



Attendees (16)	
▼ Hosts (1)	
Mike Toillion	
▼ Presenters (4)	
Andy Burnett	
Kelsi Singer	
Pauli Laine	
Penny Boston	
▼ Participants (11)	
astrobiology	
Chris German	
Gal Sarid (Harvard)	
Isabelle	
Joyce Penagos	
Lindsay Hays	
Lively Lie	
RavenC	
roger wartell	
ron oremland	
Tom McCollom	

Open Chat (Everyone)

indicative of microbial life below the ice, especially if there is also a stable C enrichment of 12C in the products.

Gal Sarid (Harvard): Pluto and Charon are a good example of a large KBO, which had a complex history

Gal Sarid (Harvard): and a suite of lovely instruments

Gal Sarid (Harvard): ok, I can do that. Perhaps a little bit later though :)

----- (01/08/2014 11:38) -----

ron oremland: I trust you, Penny. Feel better too (I just got over the flu...yeech!).

----- (01/08/2014 11:39) -----

Gal Sarid (Harvard): Thanks to all presenters

Kelsi Singer: thanks everyone!

Pauli Laine: Thanks!

Penny Boston is typing...

Teleconference Instructions (Parti...

Teleconference Line: 866-692-3158

Passcode: 9109668#

Please use *6 (STAR, then 6) to **MUTE** your phone's mic when not speaking.

More info: <https://astrobiologyfuture.org>

Did Life/Prebiotic Chemistry Evolve on Geologically Differentiated Icy Worlds?

Full Screen

9. *What are the likely sources of the materials that are in/on icy satellites? What was available early, what arrived late, what may still be arriving?*

- * The high degree of variability of all properties of icy bodies found in the solar system makes a blanket assessment of material sources difficult. There is a vast literature that pertains to this question. A few germane examples follow:
- * Obviously, Titan has a huge and ongoing production of organic materials derived from the hydrocarbons in the atmosphere and fluids of the body (e.g. Makalkin & Dorofeeva, 2006).
- * Europa's production and export of salts from the interior has been theoretically dealt with (Travis et al 2012). And sodium salts detected in Saturn's outermost rings appears to hale from Enceladus' plumes.
- * General considerations of organic delivery to planets and moons by comets has been explored by Court & Sephton (2012).
- * Amino acid production from shock heating of cometary infall has recently been simulated in the laboratory (Martins et al. 2013).
- * Hydrated silicate formation on Kuiper Belt objects has been discussed (Busarev et al 2003).

