
AbSciCon
2019

1
00:00:00,790 --> 00:00:07,320
[Music]

2
00:00:12,080 --> 00:00:08,990
[Applause]

3
00:00:15,060 --> 00:00:12,090
so I only started working on this topic

4
00:00:17,580 --> 00:00:15,070
recently so this talk will mainly be

5
00:00:21,929 --> 00:00:17,590
based on some previous studies and also

6
00:00:25,849 --> 00:00:21,939
our recent experimental work and I want

7
00:00:29,429 --> 00:00:25,859
to firstly classify the life elements by

8
00:00:31,620 --> 00:00:29,439
into two categories first is that the

9
00:00:34,700 --> 00:00:31,630
the molecules that build their life

10
00:00:37,830 --> 00:00:34,710
which include the nutrients salinity

11
00:00:43,590 --> 00:00:37,840
biomolecules and about functional metals

12
00:00:46,830 --> 00:00:43,600
and then these these molecules to build

13
00:00:49,920 --> 00:00:46,840

build the life and another category is

14
00:00:54,540 --> 00:00:49,930
the metabolism substrates which can

15
00:00:56,549 --> 00:00:54,550
provide energy for the life - for the

16
00:00:59,840 --> 00:00:56,559
metabolism of the life which included

17
00:01:03,509 --> 00:00:59,850
the gases in organics and organics and

18
00:01:07,530 --> 00:01:03,519
manero's so in this talk I will mainly

19
00:01:11,210 --> 00:01:07,540
be focus on the these compounds and also

20
00:01:14,850 --> 00:01:11,220
the geologically abandon their manners

21
00:01:16,469 --> 00:01:14,860
so because the same of this session and

22
00:01:19,789 --> 00:01:16,479
also madhawk is about the surface

23
00:01:22,050 --> 00:01:19,799
absorption so I want to first leave

24
00:01:25,080 --> 00:01:22,060
emphasized the importance of the

25
00:01:28,050 --> 00:01:25,090
surfaces option to you and the first one

26
00:01:29,910 --> 00:01:28,060
is to protect the biomolecules against

27
00:01:32,850 --> 00:01:29,920
the harsh environments on the early

28
00:01:36,179 --> 00:01:32,860
Earth or other planets for example here

29
00:01:39,569 --> 00:01:36,189
this study shows the degradation of the

30
00:01:43,499 --> 00:01:39,579
DA without the manual and with mineral

31
00:01:46,350 --> 00:01:43,509
so from this figure you can see that is

32
00:01:48,569 --> 00:01:46,360
it is quite obvious that the complex

33
00:01:53,219 --> 00:01:48,579
ition between the clay mineral and also

34
00:01:56,819 --> 00:01:53,229
ta can help preserve the ta against the

35
00:01:58,920 --> 00:01:56,829
damage of the UV radiation so this is

36
00:02:00,959 --> 00:01:58,930
the very relevant with the early Earth's

37
00:02:03,330 --> 00:02:00,969
environment because there's no ozone and

38
00:02:07,139 --> 00:02:03,340

the UV radiation will be very harsh for

39
00:02:09,540 --> 00:02:07,149
the early life and the the second

40
00:02:12,780 --> 00:02:09,550
importance is to concentrate and

41
00:02:14,490 --> 00:02:12,790
polymerize the biomolecules on the

42
00:02:19,630 --> 00:02:14,500
surface of the

43
00:02:24,610 --> 00:02:19,640
manners in this example the the people

44
00:02:27,910 --> 00:02:24,620
used numerical simulations mechanical

45
00:02:30,580 --> 00:02:27,920
quantum simulations to study the

46
00:02:33,700 --> 00:02:30,590
adoption of the peptide and amino acid

47
00:02:37,420 --> 00:02:33,710
on to the double layer hydroxide

48
00:02:39,340 --> 00:02:37,430
manero's and the results is quite

49
00:02:41,530 --> 00:02:39,350
interesting but difficult to show but

50
00:02:44,290 --> 00:02:41,540
