



1  
00:00:00,500 --> 00:00:01,568  
TODAY, WE HAVE NOT ONE, BUT TWO

2  
00:00:01,568 --> 00:00:02,635  
SCIENTIFIC FINDINGS FOR YOU

3  
00:00:02,635 --> 00:00:04,304  
ABOUT OCEANS BEYOND EARTH.

4  
00:00:04,304 --> 00:00:05,939  
WE WILL BE GOING COAST TO COAST

5  
00:00:05,939 --> 00:00:08,074  
AND OCEAN TO OCEAN TO TALK TO

6  
00:00:08,074 --> 00:00:09,209  
EXPERTS STARTING FROM PEOPLE

7  
00:00:09,209 --> 00:00:12,112  
RIGHT HERE IN WASHINGTON D.C.

8  
00:00:12,112 --> 00:00:13,413  
AND THEN ALSO GOING ALL THE WAY

9  
00:00:13,413 --> 00:00:16,116  
TO THE WEST COAST TO TALK TO

10  
00:00:16,116 --> 00:00:19,152  
NASA'S JET PROPULSION LABORATORY

11  
00:00:19,152 --> 00:00:20,787  
IN PASADENA, CALIFORNIA.

12  
00:00:20,787 --> 00:00:22,055  
AND THEN, WE WILL GO ALL THE WAY

13  
00:00:22,055 --> 00:00:24,391

TO THE EAST COAST TO TALK TO

14

00:00:24,391 --> 00:00:27,861

NASA'S GODDARD SPACE FLIGHT

15

00:00:27,861 --> 00:00:30,230

CENTER IN GREENBELT, MARYLAND.

16

00:00:30,230 --> 00:00:32,465

TODAY'S PAN LISTS ARE THOMAS

17

00:00:32,465 --> 00:00:37,203

ZURBUCHEN, ASSOCIATE

18

00:00:37,203 --> 00:00:40,707

ADMINISTRATOR FOR TO THE SCIENCE

19

00:00:40,707 --> 00:00:44,677

MISSION DIRECTORATE, MARY, LEAD

20

00:00:44,677 --> 00:00:46,146

SCIENTIST FOR NASA'S ASTRO

21

00:00:46,146 --> 00:00:46,846

BIOLOGY PROGRAM.

22

00:00:46,846 --> 00:00:50,250

THE ALISTS AT J.P.L. IN

23

00:00:50,250 --> 00:00:54,187

CALIFORNIA ARE LINDA SPILKER,

24

00:00:54,187 --> 00:00:58,324

PROJECT SCIENTIST, HUNTER WAITE,

25

00:00:58,324 --> 00:01:00,794

THE IMMS TEAM LEAD WITH THE

26  
00:01:00,794 --> 00:01:02,729  
SOUTHWEST RESEARCH INSTITUTE IN

27  
00:01:02,729 --> 00:01:05,865  
SAN ANTONIO, TEXAS.

28  
00:01:05,865 --> 00:01:11,504  
CHRIS GLINE, THE INMS TEAM

29  
00:01:11,504 --> 00:01:11,871  
ASSOCIATE.

30  
00:01:11,871 --> 00:01:15,475  
AND, JOINING US FROM GODDARD IN

31  
00:01:15,475 --> 00:01:17,210  
MARYLAND, WILLIAM SPARKS,

32  
00:01:17,210 --> 00:01:18,645  
ASTRONOMER AND LEAD AUTHOR OF

33  
00:01:18,645 --> 00:01:22,282  
THE HUBBLE FINDINGS.

34  
00:01:22,282 --> 00:01:27,187  
THE NEWS TODAY CAN BE FOUND AT

35  
00:01:27,187 --> 00:01:31,391  
NASA .GOV AND ALSO THE FOLLOWING

36  
00:01:31,391 --> 00:01:31,991  
WEB PAGES.

37  
00:01:31,991 --> 00:01:33,893  
IF YOU WOULD LIKE TO ASK

38  
00:01:33,893 --> 00:01:35,295

QUESTIONS VIA SOCIAL MEDIA,

39  
00:01:35,295 --> 00:01:36,863  
PLEASE USE THE HASHTAG ASK NASA.

40  
00:01:36,863 --> 00:01:38,998  
WITH THAT, THOMAS, CAN YOU KICK

41  
00:01:38,998 --> 00:01:40,233  
US OFF.

42  
00:01:40,233 --> 00:01:43,236  
>> THANKS SO MUCH, FELICIA.

43  
00:01:43,236 --> 00:01:44,871  
IT'S ANOTHER GREAT DAY OF

44  
00:01:44,871 --> 00:01:45,638  
SCIENCE AT NASA.

45  
00:01:45,638 --> 00:01:47,841  
WE FOCUS ON THREE OBJECTIVES.

46  
00:01:47,841 --> 00:01:49,175  
THE FIRST ONE IS TO UNDERSTAND

47  
00:01:49,175 --> 00:01:53,012  
AND TO IMPROVE LIFE ON EARTH.

48  
00:01:53,012 --> 00:01:55,048  
WE ALSO DO FUNDAMENTAL RESEARCH

49  
00:01:55,048 --> 00:01:57,484  
FROM HERE TO THE DEPTHS OF THE

50  
00:01:57,484 --> 00:01:59,352  
UNIVERSE AND UNDERSTAND

51  
00:01:59,352 --> 00:02:00,753  
PROCESSES WE HAVE NEVER

52  
00:02:00,753 --> 00:02:02,021  
UNDERSTOOD BEFORE AND, THE THIRD

53  
00:02:02,021 --> 00:02:03,723  
TOPIC IS ONE THAT THIS IS ALL

54  
00:02:03,723 --> 00:02:06,926  
ABOUT, WHICH IS ABOUT A

55  
00:02:06,926 --> 00:02:10,830  
FUNDAMENTAL QUESTION THAT HAS --

56  
00:02:10,830 --> 00:02:12,465  
HAS FAILED THE THINKS OF SO MANY

57  
00:02:12,465 --> 00:02:14,868  
IN THE PAST AND WE CAN ANSWER

58  
00:02:14,868 --> 00:02:17,136  
NOW, HOPEFULLY IN THE NEAR

59  
00:02:17,136 --> 00:02:18,638  
FUTURE AND THAT IS -- IS THERE

60  
00:02:18,638 --> 00:02:20,907  
LIFE ELSEWHERE?

61  
00:02:20,907 --> 00:02:21,941  
HERE ON EARTH THERE'S A NUMBER

62  
00:02:21,941 --> 00:02:23,276  
OF THINGS THAT HELP LIFE.

63  
00:02:23,276 --> 00:02:25,211

THERE'S WATER IN A LIQUID FORM.

64

00:02:25,211 --> 00:02:27,914

WE HAVE AN ATMOSPHERE, A

65

00:02:27,914 --> 00:02:29,048

MAGNETIC FIELD THAT PROTECTS US

66

00:02:29,048 --> 00:02:31,317

FROM THE HAZARDS OF SPACE.

67

00:02:31,317 --> 00:02:32,585

THERE'S MANY THINGS WE HAVE

68

00:02:32,585 --> 00:02:34,787

GOING FOR OUR SELF.

69

00:02:34,787 --> 00:02:35,989

SO, THE QUESTION OF WHETHER

70

00:02:35,989 --> 00:02:37,423

THERE IS LIFE OUT THERE RELATES

71

00:02:37,423 --> 00:02:39,025

TO QUESTIONS THAT WE ARE MAKING

72

00:02:39,025 --> 00:02:41,794

PROGRESS WITH ALL THE TIME AND

73

00:02:41,794 --> 00:02:43,563

QUESTIONS THAT WE HAVE, NEW

74

00:02:43,563 --> 00:02:44,831

QUESTIONS THAT ARE COMING

75

00:02:44,831 --> 00:02:46,666

FORWARD WE DON'T KNOW YET.

76  
00:02:46,666 --> 00:02:49,369  
WHETHER THERE IS LIFE OUT THERE.

77  
00:02:49,369 --> 00:02:50,703  
BUT, RIGHT NOW WE ARE MAKING A

78  
00:02:50,703 --> 00:02:52,605  
LOT OF PROGRESS ESPECIALLY THE

79  
00:02:52,605 --> 00:02:54,707  
OUTER SOLAR SYSTEM.

80  
00:02:54,707 --> 00:02:56,843  
SO, THIS IS EXACTLY WHAT TODAY'S

81  
00:02:56,843 --> 00:02:58,878  
STORIES ARE ALL ABOUT.

82  
00:02:58,878 --> 00:03:01,114  
WITH THIS RESEARCH, WE ARE

83  
00:03:01,114 --> 00:03:05,852  
MAKING A BIG STEP FORWARD TOWARD

84  
00:03:05,852 --> 00:03:07,020  
ANSWERING THE QUESTION -- IS

85  
00:03:07,020 --> 00:03:08,154  
THERE LIFE OUT THERE?

86  
00:03:08,154 --> 00:03:10,089  
AND WITH THAT, I AM TURNING IT

87  
00:03:10,089 --> 00:03:12,559  
OVER TO THE TEAM.

88  
00:03:12,559 --> 00:03:14,227

>> THANK YOU, THOMAS.

89  
00:03:14,227 --> 00:03:16,429  
SO, NASA STRATEGY FOR SEARCHING

90  
00:03:16,429 --> 00:03:17,730  
FOR LIFE IN THE UNIVERSE BEGINS

91  
00:03:17,730 --> 00:03:19,299  
AT HOME WITH AN UNDERSTANDING OF

92  
00:03:19,299 --> 00:03:21,134  
HOW LIFE EMERGED AND EVOLVED

93  
00:03:21,134 --> 00:03:23,102  
HERE ON EARTH AND WHAT THE

94  
00:03:23,102 --> 00:03:25,138  
LIMITS TO LIFE ARE ON THIS

95  
00:03:25,138 --> 00:03:25,471  
PLANET.

96  
00:03:25,471 --> 00:03:26,940  
WE THEN PROJECT THAT OUT ON TO

97  
00:03:26,940 --> 00:03:28,875  
OTHER PLACES IN OUR SOLAR SYSTEM

98  
00:03:28,875 --> 00:03:31,744  
TO SEE IF WE CAN FIND HABITABLE

99  
00:03:31,744 --> 00:03:32,579  
ENVIRONMENTS THAT CAN SUPPORT

100  
00:03:32,579 --> 00:03:34,514  
LIFE AS WE KNOW IT.

101  
00:03:34,514 --> 00:03:36,683  
40 YEARS AGO, NASA SENT TWO

102  
00:03:36,683 --> 00:03:38,418  
VIKING LANDERS TO MARS TO LOOK

103  
00:03:38,418 --> 00:03:41,688  
FOR EVIDENCE OF LIFE ON THE RED

104  
00:03:41,688 --> 00:03:42,021  
PLANET.

105  
00:03:42,021 --> 00:03:44,090  
AT THE SAME TIME, OCEANOGRAPHERS

106  
00:03:44,090 --> 00:03:46,059  
HERE ON THIS PLANET, ON EARTH,

107  
00:03:46,059 --> 00:03:47,961  
WERE EXPLORING THE LAST

108  
00:03:47,961 --> 00:03:48,328  
FRONTIER.

109  
00:03:48,328 --> 00:03:49,195  
THE DEEP OCEAN.

110  
00:03:49,195 --> 00:03:50,830  
AND DURING THAT EXPLORATION,

111  
00:03:50,830 --> 00:03:53,900  
THEY FOUND AN ASTONISH -- OR

112  
00:03:53,900 --> 00:03:55,535  
MADE AN ASTONISHING DISCOVERY

113  
00:03:55,535 --> 00:03:56,769

THAT CHANGED HOW WE THOUGHT

114

00:03:56,769 --> 00:03:57,971

ABOUT EARTH AND HOW WE THOUGHT

115

00:03:57,971 --> 00:03:59,439

ABOUT LIFE HERE ON EARTH AND

116

00:03:59,439 --> 00:04:02,809

THAT WAS AN INCREDIBLE OASIS OF

117

00:04:02,809 --> 00:04:04,143

LIFE SUPPORTED THOUSANDS OF

118

00:04:04,143 --> 00:04:05,812

METERS BENEATH THE SURFACE OF

119

00:04:05,812 --> 00:04:08,915

THE OCEAN FAR AWAY FROM SUNLIGHT

120

00:04:08,915 --> 00:04:10,083

AND IT WAS SUPPORTED BY THE

121

00:04:10,083 --> 00:04:14,787

ENERGY PRODUCED BY HYDROTHERMAL

122

00:04:14,787 --> 00:04:15,154

ACTIVITY.

123

00:04:15,154 --> 00:04:16,656

NOW THIS DISCOVERY WAS

124

00:04:16,656 --> 00:04:18,224

INCREDIBLE FOR HERE ON EARTH.

125

00:04:18,224 --> 00:04:19,859

IT LED TO INVESTIGATIONS OF MANY

126

00:04:19,859 --> 00:04:22,595

OTHER EVENTS, HUNDREDS OF

127

00:04:22,595 --> 00:04:24,063

EVENTS, WHICH IS ONLY A TINY

128

00:04:24,063 --> 00:04:26,099

PORTION OF THE NUMBER OF EVENTS

129

00:04:26,099 --> 00:04:27,467

THAT MUST BE ACTIVE HERE ON

130

00:04:27,467 --> 00:04:28,968

EARTH BUT IT POINTED OUT A NEW

131

00:04:28,968 --> 00:04:31,904

TYPE OF BIOLOGY SUPPORTED BY

132

00:04:31,904 --> 00:04:33,606

CHEMISTRY THAT DIDN'T REQUIRE

133

00:04:33,606 --> 00:04:34,841

SUNLIGHT, WHICH MEANT THAT WE

134

00:04:34,841 --> 00:04:38,177

COULD EXTEND OUR HABITABLE

135

00:04:38,177 --> 00:04:38,878

ENVIRONMENT WELL BEYOND THE

136

00:04:38,878 --> 00:04:41,047

REACH OF OUR SUN.

137

00:04:41,047 --> 00:04:43,650

OUT INTO THE OUTER SOLAR SYSTEM.

138

00:04:43,650 --> 00:04:46,319

OUT TO THE MOONS OF SATURN AND

139

00:04:46,319 --> 00:04:46,653

JUPITER.

140

00:04:46,653 --> 00:04:48,121

AS WE IMAGINE ENVIRONMENTS VERY

141

00:04:48,121 --> 00:04:50,790

MUCH LIKE OUR OWN HYDROTHERMAL

142

00:04:50,790 --> 00:04:51,924

EVENTS HERE ON EARTH COULD EXIST

143

00:04:51,924 --> 00:04:52,625

OUT THERE.

144

00:04:52,625 --> 00:04:53,993

SO TODAY'S DISCOVERIES HAVE TO

145

00:04:53,993 --> 00:04:56,462

DO WITH OCEAN WORLDS BEYOND OUR

146

00:04:56,462 --> 00:04:58,031

OWN PLANET AND JIM'S GOING TO

147

00:04:58,031 --> 00:04:59,632

TELL YOU ABOUT THE MISSIONS THAT

148

00:04:59,632 --> 00:05:00,733

BROUGHT THIS TO US.

149

00:05:00,733 --> 00:05:03,202

>> IT REALLY BEGAN IN THE LATE

150

00:05:03,202 --> 00:05:06,639

1990s WITH THE MISSION

151  
00:05:06,639 --> 00:05:07,740  
GALLILEO.

152  
00:05:07,740 --> 00:05:09,942  
GALLILEO ORBITING JUPITER WAS

153  
00:05:09,942 --> 00:05:12,145  
FLYING BY THE INDIVIDUAL MOONS,

154  
00:05:12,145 --> 00:05:15,314  
THE GALLILAND MOONS, MAKING

155  
00:05:15,314 --> 00:05:16,916  
OBSERVATIONS IN THE ATMOSPHERE,

156  
00:05:16,916 --> 00:05:18,685  
MANY MANY THINGS IN THAT SOLAR

157  
00:05:20,353 --> 00:05:19,018  
SYSTEM.

158  
00:05:20,353 --> 00:05:26,492  
WHAT IT DISCOVERED FROM ITS

159  
00:05:26,492 --> 00:05:27,360  
MAGNETOMETERS, IT FLEW REALLY

160  
00:05:27,360 --> 00:05:30,430  
CLOSE TO EUROPEA, WAS A MAGNETIC

161  
00:05:30,430 --> 00:05:31,731  
SIGNATURE THAT'S VERY FAMILIAR

162  
00:05:31,731 --> 00:05:33,666  
WITH OUR SCIENTISTS BECAUSE WE

163  
00:05:33,666 --> 00:05:34,834

INTERPRET IT AS A CURRENT WITHIN

164

00:05:34,834 --> 00:05:39,238

AN OCEAN UNDERNEATH AN ICE

165

00:05:39,238 --> 00:05:39,572

SHELF.

166

00:05:39,572 --> 00:05:43,743

IN 2005, CASIMI, ORBITING

167

00:05:43,743 --> 00:05:46,345

SATURN, FLYING BY THE MOONS OF

168

00:05:46,345 --> 00:05:50,817

SATURN, WITH CLOSE FLY BYES OF

169

00:05:50,817 --> 00:05:52,785

INSOLIDUS, IT OBSERVED HUGE

170

00:05:52,785 --> 00:05:54,687

PLUMES OF WATER EMANATING FROM

171

00:05:54,687 --> 00:05:55,021

CRACKS.

172

00:05:55,021 --> 00:06:00,259

WE NOW BELIEVE THAT INSOLIDUS

173

00:06:00,259 --> 00:06:01,527

ALSO HAS A HUGE OCEAN.

174

00:06:01,527 --> 00:06:02,962

WE CALL THESE BODIES AND MANY

175

00:06:02,962 --> 00:06:04,664

OTHERS THAT ARE LIKE THEM --

176

00:06:04,664 --> 00:06:05,364

OCEAN WORLDS.

177

00:06:05,364 --> 00:06:09,569

THEY ARE PROTECTED BY AN ICE

178

00:06:09,569 --> 00:06:11,637

SHELL MUCH LIKE OUR ATMOSPHERE

179

00:06:11,637 --> 00:06:13,539

PROTECTS US, OUR LIFE HERE ON

180

00:06:13,539 --> 00:06:15,308

EARTH AND OUR OCEAN MAINTAINING

181

00:06:15,308 --> 00:06:16,442

ITS LIQUID.

