



## Attendees (17)

## ▼ Hosts (1)

Marco Boldt

## ▼ Presenters (3)

Jake Bailey

Mike Tice

Stavros Michailidis

## ▼ Participants (13)

Dan Jones

Glenn Ciolek

Huiming Bao

Jamie Elsila

John Rummel

John Tarduno

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JTG

Lee Bebout

Lindsay Hays

Michael New

Suzanne Baldwin

Tony Del Genio

## Open Chat (Everyone)

----- (09/25/2013 10:46) -----  
 Stavros Michailidis: See a schedule of upcoming online discussions:  
<https://astrobiologyfuture.org/>

## Teleconference Instructions (Parti...

Teleconference Line: 866-692-3158  
 Passcode: 9109668#  
 Please use \*6 to **MUTE** your phone's mic when not speaking.  
 More info: <https://astrobiologyfuture.org>

## NAI webinar slides jvb.pdf

Full Screen

- Each of Earth's unique habitable states represents a potential test case for life on other planetary bodies.



## Notepad

Presenters:

- Jake Bailey
- Mike Tice

Co-Authors:

Tim Lyons, Jake Bailey, Mike Tice, Dave Johnston, Chris Reinhard, Clark Johnson, Mark Patzkowsky

Agenda:

Topic Introduction  
 Approach  
 Justification

Overview of Key Questions

- - -

Comments, Q&A and feedback from the audience

Key Questions:

How did Earth attain and retain habitability through its history?

What are the roles of tectonics and climate in shaping a habitable world?