this illustration shows the basic

51
00:02:47,860 --> 00:02:44,300
conclusion of the study is that the

52
00:02:50,110 --> 00:02:47,870
adoption will redistribute the charge of

53
00:02:53,800 --> 00:02:50,120
the charge of the amino acid and

54
00:02:57,100 --> 00:02:53,810
activates the carboxyl group in order to

55
00:02:59,590 --> 00:02:57,110
facilitate the count the polymerization

56
00:03:03,250 --> 00:02:59,600
of the amino acid and the more

57
00:03:06,490 --> 00:03:03,260
interesting is that the after the

58
00:03:08,890 --> 00:03:06,500
polymerization the complexity and

59
00:03:11,170 --> 00:03:08,900
strengths of the peptide onto the

60
00:03:14,290 --> 00:03:11,180
mineral surface changed and it will

61
00:03:17,530 --> 00:03:14,300
allow the removal of the peptide after

62
00:03:20,949 --> 00:03:17,540
the after the polymerization which is

63
00:03:24,070 --> 00:03:20,959

very important for the early complexity

64
00:03:27,130 --> 00:03:24,080
of the life and they are also other

65
00:03:30,070 --> 00:03:27,140
important the effects of the surface

66
00:03:33,430 --> 00:03:30,080
absorption for example here in this

67
00:03:37,060 --> 00:03:33,440
example the the people studied the

68
00:03:39,040 --> 00:03:37,070
reduction of the carbon dioxide with the

69
00:03:41,740 --> 00:03:39,050
chromium oxide all without chromium

70
00:03:44,490 --> 00:03:41,750
oxide you can see that when you add the

71
00:03:48,870 --> 00:03:44,500
chromium oxide it kind of facilities the

72
00:03:52,030 --> 00:03:48,880
reaction quite rapidly so which will

73
00:03:55,750 --> 00:03:52,040
which will reduce the carbon dioxide the

74
00:03:59,440 --> 00:03:55,760
for the early for the earlier synthesize

75
00:04:02,560 --> 00:03:59,450
and in this example people studied the

76
00:04:05,590 --> 00:04:02,570
the weathering of the basalt without

77
00:04:07,870 --> 00:04:05,600
with organic or ligand and although

78
00:04:10,630 --> 00:04:07,880
without organic ligand you can see that

79
00:04:14,140 --> 00:04:10,640
with organic elegant probably by the

80
00:04:18,180 --> 00:04:14,150
surface complex ition the release of the

81
00:04:21,670 --> 00:04:18,190
phosphorus and the copper is a is quite

82
00:04:24,649 --> 00:04:21,680
significant compared with without the

83
00:04:31,649 --> 00:04:27,869
so the surface complex Asian reaction

84
00:04:34,350 --> 00:04:31,659
involves several important processes

85
00:04:38,189 --> 00:04:34,360
including the speciation of the surface

86
00:04:40,350 --> 00:04:38,199
sites and also of solvents and also the

87
00:04:42,779 --> 00:04:40,360
sites are solving the complex system

88
00:04:46,020 --> 00:04:42,789

reaction for example this reaction and

89
00:04:49,260 --> 00:04:46,030
also the electrostatic interaction so

90
00:04:52,649 --> 00:04:49,270
all these processes are affected by a

91
00:04:54,839 --> 00:04:52,659
lot of different Prem factors including

92
00:04:57,059 --> 00:04:54,849
the type of the mineral surface the

93
00:05:00,570 --> 00:04:57,069
travel the travel of the adsorbent and

94
00:05:03,899 --> 00:05:00,580
also an extremes pH salinity and

95
00:05:07,140 --> 00:05:03,909
temperature and pressure among these

96
00:05:09,029 --> 00:05:07,150
factors all these all these factors

97
00:05:12,480 --> 00:05:09,039
except temperature and pressure are

98
00:05:14,760 --> 00:05:12,490
studied again again but the temperature

