



AbSciCon  
2019

The logo is a circular emblem with a green border. Inside, a blue satellite with a long antenna orbits a stylized landscape. The landscape includes a row of green evergreen trees at the bottom, blue mountains in the middle, and a white lighthouse-like tower in the background. The text 'AbSciCon' is written in a black, sans-serif font across the top half of the circle, and '2019' is written in a larger, bold, black, sans-serif font across the bottom half. Small white stars are scattered around the circle.

1  
00:00:00,790 --> 00:00:07,320

[Music]

2  
00:00:12,040 --> 00:00:09,090

[Applause]

3  
00:00:14,380 --> 00:00:12,050

thank you very much the second part of

4  
00:00:18,670 --> 00:00:14,390

my talk will be about the experimental

5  
00:00:20,490 --> 00:00:18,680

side of my model the question we want to

6  
00:00:23,650 --> 00:00:20,500

answer here is can we experimentally

7  
00:00:26,380 --> 00:00:23,660

reproduce something like an evolution

8  
00:00:29,800 --> 00:00:26,390

process on a system which does not self

9  
00:00:32,050 --> 00:00:29,810

replicate and as always as mentioned

10  
00:00:33,819 --> 00:00:32,060

before whenever we want something to

11  
00:00:36,640 --> 00:00:33,829

evolve we need to follow a very

12  
00:00:38,080 --> 00:00:36,650

important principle which has to be

13  
00:00:40,390 --> 00:00:38,090

followed otherwise nothing is happening

14

00:00:42,490 --> 00:00:40,400

we need to apply a constant non

15

00:00:46,630 --> 00:00:42,500

equilibrium equilibrium we need to have

16

00:00:50,020 --> 00:00:46,640

a situation where we have a constant non

17

00:00:52,990 --> 00:00:50,030

equilibrium phase where the complexity

18

00:00:54,850 --> 00:00:53,000

can rise over time how can we do that

19

00:00:57,370 --> 00:00:54,860

well the simplest way to do that is to

20

00:00:59,470 --> 00:00:57,380

take any reaction condition for example

21

00:01:02,590 --> 00:00:59,480

moisture switch that back and forth

22

00:01:04,929 --> 00:01:02,600

change that periodically and hereby

23

00:01:07,090 --> 00:01:04,939

create something like a moving target

24

00:01:10,030 --> 00:01:07,100

for the process and this moving target

25

00:01:11,340 --> 00:01:10,040

forces the process to go on in the non

26

00:01:15,429 --> 00:01:11,350

equilibrium State

27

00:01:17,649 --> 00:01:15,439

examples are well known dry weight

28

00:01:19,330 --> 00:01:17,659

cycling and dry wet cycling like I said

29

00:01:21,489 --> 00:01:19,340

the moisture is changed or the chemical

30

00:01:23,499 --> 00:01:21,499

potential of water is changed and it's a

31

00:01:25,809 --> 00:01:23,509

very powerful situation for

32

00:01:27,550 --> 00:01:25,819

polymerization or even of very efficient

33

00:01:29,469 --> 00:01:27,560

polymerization doing that I've mentioned

34

00:01:32,230 --> 00:01:29,479

two papers here of people who are

35

00:01:34,630 --> 00:01:32,240

present which deal with this efficiency

36

00:01:37,330 --> 00:01:34,640

of that process now we are looking

37

00:01:39,520 --> 00:01:37,340

something more exotic we're looking at a

38

00:01:41,889 --> 00:01:39,530

periodic change of the face state of

39

00:01:44,800 --> 00:01:41,899

carbon dioxide in a water carbon dioxide

40

00:01:47,529 --> 00:01:44,810

two-phase system so we have water carbon

41

00:01:49,270 --> 00:01:47,539

dioxide in the we change the face state

42

00:01:51,699 --> 00:01:49,280

of carbon dioxide from supercritical

43

00:01:53,469 --> 00:01:51,709

where it's a very good solvent to

44

00:01:55,330 --> 00:01:53,479

subcritical where it's a very bad salt

45

00:01:58,480 --> 00:01:55,340

and so it's actually switching back and

46

00:02:01,660 --> 00:01:58,490

forth of the solvent quality of carbon

47

00:02:03,099 --> 00:02:01,670

dioxide okay now where do we expect

48

