELL.

646
00:58:44,938 --> 00:58:48,358
SO THE LAST PIECE OF EVIDENCE
WAS SO CALLED GULLIES.

647
00:58:48,358 --> 00:58:55,882
AND IN IS AN EXAMPLE OF NETWORK
OF GULLIES IN THE CRATER.

648
00:58:55,882 --> 00:59:02,305
YOU SEE THAT THEY'RE KIND OF DEN
DRIDIC VERSUS THESE GULLIES IN

649
00:59:02,305 --> 00:59:18,989
ANOTHER CRATER WHICH ARE ALL
STRAIGHT.

650
00:59:18,989 --> 00:59:24,127
SO THESE ARE INTERPRETED AS

BEING A PROSECUTETY HERETICAL

651

00:59:24,127 --> 00:59:25,245
THING TO SAY.

652

00:59:25,245 --> 00:59:30,350
BUT ALL OF THIS EVIDENCE IS
REALLY POINTING TO A VERY

653

00:59:30,350 --> 00:59:43,897
EPHEMERAL, TRANSIENT WATER FLOW.

654

00:59:43,897 --> 00:59:52,355
SO MAYBE AN ICE-RICH BODY CAME
AND IMPACKED VESTA.

655

00:59:52,355 --> 00:59:55,192
AND THEN YOU'VE GOT AN ICE
LAYER.

656

00:59:55,192 --> 01:00:00,347
AND THEN YOU HAVE ANOTHER IMPACT
COMES IN WITH IMPACT HEAT.

657

01:00:00,347 --> 01:00:05,202
IT WARMS IT UP, RELEASES THE
WATER FROM AN ICE LAYER OR FROM

658

01:00:05,202 --> 01:00:21,301
A LAYER OF MATERIAL WHICH HAS
BOUND WATER.

659

01:00:21,301 --> 01:00:24,237
AND THEN FORMS THIS PIT IN THE
BOTTOM.

660

01:00:24,237 --> 01:00:27,307
IT'S STILL QUITE CONTROVERSIAL.

661

01:00:27,307 --> 01:00:30,360
SO I'LL LEAVE YOU WITH THESE
QUESTIONS, YOU KNOW.

662
01:00:30,360 --> 01:00:34,998
WE'RE STILL GRAPPLING WITH IS
THERE BURIED ICE ON VESTA.

663
01:00:34,998 --> 01:00:38,335
ARE ALL OF THESE WATERERER-TYPE
FEATURES COMING FROM MINERALS

664
01:00:38,335 --> 01:00:55,235
THAT ARE RELEASING WATER?

665
01:00:55,235 --> 01:01:01,992
THAT ICE A VERY IMPORTANT
QUESTION.

666
01:01:01,992 --> 01:01:10,400
WE THINK THAT ASTEROIDS ARE
PROBABLY THE MOST LIKELY WAY TO

667
01:01:10,400 --> 01:01:17,173
DELIVER WATER TO THE EARTH NOW
THAT WE'VE GOTTEN AN ANSWER FROM

668
01:01:17,173 --> 01:01:20,110
ROSETTA THAT ITS WATER DOESN'T
HAVE THE RIGHT COMPOSITION TO

669
01:01:20,110 --> 01:01:33,006
MATCH THE EARTH'S WATER.

670
01:01:33,006 --> 01:01:36,076
SO KMEBTS ARE A LITTLE MORE OUT
OF FAVOR.

671
01:01:36,076 --> 01:01:45,051
>> I'LL JUST END WITH A SUMMARY

HERE.

672

01:01:45,051 --> 01:01:49,356

WE'RE STILL WAY IN THE MIDDLE OF
ALL OF THIS WORK.

673

01:01:49,356 --> 01:02:04,337

IT'S ALREADY HAVING SOME
PROFOUND ITCHLY CASES.