What is the relationship between

1  
00:00:14,600 --> 00:00:12,350  
so I'll just reemphasize the grand

2  
00:00:16,160 --> 00:00:14,610  
question or the theme that we had here

3  
00:00:17,470 --> 00:00:16,170  
how might the evolution of the

4  
00:00:19,550 --> 00:00:17,480  
atmosphere through Earth's history

5  
00:00:21,620 --> 00:00:19,560  
including its interactions with the

6  
00:00:26,660 --> 00:00:21,630  
solid earth and biosphere inform our

7  
00:00:30,109 --> 00:00:26,670  
exploration high-level worlds the the

8  
00:00:33,979 --> 00:00:30,119  
main offers on this the sort of white

9  
00:00:36,590 --> 00:00:33,989  
paper were Tim Lions take Bailey myself

10  
00:00:39,139 --> 00:00:36,600  
Dave Johnston Chris Reinhard Park

11  
00:00:41,510 --> 00:00:39,149  
Johnson and Mark cut skalski and there

12  
00:00:43,729 --> 00:00:41,520  
were thrown the comments from a number

13  
00:00:47,060 --> 00:00:43,739

of other folks that had been reading

14

00:00:48,920 --> 00:00:47,070

that beating and we've incorporated at

15

00:00:52,220 --> 00:00:48,930

least a few of those in this document

16

00:00:54,319 --> 00:00:52,230

and I'll just emphasize that we're

17

00:00:56,900 --> 00:00:54,329

really interested in starting the

18

00:00:58,970 --> 00:00:56,910

conversation and we're this and so in

19

00:01:01,479 --> 00:00:58,980

addition to that the time that you have

20

00:01:03,470 --> 00:01:01,489

to ask questions and make comments here

21

00:01:06,620 --> 00:01:03,480

we're going to be opening up the

22

00:01:09,109 --> 00:01:06,630

document for comments on Google Docs and

23

00:01:10,940 --> 00:01:09,119

so we're interested in seeing what

24

00:01:17,780 --> 00:01:10,950

people have to say and what ideas you

25

00:01:20,840 --> 00:01:17,790

all had to bring okay so this uh this

26

00:01:23,630 --> 00:01:20,850

concept paper was was really driven by

27

00:01:27,200 --> 00:01:23,640

the realization that when we speak about

28

00:01:30,200 --> 00:01:27,210

habitable planets particular about how

29

00:01:33,380 --> 00:01:30,210

to build on earth we need different

30

00:01:36,260 --> 00:01:33,390

things over the known history of earth

31

00:01:39,890 --> 00:01:36,270

and so we started to talk about the term

32

00:01:41,690 --> 00:01:39,900

states of habitability yeah the earth

33

00:01:43,370 --> 00:01:41,700

has evolved through many states is how

34

00:01:45,889 --> 00:01:43,380

the ability over its last four billion

35

00:01:48,830 --> 00:01:45,899

years of history and so what it has

36

00:01:50,690 --> 00:01:48,840

meant for the earth to sustain life and

37

00:01:55,209 --> 00:01:50,700

what life is be able to inhabit earth

38

00:01:58,730 --> 00:01:55,219

has changed radically over time and

39

00:02:02,719 --> 00:01:58,740

there's different states each represent

40

00:02:05,209 --> 00:02:02,729

a unique combination of processes that

41

00:02:07,760 --> 00:02:05,219

occur both on and below the earth's

42

00:02:10,850 --> 00:02:07,770

surface and so what we're talking about

43

00:02:12,730 --> 00:02:10,860

here are different different companies

44

00:02:16,580 --> 00:02:12,740

and feedbacks between different

45

00:02:19,010 --> 00:02:16,590

comprehensive deferred system obviously

46

00:02:22,850 --> 00:02:19,020

both above and below your surfaces are

47

00:02:28,100 --> 00:02:22,860

also different forcings external to the

48

00:02:32,600 --> 00:02:28,110

earth now each of those states we read

49

00:02:35,300 --> 00:02:32,610

argue a title test case or window very

50

00:02:38,050 --> 00:02:35,310

thinking about letting what might mean

51  
00:02:42,110 --> 00:02:38,060  
for another planet be habitable and in

52  
00:02:44,690 --> 00:02:42,120  
particular that the atmosphere is really

53  
00:02:46,760 --> 00:02:44,700  
where a lot of these processes get

54  
00:02:48,410 --> 00:02:46,770  
actually rated and become accessible to

55  
00:02:51,890 --> 00:02:48,420  
investigation when we're looking at a

56  
00:02:55,160 --> 00:02:51,900  
plan so the idea here is that within the

57  
00:02:56,960 --> 00:02:55,170  
next decade or so we have a chance

58  
00:02:59,300 --> 00:02:56,970  
essentially to start examining the

59  
00:03:03,710 --> 00:02:59,310  
composition of atmospheres around other

60  
00:03:08,030 --> 00:03:03,720  
planets and using those as a window or

61  
00:03:11,080 --> 00:03:08,040  
as variables into if you've got what may

62  
00:03:13,340 --> 00:03:11,090  
be going on in potential biospheres or

63  
00:03:17,090 --> 00:03:13,350

different compounds and those other

64

00:03:20,270 --> 00:03:17,100

plans in order to interpret what those

65

00:03:25,010 --> 00:03:20,280

things might mean we need to be able to

66

00:03:27,320 --> 00:03:25,020

use earth as a test case and evaluate

67

00:03:28,580 --> 00:03:27,330

what how the hell yah mysterious change

68

00:03:31,460 --> 00:03:28,590

they were trying to what that has meant

69

00:03:33,290 --> 00:03:31,470

for the internal state of the earth and

70

00:03:37,880 --> 00:03:33,300

for the organisms that wouldn't happen

71

00:03:39,920 --> 00:03:37,890

enough and there are isolate many

72

00:03:43,580 --> 00:03:39,930

different approaches that have been and

73

00:03:47,300 --> 00:03:43,590

will be used to examine how the earth is

74

00:03:48,740 --> 00:03:47,310

work to the system and how all these

75

00:03:52,940 --> 00:03:48,750

things have driven changes in the

76

00:03:55,340 --> 00:03:52,950

atmosphere so we wish this easier if

77

00:03:57,470 --> 00:03:55,350

they appear at different places in the

78

00:04:02,180 --> 00:03:57,480

concept paper all these things ranging

79

00:04:05,180 --> 00:04:02,190

from from what is really in chrono new

80

00:04:09,199 --> 00:04:05,190

analytical techniques coming online and

81

00:04:13,070 --> 00:04:09,209

both in terms of me availability and

82

00:04:14,630 --> 00:04:13,080

also just becoming more economical for

83

00:04:17,900 --> 00:04:14,640

use by investigators you think about

84

00:04:20,770 --> 00:04:17,910

these problems need a chemical tracers

85

00:04:24,409 --> 00:04:20,780

that are being developed and applied to

86

00:04:26,330 --> 00:04:24,419