00:02:05,050 --> 00:02:03,109

things like that to happen of course

49

00:02:07,359 --> 00:02:05,060

that's very obvious in case of dry

50

00:02:08,680 --> 00:02:07,369

weight cycling anywhere on the solids or

51  
00:02:11,530 --> 00:02:08,690  
surface of Earth

52  
00:02:13,390 --> 00:02:11,540  
however the second one's more difficult

53  
00:02:15,850 --> 00:02:13,400  
or the second one we have to look at a

54  
00:02:18,610 --> 00:02:15,860  
very specific position within the earth

55  
00:02:20,670 --> 00:02:18,620  
crust at about one kilometer of depth

56  
00:02:23,789 --> 00:02:20,680  
where the conditions are such

57  
00:02:27,449 --> 00:02:23,799  
but little variations of pressure will

58  
00:02:30,059 --> 00:02:27,459  
induce this face cycling of the carbon

59  
00:02:32,940 --> 00:02:30,069  
dioxide okay and that's exactly the

60  
00:02:35,339 --> 00:02:32,950  
environment we want to simulate in the

61  
00:02:38,339 --> 00:02:35,349  
laboratory so this is our laboratory

62  
00:02:40,559 --> 00:02:38,349  
device it's a high pressure device which

63  
00:02:43,379 --> 00:02:40,569

is computer-controlled we can go up to

64

00:02:46,050 --> 00:02:43,389

1,000 bars we can vary the temperature

65

00:02:48,360 --> 00:02:46,060

according to a program very flexible on

66

00:02:50,910 --> 00:02:48,370

that we have this is the pressure cell

67

00:02:52,740 --> 00:02:50,920

itself from the outside that's how it

68

00:02:55,140 --> 00:02:52,750

looks in the inside it's filled with

69

00:02:59,159 --> 00:02:55,150

water and carbon dioxide so these are

70

00:03:01,440 --> 00:02:59,169

the two bulk solvents that we have to

71

00:03:02,759 --> 00:03:01,450

bulk solvents up here then we add a

72

00:03:04,949 --> 00:03:02,769

mixture of two very primitive

73

00:03:07,349 --> 00:03:04,959

amphiphiles which is a long-chain fatty

74

00:03:09,479 --> 00:03:07,359

acid and a long-chain a mine following

75

00:03:13,140 --> 00:03:09,489

Ashley recommendation by David Deamer

76  
00:03:15,869 --> 00:03:13,150  
and we add a set of amino acids which

77  
00:03:18,559 --> 00:03:15,879  
are known or which actually expected to

78  
00:03:21,990 --> 00:03:18,569  
form under hydrothermal conditions where

79  
00:03:23,819 --> 00:03:22,000  
six of them happen to be polar and six

80  
00:03:26,490 --> 00:03:23,829  
of them happen to be on the more

81  
00:03:29,009 --> 00:03:26,500  
nonpolar side otherwise there's nothing

82  
00:03:33,050 --> 00:03:29,019  
else no activation no other chemistry

83  
00:03:35,849 --> 00:03:33,060  
involved okay these are the conditions

84  
00:03:37,679 --> 00:03:35,859  
120 degrees mainly due to speed up

85  
00:03:39,240 --> 00:03:37,689  
things a little bit a relatively high

86  
00:03:42,569 --> 00:03:39,250  
temperature then we switch back and

87  
00:03:45,360 --> 00:03:42,579  
forth the pressure which allows us to

88  
00:03:47,520 --> 00:03:45,370

undergo this phase transition here the

89

00:03:50,729 --> 00:03:47,530

phase transition occurs at 72 bars we

90

00:03:53,039 --> 00:03:50,739

switch between 67 and 77 and the whole

91

00:03:55,319 --> 00:03:53,049

experiment the source standard with the

92

00:03:57,179 --> 00:03:55,329

latest experiments is being run for five

93

00:04:01,409 --> 00:03:57,189

hundred hours which is approximately

94

00:04:05,610 --> 00:04:01,419

three weeks which means 1500 cycles with

95

00:04:09,390 --> 00:04:05,620

a period of 20 minutes okay what does

96

00:04:11,849 --> 00:04:09,400

this phase cycling do well first it does

97

00:04:14,969 --> 00:04:11,859

very something very similar to what dry

98

00:04:17,729 --> 00:04:14,979

cycling it also involves condensation

99

00:04:19,259 --> 00:04:17,739

whenever we bring the carbon dioxide in

100

00:04:22,140 --> 00:04:19,269

the supercritical phase it suddenly