674

01:02:04,337 --> 01:02:10,193

THE SCATTERING OF MATERIAL
BETWEEN DIFFERENT PARTS OF THE

675

01:02:10,193 --> 01:02:14,047

SOLAR SYSTEM BOTH IN THE
DISTRIBUTION OF MATERIAL IN

676

01:02:14,047 --> 01:02:32,999

MAKING UP THE PLAN PLARN ETS AS
WELL AS THE ASTEROID POPULATION.

677

01:02:32,999 --> 01:02:42,142

THESE WET, IT'S SILL BODIES HAD
ENVIRONMENTS CONDUCIVE TO LIFE.

678

01:02:42,142 --> 01:02:48,048

WE'RE VERY PLEASED THAT WE
DECIDED TO GO TO THESE BODIES.

679

01:02:48,048 --> 01:02:50,150

I'M AMGS VERY HAPPY TO SHARE
THAT WITH YOU TONIGHT.

680

01:02:50,150 --> 01:02:55,088

THANK YOU FOR YOUR ATTENTION.

681

01:02:55,088 --> 01:03:06,333

[APPLAUSE]

NOW I'M GOING TO FIND SOMETHING

682

01:03:06,333 --> 01:03:21,181
FUN FOR A BACKDROP.

683

01:03:21,181 --> 01:03:21,982
HOPEFULLY THAT ONE.

684

01:03:21,982 --> 01:03:23,967
OKAY.

685

01:03:23,967 --> 01:03:26,069
IF YOU WANT TO ASK A QUESTION,
CAN YOU PLEASE USE THE

686

01:03:26,069 --> 01:03:33,159
MICROPHONE.

687

01:03:33,159 --> 01:03:36,946
>> THAT IMAGE LOOKED LIKE IT HAD
THE FLOW FEATURE.

688

01:03:36,946 --> 01:03:40,216
IT LOOKDED MORE LIKE FLUID FLOW
THAN DUST FLOWING.

689

01:03:40,216 --> 01:03:43,353
WAS IT ACTUALLY A
STRANGELY-SHAPED FRACTURE.

690

01:03:43,353 --> 01:03:54,230
>> I'M SORRY --
>> IN THE KRATER.

691

01:03:54,230 --> 01:04:01,888
>> YEAH, IT'S LIKELY IT WAS SOME
SORT OF A MASS-WASTING SLURPING

692

01:04:01,888 --> 01:04:11,331
EVENT.

693

01:04:11,331 --> 01:04:16,186

IT WAS A LITTLE CRATER ON THE
SIDE.

694

01:04:16,186 --> 01:04:21,291

I'M SURE YOU SAW IT'S HELD THE
LAYERING MAINTAINED AS THAT

695

01:04:21,291 --> 01:04:27,180

SLUMP WAS GOING IN THERE.

696

01:04:27,180 --> 01:04:35,305

>> WITHOUT COMET-LIKE JETS, HOW
GOOD OF THE INFORMATION DID WE

697

01:04:35,305 --> 01:04:38,007

GET?

698

01:04:38,007 --> 01:04:39,375

WILL WE BE ABLE TO CONSTRAIN
THAT?

699

01:04:39,375 --> 01:04:46,199

>> NO, WE CAN'T, UNFORTUNATELY.

700

01:04:46,199 --> 01:04:47,350

>> SO WE FEEL TO GO BACK.

701

01:04:47,350 --> 01:04:52,088

>> THANK YOU FOR YOUR
PRESENTATION.

702

01:04:52,088 --> 01:04:54,224

I HAVE A TWO-PART QUESTION.

703

01:04:54,224 --> 01:04:59,079

NUMBER ONE, I UNDERSTAND THE
MISSION WAS PROPELLED BY ION

704

01:04:59,079 --> 01:05:00,330

PROPULSION.

705

01:05:00,330 --> 01:05:04,200

IT'S JUST GOING TO GIVE YOU THE
CASE IN FRUITION.