182

00:06:16,442 --> 00:06:17,944

THIS IS TRULY AN EXCITING TIME

183

00:06:17,944 --> 00:06:20,446

FOR US TO BE ABLE TO PROBE THOSE

184

00:06:20,446 --> 00:06:22,815

AND REALLY TRY TO UNDERSTAND

185

00:06:22,815 --> 00:06:24,517

WHAT'S HAPPENING IN THESE OCEAN

186

00:06:24,517 --> 00:06:26,586

WORLDS.

187

00:06:26,586 --> 00:06:28,788

WHAT WE WILL TALK ABOUT TODAY

188

00:06:28,788 --> 00:06:32,024

ARE TWO REALLY WONDERFUL

189

00:06:32,024 --> 00:06:35,528

DISCOVERIES CONTINUING BACK TO

190

00:06:35,528 --> 00:06:36,529

CASINI WHICH HAS ALWAYS BEEN ONE

191

00:06:36,529 --> 00:06:39,365

OF THE MAJOR MISSIONS THAT WE

192

00:06:39,365 --> 00:06:40,967

HAVE MAKING HUGE NUMBER OF

193

00:06:40,967 --> 00:06:42,802

DISCOVERIES AND WE WILL TALK

194

00:06:42,802 --> 00:06:44,737

ABOUT INSOLIDUS AND WHAT IT'S

195

00:06:44,737 --> 00:06:45,404

FOUND OUT.

196

00:06:45,404 --> 00:06:48,174

WE WILL ALSO TALK ABOUT HUBBLE

197

00:06:48,174 --> 00:06:50,009

OBSERVATIONS BACK TO EUROPEA.

198

00:06:50,009 --> 00:06:53,012

THESE TWO OCEAN WORLDS WE ARE

199

00:06:53,012 --> 00:06:55,481

GOING TO LINK TOGETHER BECAUSE

200

00:06:55,481 --> 00:06:56,849

THEY ARE SO SIMILAR IN MANY,

201  
00:06:56,849 --> 00:06:58,151  
MANY WAYS THAT I HOPE YOU WILL

202  
00:06:58,151 --> 00:07:00,119  
SEE AS WE GO THROUGH OUR

203  
00:07:00,119 --> 00:07:01,287  
DISCOVERIES TODAY.

204  
00:07:01,287 --> 00:07:03,489  
SO, WITHOUT FURTHER ADO, LET'S

205  
00:07:03,489 --> 00:07:07,460  
GO TO J.P.L. AND TALK TO LINDA

206  
00:07:07,460 --> 00:07:08,161  
SPILKER.

207  
00:07:08,161 --> 00:07:11,664  
LINDA, WHAT'S CASINI BEEN

208  
00:07:11,664 --> 00:07:12,064  
OBSERVING?

209  
00:07:12,064 --> 00:07:13,666  
>> WELL IT'S BEEN IN ORBIT

210  
00:07:13,666 --> 00:07:15,768  
AROUND SATURN FOR ALMOST 13

211  
00:07:15,768 --> 00:07:17,904  
YEARS AND OUR UNEXPECTED

212  
00:07:17,904 --> 00:07:20,239  
DISCOVERIES ABOUT INSOLIDUS HAVE

213  
00:07:20,239 --> 00:07:21,474

BEEN SOME OF THE MOST

214

00:07:21,474 --> 00:07:21,874

SURPRISING.

215

00:07:21,874 --> 00:07:23,643

TODAY WE ARE PUBLISHING A PAPER

216

00:07:23,643 --> 00:07:28,648

ABOUT OUR RESENT FINDINGS BY

217

00:07:28,648 --> 00:07:30,917

CASINI ON INSOLIDUS.

218

00:07:30,917 --> 00:07:32,385

WE DISCOVERED HYDROGEN COMING

219

00:07:32,385 --> 00:07:34,987

FROM A HYDROTHERMAL VENT ON THE

220

00:07:34,987 --> 00:07:36,956

SEA FLOOR GOING OUT INTO SPACE

221

00:07:36,956 --> 00:07:37,523

THROUGH THE PLUME.

222

00:07:37,523 --> 00:07:42,261

SO THIS IS A VERY SIGNIFICANT

223

00:07:42,261 --> 00:07:44,664

FINDING BECAUSE THE HYDROGENERAL

224

00:07:44,664 --> 00:07:46,732

COULD BE A POTENTIAL SOURCE OF

225

00:07:46,732 --> 00:07:50,002

CHEMICAL ENERGY FOR ANY MICROBES

226  
00:07:50,002 --> 00:07:52,638  
THAT COULD BE IN INSOLIDUS

227  
00:07:52,638 --> 00:07:52,972  
OCEAN.

228  
00:07:52,972 --> 00:07:56,242  
THIS IS A SIGNIFICANT FINDING.

229  
00:07:56,242 --> 00:07:57,743  
INSOLIDUS IS TOO SMALL TO RETAIN

230  
00:07:57,743 --> 00:08:00,913  
THE HYDROGEN WHEN IT FORMED.

231  
00:08:00,913 --> 00:08:02,215  
THE HYDROGEN GAS WE SEE IS

232  
00:08:02,215 --> 00:08:05,218  
COMING FROM INSIDE INSOLIDUS.

233  
00:08:05,218 --> 00:08:06,485  
LET'S TAKE A QUICK LOOK AT SOME

234  
00:08:06,485 --> 00:08:08,521  
OF CASINI'S FIRST FINDINGS.

235  
00:08:08,521 --> 00:08:11,357  
THIS IS A VIEW OF THE SOUTH POLE

236  
00:08:11,357 --> 00:08:17,363  
OF INSOLIDUS AND THE GEYSERS ARE

237  
00:08:17,363 --> 00:08:20,066  
COMING FROM THOSE TIGER STRIPES,

238  
00:08:20,066 --> 00:08:21,634

THOSE BLuish FRACTURES THAT YOU

239

00:08:21,634 --> 00:08:22,335

CAN SEE.

240

00:08:22,335 --> 00:08:23,536

IN THE NEXT PICTURE, YOU CAN SEE

241

00:08:23,536 --> 00:08:25,271

THE JETS SHOOTING OUT INTO SPACE

242

00:08:25,271 --> 00:08:28,908

FORMING THE GIANT PLUME AROUND

243

00:08:28,908 --> 00:08:29,308

INSOLIDUS.

244

00:08:29,308 --> 00:08:30,910

UNDERNEATH THAT ICY CRUST AS JIM

245

00:08:30,910 --> 00:08:32,245

SAID IS A GLOBAL OCEAN.

246

00:08:32,245 --> 00:08:34,080

THAT GLOBAL OCEAN SITS ON TOP OF

247

00:08:34,080 --> 00:08:35,815

A ROCKY CORE.

248

00:08:35,815 --> 00:08:39,452

AND, SOME OF CASINI'S FINDINGS

249

00:08:39,452 --> 00:08:41,988

POINTED TO HYDROTHERMAL VENTS,

250

00:08:41,988 --> 00:08:43,222

BASICALLY HOT WATER COMING OUT

251  
00:08:43,222 --> 00:08:44,724  
AFTER IT'S BEEN MIXED WITH THE

252  
00:08:44,724 --> 00:08:46,192  
ROCKY CORE AND THIS FINAL IMAGE

253  
00:08:46,192 --> 00:08:47,260  
SHOWS A THERMAL MAP.

254  
00:08:47,260 --> 00:08:49,228  
THE TEMPERATURE OF THE SOUTH

255  
00:08:49,228 --> 00:08:49,528  
POLE.

256  
00:08:49,528 --> 00:08:50,429  
WE CAN SEE THE WARMEST

257  
00:08:50,429 --> 00:08:51,797  
TEMPERATURES WITH THE YELLOW AND

258  
00:08:51,797 --> 00:08:54,433  
RED ARE RIGHT ALONG THE TIGER

259  
00:08:54,433 --> 00:08:55,735  
STRIPE FRACTURES.

260  
00:08:55,735 --> 00:08:57,236  
SO, WHAT'S NEW TODAY?

261  
00:08:57,236 --> 00:08:59,939  
THE NEW FINDING IS FINDING

262  
00:08:59,939 --> 00:09:02,174  
HYDROGEN COMING FROM THE PLUME

263  
00:09:02,174 --> 00:09:03,676

OF INSOLIDUS AND THE FACT THAT

264

00:09:03,676 --> 00:09:06,312

IT COULD SUPPORT, POTENTIALLY,

265

00:09:06,312 --> 00:09:07,980

MICROBES WITH ENERGY ON THE SEA

266

00:09:07,980 --> 00:09:09,015

FLOOR OF INSOLIDUS.

267

00:09:09,015 --> 00:09:10,983

NOW, THIS FINDING IS THE RESULT

268

00:09:10,983 --> 00:09:14,287

OF 12 YEARS OF CASINI

269

00:09:14,287 --> 00:09:14,720

INVESTIGATION.

270

00:09:14,720 --> 00:09:16,656

AND IT REALLY REPRESENTS A

271

00:09:16,656 --> 00:09:18,024

CAPSTONE FINDING FOR THE

272

00:09:18,024 --> 00:09:18,391

MISSION.

273

00:09:18,391 --> 00:09:20,459

BECAUSE WE NOW KNOW THAT

274

00:09:20,459 --> 00:09:22,995

INSOLIDUS HAS ALMOST ALL OF THE

275

00:09:22,995 --> 00:09:24,597

INGREDIENTS THAT YOU WOULD NEED

276  
00:09:24,597 --> 00:09:26,599  
TO SUPPORT LIFE AS WE KNOW IT ON

277  
00:09:26,599 --> 00:09:28,034  
EARTH.

278  
00:09:28,034 --> 00:09:30,436  
WELL, HERE I HAVE A MODEL OF THE

279  
00:09:30,436 --> 00:09:31,704  
CASINI SPACE CRAFT AND HUNTER,

280  
00:09:31,704 --> 00:09:33,572  
MAYBE YOU CAN SHOW US WHERE YOUR

281  
00:09:33,572 --> 00:09:35,308  
INSTRUMENT IS THAT DETECTED THE

282  
00:09:35,308 --> 00:09:35,675  
HYDROGEN.

283  
00:09:35,675 --> 00:09:37,276  
>> YES, LINDA.

284  
00:09:37,276 --> 00:09:41,914  
THE INSTRUMENT, THE ION

285  
00:09:41,914 --> 00:09:43,182  
SPECTROMETER SITTING ON THE

286  
00:09:43,182 --> 00:09:44,684  
PLATFORM RIGHT HERE, IT DIRECTLY

287  
00:09:44,684 --> 00:09:46,118  
SAMPLES THE GAS THAT COMES IN AS

288  
00:09:46,118 --> 00:09:48,187

WE FLY THROUGH THE PLUME.

289

00:09:48,187 --> 00:09:53,392

AS OPPOSED TO AN ULTRAVIOLET

290

00:09:53,392 --> 00:09:59,165

SPECTROMETER OR INTRA VIOLET

291

00:09:59,165 --> 00:10:00,766

SPECTROMETER.

292

00:10:00,766 --> 00:10:03,602

SO, THIS SAMPLING IS EXTREMELY

293

00:10:03,602 --> 00:10:05,504

IMPORTANT FOR DETECTING TRACE

294

00:10:05,504 --> 00:10:05,871

SPECIES.

295

00:10:05,871 --> 00:10:08,107

AND WE WERE ABLE TO, FROM

296

00:10:08,107 --> 00:10:10,743

PREVIOUS FLY-BYES AND PREVIOUS

297

00:10:10,743 --> 00:10:11,577

MEASUREMENTS, FIND OUT THAT THE

298

00:10:11,577 --> 00:10:14,981

PLUME IS 98% WATER.

299

00:10:14,981 --> 00:10:18,818

IT HAS TRACES OF AMMONIA, CARBON

300

00:10:18,818 --> 00:10:20,386

DIOXIDE, AND METHANE, AS WELL AS

301  
00:10:20,386 --> 00:10:22,254  
SOME ORGANICS.

302  
00:10:22,254 --> 00:10:24,890  
NOW, THE PART THAT HAD BEEN

303  
00:10:24,890 --> 00:10:27,626  
ELUSIVE TO US BEFORE WAS THE

304  
00:10:27,626 --> 00:10:28,027  
HYDROGEN.

305  
00:10:28,027 --> 00:10:30,696  
AND, SO LET ME BACK OFF HERE AND

306  
00:10:30,696 --> 00:10:34,367  
PICK UP A SIMILAR MODEL.

307  
00:10:34,367 --> 00:10:38,738  
WE HAVE A SIMULATION HERE OF

308  
00:10:38,738 --> 00:10:40,473  
INSOLIDUS AND THE TIGER STRIPE.

309  
00:10:40,473 --> 00:10:44,210  
AND SO, LET ME FLY MY SPACE

310  
00:10:44,210 --> 00:10:46,112  
CRAFT WITH THE I.M.S. POINTED IN

311  
00:10:46,112 --> 00:10:49,849  
THE DIRECTION OF MOTION OF THE

312  
00:10:49,849 --> 00:10:51,183  
PLACE CRAFT THROUGH THE PLUME

313  
00:10:51,183 --> 00:10:52,718

MATERIAL SAMPLING THE GAS.

314

00:10:52,718 --> 00:10:54,186

THIS IS HOW IT HAPPENED WHEN WE

315

00:10:54,186 --> 00:10:55,921

WERE MAKING THE MEASUREMENT.

316

00:10:55,921 --> 00:10:58,324

IT WAS ABOUT EIGHT KILOMETERS

317

00:10:58,324 --> 00:10:59,191

ABOVE THE SURFACE.

318

00:10:59,191 --> 00:11:00,659

THIS HAPPENED IN OCTOBER OF

319

00:11:00,659 --> 00:11:01,694

2015.

320

00:11:01,694 --> 00:11:04,063

IT'S INTERESTING TO PUT THIS

321

00:11:04,063 --> 00:11:05,798

TOGETHER WITH THE OTHER

322

00:11:05,798 --> 00:11:08,034

MEASUREMENTS WE MADE OF THE

323

00:11:08,034 --> 00:11:10,469

COMPOSITION TO TRY TO DRAW SOME

324

00:11:10,469 --> 00:11:11,771

INFERENCES ABOUT WHAT'S GOING ON

325

00:11:11,771 --> 00:11:13,839

IN THE INTERIOR OF THE OCEAN.

326  
00:11:13,839 --> 00:11:15,474  
BECAUSE THIS MATERIAL IS TELLING

327  
00:11:15,474 --> 00:11:16,876  
US ABOUT COMPOSITION OF THE

328  
00:11:16,876 --> 00:11:17,843  
OCEAN.

329  
00:11:17,843 --> 00:11:19,512  
>> WELL HUNTER, WHAT WAS GOING

330  
00:11:19,512 --> 00:11:20,679  
THROUGH YOUR HEAD WHEN YOU

331  
00:11:20,679 --> 00:11:23,015  
LOOKED AT THE DATA AND YOU SAW

332  
00:11:23,015 --> 00:11:23,449  
HYDROGEN?

333  
00:11:23,449 --> 00:11:24,917  
>> WELL, OF COURSE WE WERE VERY

334  
00:11:24,917 --> 00:11:26,419  
EXCITED BECAUSE WE HAD BEEN

335  
00:11:26,419 --> 00:11:27,520  
PLANNING THIS FOR QUITE A WHILE

336  
00:11:27,520 --> 00:11:29,855  
AND WE HAD BEEN THINKING ABOUT

337  
00:11:29,855 --> 00:11:32,458  
WHAT POSSIBLE IMPLICATIONS MIGHT

338  
00:11:32,458 --> 00:11:32,992

BE.

339

00:11:32,992 --> 00:11:34,460

SO, TO DISCUSS THAT, LET ME TURN

340

00:11:34,460 --> 00:11:35,928

IT OVER TO CHRIS AND LET HIM

341

00:11:35,928 --> 00:11:38,431

TALK A LITTLE BIT ABOUT THAT.

342

00:11:38,431 --> 00:11:39,899

>> WILL LINDA, OUR TEAM

343

00:11:39,899 --> 00:11:40,666

CONSIDERED NUMEROUS

344

00:11:40,666 --> 00:11:41,834

POSSIBILITIES AND AFTER

345

00:11:41,834 --> 00:11:44,837

PERFORMING DETAILED CHEMICAL

346

00:11:44,837 --> 00:11:46,338

ANALYSIS, WE FOUND THAT THE BEST

347

00:11:46,338 --> 00:11:48,441

EXPLANATION IS THE HYDROGEN IS

348

00:11:48,441 --> 00:11:49,775

PRODUCED BY CHEMICAL REACTION

349

00:11:49,775 --> 00:11:51,077

BETWEEN WARM WATER AND ROCK.

350

00:11:51,077 --> 00:11:52,378

HERE'S A GRAPHIC SHOWING WHAT WE

351  
00:11:52,378 --> 00:11:55,281  
THINK IS GOING ON.

352  
00:11:55,281 --> 00:11:57,416  
WE THINK THAT HYDROTHERMAL

353  
00:11:57,416 --> 00:11:59,685  
FLUIDS ARE CIRCULATING BELOW THE

354  
00:11:59,685 --> 00:12:00,886  
OCEAN FLOOR ON INSOLIDUS.

355  
00:12:00,886 --> 00:12:04,290  
THIS EXPOSES ROCK TO WARM WATER

356  
00:12:04,290 --> 00:12:07,026  
WHICH DRIES GEO CHEMICAL

357  
00:12:07,026 --> 00:12:07,493  
TRANSFORMATION.

358  
00:12:07,493 --> 00:12:08,494  
AN IMPORTANT PROCESS THAT

359  
00:12:08,494 --> 00:12:10,096  
PRODUCES HUGE AMOUNTS OF

360  
00:12:10,096 --> 00:12:15,601  
HYDROGEN IS CALL ASKED

361  
00:12:15,601 --> 00:12:16,102  
SERPENTINIZATION.

362  
00:12:16,102 --> 00:12:17,803  
CERTAIN MINERALS THAT ARE RICH

363  
00:12:17,803 --> 00:12:20,906

IN IRON REACT WITH WATER TO FORM

364

00:12:20,906 --> 00:12:23,142

NEW MINERALS AND HYDROGEN IS

365

00:12:23,142 --> 00:12:23,509

PRODUCED.

366

00:12:23,509 --> 00:12:24,243

THIS IS IMPORTANT BECAUSE IT

367

00:12:24,243 --> 00:12:26,879

SHOWS THAT THE GEOCHEMISTRY ACTS

368

00:12:26,879 --> 00:12:27,513

ON INSOLIDUS.