99
00:05:18,270 --> 00:05:14,770
and the pressure are not so well another

100
00:05:21,260 --> 00:05:18,280
well understood yet so that's why I want

101
00:05:23,640 --> 00:05:21,270
to focus on this study and the the

102
00:05:25,260 --> 00:05:23,650
another reason is that the temperature

103
00:05:28,290 --> 00:05:25,270
and pressure condition on the early

104
00:05:31,459 --> 00:05:28,300
Earth show that there's a large gradient

105
00:05:35,309 --> 00:05:31,469
of the temperature from the hydrothermal

106
00:05:40,230 --> 00:05:35,319
fluid which can reach up to 400 degree C

107
00:05:43,290 --> 00:05:40,240
and the surface temperature which is

108
00:05:46,350 --> 00:05:43,300
very controversial the studies showing

109
00:05:50,309 --> 00:05:46,360
that media is below 0 degree C or is a

110
00:05:52,769 --> 00:05:50,319
less than 1 her degree C and and and

111
00:05:55,619 --> 00:05:52,779
there are also a large large gradient of

112
00:06:01,080 --> 00:05:55,629
the pressure from less than 1,000 bars

113
00:06:03,059 --> 00:06:01,090

to about wine bar so this large increase

114
00:06:06,379 --> 00:06:03,069
this starts gradient of the temperature

115
00:06:09,360 --> 00:06:06,389
and the pressure showing that the

116
00:06:11,550 --> 00:06:09,370
composition under this large Rodina is

117
00:06:12,980 --> 00:06:11,560
critical for the habitability of the

118
00:06:17,879 --> 00:06:12,990
early Earth

119
00:06:20,869 --> 00:06:17,889
so here's one example of the assumption

120
00:06:24,390 --> 00:06:20,879
of the gas on to the mineral surface the

121
00:06:28,379 --> 00:06:24,400
x-axis is the pressure and y-axis is the

122
00:06:31,800 --> 00:06:28,389
the amount of the gas absorbed and this

123
00:06:35,010 --> 00:06:31,810
shows also three temperature cases you

124
00:06:37,090 --> 00:06:35,020
can see that with the same pressure

125
00:06:40,110 --> 00:06:37,100
increasing temperature will release

126
00:06:42,580 --> 00:06:40,120
the gas from the surface which is very

127
00:06:44,740 --> 00:06:42,590
easy to understand is that the

128
00:06:49,740 --> 00:06:44,750
increasing temperature will activate the

129
00:06:53,530 --> 00:06:49,750
the will make the gas more active more

130
00:06:55,930 --> 00:06:53,540
more active and will remove from the

131
00:06:59,560 --> 00:06:55,940
manual surface and the increasing

132
00:07:03,310 --> 00:06:59,570
pressure will greatly increase the

133
00:07:07,180 --> 00:07:03,320
adoption that's because the the surface

134
00:07:10,270 --> 00:07:07,190
adoption of the gas is a it's a volume

135
00:07:15,190 --> 00:07:10,280
decrease process and the increasing

136
00:07:18,490 --> 00:07:15,200
pressure will increase the adoption and

137
00:07:21,760 --> 00:07:18,500
this is the study about the adoption of

138
00:07:25,540 --> 00:07:21,770

the zinc onto the grow tide other words

139
00:07:29,380 --> 00:07:25,550
temperatures between 10 degrees C and a

140
00:07:31,690 --> 00:07:29,390
70 degree C and a true pH the left is

141
00:07:33,930 --> 00:07:31,700
the more acidic and the right is more a

142
00:07:37,020 --> 00:07:33,940
clean you can see that in most cases

143
00:07:39,430 --> 00:07:37,030
increasing the temperature are quickly

144
00:07:41,130 --> 00:07:39,440
elevated the absorption of the zinc

145
00:07:43,900 --> 00:07:41,140
under the crew tide

146
00:07:47,890 --> 00:07:43,910
this is many because the absorption of

147