706

01:05:04,200 --> 01:05:10,190

AND NUMBER TWO, REGARDING THE
BRIGHT SPOTS IN THE CRATER, I

707

01:05:10,190 --> 01:05:14,177

UNDERSTAND THAT IT COULD BE
SATURDAY OR E FLEKTIVE

708

01:05:14,177 --> 01:05:15,962

MATERIALS.

709

01:05:15,962 --> 01:05:19,015

I WAS WONDERING IF ANYTHING HAS
BEEN FOUND ABOVE AND BEYOND

710

01:05:19,015 --> 01:05:21,234

THIS.

711

01:05:21,234 --> 01:05:24,254

>> YEAH, FIRST QUESTION, ION
PROPULSION IS AN EXTREMELY

712

01:05:24,254 --> 01:05:28,108

EFFICIENT WAY TO EXPLORE CERTAIN
PARTS OF THE SOLAR SYSTEM.

713

01:05:28,108 --> 01:05:31,227

THE ASTEROID BELT IS REALLY A
SWEET SPOT FOR A PLACE LIKE

714

01:05:31,227 --> 01:05:33,379

MARZ, YOU KNOW, CHEMICAL
PROPULSION IS PROBABLY JUST

715

01:05:33,379 --> 01:05:55,235

FINE.

716

01:05:55,235 --> 01:05:57,871

YOU HAVE TO USE ION PROPULSION.

717

01:05:57,871 --> 01:06:02,041

>>> THE SECOND QUESTION, THE
\$64,000 QUESTION WHEN \$64,000

718

01:06:02,041 --> 01:06:05,995

SEEMED LIKE A LOT.

719

01:06:05,995 --> 01:06:23,329

YES, THE SPECTROMETER CAN TEASE
OUT WHAT THESE ARE.

720

01:06:23,329 --> 01:06:29,235

LIKELY HAS A RESOLUTION, BUT IT
HANT BEEN FULLY PROCESSED.

721

01:06:29,235 --> 01:06:34,090

SOME OF THESE MATERIALS, BECAUSE
THEY'RE MIXED SALT, WATER,

722

01:06:34,090 --> 01:06:38,244

HYDRATION BANDS, VERY, VERY
COMPLEX TO UNDERSTAND.

723

01:06:38,244 --> 01:06:41,364

SO YOU HAVE TO DO MODELLING
WHERE YOU COMBINE ALL OF THESE

724

01:06:41,364 --> 01:06:46,069

DIFFERENT THINGS TOGETHER IN THE
RIGHT PROPORTIONS.

725

01:06:46,069 --> 01:06:56,095

AND IS THAT'S A VERY
TIME-CONSUMING PROCESS.

726

01:06:56,095 --> 01:06:59,315

WE WILL HAVE DEFINITIVE ANSWERS,
BUT IT'S GOING TO TAKE A LITTLE

727

01:06:59,315 --> 01:07:00,884

BIT OF TIME.

728

01:07:00,884 --> 01:07:12,278

>> THIS IMAGE, TO ME, LOOKS LIKE
MAYBE A COMET IMPACT.

729

01:07:12,278 --> 01:07:14,347

AND A COMMENT ON THE VESTA.

730

01:07:14,347 --> 01:07:18,134

THOSE GULLIES AND STREAKS THAT
YOU SAW IN THE SIDE OF THE

731

01:07:18,134 --> 01:07:20,153

CRATERS, THEY'RE REMINISCENT OF
THE RSLs THAT WERE FOUND ON

732

01:07:20,153 --> 01:07:20,336

MARS.

733

01:07:20,336 --> 01:07:22,188

>> THEY ARE.

734

01:07:22,188 --> 01:07:26,192

>> POSSIBLY FLOWING WATER.

735

01:07:26,192 --> 01:07:42,942

>> YEAH, IT WAS INTERESTING TO
ME WE HAVE HAD DISCUSSIONS.

736

01:07:42,942 --> 01:07:45,929

SO THE ANNOUNCEMENT LAST WEEK
THAT YOU HAD EVIDENCE FOR

737

01:07:45,929 --> 01:07:48,147

WATERER COMING OUT OF THE
MINERALS AND ACTUALLY FLOWING

738

01:07:48,147 --> 01:08:00,093

WAS CONSIDERED TO BE A HUGE
FINDING.