1
00:00:13,220 --> 00:00:10,610
hello everyone welcome to our next

2
00:00:15,289 --> 00:00:13,230
webinar seems to be somewhat appropriate

3
00:00:18,650 --> 00:00:15,299
but it's going to be on the topic of icy

4
00:00:22,490 --> 00:00:18,660
worlds just before we get going just a

5
00:00:24,349 --> 00:00:22,500
few brief announcement in the email that

6
00:00:26,330 --> 00:00:24,359
went out this week just in case anyone

7
00:00:30,650 --> 00:00:26,340
didn't notice it there is a link there

8
00:00:32,780 --> 00:00:30,660
to podcasts of all of these previous

9
00:00:35,150 --> 00:00:32,790
webinars and I mention that because I

10
00:00:37,430 --> 00:00:35,160
know it can be difficult to watch the

11
00:00:39,889 --> 00:00:37,440
webinars directly on your computer

12
00:00:42,470 --> 00:00:39,899
particularly in real time so if you want

13
00:00:44,209 --> 00:00:42,480

to download them and catch them later

14

00:00:46,670 --> 00:00:44,219

and you can even listen to them at

15

00:00:50,090 --> 00:00:46,680

double speed then just follow that link

16

00:00:53,479 --> 00:00:50,100

the slides for today's presentation are

17

00:00:55,700 --> 00:00:53,489

already linked on the event in the

18

00:00:58,369 --> 00:00:55,710

website so if you want to download them

19

00:01:01,279 --> 00:00:58,379

and follow along you certainly can our

20

00:01:04,520 --> 00:01:01,289

videos are up to date and the video of

21

00:01:07,700 --> 00:01:04,530

this presentation will be up in a day or

22

00:01:10,850 --> 00:01:07,710

so and this is the only presentation

23

00:01:12,440 --> 00:01:10,860

that we're doing this week the one that

24

00:01:14,359 --> 00:01:12,450

was scheduled for this week art for

25

00:01:16,670 --> 00:01:14,369

Thursday he's being rescheduled to

26

00:01:18,980 --> 00:01:16,680

slightly later in january and then just

27

00:01:20,780 --> 00:01:18,990

finally we are being recorded and that

28

00:01:23,600 --> 00:01:20,790

includes both what you say and what you

29

00:01:31,520 --> 00:01:23,610

type just so you're aware of that okay

30

00:01:37,069 --> 00:01:31,530

with that Pauly okay thank you very much

31

00:01:40,490 --> 00:01:37,079

Andy enter hi everyone if you can't hear

32

00:01:43,130 --> 00:01:40,500

me please let me know so it's nice to

33

00:01:47,330 --> 00:01:43,140

see so many participant participants

34

00:01:51,069 --> 00:01:47,340

here so my name is lola lane and I'm

35

00:01:57,819 --> 00:01:51,079

from Cleveland and with me here are

36

00:02:01,749 --> 00:01:57,829

Pentecostal and Celtic singer they can

37

00:02:06,280 --> 00:02:01,759

maybe introduce themselves if they like

38

00:02:10,690 --> 00:02:06,290

little later but uh so we have here

39

00:02:13,340 --> 00:02:10,700

topic about this life of propriety

40

00:02:18,520 --> 00:02:13,350

chemistry evolved on

41

00:02:22,100 --> 00:02:18,530

biological different eat ice words and

42

00:02:25,640 --> 00:02:22,110

hear each slide will be presented by

43

00:02:36,020 --> 00:02:25,650

corresponding author so we will talk by

44

00:02:42,800 --> 00:02:36,030

turns so let's get started so what's

45

00:02:45,320 --> 00:02:42,810

this all about so I the bodies present

46

00:02:51,380 --> 00:02:45,330

some of the clearest evidence for liquid

47

00:02:55,940 --> 00:02:51,390

water on Coco scale and so if water is

48

00:02:59,710 --> 00:02:55,950

necessary for life these parties present

49

00:03:04,100 --> 00:02:59,720

attractive target to search for life or

50

00:03:09,130 --> 00:03:04,110

propriety chemistry's and in our

51
00:03:12,650 --> 00:03:09,140
planetary system especially Europa and

52
00:03:16,100 --> 00:03:12,660
in the letters presents the most likely

53
00:03:22,490 --> 00:03:16,110
examples of different it articles with

54
00:03:26,240 --> 00:03:22,500
possible subsurface oceans or lenses so

55
00:03:34,820 --> 00:03:26,250
it's all about possible water on these

56
00:03:44,110 --> 00:03:34,830
parties then there is this justification

57
00:03:48,580 --> 00:03:44,120
part and first of all finding life or

58
00:03:51,680 --> 00:03:48,590
some propriety chemistry will establish

59
00:03:57,220 --> 00:03:51,690
establish the pounds for life beyond

60
00:04:03,560 --> 00:03:57,230
Earth they are quite with different

61
00:04:10,690 --> 00:04:03,570
places from our rocky planet earth where

62
00:04:14,930 --> 00:04:10,700
we know only life can exist today 10 and

63
00:04:19,099 --> 00:04:14,940

any indicators of life or pro particle

64

00:04:21,080 --> 00:04:19,109

irrelevant chemical processes good shed

65

00:04:25,040 --> 00:04:21,090

light on fundamental questions about the

66

00:04:27,469 --> 00:04:25,050

origin of life so

67

00:04:30,110 --> 00:04:27,479

we don't know how how the life get

68

00:04:35,719 --> 00:04:30,120

started in the first place so if we

69

00:04:42,409 --> 00:04:35,729

could find some biomarkers there some

70

00:04:46,460 --> 00:04:42,419

icy road then lick it good sit sunlight

71

00:04:51,350 --> 00:04:46,470

on the about the origin of wasn't about

72

00:04:57,680 --> 00:04:51,360

the origin of life then if there are

73

00:04:59,570 --> 00:04:57,690

really abital the icy moon may exist at

74

00:05:02,240 --> 00:04:59,580

of rocky planet their terrestrial

75

00:05:04,249 --> 00:05:02,250

primary points like third and dust be an

76

00:05:10,180 --> 00:05:04,259

extremely important plant in planetary

77

00:05:18,860 --> 00:05:16,279

that means that we don't have found any

78

00:05:23,149 --> 00:05:18,870

exomoons yet birthday they might might

79

00:05:31,010 --> 00:05:23,159

ID number them third like rocky planets

80

00:05:33,769 --> 00:05:31,020

we don't know okay then there is a

81

00:05:40,730 --> 00:05:33,779

series of sub questions related to this

82

00:05:46,930 --> 00:05:40,740

topic and the first one is why in first

83

00:05:50,570 --> 00:05:46,940

place we might expect to find life and

84

00:05:53,330 --> 00:05:50,580

how we could expect that the life could

85

00:05:59,390 --> 00:05:53,340

emerge or be sustained in your eyes

86

00:06:03,559 --> 00:05:59,400

ebook world okay first of all of the

87

00:06:07,990 --> 00:06:03,569

habitability of ice world as yet is as

88

00:06:15,070 --> 00:06:08,000

yet poorly asses it you know if they are

89

00:06:21,670 --> 00:06:15,080

habitable or not then subserve a

90

00:06:27,270 --> 00:06:21,680

subsurface fluids good offer up dance of

91

00:06:34,790 --> 00:06:29,820

I supporters may have an interior heat

92

00:06:38,100 --> 00:06:34,800