369

00:12:27,513 --> 00:12:29,215

IN ADDITION TO THIS, WE THINK

370

00:12:29,215 --> 00:12:33,119

THAT THE WARM HYDROTHERMAL

371

00:12:33,119 --> 00:12:34,286

FLUIDS CONTAIN DISSOLVED

372

00:12:34,286 --> 00:12:35,821

MINERALS AND WHEN THESE MINERALS

373

00:12:35,821 --> 00:12:36,989

MIX WITH THE OCEAN WATER WHICH

374

00:12:36,989 --> 00:12:40,926

IS COLD, MINERAL PRECIPITATES

375

00:12:40,926 --> 00:12:42,695

FORMAT THE SEA FLOOR.

376  
00:12:42,695 --> 00:12:44,363  
THESE MINERAL PRECIPITATES ON

377  
00:12:44,363 --> 00:12:46,098  
THE EARTH FORM WHITE SOLIDS SO

378  
00:12:46,098 --> 00:12:49,135  
WE CALL THEM WHITE SMOKERS.

379  
00:12:49,135 --> 00:12:50,769  
HERE'S A VIDEO SHOWING AN

380  
00:12:50,769 --> 00:12:52,271  
EXAMPLE OF ONE OF THESE SYSTEMS

381  
00:12:52,271 --> 00:12:52,838  
ON INSOLIDUS.

382  
00:12:52,838 --> 00:12:54,173  
I MEAN ON THE EARTH.

383  
00:12:54,173 --> 00:12:57,610  
WE DON'T KNOW IF THE SYSTEMS ON

384  
00:12:57,610 --> 00:12:58,577  
INSOLIDUS LOOK LIKE THIS, BUT

385  
00:12:58,577 --> 00:13:00,412  
THIS IS AN EXAMPLE FROM THE

386  
00:13:00,412 --> 00:13:00,746  
EARTH.

387  
00:13:00,746 --> 00:13:02,181  
THESE VENTS ON THE EARTH SUPPORT

388  
00:13:02,181 --> 00:13:05,317

## TEAMING COMMUNITIES OF ORGANISMS

389

00:13:05,317 --> 00:13:07,419

ANCHORED BY MICROBES THAT FIELD

390

00:13:07,419 --> 00:13:09,622

ON CHEMICAL ENERGY RATHER THAN

391

00:13:09,622 --> 00:13:09,989

SUNLIGHT.

392

00:13:09,989 --> 00:13:10,990

AN IMPORTANT REACTION AT THE

393

00:13:10,990 --> 00:13:15,461

BASE OF THE FOOD CHAIN IS CALLED

394

00:13:15,461 --> 00:13:16,262

METHANA GENESIS.

395

00:13:16,262 --> 00:13:19,565

THIS IS WHERE THEY COMBINE

396

00:13:19,565 --> 00:13:22,101

HYDROGEN WITH CARBON DIOXIDE TO

397

00:13:22,101 --> 00:13:24,470

FORM METHANE AND THEY GET A JOLT

398

00:13:24,470 --> 00:13:25,604

OF ENERGY OUT OF THE PROCESS.

399

00:13:25,604 --> 00:13:28,607

THEY USE IT TO SYNTHESIZE SOME

400

00:13:28,607 --> 00:13:30,543

OF THE MOLECULES SUCH AS SUGAR

401  
00:13:30,543 --> 00:13:31,710  
MOLECULES. WHAT IS INTRIGUING

402  
00:13:31,710 --> 00:13:33,546  
ABOUT THE DATA AT INSOLIDUS WITH

403  
00:13:33,546 --> 00:13:34,847  
THE HYDROGEN DETECTION IS THAT

404  
00:13:34,847 --> 00:13:36,315  
WE ARE NOW ABLE TO DETERMINE HOW

405  
00:13:36,315 --> 00:13:39,118  
MUCH ENERGY WOULD BE AVAILABLE

406  
00:13:39,118 --> 00:13:43,756  
FROM THE METHANAGENERAL 'TIS

407  
00:13:43,756 --> 00:13:46,959  
REACTION AT -- GENESIS REACTION.

408  
00:13:46,959 --> 00:13:48,761  
THIS IS A KEY STEP TOWARD

409  
00:13:48,761 --> 00:13:50,563  
UNDERSTANDING THE HABITABILITY

410  
00:13:50,563 --> 00:13:51,897  
OF INSOLIDUS.

411  
00:13:51,897 --> 00:13:53,098  
>> WELL CHRIS, DO YOU THINK

412  
00:13:53,098 --> 00:13:55,000  
THERE COULD BE MICROBES OR EVEN

413  
00:13:55,000 --> 00:13:57,436

SHRIMP IN THE OCEAN ON

414

00:13:57,436 --> 00:13:57,836  
INSOLIDUS?

415

00:13:57,836 --> 00:13:58,737  
>> WELL THAT WOULD BE WONDERFUL,

416

00:13:58,737 --> 00:14:02,107  
LINDA, BUT WE HAVEN'T DISCOVERED

417

00:14:02,107 --> 00:14:05,044  
ORGANISMS ON INSOLIDUS, BUT I AM

418

00:14:05,044 --> 00:14:08,581  
ENCOURAGED BY THE GEOCHEMICAL

419

00:14:08,581 --> 00:14:10,182  
DATA WHICH COULD ALLOW FOR THIS

420

00:14:10,182 --> 00:14:10,616  
POSSIBILITY.

421

00:14:10,616 --> 00:14:11,951  
>> WELL THANK YOU VERY MUCH.

422

00:14:11,951 --> 00:14:13,786  
WHEN CASINI WAS FIRST BUILT, WE

423

00:14:13,786 --> 00:14:15,387  
NEVER THOUGHT WE WOULD SEE AN

424

00:14:15,387 --> 00:14:17,823  
ACTIVE OCEAN WORLD LIKE

425

00:14:17,823 --> 00:14:19,491  
INSOLIDUS AT SATURN.

426

00:14:19,491 --> 00:14:21,660

SO, CASINI CAN LOOK FOR

427

00:14:21,660 --> 00:14:22,428

HABITABILITY BUT WE DON'T HAVE

428

00:14:22,428 --> 00:14:23,862

THE INSTRUMENTS TO LOOK FOR

429

00:14:23,862 --> 00:14:24,997

LIFE.

430

00:14:24,997 --> 00:14:27,600

WE HAVE COME AS FAR AS WE CAN

431

00:14:27,600 --> 00:14:27,866

GO.

432

00:14:27,866 --> 00:14:29,702

WHAT REMAINS FOR A FUTURE

433

00:14:29,702 --> 00:14:31,537

MISSION IS TO DETECT LIFE AT

434

00:14:31,537 --> 00:14:31,937

INSOLIDUS.

435

00:14:31,937 --> 00:14:33,839

AND THE CASINI TEAM IS SO

436

00:14:33,839 --> 00:14:35,074

EXCITED ABOUT THESE NEW FINDINGS

437

00:14:35,074 --> 00:14:36,475

AND SO MARY, WHY DON'T YOU PUT

438

00:14:36,475 --> 00:14:37,876

THIS IN A BROADER CONTEXT FOR

439

00:14:37,876 --> 00:14:39,144  
US.

440

00:14:39,144 --> 00:14:40,679  
>> THANK YOU, LINDA.

441

00:14:40,679 --> 00:14:42,214  
WELL FIRST OF ALL, CHRIS, I

442

00:14:42,214 --> 00:14:43,782  
RECOGNIZE THAT FOOTAGE FROM ONE

443

00:14:43,782 --> 00:14:46,819  
OF THE NASA RESEARCHERS, CHRIS

444

00:14:46,819 --> 00:14:48,320  
GERMAN, EXPLORING THE EAST

445

00:14:48,320 --> 00:14:50,189  
PACIFIC RISE WHICH WAS ACTUALLY

446

00:14:50,189 --> 00:14:52,191  
A HYDROTHERMAL SYSTEM VERY CLOSE

447

00:14:52,191 --> 00:14:54,994  
TO THE ORIGINAL OBSERVATION 40

448

00:14:54,994 --> 00:15:01,367  
YEARS AGO AT THE GALLAPAGOS

449

00:15:01,367 --> 00:15:03,035  
RIFT.

450

00:15:03,035 --> 00:15:04,703  
WHILE WE DON'T UNDERSTAND WHAT

451  
00:15:04,703 --> 00:15:07,840  
THE STRUCTURES ARE AND WE WON'T

452  
00:15:07,840 --> 00:15:09,208  
KNOW UNTIL WE GET INTO THE

453  
00:15:09,208 --> 00:15:11,043  
OCEANS, CERTAINLY THIS SUGGESTS

454  
00:15:11,043 --> 00:15:12,911  
A SIGNIFICANT AMOUNT OF

455  
00:15:12,911 --> 00:15:13,679  
HYDROTHERMAL ACTIVITY.

456  
00:15:13,679 --> 00:15:15,414  
SUCH A STRONG SIGNAL OF

457  
00:15:15,414 --> 00:15:15,781  
HYDROGEN.

458  
00:15:15,781 --> 00:15:17,383  
AND THIS HYDROGEN IS A GOOD

459  
00:15:17,383 --> 00:15:19,785  
SOURCE OF CHEMICAL ENERGY TO

460  
00:15:19,785 --> 00:15:21,620  
SUPPORT LIFE.

461  
00:15:21,620 --> 00:15:22,321  
NOW WHAT ELSE HAVE WE BEEN

462  
00:15:22,321 --> 00:15:23,255  
THINKING ABOUT THAT LIFE NEEDS?

463  
00:15:23,255 --> 00:15:25,224

I HAVE A FIGURE HERE TO GO OVER

464

00:15:25,224 --> 00:15:27,059

SORT OF THE TRIAD OF WHAT WE

465

00:15:27,059 --> 00:15:27,826

NEED FOR LIFE.

466

00:15:27,826 --> 00:15:29,495

SO CAN I HAVE THE FIGURE PLEASE?

467

00:15:29,495 --> 00:15:31,630

SO OF COURSE YOU KNOW WE NEED

468

00:15:31,630 --> 00:15:31,964

WATER.

469

00:15:31,964 --> 00:15:33,532

AND HERE WE ARE AT OCEAN WORLDS.

470

00:15:33,532 --> 00:15:35,567

SO, WE HAVE THE WATER.

471

00:15:35,567 --> 00:15:37,636

WE NEED CHEMICAL ELEMENTS THAT

472

00:15:37,636 --> 00:15:39,138

CAN MAKE THE BUILDING BLOCKS

473

00:15:39,138 --> 00:15:41,607

THAT GO INTO MAKING CELLS AND

474

00:15:41,607 --> 00:15:43,542

PROVIDE MOLECULES FOR

475

00:15:43,542 --> 00:15:43,942

METABOLISM.

476

00:15:43,942 --> 00:15:46,745

WE NEED CARBON, HYDROGEN,

477

00:15:46,745 --> 00:15:48,981

NITROGEN, OXYGEN, PHOSPHORUS AND

478

00:15:48,981 --> 00:15:49,982

SULFUR WHICH ARE DOWN IN THE

479

00:15:49,982 --> 00:15:51,383

LOWER LEFT OF THE TRIANGLE.

480

00:15:51,383 --> 00:15:53,152

HERE WE GET TO CHECK OFF ANOTHER

481

00:15:53,152 --> 00:15:53,419

BOX.

482

00:15:53,419 --> 00:15:55,254

WE HAVE FOUND ENERGY TO SUPPORT

483

00:15:55,254 --> 00:15:55,621

LIFE.

484

00:15:55,621 --> 00:15:58,023

HYDROGEN GASPRO VIVES THAT

485

00:15:58,023 --> 00:15:59,758

ENERGY -- GAS PROVIDES THAT

486

00:15:59,758 --> 00:16:00,092

ENERGY.

487

00:16:00,092 --> 00:16:02,194

NOW WE NEED IT SEE IF INSOLIDUS

488

00:16:02,194 --> 00:16:03,729

HAD ENOUGH TIME OR ANY OF THE

489

00:16:03,729 --> 00:16:05,497

OTHER SYSTEMS IN THIS WORLD HAD

490

00:16:05,497 --> 00:16:07,833

ENOUGH TIME TO EVOLVE LIFE AND

491

00:16:07,833 --> 00:16:10,002

HAVE LIFE MAKE ITS IMPRINT ON

492

00:16:10,002 --> 00:16:10,869

ITS OCEAN.

493

00:16:10,869 --> 00:16:12,838

SO NOW WE HAVE ANOTHER

494

00:16:12,838 --> 00:16:13,906

OBSERVATION THAT KIND OF

495

00:16:13,906 --> 00:16:15,374

CONNECTS THE WORLDS AND IS

496

00:16:15,374 --> 00:16:16,909

RELATED TO WHAT WE JUST HEARD

497

00:16:16,909 --> 00:16:18,444

ABOUT AND JIM'S GOING TO TELL

498

00:16:18,444 --> 00:16:19,445

YOU ABOUT THIS.

499

00:16:19,445 --> 00:16:21,180

>> SO IN DEED, THE NEXT

500

00:16:21,180 --> 00:16:22,614

DISCOVERY WE WANT TO TALK ABOUT,

501  
00:16:22,614 --> 00:16:25,617  
WHICH IS ALSO COMING OUT THIS

502  
00:16:25,617 --> 00:16:27,152  
WEEK IN OUR SCIENCE JOURNALS IS

503  
00:16:27,152 --> 00:16:34,793  
FROM THE HUBBLE SPACE TELESCOPE.

504  
00:16:34,793 --> 00:16:36,528  
IT'S BEEN OBSERVING EUROPEA FOR

505  
00:16:36,528 --> 00:16:37,196  
MANY YEARS.

506  
00:16:37,196 --> 00:16:41,834  
SO, LET'S GO TO GODDARD SPACE

507  
00:16:41,834 --> 00:16:44,169  
CENTER AND TALK TO WILLIAM

508  
00:16:44,169 --> 00:16:44,503  
SPARKS.

509  
00:16:44,503 --> 00:16:46,038  
BILL, GIVE US A LITTLE

510  
00:16:46,038 --> 00:16:48,440  
BACKGROUND ON WHAT WE KNOW ABOUT

511  
00:16:48,440 --> 00:16:49,074  
EUROPEA.

512  
00:16:49,074 --> 00:16:52,144  
>> EUROPEA IS ONE OF THE FOUR

513  
00:16:52,144 --> 00:16:54,413

## MAJOR MOONS OF JUPITER.

514

00:16:54,413 --> 00:16:56,415

ABOUT THE SAME SIZE AS OUR OWN

515

00:16:56,415 --> 00:16:58,851

MOON BUT LOOKS VERY DIFFERENT.

516

00:16:58,851 --> 00:17:00,719

IT HAS A SMOOTH BRIGHT WHITE

517

00:17:00,719 --> 00:17:04,857

SURFACE COVERED IN DARK

518

00:17:04,857 --> 00:17:05,224

FRACTURES.

519

00:17:05,224 --> 00:17:06,525

THE REASON FOR THAT AND WHAT

520

00:17:06,525 --> 00:17:08,560

MAKES EUROPA SO INTERESTING IS

521

00:17:08,560 --> 00:17:10,696

THAT IT'S THOUGHT TO BE ENGULFED

522

00:17:10,696 --> 00:17:12,965

BY A GLOBAL OCEAN UNDER A THICK

523

00:17:12,965 --> 00:17:13,565

CRUST OF ICE.

524

00:17:13,565 --> 00:17:15,934

UNTIL FACT, IT'S GOT TWICE AS

525

00:17:15,934 --> 00:17:17,503

MUCH OCEAN AS PLANET EARTH.

526

00:17:17,503 --> 00:17:19,605

IF WE HAVE A SALTY OCEAN IN

527

00:17:19,605 --> 00:17:22,007

CONTACT WITH A ROCKY CORE AND

528

00:17:22,007 --> 00:17:23,842

ENERGY FROM A VARIETY OF SOURCES

529

00:17:23,842 --> 00:17:25,411

AS WE JUST HEARD FROM MARY, WE

530

00:17:25,411 --> 00:17:27,413

HAVE MANY OF THE INGREDIENTS

531

00:17:27,413 --> 00:17:28,680

THOUGHT TO BE NECESSARY FOR

532

00:17:28,680 --> 00:17:34,219

LIFE.

533

00:17:34,219 --> 00:17:35,387

>> YOUR OBSERVATIONS FROM

534

00:17:35,387 --> 00:17:36,855

HUBBLE, WHAT ARE YOU NOW SEEING

535

00:17:36,855 --> 00:17:39,491

THAT'S IMPORTANT TO OUR

536

00:17:39,491 --> 00:17:43,028

UNDERSTANDING OF HABITABILITY ON

537

00:17:43,028 --> 00:17:43,429

EUROPA?

538

00:17:43,429 --> 00:17:45,230

>> IN 2014, WE USED THE HUBBLE

539

00:17:45,230 --> 00:17:46,465

AND DETECTED EVIDENCE OF WHAT

540

00:17:46,465 --> 00:17:48,801

ARE PROBABLY WATER VAPOR PLUMES

541

00:17:48,801 --> 00:17:51,703

EMERGING FROM THE SURFACE OF

542

00:17:51,703 --> 00:17:52,037

EUROPA.

543

00:17:52,037 --> 00:17:52,738

THAT'S IMPORTANT BECAUSE IT

544

00:17:52,738 --> 00:17:54,740

COULD BE GIVING US ACCESS TO

545

00:17:54,740 --> 00:17:55,941

SURFACE LIQUID WATER WITHOUT

546

00:17:55,941 --> 00:17:57,709

HAVING TO DRILL THROUGH MILES OF

547

00:17:57,709 --> 00:17:58,010

ICE.

548

00:17:58,010 --> 00:18:01,046

IN 2016, THE NEW OBSERVATIONS

549

00:18:01,046 --> 00:18:03,148

THAT WE ARE JUST PUBLISHING, WE

550

00:18:03,148 --> 00:18:05,551

SAW SIMILAR CANDIDATE, ALMOST

551  
00:18:05,551 --> 00:18:07,619  
IDENTICAL IN APPEARANCE AND AT

552  
00:18:07,619 --> 00:18:10,756  
THE IDENTICAL LOCATION TO ONE OF

553  
00:18:10,756 --> 00:18:12,224  
THE 2014 CANDIDATES.

554  
00:18:12,224 --> 00:18:14,560  
IT'S VERY IMPORTANT IN AN

555  
00:18:14,560 --> 00:18:16,895  
INTERMITTENT PHENOMENON, TO

556  
00:18:16,895 --> 00:18:17,896  
ESTABLISH REPEATABILITY.