739

01:08:00,093 --> 01:08:02,295

BUT I GUESS IT'S TOO INDIRECT.

740

01:08:02,295 --> 01:08:06,082

IT'S NOT QUITE CATCHING ON TO
THE EXTENT.

741

01:08:06,082 --> 01:08:11,070

BUT I DO THINK THAT, AGAIN,
WE'RE -- THINGS ARE REALLY

742

01:08:11,070 --> 01:08:16,059

MOVING FORWARD SO QUICKLY NOW
BECAUSE WE HAVE THESE VERY

743

01:08:16,059 --> 01:08:19,195

DETAILED DATA SETS.

744

01:08:19,195 --> 01:08:23,149

WE HAVE TIMED EVOLUTIONS AND WE
CAN COMPARE BODIES ACROSS, YOU

745

01:08:23,149 --> 01:08:25,051

KNOW, A WIDE SPECTRUM.

746

01:08:25,051 --> 01:08:31,024

SO IT'S A VERY EXCITING TIME.

747

01:08:31,024 --> 01:08:38,381

>> THE PLOOMS DETECTED IS CAUSED
BY SUBLIMATION OF WATERER?

748

01:08:38,381 --> 01:08:42,235

>> WELL, WE WOULD ASSUME IT IS.

749

01:08:42,235 --> 01:08:58,885

>> AND THEN THE CRATERS ON
VESTA.

750

01:08:58,885 --> 01:09:06,042

THEY SAY KIND OF REMIND ME OF
SAND.

751

01:09:06,042 --> 01:09:08,928

WE KNOW THAT IT'S WATER VAPOR.

752

01:09:08,928 --> 01:09:16,135

HOW IT'S COMING OUT IS JUST SOME
ICE THAT'S IN THE SUB SURFACE.

753

01:09:16,135 --> 01:09:29,899

THERE'S STILL A VERY SMALL
AMOUNT OF WAETER.

754

01:09:29,899 --> 01:09:33,886

WE WOULD HAVE A HARD TIME SEEING
IT.

755

01:09:33,886 --> 01:09:37,957

>> SO, COULD THE TOP LAYER OF
THIS BE, LIKE, FROZEN ICE?

756

01:09:37,957 --> 01:09:39,092

WATER ICE?

757

01:09:39,092 --> 01:09:46,182

AND THEN, AS IT PASSES CLOSER TO
THE SUN, THE FROZEN WATER ICE

758

01:09:46,182 --> 01:09:51,954

SUBLY MATES AND THEN UNDER IT BE
LIQUID WATER ICE -- OR LIQUID

759

01:09:51,954 --> 01:09:52,121

WATER?

760

01:09:52,121 --> 01:10:08,337

COULD THAT FLOW OUT AS A PLUME?

761

01:10:08,337 --> 01:10:10,323

IT'S UNLIKELY THAT IT'S ICE.

762

01:10:10,323 --> 01:10:16,112

THE WATER WILL JUST DISAPPEAR TO
A DEPTH.

763

01:10:16,112 --> 01:10:22,018

SF THAT ICE GETS EXPOSED, THEN
FOR A BRIEF PERIOD OF TIME,

764

01:10:22,018 --> 01:10:24,370

IT'S GOING TO GO AWAY VERY
QUICKLY.

765

01:10:24,370 --> 01:10:33,079

IT IS PRETTY UNLIKELY.

766

01:10:33,079 --> 01:10:43,990

IT'S AN IMMATURE GARDEN DUNE BARE
SALTIC RICH GRANULAR MATERIAL.

767

01:10:43,990 --> 01:10:47,260

IT'S VERY POROUS.

768

01:10:47,260 --> 01:10:49,378

SAND IS NOT A BAD ANALOGY.