101  
00:04:24,740 --> 00:04:22,150  
takes up water so we decrease the

102  
00:04:27,390 --> 00:04:24,750  
chemical potential of water and we

103  
00:04:29,670 --> 00:04:27,400  
reinforce the condensation process to

104  
00:04:32,370 --> 00:04:29,680  
occur so if we have amino acids here we

105  
00:04:34,080 --> 00:04:32,380  
will get more of the condensated

106  
00:04:36,120 --> 00:04:34,090  
products when the

107  
00:04:38,090 --> 00:04:36,130  
carbon dioxide becomes subcritical again

108  
00:04:42,420 --> 00:04:38,100  
then the water is coming back and this

109  
00:04:44,750 --> 00:04:42,430  
reinforces hydrolysis so each cycling of

110  
00:04:49,710 --> 00:04:44,760  
the pressure means one cycle of

111  
00:04:51,750 --> 00:04:49,720  
condensation and hydrolysis okay based

112  
00:04:53,610 --> 00:04:51,760  
we have done some experiments with some

113  
00:04:55,950 --> 00:04:53,620

model amino acids to determine the

114

00:04:57,780 --> 00:04:55,960

kinetics of these processes and based on

115

00:04:59,460 --> 00:04:57,790

these kinetics we have done some

116

00:05:01,650 --> 00:04:59,470

calculations just to show how the

117

00:05:04,110 --> 00:05:01,660

concentration is developed so this is

118

00:05:06,150 --> 00:05:04,120

the concentration of the amino acids so

119

00:05:08,700 --> 00:05:06,160

these are the monomers here and on the

120

00:05:10,080 --> 00:05:08,710

logarithmic scale they hardly change of

121

00:05:12,570 --> 00:05:10,090

course there is some change but it's

122

00:05:14,370 --> 00:05:12,580

hardly visible however we have the

123

00:05:15,810 --> 00:05:14,380

development of the concentration of the

124

00:05:19,620 --> 00:05:15,820

dimer of the trimer

125

00:05:21,570 --> 00:05:19,630

of the tetra mer and so on and after a

126

00:05:23,820 --> 00:05:21,580

day or so the whole thing runs into an

127

00:05:27,000 --> 00:05:23,830

equilibrium and we end up with having

128

00:05:29,969 --> 00:05:27,010

decreasing concentrations by an order of

129

00:05:31,409 --> 00:05:29,979

magnitude for each additional amino acid

130

00:05:33,770 --> 00:05:31,419

that comes to the chain that's the

131

00:05:37,529 --> 00:05:33,780

equilibrium situation without any

132

00:05:39,570 --> 00:05:37,539

activation of course the yield of for

133

00:05:43,950 --> 00:05:39,580

example the hexapeptide is terribly low

134

00:05:47,340 --> 00:05:43,960

extremely low yields in this case okay

135

00:05:49,409 --> 00:05:47,350

but there is something else when we do

136

00:05:54,529 --> 00:05:49,419

this cycling of the pressure we also

137

00:05:57,810 --> 00:05:54,539

induce the generation of vesicles reduce

138

00:05:59,909 --> 00:05:57,820

basically generations one thousand five

139

00:06:01,770 --> 00:05:59,919

hundred and in the case of our latest

140

00:06:03,900 --> 00:06:01,780

experiment so we have many generations

141

00:06:06,240 --> 00:06:03,910

of vesicles which are formed by the

142

00:06:08,100 --> 00:06:06,250

following mechanism when we are in the

143

00:06:10,409 --> 00:06:08,110

supercritical state the carbon dioxide

144

00:06:12,060 --> 00:06:10,419

is saturated with water contains the

145

00:06:17,339 --> 00:06:12,070

amplifier contains some of the amino

146

00:06:19,680 --> 00:06:17,349

acids then the supercritical the carbon

147

00:06:21,960 --> 00:06:19,690

dioxide becomes subcritical so it's a

148

00:06:24,330 --> 00:06:21,970

bad solvent first water droplets will

149

00:06:27,029 --> 00:06:24,340

condensate in the mid air in the gas

150

00:06:30,120 --> 00:06:27,039

phase and the other constituents have

151  
00:06:32,909 --> 00:06:30,130  
nothing else to go for nowhere else to

152  
00:06:34,680 --> 00:06:32,919  
go then to go in the inside of these

153  
00:06:36,659 --> 00:06:34,690  
droplets or on the surface of these