source turret from rocky core or be

93

00:06:45,590 --> 00:06:38,110

internally heated by title resonances

94

00:06:45,600 --> 00:06:51,320

life could have originated on ice world

95

00:07:00,390 --> 00:06:54,570

there is there aha hepatitis Peppa this

96

00:07:05,610 --> 00:07:00,400

is about the origin of life on Earth in

97

00:07:10,200 --> 00:07:05,620

the hydrothermal vents so it's related

98

00:07:15,680 --> 00:07:10,210

to that all the life could have arrived

99

00:07:24,500 --> 00:07:18,780

new new paper about little panspermia

100

00:07:29,820 --> 00:07:24,510

how how microwaves could have been

101
00:07:35,550 --> 00:07:29,830
transferred from earth or Mars where to

102
00:07:38,310 --> 00:07:35,560
fly first enters the outer planets and

103
00:07:40,200 --> 00:07:38,320
if now if no life is present the

104
00:07:43,650 --> 00:07:40,210
detection of organic compounds produced

105
00:07:47,420 --> 00:07:43,660
on to Isaac body by interesting

106
00:07:49,950 --> 00:07:47,430
processes for sequestered and

107
00:07:54,510 --> 00:07:49,960
concentrated from outside so has they

108
00:08:04,380 --> 00:07:54,520
help us inform about pipe pratik

109
00:08:07,950 --> 00:08:04,390
processes on earth and elsewhere dieser

110
00:08:09,930 --> 00:08:07,960
finish I can save mine yes hi everyone

111
00:08:13,860 --> 00:08:09,940
I'm penny Boston I'm at New Mexico Tech

112
00:08:15,779 --> 00:08:13,870
as a faculty member and I'm also

113
00:08:19,860 --> 00:08:15,789

associate director of the National cave

114

00:08:23,610 --> 00:08:19,870

and karst Research Institute or some

115

00:08:27,300 --> 00:08:23,620

questions to concerns how we can detect

116

00:08:30,990 --> 00:08:27,310

potential biomarkers either in or on icy

117

00:08:32,640 --> 00:08:31,000

worlds this is quite challenging we

118

00:08:35,760 --> 00:08:32,650

infer that these geologically active

119

00:08:39,060 --> 00:08:35,770

bodies have interactions between the

120

00:08:42,170 --> 00:08:39,070

surface and impossible subsurface ocean

121

00:08:45,600 --> 00:08:42,180

whether it's what liquid water or

122

00:08:48,750 --> 00:08:45,610

fracturing impactors from outside or

123

00:08:51,900 --> 00:08:48,760

various convective forces that may be

124

00:08:54,480 --> 00:08:51,910

within a plastic ice crust that could be

125

00:08:56,790 --> 00:08:54,490

analogized to the mantle and crust

126

00:08:59,370 --> 00:08:56,800

relationship here on earth could

127

00:09:02,550 --> 00:08:59,380

actually bring some of the subsurface

128

00:09:05,420 --> 00:09:02,560

derive material to the surface and that

129

00:09:09,569 --> 00:09:05,430

could be access for analysis on mission

130

00:09:10,949 --> 00:09:09,579

we certainly know that from several of

131

00:09:14,329 --> 00:09:10,959

the moons that we'll talk about in

132

00:09:17,250 --> 00:09:14,339

greater detail in a few minutes we have

133

00:09:19,530 --> 00:09:17,260

observable water and gas limbs that are

134

00:09:24,170 --> 00:09:19,540

emitted from fractures and these of

135

00:09:27,449 --> 00:09:24,180

course presented useful mission targets

136

00:09:30,030 --> 00:09:27,459

direct access to the subsurface ocean

137

00:09:31,650 --> 00:09:30,040

why is some sort of probe scheme has

138

00:09:35,430 --> 00:09:31,660

been suggested and there have been

139

00:09:40,759 --> 00:09:35,440

several NASA workshops trying to figure

140

00:09:42,960 --> 00:09:40,769

out about those kinds of access

141

00:09:46,800 --> 00:09:42,970

methodologies there are of course many

142

00:09:49,829 --> 00:09:46,810

caveats and one major one is the

143

00:09:51,630 --> 00:09:49,839

potential destructive alteration of any

144

00:09:54,990 --> 00:09:51,640

of the internal materials once they get

145

00:09:57,860 --> 00:09:55,000

exposed to radiation and other

146

00:10:01,500 --> 00:09:57,870

challenging environments on whatever

147

00:10:03,660 --> 00:10:01,510

body they're on and of course the the

148

00:10:06,329 --> 00:10:03,670

technological feats involved in actually

149

00:10:09,900 --> 00:10:06,339

trying to conduct a mission to directly

150

00:10:12,990 --> 00:10:09,910

probe a notion that is in some cases and

151
00:10:26,389 --> 00:10:13,000
suami ters below the surface are quite

152
00:10:30,889 --> 00:10:26,399
challenging okay question number three

153
00:10:34,949 --> 00:10:30,899
how can we conduct institute test for

154
00:10:43,460 --> 00:10:34,959
the existence of life and its byproducts

155
00:10:46,700 --> 00:10:43,470
or precursors on i.t works we find a

156
00:10:51,930 --> 00:10:46,710
three basic

157
00:10:56,210 --> 00:10:51,940
ways to do this this kind of testing is

158
00:11:02,790 --> 00:10:56,220
first of all who serve all other flybys

159
00:11:09,590 --> 00:11:02,800
that'll be done by voyagers and Kalia I

160
00:11:15,450 --> 00:11:09,600
get Cassini so far and then there are

161
00:11:20,640 --> 00:11:15,460
some indication of water plumes if there

162
00:11:23,850 --> 00:11:20,650
was before on Angeles and recently on on

163
00:11:28,530 --> 00:11:23,860

Europe also so it's a possible that we

164

00:11:31,620 --> 00:11:28,540

could possibly capture some sample from

165

00:11:36,780 --> 00:11:31,630

those blooms at least we can do and has

166

00:11:39,690 --> 00:11:36,790

been done already some spectroscopy then

167

00:11:45,470 --> 00:11:39,700

there is a possibility to send a lander

168

00:11:50,150 --> 00:11:45,480

do some surface chemistry testing

169

00:11:53,820 --> 00:11:50,160

Spectre spectroscopy and with gas

170

00:12:00,140 --> 00:11:53,830

chromatic metric or author of chemistry

171

00:12:05,690 --> 00:12:00,150

approaches finally the hardest ways to

172

00:12:13,140 --> 00:12:05,700

send some kind of ice penetrating probe

173

00:12:16,970 --> 00:12:13,150

for possible ocean or water lens to do

174

00:12:22,230 --> 00:12:16,980

some institute chemistry imagine

175

00:12:25,020 --> 00:12:22,240

microscopy or other tests for to test

176

00:12:34,100 --> 00:12:25,030

for existence of life on biomarkers

177

00:12:39,440 --> 00:12:37,430

okay this is kelsey sorry I can't get my

178

00:12:42,170 --> 00:12:39,450

webcam working I'm a postdoc at

179

00:12:45,440 --> 00:12:42,180

Washington University in st. Louis and

180

00:12:48,079 --> 00:12:45,450

question number four is talking about

181

00:12:51,110 --> 00:12:48,089

various aspects of mobility of material

182

00:12:54,079 --> 00:12:51,120

in the ice shell of icy satellites or in

183

00:12:55,720 --> 00:12:54,089