earlier questions and just simply new

87

00:04:30,140 --> 00:04:26,340

questions that we're now able to ask

88

00:04:33,430 --> 00:04:30,150

out Billy environments see people are

89

00:04:36,740 --> 00:04:33,440

starting to apply genomic approaches to

90

00:04:39,080 --> 00:04:36,750

understand early evolution of life and

91

00:04:46,370 --> 00:04:39,090

sign interface that one but fossil and

92

00:04:50,120 --> 00:04:46,380

geochemical record you write and then

93

00:04:52,580 --> 00:04:50,130

finally we see that there's always gonna

94

00:04:55,159 --> 00:04:52,590

be a place for classical field geology

95

00:04:57,379 --> 00:04:55,169

and going out and actually looking at

96

00:05:01,460 --> 00:04:57,389

rocks and places things in and fill

97

00:05:04,120 --> 00:05:01,470

environmental context but that combined

98

00:05:07,159 --> 00:05:04,130

with new approaches to refining

99

00:05:08,960 --> 00:05:07,169

estimates of Ages and latent processes

100

00:05:11,440 --> 00:05:08,970

would be very important for thinking

101  
00:05:16,850 --> 00:05:11,450  
about how the earth is evolving system

102  
00:05:21,110 --> 00:05:16,860  
and just one final thing we see that

103  
00:05:23,980 --> 00:05:21,120  
those kinds of studies are now being

104  
00:05:27,920 --> 00:05:23,990  
very fluently combined with with studies

105  
00:05:31,250 --> 00:05:27,930  
with modern analogs and with model

106  
00:05:33,620 --> 00:05:31,260  
systems in the lab and we predict that

107  
00:05:34,850 --> 00:05:33,630  
that those kinds of things are going to

108  
00:05:38,390 --> 00:05:34,860  
continue to be important in these

109  
00:05:41,200 --> 00:05:38,400  
problems in the future since now jake

110  
00:05:43,909 --> 00:05:41,210  
has gained at talk a bit about so the

111  
00:05:51,740 --> 00:05:43,919  
sub questions that we identified have

112  
00:05:54,320 --> 00:05:51,750  
been this overall thanks Mike okay so we

113  
00:05:56,540 --> 00:05:54,330

have a number of different sub questions

114

00:05:59,029 --> 00:05:56,550

that we identified under this theme and

115

00:06:02,839 --> 00:05:59,039

I just want to kind of summarize some of

116

00:06:05,540 --> 00:06:02,849

those the first one is to understand how

117

00:06:09,680 --> 00:06:05,550

habitable states on the earth originated

118

00:06:11,800 --> 00:06:09,690

and how they were maintained and also

119

00:06:14,180 --> 00:06:11,810

how they kind of transition into

120

00:06:17,390 --> 00:06:14,190

succeeding States of habitability and

121

00:06:19,370 --> 00:06:17,400

these if we're able to do that then we

122

00:06:21,020 --> 00:06:19,380

can kind of place kind of important

123

00:06:23,450 --> 00:06:21,030

constraints on potentially on

124

00:06:26,779 --> 00:06:23,460

understanding operable States on other

125

00:06:28,430 --> 00:06:26,789

planets as well and so how might we go

126

00:06:30,290 --> 00:06:28,440

about doing that well we could

127

00:06:32,510 --> 00:06:30,300

essentially characterize and quantify

128

00:06:35,180 --> 00:06:32,520

these different diverse states that the

129

00:06:37,310 --> 00:06:35,190

Earth's system has occupied over time

130

00:06:39,250 --> 00:06:37,320

and then look at those kind of critical

131

00:06:42,100 --> 00:06:39,260

processes that have governed its Emily

132

00:06:44,160 --> 00:06:42,110

and couple that with a modelling

133

00:06:46,330 --> 00:06:44,170

component to better understand how

134

00:06:48,760 --> 00:06:46,340

various different state variables

135

00:06:52,150 --> 00:06:48,770

measured on other planets may reflect

136

00:06:54,430 --> 00:06:52,160

that kind of their evolution and states

137

00:06:56,250 --> 00:06:54,440

of habitability on those planets and by

138

00:06:58,270 --> 00:06:56,260

state variables we mean stuff like

139

00:07:00,850 --> 00:06:58,280

atmospheric composition or the

140

00:07:04,090 --> 00:07:00,860

composition of sediments and sedimentary

141

00:07:12,580 --> 00:07:04,100

rocks or also the presence or absence of

142

00:07:15,430 --> 00:07:12,590

key metabolic processes the second one

143

00:07:17,430 --> 00:07:15,440

is a what are the roles of tectonics and

144

00:07:22,660 --> 00:07:17,440

climate and shaping a habitable world

145

00:07:25,960 --> 00:07:22,670

and the idea here is that habitability

146

00:07:29,290 --> 00:07:25,970

of a planet is a could potentially be

147

00:07:31,540 --> 00:07:29,300

heavily influenced by the kind of

148

00:07:34,330 --> 00:07:31,550

tectonic system want to point it as well

149

00:07:36,700 --> 00:07:34,340

as the types of process based bio

150

00:07:38,920 --> 00:07:36,710

signatures on a planet both of these

151  
00:07:42,730 --> 00:07:38,930  
things have the potential to be I'm

152  
00:07:44,890 --> 00:07:42,740  
heavily influenced by tectonics and so

153  
00:07:48,520 --> 00:07:44,900  
this could be addressed by learning more

154  
00:07:50,790 --> 00:07:48,530  
about kind of the origin and early

155  
00:07:53,410 --> 00:07:50,800  
evolution of plate tectonics on earth

156  
00:07:55,360 --> 00:07:53,420  
tectonics over time and kind of the

157  
00:07:58,270 --> 00:07:55,370  
relationship between tectonics and

158  
00:08:02,200 --> 00:07:58,280  
changes in the biosphere the atmosphere

159  
00:08:04,390 --> 00:08:02,210  
and the composition of the deeper and

160  
00:08:07,150 --> 00:08:04,400  
this could include kind of quantitative

161  
00:08:09,790 --> 00:08:07,160  
models of plant evolution and also

162  
00:08:13,140 --> 00:08:09,800  
looking at kind of explicit linkages

163  
00:08:15,670 --> 00:08:13,150

between models of tectonics and

164

00:08:22,630 --> 00:08:15,680

atmospheric chemistry over a kind of

165

00:08:24,850 --> 00:08:22,640

geologic time scales what is the

166

00:08:26,890 --> 00:08:24,860

relationship between transitions

167

00:08:29,440 --> 00:08:26,900

transitions in the geosphere and

168

00:08:32,140 --> 00:08:29,450

transitions evolution of the biosphere

169

00:08:35,350 --> 00:08:32,150

so examples of this would be like for

170

00:08:39,339 --> 00:08:35,360

example that the changes in oxygen and a

171

00:08:43,839 --> 00:08:39,349

paleoproterozoic and Ediacaran what kind

172