557  
00:18:17,896 --> 00:18:20,399  
IT GIVES US MORE FAITH IN THE

558  
00:18:20,399 --> 00:18:20,799  
OBSERVATION.

559  
00:18:20,799 --> 00:18:22,334  
THE OTHER THING IT ALLOWS US TO

560  
00:18:22,334 --> 00:18:25,204  
DO GIVEN THE POSITION OF THE

561  
00:18:25,204 --> 00:18:27,473  
CANDIDATE ON EUROPA IS TO LOOK

562  
00:18:27,473 --> 00:18:29,208  
WITH MORE FIDELITY AT THAT

563  
00:18:29,208 --> 00:18:30,309

POSITION AND SEE WHAT ELSE WE

564

00:18:30,309 --> 00:18:30,976

CAN FIND THERE.

565

00:18:30,976 --> 00:18:33,879

IF WE JUST LOOK AT THE MAP OF

566

00:18:33,879 --> 00:18:35,647

EUROPA, WE DON'T SEE ANYTHING

567

00:18:35,647 --> 00:18:37,683

PARTICULARLY REMARKABLE ABOUT

568

00:18:37,683 --> 00:18:39,818

THE EXACT LOCATION OF THIS PLUME

569

00:18:39,818 --> 00:18:42,087

CANDIDATE SHOWN BY THE GREEN

570

00:18:42,087 --> 00:18:42,421

ELIPSE.

571

00:18:42,421 --> 00:18:45,624

BUT IF WE LOOK BACK TO THE

572

00:18:45,624 --> 00:18:48,060

GALLILEO DATA, GALLILEO IN THE

573

00:18:48,060 --> 00:18:50,128

1990s PUBLISHED A THERMAL

574

00:18:50,128 --> 00:18:50,529

IMAGE.

575

00:18:50,529 --> 00:18:52,164

RIGHT AT THE PEAK OF THE THERMAL

576  
00:18:52,164 --> 00:18:54,366  
IMAGE, THAT'S WHERE THE PLUME

577  
00:18:54,366 --> 00:18:55,434  
CANDIDATE IS.

578  
00:18:55,434 --> 00:18:58,003  
THIS HOT SPOT ON THE SURFACE OF

579  
00:18:58,003 --> 00:18:59,471  
EUROPA, ON THE EUROPA NIGHT

580  
00:18:59,471 --> 00:19:00,906  
SIDE, WAS IDENTIFIED AT THE TIME

581  
00:19:00,906 --> 00:19:05,911  
AS A THERMAL ANOMALY AND IT'S

582  
00:19:05,911 --> 00:19:07,246  
SITTING RIGHT ON TOP OF THE

583  
00:19:07,246 --> 00:19:08,847  
POSITION OF OUR PLUME CANDIDATE.

584  
00:19:08,847 --> 00:19:09,481  
>> BILL, WOW.

585  
00:19:09,481 --> 00:19:10,649  
THAT'S FANTASTIC.

586  
00:19:10,649 --> 00:19:13,485  
YOU KNOW, WE DIDN'T KNOW WHEN

587  
00:19:13,485 --> 00:19:15,287  
GALLILEO WAS FLYING BY EUROPA

588  
00:19:15,287 --> 00:19:17,623

HOW THE OCEAN COULD POSSIBLY

589

00:19:17,623 --> 00:19:19,424

COMMUNICATE WITH THE SURFACE.

590

00:19:19,424 --> 00:19:21,760

AND NOW, THESE PLUMES THAT

591

00:19:21,760 --> 00:19:24,630

HUBBLE MAY BE OBSERVING IS

592

00:19:24,630 --> 00:19:27,766

GIVING US THAT TANTALIZING

593

00:19:27,766 --> 00:19:32,771

GLIMPSE, SOMETHING THAT WE SEE

594

00:19:32,771 --> 00:19:34,206

ON INSOLIDUS MAY BE GOING ON.

595

00:19:34,206 --> 00:19:35,440

CAN YOU TELL US MORE ABOUT HOW

596

00:19:35,440 --> 00:19:37,442

THE PLUMES AND HOT SPOT MIGHT

597

00:19:37,442 --> 00:19:38,610

RELATE TO EACH OTHER?

598

00:19:38,610 --> 00:19:40,412

>> YES, IT'S REALLY INTRIGUING.

599

00:19:40,412 --> 00:19:42,314

QUITE ASTONISHING IN FACT JUST

600

00:19:42,314 --> 00:19:43,982

TO SEE THE COINCIDENCE OF THE

601  
00:19:43,982 --> 00:19:46,218  
TWO.

602  
00:19:46,218 --> 00:19:47,119  
BUT IT WASN'T AN ACCIDENT THAT

603  
00:19:47,119 --> 00:19:49,254  
WE LOOKED FOR THE THERMAL

604  
00:19:49,254 --> 00:19:49,721  
IMAGING.

605  
00:19:49,721 --> 00:19:54,493  
WE DID IT TO FIND -- AS WE ALL

606  
00:19:54,493 --> 00:19:56,028  
KNOW, THE PLUMES OF INSOLIDUS

607  
00:19:56,028 --> 00:19:58,897  
ARE ASSOCIATED WITH A HEAT

608  
00:19:58,897 --> 00:19:59,231  
SOURCE.

609  
00:19:59,231 --> 00:20:01,199  
AND ITS VERY DISTINCTIVE

610  
00:20:01,199 --> 00:20:01,567  
SIGNATURE.

611  
00:20:01,567 --> 00:20:02,901  
WE LOOKED TO SEE IF WE COULD

612  
00:20:02,901 --> 00:20:05,671  
FIND THERMAL IMAGING OF THE

613  
00:20:05,671 --> 00:20:06,405

SURFACE OF EUROPA.

614

00:20:06,405 --> 00:20:07,139

AND WE DID.

615

00:20:07,139 --> 00:20:10,342

THE PEAK HOTTEST SPOT ON THE

616

00:20:10,342 --> 00:20:11,743

NIGHT SIDE WAS RIGHT WHERE OUR

617

00:20:11,743 --> 00:20:13,011

PLUME CANDIDATE WAS.

618

00:20:13,011 --> 00:20:14,613

THERE ARE TWO POSSIBLE

619

00:20:14,613 --> 00:20:16,114

EXPLANATIONS FOR A CAUSAL

620

00:20:16,114 --> 00:20:16,648

CONNECTION.

621

00:20:16,648 --> 00:20:18,650

OBVIOUSLY COINCIDENCES CAN JUST

622

00:20:18,650 --> 00:20:21,053

OCCUR BUT THERE ARE INSTANCES TO

623

00:20:21,053 --> 00:20:22,554

THINK THERE'S A CAUSAL

624

00:20:22,554 --> 00:20:22,988

RELATIONSHIP.

625

00:20:22,988 --> 00:20:24,222

ONE POSSIBILITY IS IF THERE'S

626  
00:20:24,222 --> 00:20:25,757  
LIQUID WATER AT THE DEPTH BELOW

627  
00:20:25,757 --> 00:20:27,659  
THE ICE SURFACE AND THE LIQUID

628  
00:20:27,659 --> 00:20:30,529  
WATER IS OBVIOUSLY WARMER, THE

629  
00:20:30,529 --> 00:20:31,863  
HEAT CAN FLOW UP THROUGH THE ICE

630  
00:20:31,863 --> 00:20:34,666  
AND CAUSE A THERMAL ANOMALY AND

631  
00:20:34,666 --> 00:20:35,834  
CRACKS IN THE ICE COULD GIVE US

632  
00:20:35,834 --> 00:20:36,735  
THE PLUME.

633  
00:20:36,735 --> 00:20:38,103  
CONVERSELY, THE PLUMES

634  
00:20:38,103 --> 00:20:40,138  
THEMSELVES COULD SIMPLY BE

635  
00:20:40,138 --> 00:20:43,976  
VENTING WATER VAPOR HIGH INTO

636  
00:20:43,976 --> 00:20:46,011  
SPACE FROM THE EUROPA SURFACE.

637  
00:20:46,011 --> 00:20:48,747  
WE SEE PLUMES RISING TO 100

638  
00:20:48,747 --> 00:20:50,449

KILOMETERS, 60 MILES, AND WE

639

00:20:50,449 --> 00:20:52,217

WOULD EXPECT THE WATER VAPOR TO

640

00:20:52,217 --> 00:20:53,852

SPREAD OUT OVER A MUCH BIGGER

641

00:20:53,852 --> 00:20:55,721

AREA THAN THAT.

642

00:20:55,721 --> 00:20:57,856

WE AREN'T AT ESCAPE VELOCITY SO

643

00:20:57,856 --> 00:20:59,424

IT'S GOT TO COME BACK DOWN.

644

00:20:59,424 --> 00:21:01,293

IF A FINE MIST OF WATER VAPOR

645

00:21:01,293 --> 00:21:02,628

RAINS BACK DOWN ON TO THE

646

00:21:02,628 --> 00:21:03,795

SURFACE, IT CAN CHANGE THE

647

00:21:03,795 --> 00:21:04,763

THERMAL CHARACTER OF THAT

648

00:21:04,763 --> 00:21:06,698

SURFACE AND ALLOW IT TO RETAIN

649

00:21:06,698 --> 00:21:07,399

HEAT LONGER.

650

00:21:07,399 --> 00:21:08,834

SO, INSTEAD OF HEAT COMING UP

651  
00:21:08,834 --> 00:21:10,302  
FROM BELOW, IT COULD BE HEAT

652  
00:21:10,302 --> 00:21:13,905  
FROM ABOVE BEING SLOWLY

653  
00:21:13,905 --> 00:21:15,807  
RERADIATED DURING THE EUROPA

654  
00:21:15,807 --> 00:21:16,241  
NIGHTTIME.

655  
00:21:16,241 --> 00:21:18,844  
SO, IT'S VERY INTRIGUING PAIR OF

656  
00:21:18,844 --> 00:21:19,177  
RESULTS.

657  
00:21:19,177 --> 00:21:20,812  
WE DISCOVERED A REPEATING PLUME

658  
00:21:20,812 --> 00:21:22,014  
CANDIDATE AND WHEN WE LOOKED AT

659  
00:21:22,014 --> 00:21:23,949  
THE GALLILEO DATA, WE FOUND A

660  
00:21:23,949 --> 00:21:25,751  
POSITION OF THAT REPEATING PLUME

661  
00:21:25,751 --> 00:21:26,918  
CANDIDATE THAT WAS RIGHT AT THE

662  
00:21:26,918 --> 00:21:29,821  
POSITION OF A THERMAL ANOMALY.

663  
00:21:29,821 --> 00:21:31,890

WE LOOK FORWARD TO THE EUROPA

664

00:21:31,890 --> 00:21:32,924

CLIPPER MISSION WHICH JIM IS

665

00:21:32,924 --> 00:21:36,395

GOING TO TELL US ABOUT AND THAT

666

00:21:36,395 --> 00:21:37,829

WILL CHARACTERIZE THIS AND OTHER

667

00:21:37,829 --> 00:21:39,064

AREAS IN GREAT DETAIL.

668

00:21:39,064 --> 00:21:41,900

>> YOU KNOW, THE CASINI

669

00:21:41,900 --> 00:21:43,035

OBSERVATIONS THAT INSOLIDUS AND

670

00:21:43,035 --> 00:21:45,070

THE HUBBLE OBSERVATIONS AT

671

00:21:45,070 --> 00:21:46,538

EUROPA TELLS YOU WE ARE USING

672

00:21:46,538 --> 00:21:47,873

EVERYTHING IN OUR ARSENAL TO

673

00:21:47,873 --> 00:21:49,608

PROBE THESE NEW OCEAN WORLDS

674

00:21:49,608 --> 00:21:50,842

THAT WE HAVE DISCOVERED.

675

00:21:50,842 --> 00:21:53,812

THIS IS TRULY A REALLY EXCITING

676  
00:21:53,812 --> 00:21:54,413  
TIME.

677  
00:21:54,413 --> 00:21:56,581  
CASINI UNFORTUNATELY IS NEAR ITS

678  
00:21:56,581 --> 00:21:59,317  
END . IT WILL BE PLUNGED INTO

679  
00:21:59,317 --> 00:22:01,153  
THE ATMOSPHERE OF SATURN, IT

680  
00:22:01,153 --> 00:22:03,388  
IT'S RUNNING OUT OF FUEL, ON THE

681  
00:22:03,388 --> 00:22:04,456  
15th OF SEPTEMBER.

682  
00:22:04,456 --> 00:22:06,425  
AND SO THESE, IN DEED, ARE THE

683  
00:22:06,425 --> 00:22:08,393  
LAST DISCOVERIES THAT WE ARE

684  
00:22:08,393 --> 00:22:11,530  
TALKING ABOUT FROM CASINI AS IT

685  
00:22:11,530 --> 00:22:12,831  
RELATES TO INSOLIDUS.

686  
00:22:12,831 --> 00:22:14,232  
THE NEXT BIG MISSION THAT WE ARE

687  
00:22:14,232 --> 00:22:16,868  
WORKING ON IS CALLED THE EUROPA

688  
00:22:16,868 --> 00:22:17,769

CLIPPER AND THIS PARTICULAR

689

00:22:17,769 --> 00:22:21,473

MISSION IS GOING TO INSOLIDUS.

690

00:22:21,473 --> 00:22:23,008

THERE ARE NINE MAJOR INSTRUMENTS

691

00:22:23,008 --> 00:22:23,508

ON IT.

692

00:22:23,508 --> 00:22:24,843

AND THESE DISCOVERIES ARE COMING

693

00:22:24,843 --> 00:22:26,945

AT JUST THE PERFECT TIME.

694

00:22:26,945 --> 00:22:29,347

IT ENABLES US TO MAKE THE RIGHT

695

00:22:29,347 --> 00:22:31,783

SET OF OBSERVATIONS THAT CAN

696

00:22:31,783 --> 00:22:34,252

TELL US MUCH MORE ABOUT THESE

697

00:22:34,252 --> 00:22:35,554

OCEAN WORLDS.

698

00:22:35,554 --> 00:22:37,622

EUROPA IN PARTICULAR.

699

00:22:37,622 --> 00:22:40,492

CAN I HAVE MY VIDEO, PLEASE?

700

00:22:40,492 --> 00:22:42,894

THE EUROPA CLIPPER WILL ORBIT

701  
00:22:42,894 --> 00:22:46,898  
JUPITER, BUT IT MAKES VERY CLOSE

702  
00:22:46,898 --> 00:22:48,633  
FLY-BYES OF EUROPA.

703  
00:22:48,633 --> 00:22:52,871  
IT HAS INSTRUMENTS LIKE THE

704  
00:22:52,871 --> 00:22:54,005  
MAGNETOMETER, ONCE AGAIN, THAT

705  
00:22:54,005 --> 00:22:55,607  
WILL MAKE MEASUREMENTS OF ITS

706  
00:22:55,607 --> 00:22:55,907  
OCEAN.

707  
00:22:55,907 --> 00:22:59,077  
IT ALSO HAS AN ICE-PENETRATING

708  
00:22:59,077 --> 00:22:59,478  
RADAR.

709  
00:22:59,478 --> 00:23:01,880  
THIS RADAR WILL TELL US HOW

710  
00:23:01,880 --> 00:23:03,982  
THICK OR THIN THESE ICE SHELLS

711  
00:23:03,982 --> 00:23:05,751  
ARE AND HOW CLOSE THEN THE OCEAN

712  
00:23:05,751 --> 00:23:07,385  
MIGHT BE TO CRACKS.

713  
00:23:07,385 --> 00:23:09,287

THE NEXT MAJOR INSTRUMENT THAT

714

00:23:09,287 --> 00:23:11,189

IT HAS IS THERMAL IMAGING GOING

715

00:23:11,189 --> 00:23:13,925

BACK TO WHAT WE LEARNED FROM

716

00:23:13,925 --> 00:23:15,961

INSOLIDUS -- HOW HOT ARE THESE

717

00:23:15,961 --> 00:23:16,261

AREAS?

718

00:23:16,261 --> 00:23:17,562

ARE THERE CRACKS THERE LIKE WE

719

00:23:17,562 --> 00:23:20,832

SEE NOW WITH THE PLUMES FROM THE

720

00:23:20,832 --> 00:23:23,902

HUBBLE OBSERVATIONS AND THE HOT

721

00:23:23,902 --> 00:23:26,238

SPOTS STILL BEING HOT FROM

722

00:23:26,238 --> 00:23:28,240

GALLILEO OBSERVATIONS MORE THAN

723

00:23:28,240 --> 00:23:29,875

15 OR SO YEARS AGO?

724

00:23:29,875 --> 00:23:33,512

IN ADDITION TO THAT, WE HAVE A

725

00:23:33,512 --> 00:23:34,913

U.V. SPECTROMETER.

726

00:23:34,913 --> 00:23:36,982

THIS IMAGER IS GOING TO BE THE

727

00:23:36,982 --> 00:23:37,716

PLUME FINDER.

728

00:23:37,716 --> 00:23:39,885

SO AS WE GO BACK, ORBIT OUT AWAY

729

00:23:39,885 --> 00:23:41,920

FROM JUPITER, WE ARE GOING TO

730

00:23:41,920 --> 00:23:42,988

LOOK BACK AT INSOLIDUS.

731

00:23:42,988 --> 00:23:44,289

WE WILL BE LOOKING FOR THOSE

732

00:23:44,289 --> 00:23:45,624

PLUMES AND THEN DIVING BACK IN

733

00:23:45,624 --> 00:23:47,826

AND HOPEFULLY, IF EVERYTHING

734

00:23:47,826 --> 00:23:50,729

WORKS RIGHT, FLYING THROUGH THE

735

00:23:50,729 --> 00:23:53,932

PLUMES MUCH LIKE CASINI HAS DONE

736

00:23:53,932 --> 00:23:54,766

AT INSOLIDUS.

737

00:23:54,766 --> 00:23:55,934

BUT, NOW WE'LL HAVE THE RIGHT

738

00:23:55,934 --> 00:23:59,237

SET OF OBSERVATIONS TO MAKE.

739

00:23:59,237 --> 00:24:01,606

ON THAT SPACE CRAFT, THE EUROPA

740

00:24:01,606 --> 00:24:03,275

CLIPPER WILL HAVE AN ADVANCED

741

00:24:03,275 --> 00:24:06,178

MASS SPECTROMETER, ACTUALLY

742

00:24:06,178 --> 00:24:08,280

HUNTER WAITE IS OUR PRINCIPLE

743

00:24:08,280 --> 00:24:09,080

INVESTIGATOR FOR THAT

744

00:24:09,080 --> 00:24:10,515

INSTRUMENT.