the ocean as well so I focus on your

184

00:12:58,069 --> 00:12:55,730

rope ah just for this presentation

185

00:13:00,620 --> 00:12:58,079

because it's what I work on and what I

186

00:13:02,540 --> 00:13:00,630

know the most about but obviously this

187

00:13:04,579 --> 00:13:02,550

is an important question for many bodies

188

00:13:06,110 --> 00:13:04,589

and we care about it both because we

189

00:13:08,540 --> 00:13:06,120

want to know about the habitability of

190

00:13:10,910 --> 00:13:08,550

these bodies but also because we want to

191

00:13:14,090 --> 00:13:10,920

know if we can get any samples that

192

00:13:16,460 --> 00:13:14,100

would help us learn about this so just

193

00:13:18,530 --> 00:13:16,470

have a cartoon of the likely internal

194

00:13:20,720 --> 00:13:18,540

structure of Europa we have constraints

195

00:13:24,620 --> 00:13:20,730

on the internal structure from Galileo

196

00:13:27,139 --> 00:13:24,630

spacecraft this outer h₂o layer which is

197

00:13:28,910 --> 00:13:27,149

shown here over a rocky mantle so both

198

00:13:30,199 --> 00:13:28,920

the ocean and ice shell together or

199

00:13:33,620 --> 00:13:30,209

something like hundred and fifty

200

00:13:36,170 --> 00:13:33,630

kilometers in thickness the actual

201
00:13:38,360 --> 00:13:36,180
thickness of the ice shell itself is of

202
00:13:40,069 --> 00:13:38,370
course a much discussed topics some

203
00:13:42,889 --> 00:13:40,079
people think it could be as thin as a

204
00:13:44,870 --> 00:13:42,899
few kilometers but most estimates are

205
00:13:46,819 --> 00:13:44,880
something like ten order of magnitude

206
00:13:49,910 --> 00:13:46,829
ten kilometers maybe even tens of

207
00:13:51,560 --> 00:13:49,920
kilometers but it's also good to keep in

208
00:13:54,889 --> 00:13:51,570
mind that the ice shell thickness can

209
00:13:58,160 --> 00:13:54,899
change over time and like they have so

210
00:14:00,110 --> 00:13:58,170
these kind of pinkish things rising

211
00:14:02,300 --> 00:14:00,120
through the shell are an example of what

212
00:14:03,860 --> 00:14:02,310
might be moving material in a sea shells

213
00:14:05,840 --> 00:14:03,870

and that would be some form of

214

00:14:08,300 --> 00:14:05,850

convection either more wholesale

215

00:14:11,569 --> 00:14:08,310

convection or something more localized

216

00:14:14,240 --> 00:14:11,579

like diapirism this would be warmer ice

217

00:14:16,850 --> 00:14:14,250

moving possibly even getting some

218

00:14:18,410 --> 00:14:16,860

partial melting going on and of course

219

00:14:22,250 --> 00:14:18,420

because the all sorts of interesting

220

00:14:23,660 --> 00:14:22,260

surface features on Europa including

221

00:14:25,340 --> 00:14:23,670

ridges and vans which could be

222

00:14:27,860 --> 00:14:25,350

indicating from kind of fracturing to

223

00:14:32,240 --> 00:14:27,870

some depth is occurring and it's broken

224

00:14:34,160 --> 00:14:32,250

up material called chaos and the overall

225

00:14:36,800 --> 00:14:34,170

surface age of Europa is quite young

226

00:14:39,199 --> 00:14:36,810

Jews from crater counting statistics so

227

00:14:45,199 --> 00:14:39,209

we know some of this motion is happening

228

00:14:49,220 --> 00:14:47,030

there are not a kind of impacts on

229

00:14:50,900 --> 00:14:49,230

Europa but I am a fan of impact so I

230

00:14:53,569 --> 00:14:50,910

just want to make sure there are not

231

00:14:56,090 --> 00:14:53,579

forgotten because they also can move in

232

00:14:58,669 --> 00:14:56,100

mixed material here's pictures of two of

233

00:15:01,069 --> 00:14:58,679

the largest impacts on Europa tire and

234

00:15:03,109 --> 00:15:01,079

callanish and just a simple

235

00:15:05,359 --> 00:15:03,119

back-of-the-envelope calculation shows

236

00:15:07,429 --> 00:15:05,369

that based on their size they could be

237

00:15:09,139 --> 00:15:07,439

ejecting material from asifa's 2

238

00:15:16,389 --> 00:15:09,149

kilometers of course they'd also be

239

00:15:21,739 --> 00:15:19,249

and terms have been mentioned so this is

240

00:15:24,530 --> 00:15:21,749

an obvious way to get material to move

241

00:15:26,869 --> 00:15:24,540

around and it's exciting that on your

242

00:15:29,389 --> 00:15:26,879

boba there's no kids of affluent also in

243

00:15:39,079 --> 00:15:29,399

the southern hemisphere from New 850

244

00:15:42,710 --> 00:15:39,089

data this one is mine we are trying to

245

00:15:45,829 --> 00:15:42,720

consider the issue of whether or not and

246

00:15:49,069 --> 00:15:45,839

or to what extent the role of freezing

247

00:15:52,160 --> 00:15:49,079

and thawing as a cyclic process might

248

00:15:54,799 --> 00:15:52,170

lead to enrichment and perhaps

249

00:15:57,530 --> 00:15:54,809

subsequent evolution of complex organics

250

00:16:00,319 --> 00:15:57,540

and prebiotic with prebiotic

251
00:16:01,699 --> 00:16:00,329
implications on icy world so I've

252
00:16:04,819 --> 00:16:01,709
rounded up a little bit of information

253
00:16:08,749 --> 00:16:04,829
about what we think we do know on earth

254
00:16:12,439 --> 00:16:08,759
in permafrost we know that periodical

255
00:16:15,189 --> 00:16:12,449
periodic freezing and thawing during the

256
00:16:19,389 --> 00:16:15,199
thawing period of time of course things

257
00:16:23,210 --> 00:16:19,399
things mix but during the freezing

258
00:16:25,879 --> 00:16:23,220
portion of the cycle liquid pockets that

259
00:16:27,829 --> 00:16:25,889
remain between the ice crystals become

260
00:16:30,980 --> 00:16:27,839
more and more concentrated with respect

261
00:16:34,039 --> 00:16:30,990
to both salt and any organic materials

262
00:16:37,449 --> 00:16:34,049
that they that they can contain some

263
00:16:41,179 --> 00:16:37,459

tunes these are quite large lenses of

264

00:16:44,359 --> 00:16:41,189

highly concentrated solute in the water

265

00:16:47,780 --> 00:16:44,369

and they're called cryo pegs excuse me

266

00:16:52,549 --> 00:16:47,790

I'm battling flu here these pockets of

267

00:16:55,100 --> 00:16:52,559

fluid can then melt again and of course

268

00:16:58,340 --> 00:16:55,110

and this is a transport mechanism for

269

00:16:59,180 --> 00:16:58,350

mixing of materials and so forth the

270

00:17:01,280 --> 00:16:59,190

utility of

271

00:17:05,870 --> 00:17:01,290

for prebiotic chemistry and perhaps even

272

00:17:11,470 --> 00:17:05,880

as microbial habitat is that it will

273

00:17:14,150 --> 00:17:11,480

force a greater interaction of chemicals

274

00:17:17,809 --> 00:17:14,160