00:08:48,610 --> 00:08:43,849

of last fear responses the company beast

173

00:08:51,640 --> 00:08:48,620

eats geosphere changes and these can be

174

00:08:53,020 --> 00:08:51,650

basically addressed in a number of

175

00:08:55,660 --> 00:08:53,030

different ways but one way

176

00:08:57,040 --> 00:08:55,670

that's kind of increasingly important is

177

00:08:59,380 --> 00:08:57,050

kind of looking at the coupled

178

00:09:02,080 --> 00:08:59,390

relationship between different

179

00:09:05,110 --> 00:09:02,090

geochemical to clump geochemical proxies

180

00:09:07,270 --> 00:09:05,120

for rioc states of the atmosphere in the

181

00:09:10,920 --> 00:09:07,280

ocean and then trying to look at those

182

00:09:13,360 --> 00:09:10,930

and their relationships with kind of the

183

00:09:20,470 --> 00:09:13,370

stratigraphic record and also the

184

00:09:23,560 --> 00:09:20,480

paleontological fossil records the next

185

00:09:25,680 --> 00:09:23,570

one is how ecosystems been structured to

186

00:09:28,720 --> 00:09:25,690

time and how is that affected their

187

00:09:31,240 --> 00:09:28,730

biogeochemical function so the critical

188

00:09:33,400 --> 00:09:31,250

questions here kind of focus on the

189

00:09:37,290 --> 00:09:33,410

development and spread of new biological

190

00:09:40,450 --> 00:09:37,300

processes environmental gradients and

191

00:09:43,180 --> 00:09:40,460

conditions that develop in response to

192

00:09:45,820 --> 00:09:43,190

the communities and also that influence

193

00:09:48,990 --> 00:09:45,830

the evolution of these new communities

194

00:09:52,720 --> 00:09:49,000

and also looking at their rates of

195

00:09:55,180 --> 00:09:52,730

biological processes and basically the

196

00:09:58,570 --> 00:09:55,190

exchange of materials between the

197

00:10:05,860 --> 00:09:58,580

biosphere and geosphere over over long

198

00:10:08,140 --> 00:10:05,870

time scales okay an important component

199

00:10:11,410 --> 00:10:08,150

of looking at kind of the coupling of

200

00:10:13,920 --> 00:10:11,420

the geosphere and biosphere is time and

201  
00:10:16,330 --> 00:10:13,930  
so if we want to look at rates of

202  
00:10:19,210 --> 00:10:16,340  
evolutionary change and environmental

203  
00:10:21,040 --> 00:10:19,220  
change then we require kind of a precise

204  
00:10:24,010 --> 00:10:21,050  
understanding of the ages of that

205  
00:10:27,100 --> 00:10:24,020  
samples that are being looked at and so

206  
00:10:34,690 --> 00:10:27,110  
this sub question kind of underscore the

207  
00:10:36,570 --> 00:10:34,700  
importance of age dating the fidelity so

208  
00:10:39,250 --> 00:10:36,580  
what's the fidelity of proxied of

209  
00:10:42,400 --> 00:10:39,260  
biology and environment over kind of

210  
00:10:45,610 --> 00:10:42,410  
long complex on geologic histories and

211  
00:10:47,530 --> 00:10:45,620  
the idea here is that the fossil record

212  
00:10:50,080 --> 00:10:47,540  
is not a complete record the rock record

213  
00:10:53,350 --> 00:10:50,090

is not a complete record and it's also a

214

00:10:57,700 --> 00:10:53,360

record that's been altered over geologic

215

00:11:00,940 --> 00:10:57,710

time and so a critical aspect of looking

216

00:11:02,890 --> 00:11:00,950

at deep time is actually understanding

217

00:11:05,770 --> 00:11:02,900

the different factors that have kind of

218

00:11:06,370 --> 00:11:05,780

influence what what record we have

219

00:11:08,500 --> 00:11:06,380

preserve

220

00:11:11,110 --> 00:11:08,510

and so these types of investigations

221

00:11:13,360 --> 00:11:11,120

could include things like diagenesis

222

00:11:14,890 --> 00:11:13,370

experiments so looking at kind of the

223

00:11:17,500 --> 00:11:14,900

roles of things like pressure and

224

00:11:20,830 --> 00:11:17,510

temperature on I'm geochemical

225

00:11:22,800 --> 00:11:20,840

signatures for example or also looking

226

00:11:25,570 --> 00:11:22,810

at for example investigating

227

00:11:33,340 --> 00:11:25,580

unconformities times of erosion or non

228

00:11:36,400 --> 00:11:33,350

deposition in a sedimentary record and

229

00:11:38,680 --> 00:11:36,410

finally how my studies of ancient earth

230

00:11:42,790 --> 00:11:38,690

inform our understanding of future

231

00:11:45,340 --> 00:11:42,800

changes to the Earth's system and so the

232

00:11:47,080 --> 00:11:45,350

idea here is basically to try to take

233

00:11:50,230 --> 00:11:47,090

what we learned in the past and try to

234

00:11:52,540 --> 00:11:50,240

use it to predict what future changes

235

00:11:55,390 --> 00:11:52,550

might occur I'm in New York system and

236

00:11:58,030 --> 00:11:55,400

so an example of this would be that

237

00:12:01,060 --> 00:11:58,040

perhaps a better understanding of the

238

00:12:03,760 --> 00:12:01,070

so-called acacia sea ocean in toxic

239

00:12:07,210 --> 00:12:03,770

event might help us better understand

240

00:12:10,900 --> 00:12:07,220

kind of the expansion of hypoxic

241

00:12:13,060 --> 00:12:10,910

conditions in the modern ocean so those

242

00:12:17,440 --> 00:12:13,070

are the kind of the sub questions that

243

00:12:19,840 --> 00:12:17,450

fall underneath this overall topic of

244

00:12:22,470 --> 00:12:19,850

looking at the evolution of that the

245

00:12:26,530 --> 00:12:22,480

atmosphere over over all of arts history

246

00:12:28,690 --> 00:12:26,540

and so we like your feedback on not just

247

00:12:31,000 --> 00:12:28,700

what we presented today but really the

248

00:12:35,050 --> 00:12:31,010

kind of the paper that this is based on

249

00:12:37,620 --> 00:12:35,060

and you can you can find that paper on

250

00:12:40,600 --> 00:12:37,630

google docs do the astrobiology future

251  
00:12:43,900 --> 00:12:40,610  
website and you can make comments there

252  
00:12:46,240 --> 00:12:43,910  
or we can start a discussion now which

253  
00:12:47,770 --> 00:12:46,250  
would be great and questions if you have

254  
00:12:50,290 --> 00:12:47,780  
any questions about what we presented

255  
00:12:53,980 --> 00:12:50,300  
today we can talk also about maybe

256  
00:12:55,810 --> 00:12:53,990  
what's missing from what we presented

257  
00:12:58,540 --> 00:12:55,820  
here or also maybe things that are