00:07:50,800 --> 00:07:47,900
the zinc onto the quartet is is taking

148
00:07:53,920 --> 00:07:50,810
energy so when you increase the

149
00:07:57,160 --> 00:07:53,930
temperature the the temperature increase

150
00:08:05,230 --> 00:07:57,170
will favor the adsorption equilibrium to

151
00:08:07,540 --> 00:08:05,240
favor more adoption and here is an

152
00:08:11,350 --> 00:08:07,550
another example about the absorption of

153
00:08:15,970 --> 00:08:11,360
the phosphate onto the colonize I can't

154
00:08:18,520 --> 00:08:15,980
find the it's it's quite a it's quite

155
00:08:22,270 --> 00:08:18,530
shocking that not so many people focus

156
00:08:24,580 --> 00:08:22,280
on this problem and I only found a very

157
00:08:27,970 --> 00:08:24,590
ancient idea about this about this

158
00:08:30,850 --> 00:08:27,980
program and but but apparently you can

159
00:08:33,520 --> 00:08:30,860
see from the 2 degree C to 40 degrees C

160
00:08:35,830 --> 00:08:33,530
increase in temperature will greatly

161
00:08:38,550 --> 00:08:35,840
elevate the absorption of the phosphate

162
00:08:41,409 --> 00:08:38,560
which has very important implications

163
00:08:44,650 --> 00:08:41,419

for the availability of the phosphates

164
00:08:48,090 --> 00:08:44,660
on the early Earth ocean or on the other

165
00:08:54,420 --> 00:08:52,050
and there are there are many compared

166
00:08:57,060 --> 00:08:54,430
with the you know organics there are not

167
00:08:59,880 --> 00:08:57,070
so many studies on the assumption of the

168
00:09:04,350 --> 00:08:59,890
organics here I showed just the several

169
00:09:06,570 --> 00:09:04,360
available pieces and this one studied

170
00:09:09,600 --> 00:09:06,580
the absorption of the Anani onto the

171
00:09:13,610 --> 00:09:09,610
graphite you can see that increasing the

172
00:09:16,640 --> 00:09:13,620
temperature from 30 degrees C to 60 will

173
00:09:21,450 --> 00:09:16,650
decrease the option of the Adhan II

174
00:09:25,200 --> 00:09:21,460
which may may be because of the the the

175
00:09:27,480 --> 00:09:25,210
the change of the pipe high interaction

176
00:09:32,880 --> 00:09:27,490
and also the hydrogen bond between the

177
00:09:37,680 --> 00:09:32,890
adenine and graphite surface there here

178
00:09:40,110 --> 00:09:37,690
is another study which investigated the

179
00:09:44,880 --> 00:09:40,120
absorption of the oxalic acid onto the

180
00:09:47,130 --> 00:09:44,890
rutile surface this is a very wide range

181
00:09:49,890 --> 00:09:47,140
of the temperature studied and also the

182
00:09:53,720 --> 00:09:49,900
very where the pH studied but there is

183
00:09:59,660 --> 00:09:53,730
no systematic change of the absorption

184
00:10:04,250 --> 00:09:59,670
related with the temperature change so

185
00:10:07,860 --> 00:10:04,260
so here's we also recently do some

186
00:10:09,870 --> 00:10:07,870
conducted some experiments to study the

187
00:10:14,070 --> 00:10:09,880
absorption of the nucleotides onto the

188
00:10:16,080 --> 00:10:14,080

non tonight so we basically put a mix

189
00:10:18,600 --> 00:10:16,090
some mineral suspension and also

190
00:10:21,390 --> 00:10:18,610
nucleotide the solution and then pulled

191
00:10:23,730 --> 00:10:21,400
into this very special tube which can

192
00:10:27,870 --> 00:10:23,740
injure or less than 100 degree C and

193
00:10:31,620 --> 00:10:27,880
also when when 1000 a bars and we see it

194