745

00:24:10,515 --> 00:24:14,252

SO, WHAT A FANTASTIC TIME COMING

746

00:24:14,252 --> 00:24:14,586

UP.

747

00:24:14,586 --> 00:24:16,655

THESE OBSERVATIONS ARE REALLY

748

00:24:16,655 --> 00:24:18,490

INFORMING US OF MAJOR THINGS

749

00:24:18,490 --> 00:24:20,292

HAPPENING IN THESE OCEAN WORLDS

750

00:24:20,292 --> 00:24:22,427

RIGHT NOW . WHAT I REALLY WANT

751  
00:24:22,427 --> 00:24:24,729  
YOU TO WALK AWAY WITH IS -- WE

752  
00:24:24,729 --> 00:24:26,531  
ARE PUSHING THE FRONTIERS.

753  
00:24:26,531 --> 00:24:29,601  
WE ARE FINDING NEW ENVIRONMENTS.

754  
00:24:29,601 --> 00:24:32,003  
WE ARE LOOKING IN A WAY THAT WE

755  
00:24:32,003 --> 00:24:34,239  
HAVE NEVER THOUGHT POSSIBLE

756  
00:24:34,239 --> 00:24:37,242  
BEFORE FOR ENVIRONMENTS IN OUR

757  
00:24:37,242 --> 00:24:39,544  
SOLAR SYSTEM WHICH MAY HARBOR

758  
00:24:39,544 --> 00:24:40,979  
LIFE TODAY.

759  
00:24:40,979 --> 00:24:42,747  
WITH THAT, LET ME GIVE IT BACK

760  
00:24:42,747 --> 00:24:46,952  
TO FELICIA.

761  
00:24:46,952 --> 00:24:47,619  
>> THANKS, JIM.

762  
00:24:47,619 --> 00:24:51,656  
NOW WE WILL GO INTO A Q. AND A.

763  
00:24:51,656 --> 00:24:51,990

SESSION.

764

00:24:51,990 --> 00:24:54,092

USE THE HASHTAG ASK NASA FOR

765

00:24:54,092 --> 00:24:54,960

THOSE ONLINE.

766

00:24:54,960 --> 00:24:56,394

FOR THOSE IN THE ROOM, IF YOU

767

00:24:56,394 --> 00:24:57,762

WOULD LIKE TO ASK A QUESTION,

768

00:24:57,762 --> 00:24:59,030

PLEASE RAISE YOUR HAND.

769

00:24:59,030 --> 00:25:00,532

IF YOU ARE PRESS, PLEASE STATE

770

00:25:00,532 --> 00:25:01,933

YOUR NAME AND AFFILIATION.

771

00:25:01,933 --> 00:25:02,868

LET'S START WITH QUESTIONS FROM

772

00:25:02,868 --> 00:25:06,638

THE ROOM.

773

00:25:06,638 --> 00:25:06,938

OK.

774

00:25:06,938 --> 00:25:08,106

WELL, BEFORE WE GO TO QUESTIONS

775

00:25:08,106 --> 00:25:09,975

FROM THE ROOM, LET'S GO AHEAD TO

776

00:25:09,975 --> 00:25:10,842

THE PHONE LINES.

777

00:25:10,842 --> 00:25:13,311

FIRST WE HAVE CAMILLE CARLISLE

778

00:25:13,311 --> 00:25:14,679

FROM THE SKY AND TELESCOPE

779

00:25:14,679 --> 00:25:16,381

MAGAZINE.

780

00:25:16,381 --> 00:25:16,748

>> HI.

781

00:25:16,748 --> 00:25:18,183

CAN YOU HEAR ME?

782

00:25:18,183 --> 00:25:19,584

>> YES.

783

00:25:19,584 --> 00:25:19,985

>> OK.

784

00:25:19,985 --> 00:25:22,954

THANKS FOR TAKING MY CALL.

785

00:25:22,954 --> 00:25:23,822

TWO QUESTIONS.

786

00:25:23,822 --> 00:25:26,157

ONE, YOU MENTIONED THAT WE

787

00:25:26,157 --> 00:25:27,525

ESSENTIALLY HAVE A CALORIE COUNT

788

00:25:27,525 --> 00:25:28,994

NOW WITH THIS HYDROGEN.

789

00:25:28,994 --> 00:25:30,195

CAN YOU TELL US HOW MUCH ENERGY

790

00:25:30,195 --> 00:25:30,929

IS AVAILABLE?

791

00:25:30,929 --> 00:25:32,297

CAN YOU PUT SOME SORT OF DETAIL

792

00:25:32,297 --> 00:25:33,164

ON THAT?

793

00:25:33,164 --> 00:25:34,833

AND -- THIS IS A LOGISTICS

794

00:25:34,833 --> 00:25:35,200

QUESTION.

795

00:25:35,200 --> 00:25:36,234

MAYBE I MISSED IT.

796

00:25:36,234 --> 00:25:37,836

IS THERE A WEBSITE FOR ALL THE

797

00:25:37,836 --> 00:25:39,471

PRESS IMAGES THAT WE CAN GO TO

798

00:25:39,471 --> 00:25:41,139

AND GET THEM?

799

00:25:41,139 --> 00:25:42,707

>> SO FELICIA, CAN YOU TELL US

800

00:25:42,707 --> 00:25:43,375

THE PRESS SITE?

801  
00:25:43,375 --> 00:25:48,380  
AND WE WILL GO TO J.P.L. TO GET

802  
00:25:48,380 --> 00:25:49,114  
THE CALORIE COUNT.

803  
00:25:49,114 --> 00:25:51,049  
>> IF YOU WANT MORE INFORMATION,

804  
00:25:51,049 --> 00:25:56,221  
GO TO NASA .GOV.

805  
00:25:56,221 --> 00:25:58,023  
OUR PRESS RELEASE WILL BE THERE.

806  
00:25:58,023 --> 00:26:01,059  
I BELIEVE BY GOING TO THE J.P.L.

807  
00:26:01,059 --> 00:26:02,460  
SAT EARN PAGE THERE WILL BE

808  
00:26:02,460 --> 00:26:02,827  
MATERIALS.

809  
00:26:02,827 --> 00:26:04,429  
PLEASE JUST GO TO THE TWO SITES

810  
00:26:04,429 --> 00:26:05,497  
THAT WERE ON THE SCREEN EARLIER

811  
00:26:05,497 --> 00:26:07,165  
AND YOU SHOULD BE ABLE TO GET

812  
00:26:07,165 --> 00:26:08,300  
THE MATERIALS YOU NEED.

813  
00:26:08,300 --> 00:26:09,267

FOR THE SECOND PART OF THE

814

00:26:09,267 --> 00:26:14,839

QUESTION, LET'S GO TO J.P.L.

815

00:26:14,839 --> 00:26:16,174

>> IT'S AN EXCELLENT QUESTION.

816

00:26:16,174 --> 00:26:18,243

THE PLUME GAS MIXTURE FROM THE

817

00:26:18,243 --> 00:26:19,444

HYDROGEN NUMBER WE DERIVE SAN

818

00:26:19,444 --> 00:26:23,081

DIEGO EQUIVALENT TO ROUGHLY 300

819

00:26:23,081 --> 00:26:24,683

PIZZAS PER HOUR IN ITS ENERGY

820

00:26:24,683 --> 00:26:26,818

CONTENT.

821

00:26:26,818 --> 00:26:33,325

>> WHAT DOES THAT MEAN?

822

00:26:33,325 --> 00:26:34,392

>> NEXT WE HAVE ON THE PHONE

823

00:26:34,392 --> 00:26:40,632

LINES WE HAVE ERIC BERGER.

824

00:26:40,632 --> 00:26:40,999

>> HI.

825

00:26:40,999 --> 00:26:43,168

THANKS VERY MUCH FOR HAVING THIS

826  
00:26:43,168 --> 00:26:43,468  
CALL.

827  
00:26:43,468 --> 00:26:47,238  
I WAS QUESTIONED ABOUT THE PLUME

828  
00:26:47,238 --> 00:26:47,739  
EVIDENCE, EUROPA.

829  
00:26:47,739 --> 00:26:49,341  
YOU SAID YOU FOUND IT IN 2014

830  
00:26:49,341 --> 00:26:51,309  
AND 2016 THIS EVIDENCE OF WATER

831  
00:26:51,309 --> 00:26:51,643  
PLUMES.

832  
00:26:51,643 --> 00:26:53,345  
HOW MANY TIMES DID YOU LOOK AND

833  
00:26:53,345 --> 00:26:54,346  
WAS IT NOT THERE?

834  
00:26:54,346 --> 00:26:56,414  
I GUESS WHAT I'M TRYING TO GET

835  
00:26:56,414 --> 00:26:58,583  
AT, IS THERE ANY SENSE OF HOW

836  
00:26:58,583 --> 00:26:59,751  
INTERMITTENT THIS PLUME MIGHT BE

837  
00:26:59,751 --> 00:27:01,886  
IF IT DOES, IN DEED, EXIST?

838  
00:27:01,886 --> 00:27:03,722

>> OF COURSE BILL NOW HAS BEEN

839

00:27:03,722 --> 00:27:06,291

ON THE, A NUMBER OF MAJOR

840

00:27:06,291 --> 00:27:07,926

OBSERVATIONS FROM HUBBLE.

841

00:27:07,926 --> 00:27:09,060

AND BILL CAN GIVE YOU THE

842

00:27:09,060 --> 00:27:13,264

ANSWER.

843

00:27:13,264 --> 00:27:13,665

>> YES.

844

00:27:13,665 --> 00:27:16,768

WE LOOKED 12 TIMES AND WE SAW IT

845

00:27:16,768 --> 00:27:18,737

TWICE IN THAT LOCATION.

846

00:27:18,737 --> 00:27:21,072

WE DID SEE SOME EVIDENCE OF

847

00:27:21,072 --> 00:27:23,641

PLUMES AROUND THE SOUTH POLE,

848

00:27:23,641 --> 00:27:25,410

POLAR REGIONS A COUPLE OF TIMES,

849

00:27:25,410 --> 00:27:25,710

TOO.

850

00:27:25,710 --> 00:27:30,048

BUT IT IT'S MUCH HARDER TO

851  
00:27:30,048 --> 00:27:31,082  
LOCATE THE SOURCE WHEN YOU ARE

852  
00:27:31,082 --> 00:27:33,018  
DOWN AT THE POLAR REGION.

853  
00:27:33,018 --> 00:27:35,453  
AND THERE ISN'T ANY COVERAGE BY

854  
00:27:35,453 --> 00:27:36,855  
GALLILEO IN THAT REGION, EITHER.

855  
00:27:36,855 --> 00:27:39,657  
SO, WE WERE LUCKY TO FIND THIS

856  
00:27:39,657 --> 00:27:41,493  
ONE THAT DID REPEAT WAS ACTUALLY

857  
00:27:41,493 --> 00:27:42,894  
NEAR THE EQUATOR.

858  
00:27:42,894 --> 00:27:45,130  
AND SO IT WAS TWICE OUT OF 12

859  
00:27:45,130 --> 00:27:45,430  
TIMES.

860  
00:27:45,430 --> 00:27:48,266  
ONE IN SIX.

861  
00:27:48,266 --> 00:27:49,401  
>> WOULD YOU CARE TO

862  
00:27:49,401 --> 00:27:50,435  
CHARACTERIZE HOW CONFIDENT YOU

863  
00:27:50,435 --> 00:27:58,777

ARE THESE ARE ACTUALLY PLUMES?

864

00:27:58,777 --> 00:27:59,611

>> THE STATISTICS TELL US THAT

865

00:27:59,611 --> 00:28:02,447

JUST FROM RANDOM PHOTON

866

00:28:02,447 --> 00:28:03,915

STATISTICS, THEY ARE REAL.

867

00:28:03,915 --> 00:28:09,587

THEY ARE WHAT WE CALL FOUR SIGMA

868

00:28:09,587 --> 00:28:10,288

RESULTS.

869

00:28:10,288 --> 00:28:11,322

THAT'S NOT QUITE AS STRONG

870

00:28:11,322 --> 00:28:12,690

EVIDENCE AS YOU WOULD REALLY

871

00:28:12,690 --> 00:28:12,991

LIKE.

872

00:28:12,991 --> 00:28:15,460

YOU WOULD PREFER IT TO BE

873

00:28:15,460 --> 00:28:16,494

STRONGER THAN THAT BECAUSE AT

874

00:28:16,494 --> 00:28:17,328

THAT LEVEL THERE'S ALWAYS THE

875

00:28:17,328 --> 00:28:18,396

POSSIBILITY THAT THERE'S SOME

876

00:28:18,396 --> 00:28:20,198

SORT OF INSTRUMENTAL EFFECT THAT

877

00:28:20,198 --> 00:28:21,533

YOU DON'T KNOW ABOUT.

878

00:28:21,533 --> 00:28:25,904

WE HAVE COVERED OUR SELFS IN

879

00:28:25,904 --> 00:28:27,705

TERMS OF TRYING TO UNDERSTAND

880

00:28:27,705 --> 00:28:29,040

WHAT POSSIBLE INSTRUMENTAL

881

00:28:29,040 --> 00:28:32,477

EFFECTS COULD HAVE CAUSED THIS.

882

00:28:32,477 --> 00:28:34,412

AND EVERY SINGLE ONE THAT WE CAN

883

00:28:34,412 --> 00:28:36,081

THINK OF DOES NOT APPEAR TO BE

884

00:28:36,081 --> 00:28:37,449

CAPABLE OF DOING IT.

885

00:28:37,449 --> 00:28:39,784

SO, FOR EXAMPLE, THE TWO

886

00:28:39,784 --> 00:28:41,086

OBSERVATIONS THAT I SHOWED,

887

00:28:41,086 --> 00:28:42,887

ALTHOUGH THEY LOOK THE SAME IN

888

00:28:42,887 --> 00:28:44,422

THE SAME POSITION WHEN WE

889

00:28:44,422 --> 00:28:46,658

PROJECT THEM ON THE SKY, WHEN

890

00:28:46,658 --> 00:28:48,393

THEY WERE TAKEN WITH THE CAMERA,

891

00:28:48,393 --> 00:28:50,361

THE HUBBLE WAS IN A COMPLETELY

892

00:28:50,361 --> 00:28:52,530

DIFFERENT ORIENTATION FOR THOSE

893

00:28:52,530 --> 00:28:53,331

TWO IMAGES.

894

00:28:53,331 --> 00:28:54,799

SO THEY ARE IN COMPLETELY

895

00:28:54,799 --> 00:28:56,167

DIFFERENT PARTS OF THE CAMERA

896

00:28:56,167 --> 00:28:59,037

WITH THE TELESCOPE ROLLED AROUND

897

00:28:59,037 --> 00:29:00,939

AT A COME PLATELY DIFFERENT

898

00:29:00,939 --> 00:29:01,272

ANGLE.

899

00:29:01,272 --> 00:29:03,341

AND THAT ELIMINATES THE WHOLE

900

00:29:03,341 --> 00:29:05,643

BUNCH OF POTENTIAL SYSTEMATICS

901  
00:29:05,643 --> 00:29:06,678  
THAT COULD HAVE CAUSED IT.

902  
00:29:06,678 --> 00:29:11,483  
SO FROM THE HUBBLE PERSPECTIVE,

903  
00:29:11,483 --> 00:29:13,151  
WE ARE -- I WOULDN'T SAY -- IT'S

904  
00:29:13,151 --> 00:29:17,188  
NOT COMPLETELY UNEQUIVOCAL THE

905  
00:29:17,188 --> 00:29:19,591  
WAY IS IT WITH INSOLIDUS.

906  
00:29:19,591 --> 00:29:20,959  
WE ARE STILL AT THE LIMITS OF

907  
00:29:20,959 --> 00:29:22,193  
WHAT HUBBLE CAN DO, BUT WE ARE

908  
00:29:22,193 --> 00:29:23,928  
GROWING IN CONFIDENCE BECAUSE OF

909  
00:29:23,928 --> 00:29:26,698  
THE REPEAT AND IN MY CASE, I

910  
00:29:26,698 --> 00:29:29,033  
FIND THE CORRELATION WITH

911  
00:29:29,033 --> 00:29:30,535  
GALLILEO THERMAL DATA QUITE

912  
00:29:30,535 --> 00:29:31,936  
INTRIGUING AND QUITE COMPELLING.

913  
00:29:31,936 --> 00:29:34,038

>> YOU KNOW FROM MY PERSPECTIVE

914

00:29:34,038 --> 00:29:36,374

AS BILL MENTIONED, THESE PLUMES

915

00:29:36,374 --> 00:29:38,643

ARE UP TO 50 KILOMETERS AND

916

00:29:38,643 --> 00:29:41,980

PERHAPS AS HIGH AS 100

917

00:29:41,980 --> 00:29:42,380

KILOMETERS.

918

00:29:42,380 --> 00:29:44,115

EUROPA IS THE SIZE OF OUR OWN

919

00:29:44,115 --> 00:29:44,415

MOON.

920

00:29:44,415 --> 00:29:45,850

IT'S AN ENORMOUS BODY.

921

00:29:45,850 --> 00:29:48,953

AND THEREFORE, THERE MUST BE

922

00:29:48,953 --> 00:29:50,155

ENORMOUS ENERGY TO BE ABLE TO

923

00:29:50,155 --> 00:29:52,991

LOFT THESE POTENTIAL WATER JETS

924

00:29:52,991 --> 00:29:56,361

HIGH ENOUGH FOR US TO BE ABLE TO

925

00:29:56,361 --> 00:29:58,897

OBSERVE IT FIVE ASTRONOMICAL

926  
00:29:58,897 --> 00:29:59,531  
UNITS AWAY.

927  
00:29:59,531 --> 00:30:02,567  
IT'S A REMARKABLE SET OF

928  
00:30:02,567 --> 00:30:03,334  
OBSERVATIONS.

929  
00:30:03,334 --> 00:30:04,102  
UNFORTUNATELY, YOU KNOW, IT'S

930  
00:30:04,102 --> 00:30:15,513  
NOT AS PERIODIC AS THE INSOLIDUS

931  
00:30:15,513 --> 00:30:15,847  
PLUMES.