258  
00:13:00,310 --> 00:12:58,550  
redundant or kind of not necessary and

259  
00:13:03,280 --> 00:13:00,320  
you keep in mind that this is just one

260  
00:13:05,560 --> 00:13:03,290  
of many many papers and many webinars

261  
00:13:08,380 --> 00:13:05,570  
that are to come this one kind of

262  
00:13:10,300 --> 00:13:08,390  
focuses on the atmosphere overcame and

263  
00:13:13,330 --> 00:13:10,310

there are lots of other diverse topics

264

00:13:16,180 --> 00:13:13,340

as well thank you jake and thank you

265

00:13:17,970 --> 00:13:16,190

Mike I'd love to open up the floor

266

00:13:19,030 --> 00:13:17,980

quickly so if you do have any questions

267

00:13:20,740 --> 00:13:19,040

there

268

00:13:22,990 --> 00:13:20,750

little man with his hand up right above

269

00:13:24,519 --> 00:13:23,000

me you can click that and raise your

270

00:13:27,670 --> 00:13:24,529

hand and I'll call people in the order

271

00:13:28,930 --> 00:13:27,680

in which they raise their hand a while

272

00:13:30,430 --> 00:13:28,940

you think of your questions or your

273

00:13:31,629 --> 00:13:30,440

comments in the meantime like tell you a

274

00:13:33,879 --> 00:13:31,639

little bit about the process and what

275

00:13:36,790 --> 00:13:33,889

we're hoping for here there are quite a

276

00:13:38,860 --> 00:13:36,800

few white papers that are have been

277

00:13:40,360 --> 00:13:38,870

released and more than a forthcoming you

278

00:13:42,999 --> 00:13:40,370

can find them on the homepage of the

279

00:13:44,829 --> 00:13:43,009

astrobiology future org right down the

280

00:13:46,900 --> 00:13:44,839

center column and if you click on the

281

00:13:48,460 --> 00:13:46,910

title it'll tell you it'll tell you a

282

00:13:49,660 --> 00:13:48,470

date that's the date that the webinar is

283

00:13:51,240 --> 00:13:49,670

happening and if you click on the title

284

00:13:54,900 --> 00:13:51,250

it take you directly to the google doc

285

00:13:57,759 --> 00:13:54,910

where you can leave comments read review

286

00:13:59,139 --> 00:13:57,769

for the authors and we really want this

287

00:14:00,910 --> 00:13:59,149

to be a community effort we want

288

00:14:02,170 --> 00:14:00,920

people's feedback and comments along the

289

00:14:05,050 --> 00:14:02,180

way so that this can be a well vetted

290

00:14:10,569 --> 00:14:05,060

peer-reviewed process which will lead to

291

00:14:13,240 --> 00:14:10,579

our new roadmap I have I put both those

292

00:14:16,389 --> 00:14:13,250

links in the chat window and it's

293

00:14:17,829 --> 00:14:16,399

actually you know if you have questions

294

00:14:18,939 --> 00:14:17,839

or comments throughout you don't feel

295

00:14:22,059 --> 00:14:18,949

like raising your hand you can also use

296

00:14:24,189 --> 00:14:22,069

the chat window I'd like to turn it over

297

00:14:35,620 --> 00:14:24,199

to somebody raised their hand for a

298

00:14:37,480 --> 00:14:35,630

second they went away okay Marco did we

299

00:14:38,949 --> 00:14:37,490

have somebody raised their hand yeah it

300

00:14:40,930 --> 00:14:38,959

looks like they logged a dime first name

301  
00:14:42,100 --> 00:14:40,940  
was John I can catch the last name but

302  
00:14:47,500 --> 00:14:42,110  
if they're still on the telecon line

303  
00:14:56,480 --> 00:14:47,510  
maybe they can chime in yeah are you

304  
00:15:01,980 --> 00:14:59,880  
alright so if anybody else has any

305  
00:15:03,990 --> 00:15:01,990  
comments or thoughts please use a raise

306  
00:15:06,210 --> 00:15:04,000  
your hand function in the meantime I'd

307  
00:15:07,470 --> 00:15:06,220  
like to review those questions like just

308  
00:15:09,540 --> 00:15:07,480  
pull them up them they're also in a

309  
00:15:11,310 --> 00:15:09,550  
notepad on the side have you look at

310  
00:15:13,110 --> 00:15:11,320  
them and tell us you know which which of

311  
00:15:15,949 --> 00:15:13,120  
these do you think is the most urgent

312  
00:15:18,000 --> 00:15:15,959  
which one is a most interest to you

313  
00:15:19,740 --> 00:15:18,010

perhaps to tell us if there's a question

314

00:15:24,060 --> 00:15:19,750

that you feel should be on this topic

315

00:15:26,970 --> 00:15:24,070

that isn't there I'll just add really

316

00:15:30,150 --> 00:15:26,980

quick sit we've identified some some

317

00:15:31,560 --> 00:15:30,160

ways in tackling questions that have

318

00:15:33,030 --> 00:15:31,570

been important that we think problem

319

00:15:37,380 --> 00:15:33,040

will be important that we try to remain

320

00:15:38,519 --> 00:15:37,390

open to new ways to ask these questions

321

00:15:41,550 --> 00:15:38,529

so we're not we're not trying to

322

00:15:43,590 --> 00:15:41,560

prescribe particular methodologies or

323

00:15:45,150 --> 00:15:43,600

approaches to entering questions we're

324

00:15:47,420 --> 00:15:45,160

really trying to focus on what we think

325

00:15:50,610 --> 00:15:47,430

are important that's the asking answer

326

00:15:52,199 --> 00:15:50,620

right and we're still open I mean that's

327

00:15:57,210 --> 00:15:52,209

what this process is about we're still

328

00:16:00,120 --> 00:15:57,220

open to revising this document so your

329

00:16:03,060 --> 00:16:00,130

comments are very welcome in or critical

330

00:16:05,639 --> 00:16:03,070

to this process because there are

331

00:16:08,639 --> 00:16:05,649

aspects of particular deep time

332

00:16:11,840 --> 00:16:08,649

investigations that you think might kind

333

00:16:14,460 --> 00:16:11,850

of address our understanding of the

334

00:16:18,319 --> 00:16:14,470

habitability or the evolution of other

335

00:16:22,860 --> 00:16:18,329

planets then definitely speak up or also

336

00:16:26,280 --> 00:16:22,870

contact us after the webinar I think our

337

00:16:29,550 --> 00:16:26,290

contact information will be available as

338

00:16:31,319 --> 00:16:29,560

part of that google doc isn't it isn't

339

00:16:33,810 --> 00:16:31,329  
currently but I think we'll put that

340

00:16:35,310 --> 00:16:33,820  
information up so in addition to

341

00:16:37,110 --> 00:16:35,320  
commenting if you have particular

342

00:16:39,689 --> 00:16:37,120  
questions for us you can contact us