769

01:10:49,378 --> 01:10:52,298

IT LOOKS LIKE SOMETHING YOU'D
SEE OUT IN THE AT THE SCENE ERT,

770

01:10:52,298 --> 01:10:56,135

YOU KNOW, JUST A BIG KIND OF
MASS-WASTING SLUMP DOWN THE

771

01:10:56,135 --> 01:11:06,195

SIDES OF THE KRATERER.

772

01:11:06,195 --> 01:11:11,317

>> LIKE I UNDERSTAND THE
MISSION, BUT I'M KIND OF CURIOUS

773

01:11:11,317 --> 01:11:13,252

ABOUT MARS.

774

01:11:13,252 --> 01:11:14,237

YOU HAVE A ROVER ON MARS, RIGHT?

775

01:11:14,237 --> 01:11:16,322

>> UM-HMM.

776

01:11:16,322 --> 01:11:20,176

>> HAVE VOW TRIED TO PUT ANY
TYPE OF LIVING ORGANISMS TO SEE

777

01:11:20,176 --> 01:11:23,112

IF THEY COULD SURVIVE ON ANOTHER
PLANET?

778

01:11:23,112 --> 01:11:29,936

>> ACTUALLY, SO THEY'RE TRYING
TO DO THE OPPOSITE, WHICH IS

779

01:11:29,936 --> 01:11:37,026

MAKE SURE WE DON'T SEND ANYTHING
TO MARS THAT WOULD CONFUSE LIFE

780

01:11:37,026 --> 01:11:45,351
ON MAR.

781

01:11:45,351 --> 01:11:49,121
IF THERE'S LIFE ON MARS AND WE
BRING SOMETHING WITH US, THEN

782

01:11:49,121 --> 01:11:51,157
WE'LL NEVER KNOW IT'S THERE.

783

01:11:51,157 --> 01:12:16,249
SO WE'RE WAY TOO FAR AHEAD.

784

01:12:16,249 --> 01:12:19,385
>> MY QUESTION IS ABOUT THE
NATURE OF THE SPACECRAFT.

785

01:12:19,385 --> 01:12:25,958
WHAT SORTS OF UNIQUE
CONSIDERATIONS WENT INTO

786

01:12:25,958 --> 01:12:28,211
CHOOSING THE INSTRUMENT TAGSZ
PACKAGE FOR THIS PARTICULAR

787

01:12:28,211 --> 01:12:32,949
SPACECRAFT VERSUS OTHERS.

788

01:12:32,949 --> 01:12:38,938
>> SO WE HAD TO FIND THE MINIMUM
SET OF INSTRUMENTS THAT COULD

789

01:12:38,938 --> 01:12:44,060
ANNALS THE MAJOR QUESTIONS THAT
WE COULD THINK OF AHEAD OF TIME.

790

01:12:44,060 --> 01:12:46,429
AND YOU NEVER KNOW WHAT YOU'RE
GOING TO FIND WHEN YOU GET

791
01:12:46,429 --> 01:12:47,129
THERE.

792
01:12:47,129 --> 01:12:51,083
WE WEREN'T THINKING ALONG THE
LINES OF WHAT WE FOUND IN SIRIS.

793
01:12:51,083 --> 01:12:57,223
BUT, CERTAINLY, CAMERAS AND
SPECTROMA IS ARE THE WORKHORSE

794
01:12:57,223 --> 01:13:01,077
OF ANY MISSION CHLTS AND THE
GAMMA RAY NEUTRON DETECTOR WAS

795
01:13:01,077 --> 01:13:05,281
CRITICAL FOR LOOKING FOR WATER
ON SIRIS, LOOKING AT TRYING TO

796
01:13:05,281 --> 01:13:08,234
MATCH THE ROCKS TO THE MEET I
DON'T RECALL IDENTITIES.

797
01:13:08,234 --> 01:13:11,203
SO IT GAVE YOU ANOTHER DIMENSION
OTHER THAN THE MINERAL

798
01:13:11,203 --> 01:13:18,261
COMPOSITION THAT YOU GET FROM
THE VISIBLE SPECK TROM MATERIAL.