00:10:33,780 --> 00:10:31,630
and put it into the water put it into

195
00:10:35,330 --> 00:10:33,790
the reactor and use the water to

196
00:10:39,840 --> 00:10:35,340
increase the temperature and a pressure

197
00:10:41,760 --> 00:10:39,850
to the target values and then after 24

198
00:10:44,400 --> 00:10:41,770
hours we assume that it is in

199
00:10:47,700 --> 00:10:44,410
equilibrium and then we quench who the

200
00:10:49,980 --> 00:10:47,710
system and pull the get the tubes out

201
00:10:53,400 --> 00:10:49,990
and centrifuge is a sample and analyze

202
00:10:56,260 --> 00:10:53,410
it analyzed the supernational using the

203
00:10:59,590 --> 00:10:56,270
UV spectroscopy and called the

204
00:11:01,300 --> 00:10:59,600
and called the solution the

205
00:11:05,970 --> 00:11:01,310
concentration of the nicaya nucleotides

206
00:11:09,130 --> 00:11:05,980
after adoption so here's the result the

207
00:11:11,440 --> 00:11:09,140
x-axis is the equilibrium condition of

208
00:11:16,090 --> 00:11:11,450
the nucleotides after absorption and the

209
00:11:18,510 --> 00:11:16,100
Y is the the amount of the absorption of

210
00:11:22,150 --> 00:11:18,520
the nucleotides and you can see that

211
00:11:25,180 --> 00:11:22,160
with the with the temperature change

212
00:11:27,820 --> 00:11:25,190
from 25 degrees C to 70 degrees C and

213
00:11:31,090 --> 00:11:27,830

also pressure to 1 bar to 1 southern the

214
00:11:32,950 --> 00:11:31,100
bars there's no a big change of the

215
00:11:35,950 --> 00:11:32,960
absorption although there's maybe a

216
00:11:39,070 --> 00:11:35,960
slightly change of the sorption but

217
00:11:43,360 --> 00:11:39,080
given the large error bar maybe that's

218
00:11:49,570 --> 00:11:43,370
that's under the within the systematic

219
00:11:53,410 --> 00:11:49,580
uncertainty the previous result seems

220
00:11:55,720 --> 00:11:53,420
boring but when we add some like twist

221
00:11:59,590 --> 00:11:55,730
amount of transition metals for example

222
00:12:01,870 --> 00:11:59,600
zinc chloride into the system it showed

223
00:12:04,270 --> 00:12:01,880
very interesting results that the

224
00:12:06,880 --> 00:12:04,280
addition of the transition metals which

225
00:12:09,760 --> 00:12:06,890
is enriched in the modern hydrothermal

226
00:12:12,730 --> 00:12:09,770
fluid can quickly elevate the adsorption

227
00:12:15,160 --> 00:12:12,740
of the of the nucleotides onto the

228
00:12:17,620 --> 00:12:15,170
mineral surface which is very relevant

229
00:12:21,480 --> 00:12:17,630
with with the earlier with the early

230
00:12:28,750 --> 00:12:21,490
Earth system and also the modern

231
00:12:30,330 --> 00:12:28,760
exoplanets so here is a conclusion is

232
00:12:32,830 --> 00:12:30,340
that the temperature and the pressure

233
00:12:35,200 --> 00:12:32,840
affects quickly the surface absorption

234
00:12:38,890 --> 00:12:35,210
of the Left elements onto the mineral

235
00:12:42,340 --> 00:12:38,900
surface but please note that I didn't

236
00:12:45,300 --> 00:12:42,350
show any different a system may behave

237
00:12:53,350 --> 00:12:45,310
differently so there's no general rules

238
00:12:56,890 --> 00:12:53,360

proposed here so the these these results

239
00:12:58,810 --> 00:12:56,900
may have very important implications for

240
00:13:00,490 --> 00:12:58,820
the photo origin and the evolution of

241
00:13:04,120 --> 00:13:00,500
the life on the early Earth and also a

242