932  
00:30:15,847 --> 00:30:17,048  
GOING BACK AND LOOKING

933  
00:30:17,048 --> 00:30:18,583  
PERIODICALLY IT'S GIVING US THE

934  
00:30:18,583 --> 00:30:19,717  
CONFIDENCE THAT THEY ARE THERE.

935  
00:30:19,717 --> 00:30:21,119  
THEY MAY NOT BE AS PERIODIC BUT

936  
00:30:21,119 --> 00:30:22,854  
IN DEED NOW IT LOOKS LIKE THE

937  
00:30:22,854 --> 00:30:24,389  
WATER, THE OCEAN, IS

938  
00:30:24,389 --> 00:30:25,256

COMMUNICATING WITH THE SURFACE.

939

00:30:25,256 --> 00:30:27,892

BILL AND HIS TEAM IS ALSO

940

00:30:27,892 --> 00:30:29,794

TALKING ABOUT HOW THEY CAN MAKE

941

00:30:29,794 --> 00:30:31,162

MORE OBSERVATIONS BETWEEN NOW

942

00:30:31,162 --> 00:30:34,899

AND WHEN WE DO IN DEED LAUNCH

943

00:30:34,899 --> 00:30:36,568

THE EUROPEA CLIPPER IN THE

944

00:30:36,568 --> 00:30:36,935

2020s.

945

00:30:36,935 --> 00:30:38,803

>> LET'S GO TO THE PHONES.

946

00:30:38,803 --> 00:30:39,237

>> OK.

947

00:30:39,237 --> 00:30:40,605

WELL, BEFORE WE GO TO THE PHONES

948

00:30:40,605 --> 00:30:42,106

LET'S GO AHEAD TO SOCIAL MEDIA

949

00:30:42,106 --> 00:30:44,309

WHERE EMILY IS HELPING FIELD THE

950

00:30:44,309 --> 00:30:44,676

QUESTIONS.

951  
00:30:44,676 --> 00:30:45,910  
SO EMILY?

952  
00:30:45,910 --> 00:30:46,311  
>> SURE.

953  
00:30:46,311 --> 00:30:47,512  
WE HAVE A LOT OF GOOD QUESTIONS

954  
00:30:47,512 --> 00:30:47,979  
COMING IN.

955  
00:30:47,979 --> 00:30:51,683  
THIS FIRST ONE IS FROM T. BATINI

956  
00:30:51,683 --> 00:30:52,317  
ON TWITTER.

957  
00:30:52,317 --> 00:30:55,119  
SHE WANTS TO KNOW ARE WE TALKING

958  
00:30:55,119 --> 00:30:57,121  
ABOUT GIANT SQUIDS OR ALGAE AND

959  
00:30:57,121 --> 00:30:59,424  
BACTERIA?

960  
00:30:59,424 --> 00:30:59,891  
[LAUGHTER]

961  
00:30:59,891 --> 00:31:00,325  
>> MARY?

962  
00:31:00,325 --> 00:31:01,192  
>> I THINK THAT MOST OF US WOULD

963  
00:31:01,192 --> 00:31:02,527

BE EXCITED WITH ANY LIFE.

964

00:31:02,527 --> 00:31:04,362

AND WE ARE CERTAINLY WHEN WE ARE

965

00:31:04,362 --> 00:31:05,530

TALKING ABOUT THE SOURCES OF

966

00:31:05,530 --> 00:31:08,199

ENERGY, THIS IS TO FEED THE BASE

967

00:31:08,199 --> 00:31:09,033

OF A FOOD WEB.

968

00:31:09,033 --> 00:31:11,102

SO WE ARE GOING TO START WITH

969

00:31:11,102 --> 00:31:12,537

BACTERIA AND IF WE GET LUCKY,

970

00:31:12,537 --> 00:31:13,638

MAYBE THERE'S SOMETHING THAT'S

971

00:31:13,638 --> 00:31:14,772

LARGER.

972

00:31:14,772 --> 00:31:16,808

>> I THINK WHAT'S REALLY ALSO

973

00:31:16,808 --> 00:31:19,077

EXCITING ABOUT THESE DISCOVERIES

974

00:31:19,077 --> 00:31:22,914

IS THESE OCEAN WORLDS WITH THEIR

975

00:31:22,914 --> 00:31:24,849

PROTECTIVE OUTER SHELL, IF IN

976  
00:31:24,849 --> 00:31:27,518  
DEED THERE'S LIFE IN THERE, IT

977  
00:31:27,518 --> 00:31:29,921  
HAS TO BE COMPLETELY DIFFERENT

978  
00:31:29,921 --> 00:31:34,192  
THAN OURS IN THE SENSE THAT IT'S

979  
00:31:34,192 --> 00:31:36,728  
GENERATED IN A WAY THAT'S NOT

980  
00:31:36,728 --> 00:31:37,428  
RELATED TO OUR LIFE.

981  
00:31:37,428 --> 00:31:44,035  
WE CALL THAT A SECOND GENESIS.

982  
00:31:44,035 --> 00:31:47,005  
>> THE SECOND QUESTION IS FROM

983  
00:31:47,005 --> 00:31:49,040  
AT DECENT MAT'S EYE ON TWITTER.

984  
00:31:49,040 --> 00:31:50,975  
HE WANTS TO KNOW COULD THERE BE

985  
00:31:50,975 --> 00:31:54,279  
MOVEMENT OF ICE SURROUNDING

986  
00:31:54,279 --> 00:31:56,481  
INSOLIDUS SIMILAR TO PLATE

987  
00:31:56,481 --> 00:31:57,415  
TECTONICS HERE ON EARTH?

988  
00:31:57,415 --> 00:31:58,783

>> YOU KNOW, THAT'S A REALLY

989

00:31:58,783 --> 00:31:59,917

GREAT QUESTION AND THE REASON

990

00:31:59,917 --> 00:32:01,486

WHY IS, IT WAS ONLY WITHIN THE

991

00:32:01,486 --> 00:32:04,389

LAST COUPLE YEARS THAT WE HAVE

992

00:32:04,389 --> 00:32:09,460

STARTED TO LOOK BACK AT THE

993

00:32:09,460 --> 00:32:10,995

EUROPEA DATA THAT HAS BEEN

994

00:32:10,995 --> 00:32:12,664

GATHERED BY GALLILEO.

995

00:32:12,664 --> 00:32:18,536

GALLILEO ONLY MADE LIKE 10 OR 11

996

00:32:18,536 --> 00:32:21,272

FLY-BYES SUCCESSFULLY BY EUROPA.

997

00:32:21,272 --> 00:32:24,409

SO WE HAVE LIMITED ENERGY.

998

00:32:24,409 --> 00:32:27,045

BUT THERE APPEARS TO BE A

999

00:32:27,045 --> 00:32:30,448

LOCATION WHERE ONE SORT OF

1000

00:32:30,448 --> 00:32:32,317

SEDUCTION IS GOING ON IN A CRACK

1001  
00:32:32,317 --> 00:32:33,584  
WHERE ONE PLATE OF THE ICY SHELL

1002  
00:32:33,584 --> 00:32:35,019  
IS MOVING UNDERNEATH ANOTHER.

1003  
00:32:35,019 --> 00:32:36,854  
WE DON'T KNOW THAT THAT'S TRUE.

1004  
00:32:36,854 --> 00:32:39,624  
IT MAY BE A MUCH GREATER

1005  
00:32:39,624 --> 00:32:41,092  
LOCATION ALL AROUND THAT BODY.

1006  
00:32:41,092 --> 00:32:42,894  
BUT YOU CAN UNDERSTAND THE

1007  
00:32:42,894 --> 00:32:45,063  
STRESSES WHEN YOU THINK ABOUT

1008  
00:32:45,063 --> 00:32:46,764  
THE TIDAL FORCES.

1009  
00:32:46,764 --> 00:32:49,967  
EUROPA IS IN AN ELLIPTICAL ORBIT

1010  
00:32:49,967 --> 00:32:52,537  
AROUND JUPITER AND IT ALSO HAS

1011  
00:32:52,537 --> 00:32:53,671  
TIDAL FORCES BEING PUSHED AROUND

1012  
00:32:53,671 --> 00:33:01,546  
BY THE OTHER GALLILEON MOONS.

1013  
00:33:01,546 --> 00:33:02,947

EVERY TWO AND A HALF TO THREE

1014

00:33:02,947 --> 00:33:04,615

DAYS AS IT MAKES ITS ORBIT T IS

1015

00:33:04,615 --> 00:33:06,417

BEING SQUEEZED AND RELEASED AND

1016

00:33:06,417 --> 00:33:07,618

SQUEEZED AND RELEASED.

1017

00:33:07,618 --> 00:33:10,455

OUR ESTIMATE TODAY IS THAT THE

1018

00:33:10,455 --> 00:33:12,724

SURFACE MOVES AS MUCH AS 30

1019

00:33:12,724 --> 00:33:13,891

METERS -- THAT'S THE HEIGHT OF

1020

00:33:13,891 --> 00:33:16,794

AN EIGHT OR NINE-STORY BUILDING

1021

00:33:16,794 --> 00:33:19,664

-- EVERY TWO OR THREE DAYS.

1022

00:33:19,664 --> 00:33:22,266

THAT HEAT HAS GOT TO GO

1023

00:33:22,266 --> 00:33:22,667

SOMEWHERE.

1024

00:33:22,667 --> 00:33:23,901

AND THE PUSHING AND THE STRESSES

1025

00:33:23,901 --> 00:33:27,338

ON THE ICY SHELL MAY, IN DEED,

1026

00:33:27,338 --> 00:33:30,708

BE LIKE OUR PLATE TECTONICS.

1027

00:33:30,708 --> 00:33:32,510

>> CAN I ADD ONE THING ABOUT IT

1028

00:33:32,510 --> 00:33:33,644

THAT'S ACTUALLY IMPORTANT FOR

1029

00:33:33,644 --> 00:33:35,079

LIFE, SO HERE ON EARTH MANY

1030

00:33:35,079 --> 00:33:36,748

PEOPLE BELIEVE THAT WE WOULDN'T

1031

00:33:36,748 --> 00:33:38,316

HAVE SUSTAINED LIFE ON EARTH IF

1032

00:33:38,316 --> 00:33:41,252

IT WEREN'T FOR PLATE TECTONICS.

1033

00:33:41,252 --> 00:33:42,954

IT'S A GREAT PROCESS FOR

1034

00:33:42,954 --> 00:33:44,021

RECYCLING MATERIALS, BRINGING

1035

00:33:44,021 --> 00:33:45,723

THINGS THAT WE NEED TO SUPPORT

1036

00:33:45,723 --> 00:33:48,159

LIFE UP FROM THE MANTLE AND

1037

00:33:48,159 --> 00:33:48,559

BELOW.

1038

00:33:48,559 --> 00:33:51,028

AND SO, IT -- THAT KIND OF A

1039

00:33:51,028 --> 00:33:52,263

PROCESS IS VERY IMPORTANT ON

1040

00:33:52,263 --> 00:33:54,499

THESE ICY MOONS, AS WELL.

1041

00:33:54,499 --> 00:33:56,934

BECAUSE WE THINK ABOUT -- WE

1042

00:33:56,934 --> 00:33:57,902

HAVE JUST HEARD ABOUT SOME

1043

00:33:57,902 --> 00:33:58,803

SOURCES OF ENERGY THAT ARE

1044

00:33:58,803 --> 00:33:59,904

COMING FROM THE INTERACTION OF

1045

00:33:59,904 --> 00:34:02,006

THE WATER AND THE CORE.

1046

00:34:02,006 --> 00:34:04,175

WE ALSO THINK ON EUROPA THERE

1047

00:34:04,175 --> 00:34:06,911

ARE CREATIONS OF OXIDANTS AT THE

1048

00:34:06,911 --> 00:34:07,912

SURFACE AS A RESULT OF THE

1049

00:34:07,912 --> 00:34:09,447

RADIATION AT THE SURFACE.

1050

00:34:09,447 --> 00:34:15,286

AND WE NEED SOME SORT OF ACTIVE

1051  
00:34:15,286 --> 00:34:16,754  
SHELL, ICE TECTONICS, IF YOU

1052  
00:34:16,754 --> 00:34:18,222  
WILL, TO ACTUALLY BRING THOSE

1053  
00:34:18,222 --> 00:34:18,823  
INTO CONTACT.

1054  
00:34:18,823 --> 00:34:20,458  
MUCH LIKE A BATTERY WHERE YOU

1055  
00:34:20,458 --> 00:34:24,395  
HAVE A POSITIVE AND A NEGATIVE

1056  
00:34:24,395 --> 00:34:26,063  
POLE, TO ACTUALLY CONNECT AND

1057  
00:34:26,063 --> 00:34:26,664  
DRIVE LIFE.

1058  
00:34:26,664 --> 00:34:27,899  
THIS PROCESS IS REALLY IMPORTANT

1059  
00:34:27,899 --> 00:34:28,666  
FOR LIFE.

1060  
00:34:28,666 --> 00:34:29,033  
>> OK.

1061  
00:34:29,033 --> 00:34:29,834  
WELL THANK YOU VERY MUCH.

1062  
00:34:29,834 --> 00:34:31,102  
WE ARE GOING TO TAKE ONE MORE

1063  
00:34:31,102 --> 00:34:32,170

QUESTION FROM SOCIAL MEDIA AND

1064

00:34:32,170 --> 00:34:33,571

THEN WE WILL GO TO THE PHONE

1065

00:34:33,571 --> 00:34:33,871

LINES.

1066

00:34:33,871 --> 00:34:35,573

SO EMILY?

1067

00:34:35,573 --> 00:34:35,973

>> SURE.

1068

00:34:35,973 --> 00:34:37,341

THIS QUESTION IS FROM PHILLIP ON

1069

00:34:37,341 --> 00:34:38,810

FACEBOOK AND HE WANTS TO KNOW

1070

00:34:38,810 --> 00:34:40,178

WHICH MOON DO YOU THINK OFFERS

1071

00:34:40,178 --> 00:34:42,947

MORE POSSIBILITY OF LIFE ON IT?

1072

00:34:42,947 --> 00:34:44,382

EUROPA OR INSOLIDUS?

1073

00:34:44,382 --> 00:34:45,683

>> WOW, THAT IT'S A GOOD --

1074

00:34:45,683 --> 00:34:46,517

THAT'S A GREAT QUESTION.

1075

00:34:46,517 --> 00:34:48,186

I WISH I KNEW FOR SURE.

1076

00:34:48,186 --> 00:34:49,420

>> WELL I HAVE AN IDEA.

1077

00:34:49,420 --> 00:34:51,122

>> ALL RIGHT, MARY WILL GIVE IT

1078

00:34:51,122 --> 00:34:51,756

A SHOT.

1079

00:34:51,756 --> 00:34:53,224

>> WELL, SO I THINK THAT THIS

1080

00:34:53,224 --> 00:34:56,360

RESULT OF FINDING SUCH A

1081

00:34:56,360 --> 00:34:58,129

SIGNIFICANT AMOUNT OF

1082

00:34:58,129 --> 00:34:59,630

HYDROTHERMAL ACTIVITY AND A GOT

1083

00:34:59,630 --> 00:35:00,965

OF HYDROGEN IS INCREDIBLE.

1084

00:35:00,965 --> 00:35:04,502

IT SPEAKS TO THE HABITABILITY.

1085

00:35:04,502 --> 00:35:05,336

ON THE OTHER HAND, THE FACT THAT

1086

00:35:05,336 --> 00:35:07,638

WE CAN MEASURE SUCH HIGH

1087

00:35:07,638 --> 00:35:10,141

CONCENTRATIONS OF HYDROGEN AND

1088

00:35:10,141 --> 00:35:11,742

CARBON DIOXIDE MEANS THAT THERE

1089

00:35:11,742 --> 00:35:13,377

MIGHT NOT BE LIFE THERE AT ALL

1090

00:35:13,377 --> 00:35:14,946

AND IF THERE IS LIFE, IT'S NOT

1091

00:35:14,946 --> 00:35:16,180

VERY ACTIVE.

1092

00:35:16,180 --> 00:35:19,116

BECAUSE WHEN YOU HAVE THOSE

1093

00:35:19,116 --> 00:35:22,086

STACKS OF PIZZA, MUCH LIKE IN A

1094

00:35:22,086 --> 00:35:23,654

GRADUATE SCHOOL DEPARTMENT, IT

1095

00:35:23,654 --> 00:35:24,055

DISAPPEARS.

1096

00:35:24,055 --> 00:35:25,723

SO, WE HAVE THIS BUILDUP OF FOOD

1097

00:35:25,723 --> 00:35:27,091

THAT'S NOT BEING USED.

1098

00:35:27,091 --> 00:35:29,327

AND PART OF THAT COULD BE

1099

00:35:29,327 --> 00:35:31,162

BECAUSE WE THINK INSOLIDUS MIGHT

1100

00:35:31,162 --> 00:35:32,630

BE FAIRLY YOUNG.

1101  
00:35:32,630 --> 00:35:34,432  
ON THE OTHER HAND, IF THE SAME

1102  
00:35:34,432 --> 00:35:35,333  
PROCESS, WHICH THERE'S NO REASON

1103  
00:35:35,333 --> 00:35:38,903  
TO THINK IT WOULDN'T BE

1104  
00:35:38,903 --> 00:35:40,671  
HAPPENING ON EUROPA, WE KNOW

1105  
00:35:40,671 --> 00:35:42,173  
EUROPA AND THE MOONS AROUND

1106  
00:35:42,173 --> 00:35:44,308  
JUPITER WERE FORMED A BILLION

1107  
00:35:44,308 --> 00:35:44,775  
YEARS AGO.

1108  
00:35:44,775 --> 00:35:46,077  
THAT'S A LOT OF TIME FOR LIFE TO

1109  
00:35:46,077 --> 00:35:53,217  
HAVE EMERGED AND STARTED TAKENG

1110  
00:35:53,217 --> 00:35:55,353  
ADVANTAGE.

1111  
00:35:55,353 --> 00:35:58,890  
MY MONEY IS STILL ON EUROPA.

1112  
00:35:58,890 --> 00:36:00,258  
BUT IT COULD BE ANY OF THESE

1113  
00:36:00,258 --> 00:36:01,259

MOONS AND WOULD BE GREAT IF IT

1114

00:36:01,259 --> 00:36:02,226

WAS ALL OF THEM.

1115

00:36:02,226 --> 00:36:03,094

>> WELL THANK YOU SO MUCH.

1116

00:36:03,094 --> 00:36:05,396

NEXT WE HAVE MIKE FROM SPACE.COM

1117

00:36:05,396 --> 00:36:06,731

ON THE PHONE LINES.