799
01:13:18,261 --> 01:13:21,047
AND THEN GRAVITY IS KIND OF FOR
FREE.

800
01:13:21,047 --> 01:13:26,319

IF YOU DO THE NAVIGATION
PRECISELY ENOUGH, IT DIDN'T

801

01:13:26,319 --> 01:13:31,958
REQUIRE ANY EXTRA EQUIPMENT.

802

01:13:31,958 --> 01:13:34,944
SO IT WAS COST CONSTRAINT AND
MASS CONSTRAINT.

803

01:13:34,944 --> 01:13:37,363
AND THOSE THREE STRIMTS WERE
JUST THE ONES WE THOUGHT WERE

804

01:13:37,363 --> 01:13:40,132
GOING TO GIVE US THE MOST
INFORMATION FOR THE RESOURCES WE

805

01:13:40,132 --> 01:13:45,988
HAD.

806

01:13:45,988 --> 01:13:48,074
AND THEN BECAUSE WE HAD GOTTEN
TWO OF THEM, THAT MADE ALL THE

807

01:13:48,074 --> 01:13:50,092
DIFFERENCE.

808

01:13:50,092 --> 01:14:03,289
THAT CONTRIBUTION, NOSE
INSTRUMENTS COST BETWEEN 20 AND

809

01:14:03,289 --> 01:14:13,916
345 MILLION DLARS A PIECE.

810

01:14:13,916 --> 01:14:15,968
>> I THANK YOU FOR YOUR SCIENCE.

811

01:14:15,968 --> 01:14:20,172

JUST CURIOUS.

812

01:14:20,172 --> 01:14:23,242

YOU'VE SEARCHING FOR OTHER
ELEMENTS SUCH AS HELIUM THREE ON

813

01:14:23,242 --> 01:14:25,177

SOME OF THESE BODIES.

814

01:14:25,177 --> 01:14:26,178

>> WE'RE NOT GOING TO BE ABLE --
NO.

815

01:14:26,178 --> 01:14:29,231

BECAUSE WE CAN'T.

816

01:14:29,231 --> 01:14:34,153

>> OKAY.

817

01:14:34,153 --> 01:14:35,021

A QUESTION FROM ONLINE.

818

01:14:35,021 --> 01:14:35,221

A COUPLE.

819

01:14:35,221 --> 01:14:38,290

OKAY.

820

01:14:38,290 --> 01:14:42,294

SO CEBA 5 OF 18 SKSZ.

>> GLOERNTDS GLOERNTDS

821

01:14:42,294 --> 01:14:46,999

GLOIRJTSDS WHEN WE'VE GOT A
CONFER MAEGS OF WHAT THE BRIEGTS

822

01:14:46,999 --> 01:14:48,134

SPOTS ARE.

823

01:14:48,134 --> 01:14:52,104

SO THE REASON I THINK SOMEBODY
WHO KNOWS SOMETHING ABOUT THE

824

01:14:52,104 --> 01:14:56,158

MISSION BECAUSE IN DECEMBER WILL
BE ATTAINING OUR LOWEST ALTITUDE

825

01:14:56,158 --> 01:14:56,942

OSHT.

826

01:14:56,942 --> 01:14:59,895

WE'LL BE JUST 375 KILOMETERS
ABOVE THE SURFACE WITHIN ONE

827

01:14:59,895 --> 01:15:01,297

BODY RADIUS.

828

01:15:01,297 --> 01:15:05,935

AND THAT'S WHEN OUR GAMMA RAY
NEUTRON DETECTOR GETS THE

829

01:15:05,935 --> 01:15:12,058

RESOLUTION OF THE LMTS ON THE
SURFACE.

830

01:15:12,058 --> 01:15:15,061

SO WOE 'GETTING HIGH RESOLUTION
DATA AND A NEW DATA SET.