343

00:16:44,310 --> 00:16:39,699  
directly link we have an end up from

344

00:16:48,720 --> 00:16:44,320  
John all it says is are you m dot dot

345

00:16:50,610 --> 00:16:48,730  
dot John yeah this is John normal anyway

346

00:16:53,579 --> 00:16:50,620  
I just wondered whether or not under the

347

00:16:56,100 --> 00:16:53,589  
plate tectonic activity as a subset was

348

00:16:58,110 --> 00:16:56,110  
somewhere else if there's a

349

00:17:01,430 --> 00:16:58,120  
consideration of the effects of tidal

350

00:17:04,319 --> 00:17:01,440  
forces on the evolution of years crust

351  
00:17:07,460 --> 00:17:04,329  
but I say that for two reasons one

352  
00:17:10,500 --> 00:17:07,470  
because tidal force is certainly a

353  
00:17:12,840 --> 00:17:10,510  
parts of the air surface the weather up

354  
00:17:15,510 --> 00:17:12,850  
is a crustal effect that leads into its

355  
00:17:17,970 --> 00:17:15,520  
like tectonic world but whether or not

356  
00:17:21,420 --> 00:17:17,980  
as Peter warden don brownlee excited I

357  
00:17:22,440 --> 00:17:21,430  
mean is required it would be interesting

358  
00:17:26,850 --> 00:17:22,450  
they have that at least as a

359  
00:17:29,160 --> 00:17:26,860  
consideration in this process right I

360  
00:17:30,110 --> 00:17:29,170  
think that's a great comment I think

361  
00:17:35,160 --> 00:17:30,120  
that's something that we could

362  
00:17:36,840 --> 00:17:35,170  
potentially include unto that that's

363  
00:17:44,370 --> 00:17:36,850

some topic of looking at kind of

364

00:17:47,610 --> 00:17:44,380

tectonics is one driver like to make a

365

00:17:49,230 --> 00:17:47,620

big difference for Europa and so if i

366

00:17:51,570 --> 00:17:49,240

can read overhead and one with our first

367

00:17:57,270 --> 00:17:51,580

poet and all I let you live in the same

368

00:17:58,650 --> 00:17:57,280

book I'm good looking four times yeah I

369

00:18:03,450 --> 00:17:58,660

had a little bit of a hard time hearing

370

00:18:06,740 --> 00:18:03,460

there and but the point I was just

371

00:18:10,350 --> 00:18:06,750

saying that the tidal forces are clearly

372

00:18:11,940 --> 00:18:10,360

important in a place like Europa right

373

00:18:16,610 --> 00:18:11,950

there was a more generic thing I do

374

00:18:20,370 --> 00:18:16,620

think we need to keep it in mind right

375

00:18:22,440 --> 00:18:20,380

that's a great point thank you very much

376

00:18:26,070 --> 00:18:22,450

John we also have some comments in the

377

00:18:28,080 --> 00:18:26,080

chat from Sean he says a key question to

378

00:18:29,580 --> 00:18:28,090

me is how did the interfaces from

379

00:18:31,290 --> 00:18:29,590

different components of the earth system

380

00:18:32,550 --> 00:18:31,300

change over time and then he elaborates

381

00:18:40,539 --> 00:18:32,560

Sean would you would you like to say a

382

00:18:45,979 --> 00:18:43,399

he may be in a place where he can't talk

383

00:18:54,889 --> 00:18:45,989

so he's he's continuing to type it looks

384

00:18:59,089 --> 00:18:54,899

like yeah that's a bummer and as a

385

00:19:00,739 --> 00:18:59,099

follow-up to the tidal forces comment go

386

00:19:04,759 --> 00:19:00,749

off they probably find that there's some

387

00:19:06,019 --> 00:19:04,769

other headings on other papers where

388

00:19:07,669 --> 00:19:06,029

that would be inappropriate comment as

389

00:19:09,969 --> 00:19:07,679

well i'm not i'm not saying it isn't q

390

00:19:14,060 --> 00:19:09,979

of it you should probably bring that up

391

00:19:20,049 --> 00:19:14,070

in several places and make sure it gets

392

00:19:26,989 --> 00:19:24,589

Sean's comment is includes a discussion

393

00:19:29,629 --> 00:19:26,999

of the subsurface class here that's

394

00:19:33,529 --> 00:19:29,639

often parameterised in atmospheric

395

00:19:36,249 --> 00:19:33,539

models and I think that's a really good

396

00:19:39,560 --> 00:19:36,259

point and something to consider is how

397

00:19:41,869 --> 00:19:39,570

how is the deep biosphere actually

398

00:19:44,899 --> 00:19:41,879

recorded in the ancient rock record I

399

00:19:47,389 --> 00:19:44,909

think that I'm an area that's still sort

400

00:19:55,849 --> 00:19:47,399

of underexplored and could potentially

401  
00:19:58,279 --> 00:19:55,859  
be important well I was trying to type

402  
00:20:00,409 --> 00:19:58,289  
your butt can figure out how to get it

403  
00:20:02,869 --> 00:20:00,419  
at the moment but Sean I'd be really

404  
00:20:05,259 --> 00:20:02,879  
interested in hearing a little bit more

405  
00:20:08,359 --> 00:20:05,269  
about what you mean by interfaces and

406  
00:20:14,359 --> 00:20:08,369  
maybe an example of how those might have

407  
00:20:32,529 --> 00:20:14,369  
evolved it looks like we're slowly

408  
00:20:38,269 --> 00:20:36,589  
so while we wait I urge those online to

409  
00:20:39,379 --> 00:20:38,279  
to review the questions to think about

410  
00:20:40,969 --> 00:20:39,389  
how they might contribute in this

411  
00:20:43,129 --> 00:20:40,979  
conversation because the richer we make

412  
00:20:45,049 --> 00:20:43,139  
it the more valuable the end product

413  
00:20:46,700 --> 00:20:45,059

will be and I know you may not have had

414

00:20:50,719 --> 00:20:46,710

time to review the white paper ahead of

415

00:20:57,440 --> 00:20:50,729

this this webinar but your thoughts even

416

00:20:59,539 --> 00:20:57,450

at this stage are very welcome also

417

00:21:01,729 --> 00:20:59,549

because this is an ongoing process will

418

00:21:04,580 --> 00:21:01,739

be doing this for a while and really

419

00:21:06,259 --> 00:21:04,590

love your feedback on how the process is

420

00:21:08,060 --> 00:21:06,269

working for you and how how it in

421

00:21:10,310 --> 00:21:08,070

gauging you and how we might make it

422

00:21:15,139 --> 00:21:10,320

better for you so I see we do have a

423

00:21:17,029 --> 00:21:15,149

response from Shawn he says how for

424

00:21:18,950 --> 00:21:17,039

example how different planet sizes

425

00:21:21,950 --> 00:21:18,960

interior heating rates and sources etc

426  
00:21:26,060 --> 00:21:21,960  
translate into volcanic outgassing rates

427  
00:21:27,969 --> 00:21:26,070  