1118

00:36:06,731 --> 00:36:09,834

MIKE, ARE YOU THERE?

1119

00:36:09,834 --> 00:36:10,768

>> YES, I'M HERE.

1120

00:36:10,768 --> 00:36:12,403

THANK YOU GUYS.

1121

00:36:12,403 --> 00:36:16,607

REALLY EXCITING STUFF AND I HAVE

1122

00:36:16,607 --> 00:36:18,009

ANOTHER QUESTION FOR BILL ABOUT

1123

00:36:18,009 --> 00:36:19,110

THE PLUMES.

1124

00:36:19,110 --> 00:36:21,145

SO, JUST, YEAH, JUST SO I'M SORT

1125

00:36:21,145 --> 00:36:23,915

OF CLEAR ON THIS, THIS IS NOT A

1126  
00:36:23,915 --> 00:36:25,016  
CONFIRMATION THAT THE PLUMES

1127  
00:36:25,016 --> 00:36:27,485  
EXIST, I KNOW YOU GUYS -- I KEEP

1128  
00:36:27,485 --> 00:36:28,953  
SEEING MORE AND MORE SIGNS, BUT

1129  
00:36:28,953 --> 00:36:30,288  
YOU ARE STOPPING SHORT OF SAYING

1130  
00:36:30,288 --> 00:36:31,789  
THAT THEY DEFINITELY EXIST.

1131  
00:36:31,789 --> 00:36:34,425  
AND JUST SO I UNDERSTAND, ARE

1132  
00:36:34,425 --> 00:36:35,760  
THESE IN THE SAME LOCATION AS

1133  
00:36:35,760 --> 00:36:37,795  
THE ORIGINAL 2012 SECTION?

1134  
00:36:37,795 --> 00:36:39,730  
OR LIKE DO THE PLUMES -- I MEAN

1135  
00:36:39,730 --> 00:36:41,232  
HAVE THEY BEEN SPOTTED IN

1136  
00:36:41,232 --> 00:36:43,067  
MULTIPLE LOCATIONS ALL AROUND

1137  
00:36:43,067 --> 00:36:43,401  
EUROPA?

1138  
00:36:43,401 --> 00:36:46,704

THANK YOU.

1139

00:36:46,704 --> 00:36:48,105

>> LET'S HAVE BILL SPARKS OF

1140

00:36:48,105 --> 00:36:49,874

COURSE ANSWER THAT.

1141

00:36:49,874 --> 00:36:51,909

>> OK.

1142

00:36:51,909 --> 00:36:54,478

IT'S NOT COMPLETELY UNEQUIVOCAL.

1143

00:36:54,478 --> 00:36:58,616

BUT, IN MY MIND, THE PENDULUM

1144

00:36:58,616 --> 00:37:00,851

HAS SWUNG FROM CAUTION TO

1145

00:37:00,851 --> 00:37:01,986

OPTIMISM.

1146

00:37:01,986 --> 00:37:02,954

THE EVIDENCE IS GROWING.

1147

00:37:02,954 --> 00:37:05,890

THE FACT THAT WE SAW A REPEAT AT

1148

00:37:05,890 --> 00:37:08,025

THE EXACT SAME LOCATION, THAT'S

1149

00:37:08,025 --> 00:37:10,094

ONE OF THE THE GOLD STANDARDS

1150

00:37:10,094 --> 00:37:13,464

FOR DEALING WITH AN INTERMITTENT

1151  
00:37:13,464 --> 00:37:13,864  
PHENOMENON.

1152  
00:37:13,864 --> 00:37:15,466  
IT'S NOT PROOF, BECAUSE WE ARE

1153  
00:37:15,466 --> 00:37:17,001  
RIGHT AT THE LIMIT OF WHAT THE

1154  
00:37:17,001 --> 00:37:23,207  
HUBBLE CAN DO.

1155  
00:37:23,207 --> 00:37:26,143  
IT'S NOT COMPLETELY UNEQUIVOCAL.

1156  
00:37:26,143 --> 00:37:27,345  
ON INSOLIDUS, HAVE YOU MOVEMENTS

1157  
00:37:27,345 --> 00:37:28,779  
OF THE PLUMES AND WONDERFUL MAPS

1158  
00:37:28,779 --> 00:37:31,482  
AND TEMPERATURE MAPS AND MASS

1159  
00:37:31,482 --> 00:37:33,150  
SPECTROMETER MEASUREMENTS OF THE

1160  
00:37:33,150 --> 00:37:35,086  
COMPOSITION AND WE HAVE A LITTLE

1161  
00:37:35,086 --> 00:37:37,321  
SMUDGE NEXT TO AN IMAGE FROM THE

1162  
00:37:37,321 --> 00:37:37,655  
HUBBLE.

1163  
00:37:37,655 --> 00:37:40,491

IT'S A FANTASTIC IMAGE AND --

1164

00:37:40,491 --> 00:37:42,059

BUT IT'S RIGHT AT THE WILL LIMIT

1165

00:37:42,059 --> 00:37:43,928

OF WHAT THE -- THE LIMIT OF WHAT

1166

00:37:43,928 --> 00:37:44,795

THE HUBBLE CAN DO.

1167

00:37:44,795 --> 00:37:45,896

THE FACT THAT WE HAVE A REPEAT

1168

00:37:45,896 --> 00:37:47,698

TELLS YOU IN A FORMAL

1169

00:37:47,698 --> 00:37:48,733

STATISTICAL SENSE, IT CAN'T

1170

00:37:48,733 --> 00:37:49,433

HAPPEN BY CHANCE.

1171

00:37:49,433 --> 00:37:51,936

SO, WE HAVE TO LOOK FOR

1172

00:37:51,936 --> 00:37:53,204

SYSTEMATIC EFFECTS THAT MIGHT

1173

00:37:53,204 --> 00:37:53,704

CAUSE IT.

1174

00:37:53,704 --> 00:37:55,940

WE DON'T KNOW OF ANY, WHICH IS

1175

00:37:55,940 --> 00:37:58,409

WHY MOST OF US, SOME OF US, ARE

1176  
00:37:58,409 --> 00:38:00,077  
LEANING TOWARD THINKING THAT

1177  
00:38:00,077 --> 00:38:02,513  
THIS IS -- THIS MEANS THEY ARE

1178  
00:38:02,513 --> 00:38:02,813  
REAL.

1179  
00:38:02,813 --> 00:38:04,982  
AND THEN THE SECONDARY

1180  
00:38:04,982 --> 00:38:07,418  
INFORMATION WITH THE THERMAL

1181  
00:38:07,418 --> 00:38:08,252  
IMAGING, AS SOON AS I WENT TO

1182  
00:38:08,252 --> 00:38:12,256  
LOOK FOR THE THERMAL IMAGING,

1183  
00:38:12,256 --> 00:38:13,958  
GIVES YOU SOME ADDITIONAL

1184  
00:38:13,958 --> 00:38:15,960  
STATISTICAL EVIDENCE THAT IN

1185  
00:38:15,960 --> 00:38:17,261  
FACT THEY ARE REAL.

1186  
00:38:17,261 --> 00:38:18,529  
IT DOESN'T PROVE IT, BECAUSE,

1187  
00:38:18,529 --> 00:38:21,465  
YOU KNOW, UNFORTUNATE

1188  
00:38:21,465 --> 00:38:22,266

COINCIDENCES CAN HAPPEN IN THE

1189

00:38:22,266 --> 00:38:22,600

WORLD.

1190

00:38:22,600 --> 00:38:28,139

IN TERMS OF THE LOCATION, THE

1191

00:38:28,139 --> 00:38:30,374

ORIGINAL DETECTION BY THE ROTH

1192

00:38:30,374 --> 00:38:32,043

TEAM WAS AROUND THE SOUTH POLAR

1193

00:38:32,043 --> 00:38:32,376

REGION.

1194

00:38:32,376 --> 00:38:36,313

THESE ARE THE DISSOCIATION

1195

00:38:36,313 --> 00:38:37,815

PROJECTS OF WATER AT HIGH

1196

00:38:37,815 --> 00:38:39,450

ALTITUDE DOWN AROUND THE SOUTH

1197

00:38:39,450 --> 00:38:40,584

POLE.

1198

00:38:40,584 --> 00:38:42,353

AND, IN OUR TRANSIT OBSERVATIONS

1199

00:38:42,353 --> 00:38:44,221

WHERE WE WERE LOOKING FOR

1200

00:38:44,221 --> 00:38:45,489

ABSORBING MATERIAL AROUND

1201  
00:38:45,489 --> 00:38:51,195  
EUROPA, WE DID SEE A COUPLE OF

1202  
00:38:51,195 --> 00:38:52,830  
FEATURES IN THAT -- IN THAT

1203  
00:38:52,830 --> 00:38:53,264  
AREA.

1204  
00:38:53,264 --> 00:38:55,132  
BUT, IT'S HARDER TO LOCALIZE

1205  
00:38:55,132 --> 00:38:57,635  
THINGS AROUND THE POLES.

1206  
00:38:57,635 --> 00:38:59,804  
THIS PARTICULAR ONE WAS WELL

1207  
00:38:59,804 --> 00:39:00,171  
LOCALIZED.

1208  
00:39:00,171 --> 00:39:02,306  
IT WASN'T QUITE AS HIGH AS THE

1209  
00:39:02,306 --> 00:39:02,773  
PREVIOUS ONE.

1210  
00:39:02,773 --> 00:39:04,075  
AND THAT'S THE ONE THAT REPEATED

1211  
00:39:04,075 --> 00:39:05,409  
AND SO THAT'S REALLY QUITE

1212  
00:39:05,409 --> 00:39:09,346  
INTERESTING.

1213  
00:39:09,346 --> 00:39:10,047

>> THANK YOU.

1214

00:39:10,047 --> 00:39:11,182

THERE'S A COUPLE OF OTHER PIECES

1215

00:39:11,182 --> 00:39:12,683

OF EVIDENCE THAT THINK IS ALSO

1216

00:39:12,683 --> 00:39:13,918

REALLY TANTALIZING.

1217

00:39:13,918 --> 00:39:16,687

YOU KNOW, WE LOOK AT INSOLIDUS,

1218

00:39:16,687 --> 00:39:17,955

PARTICULARLY AROUND THOSE TIGER

1219

00:39:17,955 --> 00:39:19,924

STRIPES, THERE'S ABSOLUTELY NO

1220

00:39:19,924 --> 00:39:20,324

CRATERS.

1221

00:39:20,324 --> 00:39:22,159

THEY ARE COMPLETELY FILLED IN.

1222

00:39:22,159 --> 00:39:25,129

AS YOU GO TO THE MID LATITUDES

1223

00:39:25,129 --> 00:39:28,999

AND UP TO THE NORTH POLE OF

1224

00:39:28,999 --> 00:39:30,568

INSOLIDUS, YOU DO, IN DEED, SEE

1225

00:39:30,568 --> 00:39:31,902

A NUMBER OF CRATERS.

1226  
00:39:31,902 --> 00:39:36,640  
IF WE LOOK NOW AT EUROPA, WE CAN

1227  
00:39:36,640 --> 00:39:38,075  
HARDLY SEE ANY CRATERS.

1228  
00:39:38,075 --> 00:39:39,510  
THIS HAS ALWAYS BEEN A BIG

1229  
00:39:39,510 --> 00:39:42,513  
PUZZLE IN TERMS OF HOW THIS

1230  
00:39:42,513 --> 00:39:45,182  
SURFACE IS MORPHING, ELIMINATING

1231  
00:39:45,182 --> 00:39:47,084  
THE CRATERS THAT MUST HAVE BEEN

1232  
00:39:47,084 --> 00:39:48,953  
THERE AT ONE TIME AND ARE

1233  
00:39:48,953 --> 00:39:51,856  
CONTINUALLY BOMBARDING THE BODY,

1234  
00:39:51,856 --> 00:39:53,424  
BUT OVER THE LENGTH OF TIME THAT

1235  
00:39:53,424 --> 00:39:55,693  
WE HAVE OBSERVED IT WITH THE

1236  
00:39:55,693 --> 00:39:56,927  
GALLILEO MISSION, THOSE SEVERAL

1237  
00:39:56,927 --> 00:39:58,729  
YEARS, ONLY A HANDFUL OF CRATERS

1238  
00:39:58,729 --> 00:39:59,663

WERE FOUND.

1239

00:39:59,663 --> 00:40:02,299

THE PLUMES -- THE PLUME IDEA

1240

00:40:02,299 --> 00:40:11,175

THAT IT IS RESURFACING AND THE

1241

00:40:11,175 --> 00:40:12,176

SUBDUCTION MUST BE IN A WAY

1242

00:40:12,176 --> 00:40:13,644

THAT'S ELIMINATING THESE

1243

00:40:13,644 --> 00:40:13,978

CRATERS.

1244

00:40:13,978 --> 00:40:15,913

THIS FITS PERFECTLY WITH THESE

1245

00:40:15,913 --> 00:40:16,347

OBSERVATIONS.

1246

00:40:16,347 --> 00:40:18,983

>> I THINK IS' A ZAMBONI.

1247

00:40:18,983 --> 00:40:20,017

[LAUGHTER]

1248

00:40:20,017 --> 00:40:21,185

>> NEXT WE HAVE TWO QUESTIONS ON

1249

00:40:21,185 --> 00:40:21,886

THE PHONE LINE.

1250

00:40:21,886 --> 00:40:23,721

THEN WE WILL GO AHEAD AND GO TO

1251  
00:40:23,721 --> 00:40:25,289  
SOCIAL MEDIA.

1252  
00:40:25,289 --> 00:40:27,324  
SO, THE FIRST CALL-IN PERSON WE

1253  
00:40:27,324 --> 00:40:30,795  
HAVE IS KEITH FROM NASA WATCH.

1254  
00:40:30,795 --> 00:40:31,128  
KEITH?

1255  
00:40:31,128 --> 00:40:36,167  
>> A TWO-PART QUESTION FOR

1256  
00:40:36,167 --> 00:40:37,334  
THOMAS ZURBUCHEN.

1257  
00:40:37,334 --> 00:40:39,703  
NASA WAS DIRECTED TO CREATE AN

1258  
00:40:39,703 --> 00:40:40,671  
OCEAN WORLDS PROGRAM.

1259  
00:40:40,671 --> 00:40:42,540  
NOW I SEE THAT PHRASE

1260  
00:40:42,540 --> 00:40:42,940  
EVERYWHERE.

1261  
00:40:42,940 --> 00:40:44,909  
HAVE YOU FORMALLY ESTABLISHED A

1262  
00:40:44,909 --> 00:40:45,976  
PROGRAM OFFICE?

1263  
00:40:45,976 --> 00:40:47,511

WHO'S IN CHARGE OF IT, WHAT'S

1264

00:40:47,511 --> 00:40:48,479

THE BUDGET?

1265

00:40:48,479 --> 00:40:50,247

SECOND, WHY IS IT THAT SOME NEWS

1266

00:40:50,247 --> 00:40:51,782

MEDIA WERE GIVEN ADVANCE ACCESS

1267

00:40:51,782 --> 00:40:54,251

TO NASA PERSONNEL ON THIS

1268

00:40:54,251 --> 00:40:55,686

TAXPAYER FUNDED RESEARCH AND

1269

00:40:55,686 --> 00:40:59,423

OTHERS OF US WERE NOT?

1270

00:40:59,423 --> 00:41:01,158

>> SO, LET ME CERTAINLY TAKE ON

1271

00:41:01,158 --> 00:41:03,427

THE FIRST ONE AS HEAD OF

1272

00:41:03,427 --> 00:41:05,830

PLANETARY SCIENCE AND WE DID IN

1273

00:41:05,830 --> 00:41:06,664

DEED RECEIVE CONGRESSIONAL

1274

00:41:06,664 --> 00:41:09,066

DIRECTION ABOUT ESTABLISHING AN

1275

00:41:09,066 --> 00:41:11,936

OCEAN WORLDS PROGRAM.

1276  
00:41:11,936 --> 00:41:13,704  
WE HAVE IN DEED COMMUNICATED

1277  
00:41:13,704 --> 00:41:15,339  
BACK TO CONGRESS IN OUR

1278  
00:41:15,339 --> 00:41:18,776  
BUDGETARY ASPECTS THAT WE ARE

1279  
00:41:18,776 --> 00:41:23,247  
DOING THAT IN WITH RESPECT TO

1280  
00:41:23,247 --> 00:41:24,648  
THE NEXT SET OF MISSIONS AND

1281  
00:41:24,648 --> 00:41:27,384  
THAT NEXT SET IS IN DEED THE

1282  
00:41:27,384 --> 00:41:29,553  
EUROPA CLIPPER MISSION.

1283  
00:41:29,553 --> 00:41:31,522  
AS FAR AS THE PRESS CENTER

1284  
00:41:31,522 --> 00:41:32,590  
ACTION THAT -- THAT'S DONE IN

1285  
00:41:32,590 --> 00:41:33,224  
ANOTHER WAY.

1286  
00:41:33,224 --> 00:41:36,060  
>> SO WE HAVE ALSO BEEN DIRECTED

1287  
00:41:36,060 --> 00:41:37,461  
TO ESTABLISH A PROGRAM FOR

1288  
00:41:37,461 --> 00:41:38,329

INVESTIGATING OCEAN WORLDS AND

1289

00:41:38,329 --> 00:41:40,965

WE WENT TO OUR OUTER PLANET

1290

00:41:40,965 --> 00:41:41,932

ASSESSMENT GROUP AND ASKED THEM

1291

00:41:41,932 --> 00:41:44,468

TO HELP US OUT BY DEVELOPING A

1292

00:41:44,468 --> 00:41:45,970

ROADMAP FOR EXPLORING THESE

1293

00:41:45,970 --> 00:41:46,303

WORLDS.

1294

00:41:46,303 --> 00:41:48,105

AND THAT IS IN PROCESS.

1295

00:41:48,105 --> 00:41:49,440

THEY ARE ABOUT TO DELIVER THAT

1296

00:41:49,440 --> 00:41:52,276

TO US ANY DAY NOW OR ANY MONTH

1297

00:41:52,276 --> 00:41:52,543

NOW.

1298

00:41:52,543 --> 00:41:53,210

WEEK.