compounds of interest for prebiotic

275

00:17:21,290 --> 00:17:17,819

chemistry and they could also ultimately

276

00:17:24,910 --> 00:17:21,300

then serve as little microhabitats for

277

00:17:27,740 --> 00:17:24,920

microbes within the icy frozen mouth

278

00:17:30,020 --> 00:17:27,750

when we have sporadic thawing of course

279

00:17:33,170 --> 00:17:30,030

this is where we get exchange of

280

00:17:36,380 --> 00:17:33,180

materials but also if any organisms on

281

00:17:40,010 --> 00:17:36,390

an icy body possess anything like the

282

00:17:42,620 --> 00:17:40,020

type of genetic coding that we

283

00:17:45,680 --> 00:17:42,630

experience here on this planet this

284

00:17:48,680 --> 00:17:45,690

could allow for at least episodic gene

285

00:17:50,000 --> 00:17:48,690

flow but it's clear to us from from

286

00:17:52,940 --> 00:17:50,010

looking at the literature that we have

287

00:17:55,640 --> 00:17:52,950

been able to interrogate that the word

288

00:17:58,940 --> 00:17:55,650

on these these concentrated brine and

289

00:18:02,090 --> 00:17:58,950

organic pockets is quite insufficient to

290

00:18:03,730 --> 00:18:02,100

really put this in context nevertheless

291

00:18:06,650 --> 00:18:03,740

three things of the notions are

292

00:18:08,300 --> 00:18:06,660

tantalizing enough that this is

293

00:18:11,780 --> 00:18:08,310

something that's quite worthy of being

294

00:18:25,490 --> 00:18:11,790

incorporated into the menu of topics

295

00:18:32,450 --> 00:18:30,020

Oh this week so here we just for this is

296

00:18:33,980 --> 00:18:32,460

a course a relevant question talking

297

00:18:36,080 --> 00:18:33,990

about internal heating sources for any

298

00:18:38,480 --> 00:18:36,090

of these bodies so it just started

299

00:18:41,360 --> 00:18:38,490

making a list here obviously radiogenic

300

00:18:43,700 --> 00:18:41,370

eating tidal heating and early in the

301

00:18:45,620 --> 00:18:43,710

history of these bodies heat of

302

00:18:47,840 --> 00:18:45,630

accretion and possibly heat from

303

00:18:51,710 --> 00:18:47,850

differentiation if that is what happens

304

00:18:54,320 --> 00:18:51,720

to a given satellite and we just made a

305

00:18:56,090 --> 00:18:54,330

little note of when these were most

306

00:18:57,890 --> 00:18:56,100

important there is some radiogenic

307

00:19:00,140 --> 00:18:57,900

heating remaining but of course that was

308

00:19:02,450 --> 00:19:00,150

much more important portant early on and

309

00:19:04,970 --> 00:19:02,460

tidal heating is what really keeps these

310

00:19:06,950 --> 00:19:04,980

audios geologically active today there's

311

00:19:10,100 --> 00:19:06,960

also plenty of interesting research

312

00:19:19,280 --> 00:19:10,110

about potential previous resonances that

313

00:19:21,920 --> 00:19:19,290

these bodies went through our next

314

00:19:27,260 --> 00:19:21,930

question addresses whether or not we can

315

00:19:30,250 --> 00:19:27,270

have any way of detecting subterranean

316

00:19:34,610 --> 00:19:30,260

or sub oceanic hydrothermal activity

317

00:19:37,570 --> 00:19:34,620

should there be the actual oceans that

318

00:19:40,810 --> 00:19:37,580

we are led to believe that there is now

319

00:19:44,090 --> 00:19:40,820

this is quite a difficult task we have

320

00:19:47,150 --> 00:19:44,100

described to do the creative approach to

321

00:19:50,990 --> 00:19:47,160

imagine what might be indicators of

322

00:19:53,060 --> 00:19:51,000

hydrothermal activity on earth we know

323

00:19:56,590 --> 00:19:53,070

that hydrothermal vents have been

324

00:20:00,920 --> 00:19:56,600

detected on my beers and colleagues

325

00:20:04,370 --> 00:20:00,930

using a combination of conductivity

326

00:20:05,570 --> 00:20:04,380

temperature and depth measurements which

327

00:20:07,880 --> 00:20:05,580

of course they're able to conduct

328

00:20:10,010 --> 00:20:07,890

because they have access to the surface

329

00:20:13,190 --> 00:20:10,020

of the ocean on earth whether or not

330

00:20:17,830 --> 00:20:13,200

this approach could actually be employed

331

00:20:19,550 --> 00:20:17,840

in on an icy moon remains debatable

332

00:20:22,460 --> 00:20:19,560

nevertheless it's an interesting

333

00:20:25,610 --> 00:20:22,470

suggestion we certainly know that for

334

00:20:27,890 --> 00:20:25,620

Vostok which is one of the subsurface

335

00:20:31,910 --> 00:20:27,900

fluid-filled lenses that I think of as

336

00:20:34,850 --> 00:20:31,920

caves and water ice up shows a clear

337

00:20:37,180 --> 00:20:34,860

footprint on the surface of the ice it

338

00:20:39,350 --> 00:20:37,190

over lives it and this is due to

339

00:20:41,350 --> 00:20:39,360

differential temperature effects

340

00:20:44,840 --> 00:20:41,360

from the fact that there is a

341

00:20:49,660 --> 00:20:44,850

encapsulated liquid water right at the

342

00:20:53,570 --> 00:20:49,670

freezing point and this apparently

343

00:20:56,770 --> 00:20:53,580

seduces this shadow flattening of course

344

00:20:59,840 --> 00:20:56,780

this is a a much thinner amount of ice

345

00:21:05,299 --> 00:20:59,850

than we anticipate for many of the other

346

00:21:09,380 --> 00:21:05,309

icy moons of entry pass on the order of

347

00:21:11,659 --> 00:21:09,390

about 3.8 kilometers is the depth of

348

00:21:15,950 --> 00:21:11,669

this feature but nevertheless there may

349

00:21:18,470 --> 00:21:15,960

be some counterpart to this on other

350

00:21:22,960 --> 00:21:18,480

moons and syllabus as I understand it

351

00:21:25,190 --> 00:21:22,970

they have a much thinner ice cover we

352

00:21:27,169 --> 00:21:25,200

contemplated the idea of measuring the

353

00:21:29,570 --> 00:21:27,179

ice temperature gradients via some sort

354

00:21:33,230 --> 00:21:29,580

of pouring from the surface however on

355

00:21:36,020 --> 00:21:33,240

moons with very thick icy crusts this

356

00:21:46,210 --> 00:21:36,030

may be far short of where one would

357

00:21:53,170 --> 00:21:49,130

okay then there was a question about

358

00:21:58,400 --> 00:21:53,180

sample return for mighty words is it

359

00:22:04,850 --> 00:21:58,410

necessary and is it peaceful first of

360

00:22:08,270 --> 00:22:04,860

all is it really necessary they're easy

361

00:22:11,840 --> 00:22:08,280

straight the orbitals spectroscopy of

362

00:22:13,820 --> 00:22:11,850

surface modulus can tell us much not all

363

00:22:22,700 --> 00:22:13,830

science questions can be answered this

364

00:22:25,340 --> 00:22:22,710

way desirable of more elaborate