and compositions and so basically on the

428  
00:21:31,269 --> 00:21:27,979  
earth we might be talking about how

429  
00:21:37,669 --> 00:21:31,279  
these things have changed in response to

430  
00:21:41,089 --> 00:21:37,679  
different interior themeing rates right

431  
00:21:43,129 --> 00:21:41,099  
I don't recall exactly what section is I

432  
00:21:45,529 --> 00:21:43,139  
think it might be the tectonic sub

433  
00:21:49,369 --> 00:21:45,539  
question of the paper that kind of looks

434  
00:21:53,089 --> 00:21:49,379  
at the changing kind of composition of

435  
00:21:57,889 --> 00:21:53,099  
the deeper is over time and then trying

436  
00:22:00,049 --> 00:21:57,899  
to apply looking at the our

437  
00:22:03,200 --> 00:22:00,059  
understanding of the deeper our own

438  
00:22:07,690 --> 00:22:03,210

planets deeper evolution and trying to

439

00:22:10,369 --> 00:22:07,700

apply that to other types of planets I

440

00:22:11,899 --> 00:22:10,379

think that that is a really important

441

00:22:20,640 --> 00:22:11,909

question I think at least some of that

442

00:22:27,180 --> 00:22:23,760

there's way that yet would suggest that

443

00:22:35,780 --> 00:22:27,190

we add to that cooler section we're

444

00:22:43,500 --> 00:22:38,340

we have Lindsay slowly typing into the

445

00:22:45,450 --> 00:22:43,510

chat and she says that there's a white

446

00:22:47,640 --> 00:22:45,460

paper how expensive diverse and robust

447

00:22:49,890 --> 00:22:47,650

our surface and beat biospheres and how

448

00:22:53,250 --> 00:22:49,900

do they function so there's a there's

449

00:22:54,960 --> 00:22:53,260

obviously a place for for that comment

450

00:22:56,580 --> 00:22:54,970

but it also exists here so there's a lot

451  
00:23:00,060 --> 00:22:56,590  
of overlap between the topics which i

452  
00:23:01,380 --> 00:23:00,070  
think is is only valuable if not it's

453  
00:23:02,850 --> 00:23:01,390  
not it's not a bad thing and we should

454  
00:23:05,670 --> 00:23:02,860  
bring those things up as many times as

455  
00:23:08,040 --> 00:23:05,680  
we feel they should come up right and a

456  
00:23:12,330 --> 00:23:08,050  
lot of the investigations of the deepest

457  
00:23:15,420 --> 00:23:12,340  
fear focus on modern biosphere or a

458  
00:23:17,340 --> 00:23:15,430  
biosphere that's a modern extant blaster

459  
00:23:20,190 --> 00:23:17,350  
that's presence in ancient sediments and

460  
00:23:22,500 --> 00:23:20,200  
not so much on the actual record of an

461  
00:23:25,920 --> 00:23:22,510  
ancient subsurface last year and so

462  
00:23:29,280 --> 00:23:25,930  
that's potentially a place where this

463  
00:23:38,220 --> 00:23:29,290

topic and that topic could interface

464

00:23:40,550 --> 00:23:38,230

your form whatever well are there any

465

00:23:48,780 --> 00:23:40,560

other thoughts or questions from the

466

00:23:52,620 --> 00:23:50,880

Jake mike is there anything in

467

00:23:56,040 --> 00:23:52,630

particular that you're very curious to

468

00:23:57,000 --> 00:23:56,050

hear from the audience from people we're

469

00:23:59,040 --> 00:23:57,010

going to be watching this now or

470

00:24:03,540 --> 00:23:59,050

recorded is there anything specific that

471

00:24:06,030 --> 00:24:03,550

you'd like to know from them I'd be

472

00:24:09,590 --> 00:24:06,040

particularly interested especially if

473

00:24:13,170 --> 00:24:09,600

they're a biologist in the group here

474

00:24:16,860 --> 00:24:13,180

about especially what what aspects of

475

00:24:20,280 --> 00:24:16,870

how organisms organizing the ecosystems

476  
00:24:24,810 --> 00:24:20,290  
we we may want to address that aren't in

477  
00:24:28,020 --> 00:24:24,820  
this document already that's something

478  
00:24:29,550 --> 00:24:28,030  
that I think people are starting to

479  
00:24:34,080 --> 00:24:29,560  
think about we certainly tried to stay

480  
00:24:35,910 --> 00:24:34,090  
to take a crap out it in this group but

481  
00:24:37,860 --> 00:24:35,920  
I think that's that part is potentially

482  
00:24:39,960 --> 00:24:37,870  
something that could be even better

483  
00:24:45,750 --> 00:24:39,970  
developed by interfacing with a few more

484  
00:24:48,240 --> 00:24:45,760  
biologist so are there any biologists

485  
00:24:50,120 --> 00:24:48,250  
out there listening right now who would

486  
00:24:52,860 --> 00:24:50,130  
like to raise their hand in chimein and

487  
00:24:54,750 --> 00:24:52,870  
and are there any biologist who are

488  
00:24:56,280 --> 00:24:54,760

watching this in recording and perhaps

489

00:25:00,840 --> 00:24:56,290

want to leave a comment on the google

490

00:25:03,140 --> 00:25:00,850

doc and and reach out to Mike Jake are

491

00:25:05,910 --> 00:25:03,150

you particularly curious about anything

492

00:25:09,840 --> 00:25:05,920

well I guess one thing I would kind of

493

00:25:15,200 --> 00:25:09,850

mention to the group here that there's a

494

00:25:17,790 --> 00:25:15,210

particular you know kind of discipline

495

00:25:19,860 --> 00:25:17,800

focused to our group are kind of working

496

00:25:23,820 --> 00:25:19,870

group here that's you know focused a lot

497

00:25:26,880 --> 00:25:23,830

on geochemistry and Talia biology but

498

00:25:29,730 --> 00:25:26,890

there are other potential sub

499

00:25:32,640 --> 00:25:29,740

disciplines of life sciences and earth

500

00:25:34,380 --> 00:25:32,650

sciences that could also they probably

501  
00:25:36,960 --> 00:25:34,390  
aren't very well represented in our

502  
00:25:39,870 --> 00:25:36,970  
group like for example paleomagnetism so

503  
00:25:42,060 --> 00:25:39,880  
we're looking at for example that the

504  
00:25:44,130 --> 00:25:42,070  
role of magnetic field evolution of

505  
00:25:46,560 --> 00:25:44,140  
Earth's magnetic field or other plants

506  
00:25:48,120 --> 00:25:46,570  
magnetic field over time I don't think

507  
00:25:49,830 --> 00:25:48,130  
that that's something that we covered

508  
00:25:53,160 --> 00:25:49,840  
for instance and maybe we should so

509  
00:25:56,880 --> 00:25:53,170  
certainly if there are people from kind

510  
00:25:59,760 --> 00:25:56,890  
of sub disciplines outside of just kind

511  
00:26:01,260 --> 00:25:59,770  