00:13:07,060 --> 00:13:04,130
so planets for example it may affect the

243
00:13:10,210 --> 00:13:07,070
the assembling of the the first to life

244
00:13:12,580 --> 00:13:10,220
by different you know the

245
00:13:14,800 --> 00:13:12,590
different the behavior of the of the

246
00:13:16,300 --> 00:13:14,810
Assumption of the materials onto the

247
00:13:18,030 --> 00:13:16,310
metal surface and there are different

248
00:13:20,560 --> 00:13:18,040
temperature and pressure conditions

249
00:13:23,700 --> 00:13:20,570
given that we propose hydrothermal

250
00:13:27,130 --> 00:13:23,710
system is my credo of their first life

251
00:13:29,080 --> 00:13:27,140
and also it will greatly affect the

252
00:13:31,570 --> 00:13:29,090
availability of the materials for the

253
00:13:32,980 --> 00:13:31,580
primitive life and also habitability of

254
00:13:35,440 --> 00:13:32,990
the other planets

255
00:13:39,220 --> 00:13:35,450
for example the phosphate the night and

256
00:13:41,830 --> 00:13:39,230
nitrate ammonium and also other as a

257
00:13:43,930 --> 00:13:41,840
software and also for example the

258
00:13:46,350 --> 00:13:43,940
absorption onto the metal surface may

259
00:13:50,320 --> 00:13:46,360
change the gas to the aqueous

260
00:13:55,210 --> 00:13:50,330
equilibrium reaction which is currently

261
00:13:59,380 --> 00:13:55,220
fully unknown and I think it's the worst

262
00:14:02,170 --> 00:13:59,390
to investigating in the future and so I

263
00:14:04,630 --> 00:14:02,180

want to acknowledge in finally my

264
00:14:16,810 --> 00:14:04,640
collaborators and colleagues and also my

265
00:14:42,930 --> 00:14:16,820
funny funny sources so thank you we have

266
00:14:51,310 --> 00:14:47,670
this is a very good question so we also

267
00:14:54,190 --> 00:14:51,320
investigated this phenomenon observe

268
00:14:56,530 --> 00:14:54,200
this phenomena in the Ameena conditions

269
00:14:59,650 --> 00:14:56,540
and also our collaborator also used on

270
00:15:04,390 --> 00:14:59,660
other transition metal davender Aron and

271
00:15:08,530 --> 00:15:04,400
also also showed this in Han elevating

272
00:15:12,720 --> 00:15:08,540
absorption phenomenon what do we think

273
00:15:16,420 --> 00:15:12,730
that there are several possible Magnum

274
00:15:19,270 --> 00:15:16,430
mechanisms firstly that the those option

275
00:15:21,340 --> 00:15:19,280
of the link which is very strong may

276
00:15:24,130 --> 00:15:21,350
change the surface charge of the mana

277
00:15:27,880 --> 00:15:24,140
reserve of the manual and another is

278
00:15:31,360 --> 00:15:27,890
that as option of the zinc can induce

279
00:15:34,330 --> 00:15:31,370
the surface precipitation of the padamu

280
00:15:38,200 --> 00:15:34,340
link hydroxide which will change their

281
00:15:42,310 --> 00:15:38,210
surface property of the of the of zone

282
00:15:44,560 --> 00:15:42,320
of the clay and also they're probably

283
00:15:48,270 --> 00:15:44,570
the complex ition of the zinc with the

284
00:15:52,990 --> 00:15:48,280
nucleotide can also council affect this

285
00:15:55,870 --> 00:15:53,000
probe ma this process so I think always

286
00:15:59,890 --> 00:15:55,880
more we need to use some more advanced

287
00:16:02,650 --> 00:15:59,900
facility facility to to really know

288
00:16:10,270 --> 00:16:02,660

which mechanism is dominant or is a

289
00:16:11,250 --> 00:16:10,280
combination in fact well thank you thank