365

00:22:29,000 --> 00:22:25,350

resonance erectus awake information from

366

00:22:31,880 --> 00:22:29,010

individual missions I space samples will

367

00:22:34,700 --> 00:22:31,890

require major efforts to preserve them

368

00:22:38,000 --> 00:22:34,710

in their original states probably

369

00:22:49,190 --> 00:22:38,010

necessary active cooling capacities on

370

00:22:53,900 --> 00:22:49,200

the return voyage so it will eventually

371

00:23:00,050 --> 00:22:53,910

be necessary to do sample return mission

372

00:23:05,000 --> 00:23:00,060

if all the evidence so that it's

373

00:23:09,680 --> 00:23:05,010

necessary but is it feasible of course

374

00:23:14,450 --> 00:23:09,690

the required Delta V cost to the outer

375

00:23:18,520 --> 00:23:14,460

solar system and return mission is very

376

00:23:23,210 --> 00:23:18,530

expensive and such mission would be

377

00:23:31,250 --> 00:23:23,220

extremely complex that means it's very

378

00:23:35,810 --> 00:23:31,260

expensive and difficult and that also

379

00:23:38,930 --> 00:23:35,820

means about the question can we really

380

00:23:45,950 --> 00:23:38,940

reach the possible habitable location

381

00:23:48,560 --> 00:23:45,960

record 24 required sample so if the fire

382

00:23:52,370 --> 00:23:48,570

markers or chemistry we are looking for

383

00:23:55,790 --> 00:23:52,380

a thunder

384

00:24:04,040 --> 00:23:55,800

some tig I shell it will be very

385

00:24:06,820 --> 00:24:04,050

difficult to take there is a potentially

386

00:24:13,760 --> 00:24:06,830

highly out red surface sample

387

00:24:17,660 --> 00:24:13,770

interpretable or is the surface sample

388

00:24:27,110 --> 00:24:17,670

better analyzed in to do like in a stone

389

00:24:33,590 --> 00:24:27,120

number 3 X okay um our last major sub

390

00:24:37,310 --> 00:24:33,600

question is what that are in or on icy

391

00:24:38,630 --> 00:24:37,320

satellites might be we distinguish this

392

00:24:42,350 --> 00:24:38,640

into what might have been available

393

00:24:45,830 --> 00:24:42,360

early and what arrived later in the

394

00:24:49,040 --> 00:24:45,840

history of body and in feed what may

395

00:24:52,750 --> 00:24:49,050

still be arriving the high degree of

396

00:24:55,760 --> 00:24:52,760

variability of icy bodies means that is

397

00:24:57,970 --> 00:24:55,770

difficult and perhaps not productive to

398

00:25:00,620 --> 00:24:57,980

try to consider them as a single class

399

00:25:02,810 --> 00:25:00,630

obviously there are great differences in

400

00:25:08,270 --> 00:25:02,820

size great differences in degree of

401
00:25:10,940 --> 00:25:08,280
geological differentiation we plowed

402
00:25:14,600 --> 00:25:10,950
through literature's try to pick out a

403
00:25:18,290 --> 00:25:14,610
few catalogs and kids it's clearly

404
00:25:21,040 --> 00:25:18,300
tightened the poster child for a

405
00:25:24,080 --> 00:25:21,050
gigantic production of organic materials

406
00:25:28,610 --> 00:25:24,090
because of its the nature of its

407
00:25:32,210 --> 00:25:28,620
hydrocarbon geochemistry and atmospheric

408
00:25:36,320 --> 00:25:32,220
chemistry and fluids so it's anticipated

409
00:25:39,860 --> 00:25:36,330
that it has very thick regulus

410
00:25:43,030 --> 00:25:39,870
essentially of hydrocarbons and perhaps

411
00:25:45,140 --> 00:25:43,040
even more complicated and elaborate

412
00:25:50,800 --> 00:25:45,150
organic chemistry so this is an

413
00:25:55,160 --> 00:25:50,810

intrinsic mechanism on titan europa

414

00:25:57,530 --> 00:25:55,170

production of salt from its interior was

415

00:26:03,860 --> 00:25:57,540

actually theoretically dealt with a

416

00:26:06,010 --> 00:26:03,870

couple of years ago but the time

417

00:26:09,350 --> 00:26:06,020

concepts for that of course are unknown

418

00:26:13,010 --> 00:26:09,360

and more recently of course the sodium

419

00:26:16,250 --> 00:26:13,020

salts putative Lee from Enceladus

420

00:26:19,730 --> 00:26:16,260

assumes i've been detected in Saturn's

421

00:26:23,110 --> 00:26:19,740

outermost rings so we actually appear to

422

00:26:28,670 --> 00:26:23,120

have a smoking gun there for export of

423

00:26:31,070 --> 00:26:28,680

salt there have been general

424

00:26:33,080 --> 00:26:31,080

considerations of organic delivery two

425

00:26:35,450 --> 00:26:33,090

planets and moons there are several

426

00:26:38,150 --> 00:26:35,460

papers involving court and sex and I

427

00:26:40,700 --> 00:26:38,160

just wrote one here up there are other

428

00:26:42,310 --> 00:26:40,710

papers coming out of that group with

429

00:26:47,930 --> 00:26:42,320

additional co-authors that have

430

00:26:50,630 --> 00:26:47,940

considered various aspects of cometary

431

00:26:53,720 --> 00:26:50,640

organics materials things created on

432

00:26:56,360 --> 00:26:53,730

commentary bodies over time and the rate

433

00:26:59,480 --> 00:26:56,370

of delivery of those to icy bodies and

434

00:27:01,820 --> 00:26:59,490

other planets certainly we know that

435

00:27:04,520 --> 00:27:01,830

while the work very recently published

436

00:27:07,580 --> 00:27:04,530

in this past year by martins and their

437

00:27:11,450 --> 00:27:07,590

colleagues have shown amino acid

438

00:27:14,060 --> 00:27:11,460

production of a significant degree from

439

00:27:17,660 --> 00:27:14,070

simulations of shock meeting that one

440

00:27:20,780 --> 00:27:17,670

would expect from commentary info we

441

00:27:24,800 --> 00:27:20,790

certainly know that even on Piper belt

442

00:27:27,170 --> 00:27:24,810

objects many of whom are have been in

443

00:27:29,540 --> 00:27:27,180

the past thought to be not geologically

444

00:27:31,810 --> 00:27:29,550

very active but nevertheless they seem

445

00:27:35,090 --> 00:27:31,820

to have significant alteration products

446

00:27:37,400 --> 00:27:35,100

including hydrated silicates so this is

447

00:27:41,300 --> 00:27:37,410

just a brief overview of the things that

448

00:27:43,490 --> 00:27:41,310

caught my attention recently but as I as

449

00:27:46,010 --> 00:27:43,500

I mentioned in the first item there is

450

00:27:50,090 --> 00:27:46,020

really a vast array of literature that

451

00:27:51,910 --> 00:27:50,100

can pertain to this question and I do

452

00:27:55,370 --> 00:27:51,920

not believe that anyone has done a

453

00:28:01,630 --> 00:27:55,380

review article on this so with that I'll

454

00:28:15,170 --> 00:28:09,020

okay thanks so here are there's our last

455

00:28:18,540 --> 00:28:15,180