of paleo biology in geochemistry and we

512  
00:26:08,820 --> 00:26:01,270  
definitely want to hear from

513  
00:26:10,770 --> 00:26:08,830

mew as well and maybe just one last

514

00:26:14,880 --> 00:26:10,780

comment or this is really in the

515

00:26:16,560 --> 00:26:14,890

comments something that I think is maybe

516

00:26:19,770 --> 00:26:16,570

a little bit unusual about this white

517

00:26:23,670 --> 00:26:19,780

paper and maybe it hasn't quite struck

518

00:26:25,740 --> 00:26:23,680

people yet yeah we want these fairly in

519

00:26:27,660 --> 00:26:25,750

fact that there is more to be learned

520

00:26:30,150 --> 00:26:27,670

from Earth history than just focusing on

521

00:26:34,350 --> 00:26:30,160

precambrian but a lot of these states of

522

00:26:36,870 --> 00:26:34,360

how do we are in some ways even better

523

00:26:38,970 --> 00:26:36,880

understood once you get up into the

524

00:26:40,650 --> 00:26:38,980

phanerozoic and and their their work

525

00:26:43,320 --> 00:26:40,660

continuing to study and learn more about

526  
00:26:45,300 --> 00:26:43,330  
and thinking about how planets evolved

527  
00:26:50,310 --> 00:26:45,310  
and how that might inform how we look

528  
00:26:51,690 --> 00:26:50,320  
for other biospheres and so I just

529  
00:26:54,000 --> 00:26:51,700  
wanted to get that out there and the

530  
00:26:56,850 --> 00:26:54,010  
desk in that office folks we thought I

531  
00:27:00,360 --> 00:26:56,860  
tell you if it does please come to some

532  
00:27:02,370 --> 00:27:00,370  
comments right and just to follow up on

533  
00:27:04,620 --> 00:27:02,380  
that another thing that we were kind of

534  
00:27:08,430 --> 00:27:04,630  
interested in is not just looking at

535  
00:27:10,230 --> 00:27:08,440  
kind of the the exciting period of

536  
00:27:13,020 --> 00:27:10,240  
change in Earth's history but also

537  
00:27:15,180 --> 00:27:13,030  
looking at kind of the long period of

538  
00:27:17,010 --> 00:27:15,190

stability and like what allows those to

539

00:27:19,380 --> 00:27:17,020

occur those are something that top and

540

00:27:22,920 --> 00:27:19,390

not really focused on you know the

541

00:27:25,290 --> 00:27:22,930

boring billion or you know boring parts

542

00:27:27,060 --> 00:27:25,300

of what's thought them as being boring

543

00:27:28,830 --> 00:27:27,070

parts of Earth's history might be really

544

00:27:32,460 --> 00:27:28,840

important and be telling us important

545

00:27:34,710 --> 00:27:32,470

things but they're not often not as sexy

546

00:27:36,510 --> 00:27:34,720

or whatever and so that's something that

547

00:27:42,150 --> 00:27:36,520

we kind of tried to address a little bit

548

00:27:44,100 --> 00:27:42,160

i miss my paper as well I even asked if

549

00:27:48,030 --> 00:27:44,110

there are those times of accountability

550

00:27:50,730 --> 00:27:48,040

really were stable or simply just long

551  
00:27:56,040 --> 00:27:50,740  
term slow transitions and uh company

552  
00:27:57,690 --> 00:27:56,050  
house all right thank you very much John

553  
00:28:01,430 --> 00:27:57,700  
and I appreciate your time today and I

554  
00:28:03,330 --> 00:28:01,440  
want to ask the audience before we go

555  
00:28:05,760 --> 00:28:03,340  
we're going to do them quite a few of

556  
00:28:07,230 --> 00:28:05,770  
these online discussions as ways to kind

557  
00:28:08,920 --> 00:28:07,240  
of launch the white papers and collect

558  
00:28:10,540 --> 00:28:08,930  
feedback and share share they

559  
00:28:13,660 --> 00:28:10,550  
the current state of thought with the

560  
00:28:15,760 --> 00:28:13,670  
community and we'd love to have your

561  
00:28:17,860 --> 00:28:15,770  
feedback on this how was this discussion

562  
00:28:20,440 --> 00:28:17,870  
for you and how can we what would you

563  
00:28:22,270 --> 00:28:20,450

like to see in future discussions if

564

00:28:23,290 --> 00:28:22,280

there's if there's anybody who can raise

565

00:28:24,610 --> 00:28:23,300

their hand and tell us what they

566

00:28:26,440 --> 00:28:24,620

particularly liked about this experience

567

00:28:28,840 --> 00:28:26,450

that we should replicate in future ones

568

00:28:30,130 --> 00:28:28,850

and and what they they were expecting

569

00:28:31,450 --> 00:28:30,140

maybe didn't get that we should try to

570

00:28:33,130 --> 00:28:31,460

incorporate them for the future ones

571

00:28:34,930 --> 00:28:33,140

that would actually be very useful you

572

00:28:37,300 --> 00:28:34,940

can type into the chat or you can raise

573

00:28:38,860 --> 00:28:37,310

your hand and we'll call on you to speak

574

00:28:42,880 --> 00:28:38,870

through the phone whatever is better for

575

00:28:44,710 --> 00:28:42,890

you I'll give a minute to participants

576

00:28:56,680 --> 00:28:44,720

to see if we have any feedback on our

577

00:29:03,020 --> 00:29:00,800

all right well if you do have any

578

00:29:04,820 --> 00:29:03,030

thoughts about that please communicate

579

00:29:06,590 --> 00:29:04,830

them to us through the through the

580

00:29:09,680 --> 00:29:06,600

website you can reach out to any of the

581

00:29:11,410 --> 00:29:09,690

ki no innovation staff we are there on

582

00:29:13,700 --> 00:29:11,420

the website you can also reach out to

583

00:29:15,770 --> 00:29:13,710

anybody from the NASA team they'd be

584

00:29:18,230 --> 00:29:15,780

happy to to incorporate your feedback as

585

00:29:20,660 --> 00:29:18,240

we move forward gentlemen any closing

586

00:29:23,950 --> 00:29:20,670

thoughts well we look forward to your

587

00:29:27,380 --> 00:29:23,960

comments on the google doc on the paper

588

00:29:28,790 --> 00:29:27,390

so you haven't read it please we do and

589

00:29:32,930 --> 00:29:28,800

we really look forward to reading

590

00:29:35,690 --> 00:29:32,940

against a and the o per unit contact

591

00:29:38,720 --> 00:29:35,700

with will either to talk about these

592

00:29:40,370 --> 00:29:38,730

things thank you very much gentlemen and

593

00:29:43,910 --> 00:29:40,380

thank you very much to our audience for

594

00:29:46,070 --> 00:29:43,920

for your attention today have a great

595

00:29:47,440 --> 00:29:46,080

afternoon and we hope to see you at the