1299

00:41:53,210 --> 00:41:55,779

AND SO WE ARE MOVING FORWARD ON

1300

00:41:55,779 --> 00:41:57,448

SETTING THE SCIENCE AS WE ALWAYS

1301

00:41:57,448 --> 00:41:59,283

DO, SETTING THE SCIENCE

1302

00:41:59,283 --> 00:42:00,117

PRIORITIES AND THEN FILLING IN

1303

00:42:00,117 --> 00:42:01,352

THE TECHNOLOGIES THAT WE ARE

1304

00:42:01,352 --> 00:42:03,821

GOING TO NEED FOR IT AND

1305

00:42:03,821 --> 00:42:04,855

DISCUSSING TYPES OF MISSIONS

1306

00:42:04,855 --> 00:42:06,490

THOSE WOULD LOOK LIKE TO THE

1307

00:42:06,490 --> 00:42:07,558

VARIOUS OCEAN WORLDS THAT WE

1308

00:42:07,558 --> 00:42:10,194

HAVE TO EXPLORE.

1309

00:42:10,194 --> 00:42:11,896

>> NEXT WE HAVE TRACY WATSON

1310

00:42:11,896 --> 00:42:13,731

FROM USA TODAY.

1311

00:42:13,731 --> 00:42:15,332

TRACY?

1312

00:42:15,332 --> 00:42:17,401

>> HI, THANK YOU FOR DR. GREEN.

1313

00:42:17,401 --> 00:42:18,936

CAN YOU TALK ABOUT NOW HOW THIS

1314

00:42:18,936 --> 00:42:22,439

MISSION AFFECTS YOUR DESIRE TO

1315

00:42:22,439 --> 00:42:23,974

SEND -- HOW THE RESULTS AFFECT

1316

00:42:23,974 --> 00:42:27,344

YOUR DESIRE TO SEND A MISSION TO

1317

00:42:27,344 --> 00:42:27,745

INSOLIDUS?

1318

00:42:27,745 --> 00:42:28,812

DOES THIS MAKE IT SIGNED OF RISE

1319

00:42:28,812 --> 00:42:30,047

TO THE TOP OF WHAT SHOULD BE

1320

00:42:30,047 --> 00:42:30,347

NEXT?

1321

00:42:30,347 --> 00:42:31,749

THANKS.

1322

00:42:31,749 --> 00:42:36,687

>> WELL, IN DEED, WE ANNOUNCED

1323

00:42:36,687 --> 00:42:38,255

IN JANUARY A PROGRAM CALLED NEW

1324

00:42:38,255 --> 00:42:40,891

FRONTIERS AND THAT IS A VERY

1325

00:42:40,891 --> 00:42:42,960

TARGETED LIST OF OBJECTS.

1326  
00:42:42,960 --> 00:42:45,462  
ON THAT LIST, TURNS OUT TO BE

1327  
00:42:45,462 --> 00:42:45,829  
INSOLIDUS.

1328  
00:42:45,829 --> 00:42:48,499  
THIS IS AN ELEMENT IN DEED OF

1329  
00:42:48,499 --> 00:42:49,967  
RECOGNITION THAT THIS IS AN

1330  
00:42:49,967 --> 00:42:50,567  
ACTIVE WORLD.

1331  
00:42:50,567 --> 00:42:52,069  
THAT THIS IS NEW DISCOVERIES

1332  
00:42:52,069 --> 00:42:55,072  
THAT HAVE BEEN MADE BY CASINI

1333  
00:42:55,072 --> 00:42:58,676  
SINCE THE TIME OUR PLANETARY

1334  
00:42:58,676 --> 00:43:00,144  
DECADLE ACTUALLY IDENTIFIED WHAT

1335  
00:43:00,144 --> 00:43:01,278  
THOSE TARGETS ARE.

1336  
00:43:01,278 --> 00:43:03,948  
SO, THAT'S IN COMPETITION RIGHT

1337  
00:43:03,948 --> 00:43:05,983  
NOW AND WE WILL BE RECEIVING THE

1338  
00:43:05,983 --> 00:43:07,685

PROPOSALS SOON AND WILL BE

1339

00:43:07,685 --> 00:43:10,454

EVALUATING THEM AND ANNOUNCING

1340

00:43:10,454 --> 00:43:12,623

THE STEP ONE SELECTEES BY THE

1341

00:43:12,623 --> 00:43:14,959

END OF THE CALENDAR YEAR IS WHAT

1342

00:43:14,959 --> 00:43:16,026

WE HOPE.

1343

00:43:16,026 --> 00:43:16,593

>> THANKS, JIM.

1344

00:43:16,593 --> 00:43:18,062

NEXT WE WILL GO TO SOCIAL MEDIA.

1345

00:43:18,062 --> 00:43:21,298

SO, EMILY, WHAT ARE THE NETIZANS

1346

00:43:21,298 --> 00:43:22,232

TALKING ABOUT TODAY?

1347

00:43:22,232 --> 00:43:23,200

>> YEAH, THERE'S A LOT OF

1348

00:43:23,200 --> 00:43:24,435

INTEREST ON SOCIAL MEDIA.

1349

00:43:24,435 --> 00:43:27,638

THIS QUESTION IS FROM LORENZO ON

1350

00:43:27,638 --> 00:43:28,005

FACEBOOK.

1351  
00:43:28,005 --> 00:43:30,207  
SO THE JUNO SPACE CRAFT WENT

1352  
00:43:30,207 --> 00:43:31,608  
INTO ORBIT AROUND JUPITER.

1353  
00:43:31,608 --> 00:43:33,077  
IS THERE ANY POSSIBILITY FOR

1354  
00:43:33,077 --> 00:43:35,379  
THAT SPACE CRAFT TO HELP WITH

1355  
00:43:35,379 --> 00:43:36,380  
OBSERVATIONS OF THE PLUMES

1356  
00:43:36,380 --> 00:43:37,348  
AROUND EUROPA?

1357  
00:43:37,348 --> 00:43:40,684  
>> WELL, IN DEED, JUNO WAS

1358  
00:43:40,684 --> 00:43:41,752  
LAUNCHED IN 2011.

1359  
00:43:41,752 --> 00:43:43,687  
WE MAY HAVE HAD A HINT OF THE

1360  
00:43:43,687 --> 00:43:46,323  
PLUMES OF COURSE FROM CASINI.

1361  
00:43:46,323 --> 00:43:48,192  
BUT, ABSOLUTELY NOTHING FROM

1362  
00:43:48,192 --> 00:43:49,560  
EUROPA BY THAT TIME.

1363  
00:43:49,560 --> 00:43:51,862

AND SO, IT'S CONCENTRATING ON

1364

00:43:51,862 --> 00:43:54,865

REALLY ORBITING JUPITER AND

1365

00:43:54,865 --> 00:43:59,169

UNDERSTANDING THE STRUCTURE THAT

1366

00:43:59,169 --> 00:44:00,537

LARGE PLANET, THE LARGEST PLANET

1367

00:44:00,537 --> 00:44:02,706

IN OUR SOLAR SYSTEM.

1368

00:44:02,706 --> 00:44:04,475

IT ALSO IS SO IMPORTANT TO

1369

00:44:04,475 --> 00:44:07,244

UNDERSTAND THAT, BECAUSE THE

1370

00:44:07,244 --> 00:44:10,914

REMNANTS LEFT OVER AFTER JUPITER

1371

00:44:10,914 --> 00:44:12,316

AND SUN CREATED THE REST OF THE

1372

00:44:12,316 --> 00:44:13,017

SOLAR SYSTEM.

1373

00:44:13,017 --> 00:44:14,618

SO, WE ARE REALLY QUITE

1374

00:44:14,618 --> 00:44:15,919

INTERESTED IN UNDERSTANDING THE

1375

00:44:15,919 --> 00:44:17,221

ORIGIN AND EVOLUTION OF OUR

1376  
00:44:17,221 --> 00:44:18,989  
SOLAR SYSTEM AND UNDERSTANDING

1377  
00:44:18,989 --> 00:44:20,257  
HOW JUPITER WAS PUT TOGETHER IS

1378  
00:44:20,257 --> 00:44:21,492  
A MAJOR SEGMENT OF THAT.

1379  
00:44:21,492 --> 00:44:26,063  
, SO UNFORTUNATELY NO EUROPA

1380  
00:44:26,063 --> 00:44:28,365  
OBSERVATION.

1381  
00:44:28,365 --> 00:44:30,534  
>> THIS NEXT ONE IS FROM CARRIE

1382  
00:44:30,534 --> 00:44:31,135  
ON FACEBOOK.

1383  
00:44:31,135 --> 00:44:33,604  
THEY WANT IT KNOW WHAT CHEMICALS

1384  
00:44:33,604 --> 00:44:36,640  
ARE CAUSING THE COLORATION OF

1385  
00:44:36,640 --> 00:44:37,941  
THE CRACKS AROUND EUROPA?

1386  
00:44:37,941 --> 00:44:42,012  
>> SO WITH THAT, PERHAPS GODDARD

1387  
00:44:42,012 --> 00:44:43,180  
COULD TALK A LITTLE BIT ABOUT

1388  
00:44:43,180 --> 00:44:43,480

THAT.

1389

00:44:43,480 --> 00:44:46,316

BILL?

1390

00:44:46,316 --> 00:44:47,785

>> I THINK THE SHORT ANSWER IS

1391

00:44:47,785 --> 00:44:49,553

-- WE DON'T KNOW.

1392

00:44:49,553 --> 00:44:53,023

THERE ARE SYSTEMS OF SALT FROM

1393

00:44:53,023 --> 00:44:55,125

THE OCEAN, BUT IT'S NOT KNOWN

1394

00:44:55,125 --> 00:44:56,360

WHAT SORT OF SALT AND THAT

1395

00:44:56,360 --> 00:44:58,896

POTENTIALLY THERE'S A

1396

00:44:58,896 --> 00:45:02,566

CONTRIBUTION FROM THE JOBIAN --

1397

00:45:02,566 --> 00:45:04,401

FROM EYE ONS BEING IMPLANTED

1398

00:45:04,401 --> 00:45:06,904

FROM THE NEXT MOON IN THAT'S

1399

00:45:06,904 --> 00:45:07,971

DEFINITELY GOT PLUMES.

1400

00:45:07,971 --> 00:45:12,443

IT'S GOT SULFUR VOLCANOS

1401  
00:45:12,443 --> 00:45:14,078  
SPRAYING SULFUR INTO THE WHOLE

1402  
00:45:14,078 --> 00:45:14,511  
ENVIRONMENT.

1403  
00:45:14,511 --> 00:45:15,612  
BUT THE DETAILED COMPOSITION OF

1404  
00:45:15,612 --> 00:45:17,614  
THE CRACKS IN THE DARK AREAS,

1405  
00:45:17,614 --> 00:45:20,818  
IT'S AN ONGOING STUDY OF

1406  
00:45:20,818 --> 00:45:21,218  
RESEARCH.

1407  
00:45:21,218 --> 00:45:23,220  
PEOPLE ARE TRYING TO FIND OUT.

1408  
00:45:23,220 --> 00:45:25,155  
IT'S OBVIOUSLY A VERY

1409  
00:45:25,155 --> 00:45:26,323  
INTERESTING QUESTION.

1410  
00:45:26,323 --> 00:45:28,192  
IT WILL BE VERY NICE TO KNOW THE

1411  
00:45:28,192 --> 00:45:29,860  
ANSWER TO THAT.

1412  
00:45:29,860 --> 00:45:30,360  
>> ALL RIGHT.

1413  
00:45:30,360 --> 00:45:31,628

WE WILL TAKE ONE MORE QUESTION

1414

00:45:31,628 --> 00:45:34,498

FROM SOCIAL MEDIA.

1415

00:45:34,498 --> 00:45:36,333

>> THIS ONE IS FROM STEPHANIE ON

1416

00:45:36,333 --> 00:45:38,168

TWITTER. SHE WANTS TO KNOW WHAT

1417

00:45:38,168 --> 00:45:39,837

INSTRUMENTS WILL BE NEEDED TO

1418

00:45:39,837 --> 00:45:41,004

DETECT LIFE ON INSOLIDUS AND HOW

1419

00:45:41,004 --> 00:45:45,476

CAN WE HELP? IS IF

1420

00:45:45,476 --> 00:45:45,843

>> OK.

1421

00:45:45,843 --> 00:45:50,614

WITH THAT, LET'S GO TO J.P.L.

1422

00:45:50,614 --> 00:45:50,981

>> HI.

1423

00:45:50,981 --> 00:45:53,884

WELL -- THE INSTRUMENTS --

1424

00:45:53,884 --> 00:45:57,588

EXCUSE ME, THE INSTRUMENTATION

1425

00:45:57,588 --> 00:45:58,889

THAT WOULD BE -- IN THIS REGARD

1426  
00:45:58,889 --> 00:46:00,257  
ARE SIMILAR INSTRUMENTS THAT THE

1427  
00:46:00,257 --> 00:46:01,692  
ONES THAT WE WERE FLYING ON

1428  
00:46:01,692 --> 00:46:03,594  
CASINI.

1429  
00:46:03,594 --> 00:46:04,862  
AND THEY ARE CERTAINLY SIMILAR

1430  
00:46:04,862 --> 00:46:06,964  
TO THE INSTRUMENTS THAT ARE

1431  
00:46:06,964 --> 00:46:09,833  
PRESENTLY FLYING ON EUROPA.

1432  
00:46:09,833 --> 00:46:13,370  
MASS SPECTROMETER AND DUST

1433  
00:46:13,370 --> 00:46:15,405  
ANALYZER ARE BOTH IMPORTANT IN

1434  
00:46:15,405 --> 00:46:17,574  
DETERMINING THIS HABITABILITY,

1435  
00:46:17,574 --> 00:46:21,545  
AS WELL AS LOOKING FOR PERHAPS

1436  
00:46:21,545 --> 00:46:26,383  
FATTY ACIDS, LOOKING AT ISOTOPIC

1437  
00:46:26,383 --> 00:46:28,685  
RATIOS AND TRYING TO DETERMINE

1438  
00:46:28,685 --> 00:46:30,988

## SIGNS OF LIFE AS WELL AS TELLING

1439

00:46:30,988 --> 00:46:33,757

US MORE ABOUT THE HABITABILITY.

1440

00:46:33,757 --> 00:46:35,425

LEARNING A LITTLE BIT ABOUT THE

1441

00:46:35,425 --> 00:46:38,162

STRUCTURE OF THE MOLECULES

1442

00:46:38,162 --> 00:46:39,763

THEMSELVES WOULD ALSO BE

1443

00:46:39,763 --> 00:46:40,164

BENEFICIAL.

1444

00:46:40,164 --> 00:46:43,734

AND THAT CAN BE DONE THROUGH

1445

00:46:43,734 --> 00:46:53,143

TANDEM MASS SPECTROMETRY.

1446

00:46:53,143 --> 00:46:55,913

FOR FLY-THROUGH MISSIONS WHICH

1447

00:46:55,913 --> 00:46:57,080

WE THINK WOULD BE GOOD ENOUGH

1448

00:46:57,080 --> 00:46:58,148

FOR INSOLIDUS, THIS IS A NEXT

1449

00:46:58,148 --> 00:46:59,149

STEP THAT WOULD BE A GOOD

1450

00:46:59,149 --> 00:47:00,884

APPROACH.

1451

00:47:00,884 --> 00:47:01,852

>> WELL THANK YOU.

1452

00:47:01,852 --> 00:47:03,187

NOW, SO BEFORE WE CLOSE, JIM,

1453

00:47:03,187 --> 00:47:05,622

CAN YOU GIVE US SOME CLOSING

1454

00:47:05,622 --> 00:47:05,989

THOUGHTS?

1455

00:47:05,989 --> 00:47:07,691

ANYTHING YOU WOULD LIKE TO TALK

1456

00:47:07,691 --> 00:47:08,258

ABOUT?

1457

00:47:08,258 --> 00:47:09,059

>> IN DEED.

1458

00:47:09,059 --> 00:47:11,395

AND, THIS IS REALLY AN EXCITING

1459

00:47:11,395 --> 00:47:12,396

TIME.

1460

00:47:12,396 --> 00:47:14,765

OUR SCIENCE IS PROCEEDING SO

1461

00:47:14,765 --> 00:47:16,266

RAPIDLY, WE CAN HARDLY KEEP UP

1462

00:47:16,266 --> 00:47:17,935

WITH THESE DISCOVERIES.

1463

00:47:17,935 --> 00:47:20,037

YOU KNOW, WE REALLY ARE LOOKING

1464

00:47:20,037 --> 00:47:23,307

FORWARD TO MORE OF THE HUBBLE

1465

00:47:23,307 --> 00:47:26,877

OBSERVATIONS.

1466

00:47:26,877 --> 00:47:29,146

WE MAY FIND THAT EUROPA IS FAR

1467

00:47:29,146 --> 00:47:30,847

MORE ACTIVE IN A NUMBER OF

1468

00:47:30,847 --> 00:47:33,050

LOCATIONS AND THAT BODES WELL

1469

00:47:33,050 --> 00:47:34,551

WITH, AS I MENTIONED EARLIER,

1470

00:47:34,551 --> 00:47:35,786

FILLING IN THESE CRATERS.

1471

00:47:35,786 --> 00:47:37,821

THESE OCEAN WORLDS HAVE JUST

1472

00:47:37,821 --> 00:47:40,123

BEEN DISCOVERED.

1473

00:47:40,123 --> 00:47:41,725

THEY ARE IN OUR SOLAR SYSTEM.

1474

00:47:41,725 --> 00:47:43,293

WE NEED TO PROBE THEM BECAUSE

1475

00:47:43,293 --> 00:47:46,296

THEY ARE ONE OF THE BEST

1476  
00:47:46,296 --> 00:47:48,065  
LOCATIONS WE BELIEVE THAT MAY

1477  
00:47:48,065 --> 00:47:50,367  
HARBOR LIFE TODAY.

1478  
00:47:50,367 --> 00:47:50,901  
>> THANK YOU.

1479  
00:47:50,901 --> 00:47:52,536  
AND THAT'S ALL THE TIME THAT WE

1480  
00:47:52,536 --> 00:47:53,270  
HAVE LEFT.

1481  
00:47:53,270 --> 00:47:55,072  
PLEASE KEEP THOSE QUESTIONS

1482  
00:47:55,072 --> 00:47:58,342  
COMING ONLINE USING THE HASHTAG

1483  
00:47:58,342 --> 00:47:58,909  
ASK NASA.

1484  
00:47:58,909 --> 00:48:01,245  
BE SURE TO FOLLOW US ON ALL OUR

1485  
00:48:01,245 --> 00:48:02,346  
SOCIAL MEDIA.