slide listing all the connection to

456

00:28:23,430 --> 00:28:18,550

author astrobiology straightjacket

457

00:28:28,130 --> 00:28:23,440

that we have identified first of all how

458

00:28:33,450 --> 00:28:30,510

how can we identify habitable

459

00:28:35,550 --> 00:28:33,460

environments in our solar system and

460

00:28:40,260 --> 00:28:35,560

finally desserts for life on other

461

00:28:45,030 --> 00:28:40,270

worlds in all planetary system so that's

462

00:28:50,240 --> 00:28:45,040

what it we thank you and uh I think it's

463

00:28:54,720 --> 00:28:50,250

a plan for discussion and questions

464

00:28:58,170 --> 00:28:54,730

absolutely so at this point I can see

465

00:29:01,020 --> 00:28:58,180

that well at least one doesn't wrong has

466

00:29:03,480 --> 00:29:01,030

already seen you can type questions into

467

00:29:07,470 --> 00:29:03,490

the chat window and in fact he's doing

468

00:29:10,290 --> 00:29:07,480

that as as I speak um if anyone else

469

00:29:12,060 --> 00:29:10,300

wants to ask questions up at the top of

470

00:29:13,380 --> 00:29:12,070

the screen you'll see that there's a

471

00:29:15,630 --> 00:29:13,390

little button to let you raise your

472

00:29:17,730 --> 00:29:15,640

hands I think it might be worth doing

473

00:29:24,030 --> 00:29:17,740

that just because we had a number of

474

00:29:27,390 --> 00:29:24,040

people signed in today so questions and

475

00:29:29,400 --> 00:29:27,400

observations the people want to range

476

00:29:31,560 --> 00:29:29,410

and just to remind you the purpose of

477

00:29:34,290 --> 00:29:31,570

this webinar is partly to inform the

478

00:29:36,150 --> 00:29:34,300

community about different aspects of the

479

00:29:38,700 --> 00:29:36,160

overall roadmap that I'm alone but also

480

00:29:41,280 --> 00:29:38,710

to help the authors to strengthen their

481

00:29:43,200 --> 00:29:41,290

paint those so any observations that you

482

00:29:46,380 --> 00:29:43,210

want to make on this would be gratefully

483

00:29:49,020 --> 00:29:46,390

received the document itself will be

484

00:29:54,540 --> 00:29:49,030

opened up for comments very shortly as

485

00:29:57,420 --> 00:29:54,550

soon as this event is finished so gal

486

00:30:08,279 --> 00:29:57,430

has typed in a question if you want to

487

00:30:17,440 --> 00:30:12,430

perhaps I can feel that one from from

488

00:30:19,419 --> 00:30:17,450

Dell all I know since this is not my

489

00:30:22,600 --> 00:30:19,429

that is not my area of research but it

490

00:30:26,649 --> 00:30:22,610

is nevertheless and published by the

491

00:30:31,330 --> 00:30:26,659

group that I fight here nice Rev and and

492

00:30:34,029 --> 00:30:31,340

colleagues in 2003 since you raised the

493

00:30:35,950 --> 00:30:34,039

issue i can search for word on that and

494

00:30:38,590 --> 00:30:35,960

i'll make a note of that to see whether

495

00:30:41,710 --> 00:30:38,600

or not that has been discussed in later

496

00:30:44,649 --> 00:30:41,720

papers that take up that issue but

497

00:30:59,190 --> 00:30:44,659

nevertheless they were postulating that

498

00:31:04,269 --> 00:31:01,869

other questions you'll you're more than

499

00:31:08,109 --> 00:31:04,279

welcome to talk but the phone lines are

500

00:31:09,460 --> 00:31:08,119

also open so if you want to ask the

501

00:31:21,310 --> 00:31:09,470

question directly will make an

502

00:31:22,989 --> 00:31:21,320

observation please go right ahead in

503

00:31:25,259 --> 00:31:22,999

answer to Ron and maybe somebody else

504

00:31:28,269 --> 00:31:25,269

wants to chime in but yes that has been

505

00:31:32,700 --> 00:31:28,279

suggested actually by several groups is

506

00:31:36,369 --> 00:31:32,710

fly-through of the flumes for Enceladus

507

00:31:39,009 --> 00:31:36,379

now with the recent apparent discovery

508

00:31:41,379 --> 00:31:39,019

of what appear to be fluid flumes from

509

00:31:43,840 --> 00:31:41,389

Europa that Ross and company have just

510

00:31:46,840 --> 00:31:43,850

published perhaps that could be

511

00:31:49,359 --> 00:31:46,850

considered also it does not appear to me

512

00:31:52,629 --> 00:31:49,369

from the one paper that I've seen if it

513

00:31:56,649 --> 00:31:52,639

swims on Europa are anywhere near both

514

00:31:58,210 --> 00:31:56,659

sides of the plumes on Enceladus so they

515

00:32:00,249 --> 00:31:58,220

might be a more difficult target but

516

00:32:03,730 --> 00:32:00,259

nevertheless set it's probably the

517

00:32:05,950 --> 00:32:03,740

lowest dollar figure for a mission which

518

00:32:09,310 --> 00:32:05,960

actually gets something from the

519

00:32:12,460 --> 00:32:09,320

interior and because they would be

520

00:32:15,100 --> 00:32:12,470

flying through octave flumes material

521

00:32:17,980 --> 00:32:15,110

being emitted would have been exposed

522

00:32:21,160 --> 00:32:17,990

for a minimum amount of time to the

523

00:32:22,960 --> 00:32:21,170

destructive forces around whatever prime

524

00:32:25,390 --> 00:32:22,970

a planet it is whether it's a pattern

525

00:32:29,770 --> 00:32:25,400

for Jupiter and so I think it's a very

526

00:32:32,280 --> 00:32:29,780

attractive mission opportunity if it

527

00:32:34,600 --> 00:32:32,290

were combined with some sort of Lander

528

00:32:36,970 --> 00:32:34,610

of course that would be much more

529

00:32:40,240 --> 00:32:36,980

expensive but it also of course would

530

00:32:43,540 --> 00:32:40,250

give as much greater science payback I

531

00:32:53,580 --> 00:32:43,550

think so I say let's have some missions

532

00:33:04,690 --> 00:32:53,590

like that and the timing also is

533

00:33:13,920 --> 00:33:04,700

important it to do these plumes so so we

534

00:33:19,630 --> 00:33:17,410

other questions or comments and just so

535

00:33:21,790 --> 00:33:19,640

you're aware the document which is

536

00:33:25,270 --> 00:33:21,800

linked on the front of the website has

537

00:33:27,310 --> 00:33:25,280

now been opened up for comments so you

538

00:33:29,350 --> 00:33:27,320

can also write directly into that

539

00:33:31,990 --> 00:33:29,360

document if you haven't done it before

540

00:33:33,160 --> 00:33:32,000

it's a Google document you find a

541

00:33:34,960 --> 00:33:33,170

section that you're interested in

542

00:33:37,060 --> 00:33:34,970

commenting on you highlight the part

543

00:33:39,520 --> 00:33:37,070

that you want to do right click and

544

00:33:41,980 --> 00:33:39,530

choose add comment and you will then be

545

00:33:43,930 --> 00:33:41,990