831

01:15:15,061 --> 01:15:23,119

I THINK BY DECEMBER, WE WILL
HAVE A PRETTY FIRM ANSWER ON THE

832

01:15:23,119 --> 01:15:26,322

YEAH,WE'LL HAVE A FIRM ANNALS
BECAUSE AS I MENTIONED BEFORE,

833

01:15:26,322 --> 01:15:29,959

WE'LL HAVE PROCESS THROUGH THE
SPECK SFROEMT SFLOEMTSDS GLOEJSZ

834

01:15:29,959 --> 01:15:32,344
GLOEJSZ SDWLOEJSZ AND WE'LL HAVE
A LOT MORE TIME TO THINK ABOUT

835

01:15:32,344 --> 01:15:35,381
THE GEOLOGY THAT'S GOING ON AND
WHAT PROCESS MIGHT HAVE BEEN

836

01:15:35,381 --> 01:15:41,087
PLACED THERE.

837

01:15:41,087 --> 01:15:43,189
AROUND THEN CAVERN SFLEKRSZ
GLERKSZ GLOEJSZ GLOEJSZ

838

01:15:43,189 --> 01:15:47,076
GLOENTSDS GLOENCHTZ GLEJTSZ
GLOERMTSDS WILL YOU BUB LISH

839

01:15:47,076 --> 01:15:48,961
MULTISPECTRAL RAPTORS.

840

01:15:48,961 --> 01:15:51,981
THE DATA FROM THE MISSION ARE
ALL BEING ARCHIVED WITH THE

841

01:15:51,981 --> 01:15:54,100
PLANETARY DATA SYSTEM.

842

01:15:54,100 --> 01:15:59,889
AND THERE'S A BIG DAY OF
DELIVERY GOING ON RIGHT NOW FROM

843

01:15:59,889 --> 01:16:15,071
THE INITIAL PHASES OF THE
MISSION.

844

01:16:15,071 --> 01:16:19,942

AND THEN OUR KERRY ASKS WHAT ADD
VIESZ TO YOU HAVE FOR STUBTS

845

01:16:19,942 --> 01:16:20,943

GOING INTO SOLAR SYSTEM SCIENCE.

846

01:16:20,943 --> 01:16:24,980

GO IT.

847

01:16:24,980 --> 01:16:28,250

>> NO, SERIOUSLY.

848

01:16:28,250 --> 01:16:33,189

THERE'S REALLY A LOT GOING ON
RIGHT NOW.

849

01:16:33,189 --> 01:16:38,227

AND, YOU KNOW, NOT ONLY DO WE
HAVE A LOT OF THESE LOWER-COST

850

01:16:38,227 --> 01:16:41,080

MISSIONS, WE'RE GOING TO A LOT
OF DIFFERENT TAR GETS.

851

01:16:41,080 --> 01:16:44,383

AND THEN WE'RE GETTING MUCH MORE
DETAILED DATA SETS ABOUT THE

852

01:16:44,383 --> 01:16:51,056

PLANETS.

853

01:16:51,056 --> 01:16:56,312

THE EUROPE MISSION WILL BE A
FANTASTIC NEW VIEW OF ONE OF THE

854

01:16:56,312 --> 01:16:58,948

MOST INTERESTING OBJECTS IN OUR
SOLAR SYSTEM.

855

01:16:58,948 --> 01:17:02,234

AND IF THAT WEREN'T ENOUGH,
THERE'S A WHOLE REVOLUTION GOING

856

01:17:02,234 --> 01:17:30,312

ON WITH CUTE SETS AND SMALL
SETS.

857

01:17:30,312 --> 01:17:36,185

THERE'S GOING TO BE A HUE AMOUBT
OF COOL DATA COMING THROUGH.

858

01:17:36,185 --> 01:17:40,189

AS LONG AS NASA AND THE
TAXPAYERS CONTINUE TO SUPPORT

859

01:17:40,189 --> 01:17:53,319

IT.

860

01:17:53,319 --> 01:18:00,309

IT'S GOING TO BE A BRIGHT
FUTURE.