able to stick in virtual post-it notes

546

00:33:46,150 --> 00:33:43,940

on their winter extremely useful the

547

00:33:49,360 --> 00:33:46,160

only request we make is that if you have

548

00:33:51,220 --> 00:33:49,370

a google account please login first just

549

00:33:53,170 --> 00:33:51,230

so that it will record your names so

550

00:33:54,340 --> 00:33:53,180

that the author group can get back to

551

00:33:56,320 --> 00:33:54,350

you if there's anything they want to

552

00:33:58,240 --> 00:33:56,330

clarify and if you don't have a Google

553

00:34:21,399 --> 00:33:58,250

account it will be useful if you could

554

00:34:27,649 --> 00:34:25,669

let me point out that their only have

555

00:34:32,690 --> 00:34:27,659

been essentially three of us working on

556

00:34:34,190 --> 00:34:32,700

this paper and obviously we are not all

557

00:34:37,510 --> 00:34:34,200

knowledgeable in spite of being very

558

00:34:40,669 --> 00:34:37,520

good with literature searching and so

559

00:34:42,859 --> 00:34:40,679

there are many effects what we have

560

00:34:45,409 --> 00:34:42,869

addressed here that what we would

561

00:34:48,079 --> 00:34:45,419

certainly welcome additional ideas or

562

00:34:50,690 --> 00:34:48,089

clarification or little pieces of

563

00:34:53,030 --> 00:34:50,700

literature that may have passed a five

564

00:34:54,950 --> 00:34:53,040

so we're still thinking of this is a

565

00:34:57,470 --> 00:34:54,960

work in progress even though we know we

566

00:35:02,450 --> 00:34:57,480

need to be wrapping this up relatively

567

00:35:05,210 --> 00:35:02,460

soon and that's certainly one of the

568

00:35:07,640 --> 00:35:05,220

useful ways that you can add comments to

569

00:35:09,710 --> 00:35:07,650

the document with particularly links to

570

00:35:14,390 --> 00:35:09,720

any papers that you're aware of that the

571

00:35:17,930 --> 00:35:14,400

team should know about so I can see that

572

00:35:22,250 --> 00:35:17,940

Ron is currently typing a comment while

573

00:35:24,500 --> 00:35:22,260

he's doing that are there any other any

574

00:35:26,480 --> 00:35:24,510

other thoughts that people want to raise

575

00:35:28,940 --> 00:35:26,490

as I say the phone lines are open if you

576

00:35:51,580 --> 00:35:28,950

want to talk directly you're welcome to

577

00:35:59,510 --> 00:35:56,120

now here is mentioning the new horizons

578

00:36:06,710 --> 00:35:59,520

missions I think definitely is relevant

579

00:36:09,490 --> 00:36:06,720

here Clarissa I see buddy that's the

580

00:36:13,340 --> 00:36:09,500

point we we didn't really consider pluto

581

00:36:15,530 --> 00:36:13,350

partly I think because one of us know

582

00:36:20,360 --> 00:36:15,540

much about food shuffle but it's

583

00:36:24,200 --> 00:36:20,370

certainly a very large kbo and hopefully

584

00:36:26,420 --> 00:36:24,210

when the woman's the horizons mission

585

00:36:29,060 --> 00:36:26,430

gets there will be able to flesh out

586

00:36:35,750 --> 00:36:29,070

some sort of picture of what those

587

00:36:39,740 --> 00:36:35,760

bodies are lights well gal if you wanted

588

00:36:43,580 --> 00:36:39,750

to go into the document at some point

589

00:36:47,150 --> 00:36:43,590

and if you have some ideas about the

590

00:37:00,400 --> 00:36:47,160

pseudo and Caroline system to add to the

591

00:37:08,310 --> 00:37:03,390

and then I see there's a question from a

592

00:37:11,740 --> 00:37:08,320

comment from Ron which is quite the case

593

00:37:14,140 --> 00:37:11,750

definitely there are acetylene detection

594

00:37:18,280 --> 00:37:14,150

supposedly I don't know myself how

595

00:37:20,320 --> 00:37:18,290

robust azhar but taking them on face

596

00:37:25,870 --> 00:37:20,330

value it certainly is a constituent of

597

00:37:27,730 --> 00:37:25,880

the Titan atmosphere and so any of the

598

00:37:32,380 --> 00:37:27,740

metabolic products that we know come

599

00:37:34,630 --> 00:37:32,390

from the acetylene fermenting guys maybe

600

00:37:37,660 --> 00:37:34,640

they would be at very very small parts

601
00:37:40,360 --> 00:37:37,670
for billions so there are detectability

602
00:37:42,730 --> 00:37:40,370
issues I think with instrumenting for

603
00:37:46,800 --> 00:37:42,740
such a mission but it would certainly be

604
00:37:49,720 --> 00:37:46,810
very tantalizing and important objects

605
00:37:55,210 --> 00:37:49,730
or important compounds to sit on the

606
00:37:56,950 --> 00:37:55,220
list of detectable material so if you

607
00:38:00,820 --> 00:37:56,960
want you can certainly add that to our

608
00:38:03,220 --> 00:38:00,830
paper otherwise you can trust me to do

609
00:38:40,579 --> 00:38:03,230
that to try to capture the essence of

610
00:38:50,760 --> 00:38:46,440
okay if there are no other points that

611
00:38:55,380 --> 00:38:50,770
we want to raise that num I want let me

612
00:38:57,930 --> 00:38:55,390
just let me just remind everyone the

613
00:39:00,120 --> 00:38:57,940

document itself you can access straight

614

00:39:02,130 --> 00:39:00,130

from the front page at the website it

615

00:39:05,400 --> 00:39:02,140

will be up there as the number one link

616

00:39:09,540 --> 00:39:05,410

for the next week we're looking for all

617

00:39:13,500 --> 00:39:09,550

the feedback we can get on it and this

618

00:39:16,410 --> 00:39:13,510

session will be up on the website in a

619

00:39:17,910 --> 00:39:16,420

day or so if you want to review it or if

620

00:39:20,339 --> 00:39:17,920

there are other people that you think

621

00:39:23,790 --> 00:39:20,349

should be seeing the presentation and

622

00:39:29,280 --> 00:39:23,800

the slide pack itself is also directly

623

00:39:33,930 --> 00:39:29,290

available from the event upon day on the

624

00:39:37,980 --> 00:39:33,940

front page as well um we are reaching

625

00:39:40,620 --> 00:39:37,990

almost the end of our webinar series we

626
00:39:43,140 --> 00:39:40,630
have to have everything wrapped up by

627
00:39:45,359 --> 00:39:43,150
the end of January and once we've got

628
00:39:48,750 --> 00:39:45,369
that done there would be a brief hiatus

629
00:39:50,609 --> 00:39:48,760
while we're discussing the next move and

630
00:39:53,700 --> 00:39:50,619
then we'll be moving into more of a

631
00:39:56,549 --> 00:39:53,710
converging phase but will be briefing

632
00:40:00,030 --> 00:39:56,559
the community about that a very simple

633
00:40:02,359 --> 00:40:00,040
okay so thank you to our presenters and

634
00:40:05,499 --> 00:40:02,369
thank you to all of our participants