154  
00:06:38,580 --> 00:06:36,669  
droplets which the emphathize will do

155  
00:06:41,670 --> 00:06:38,590  
when these droplets settle down the

156  
00:06:44,100 --> 00:06:41,680  
surface the mono layer on the droplets

157  
00:06:45,719 --> 00:06:44,110  
and the mono layer on the surface will

158  
00:06:46,860 --> 00:06:45,729  
interact and this will lead to the

159  
00:06:48,480 --> 00:06:46,870  
formation

160  
00:06:50,820 --> 00:06:48,490  
bicycles and of course these vesicles

161  
00:06:52,950 --> 00:06:50,830  
are thermodynamically unstable so after

162  
00:06:55,110 --> 00:06:52,960  
a short period of time especially when

163  
00:06:57,689 --> 00:06:55,120

the carbon dioxide become so character

164

00:06:59,879 --> 00:06:57,699

again they fall apart that means that

165

00:07:04,650 --> 00:06:59,889

every cycling of the pressure means one

166

00:07:07,050 --> 00:07:04,660

generation of vesicles okay this is how

167

00:07:08,790 --> 00:07:07,060

they look like under the microscope when

168

00:07:11,550 --> 00:07:08,800

in studies some of them are mono lamella

169

00:07:14,070 --> 00:07:11,560

some of them multilamellar multilamellar

170

00:07:17,939 --> 00:07:14,080

ones derived from merging droplets in

171

00:07:20,909 --> 00:07:17,949

the gas phase sizes are around several

172

00:07:22,260 --> 00:07:20,919

tens of micrometers this would be the

173

00:07:25,560 --> 00:07:22,270

average size some of them are smaller

174

00:07:27,150 --> 00:07:25,570

too okay so now we have a pool of

175

00:07:29,100 --> 00:07:27,160

peptides on one side and we have

176

00:07:31,950 --> 00:07:29,110

vesicles on the other side now what we

177

00:07:34,440 --> 00:07:31,960

expect of course is interaction not that

178

00:07:36,450 --> 00:07:34,450

much of the hydrophilic ones and other

179

00:07:38,940 --> 00:07:36,460

hand completely hydrophobic ones they

180

00:07:41,580 --> 00:07:38,950

will have their own things to do but the

181

00:07:43,670 --> 00:07:41,590

amphiphilic ones some of these peptides

182

00:07:46,379 --> 00:07:43,680

are amphiphilic and they are capable of

183

00:07:48,150 --> 00:07:46,389

migrating into the bilayer and when they

184

00:07:50,279 --> 00:07:48,160

do that they will get protected against

185

00:07:52,170 --> 00:07:50,289

hydrolysis and therefore they will be

186

00:07:55,350 --> 00:07:52,180

will get pertained they will accumulate

187

00:07:57,600 --> 00:07:55,360

over time this accumulation can be

188

00:08:00,570 --> 00:07:57,610

calculated as well this is the same

189

00:08:03,930 --> 00:08:00,580

graph as before now I assume that we

190

00:08:07,170 --> 00:08:03,940

have something like 10% of hexamer which

191

00:08:09,900 --> 00:08:07,180

is amphiphilic so we start with 10% and

192

00:08:12,710 --> 00:08:09,910

a few now and if in the calculation now

193

00:08:15,000 --> 00:08:12,720

it's entered that this amphiphilic

194

00:08:17,129 --> 00:08:15,010

hexamer is somewhat protected against

195

00:08:19,320 --> 00:08:17,139

hydrolysis we see a development of the

196

00:08:22,080 --> 00:08:19,330

concentration and if we look at longer

197

00:08:24,420 --> 00:08:22,090

periods of time those 500 hours for

198

00:08:27,930 --> 00:08:24,430

example we see that the concentration of

199

00:08:29,909 --> 00:08:27,940

this hexamer will keep rising it will

200

00:08:32,250 --> 00:08:29,919

even get close to the concentration of

201  
00:08:35,190 --> 00:08:32,260  
the tetramer and that's exactly what we

202  
00:08:38,190 --> 00:08:35,200  
see in the analysis there is an analysis

203  
00:08:41,670 --> 00:08:38,200  
done on two experiments actually one is

204  
00:08:44,760 --> 00:08:41,680  
without any amphiphilic material so it's

205  
00:08:47,850 --> 00:08:44,770  
without vesicles and ones with vesicles

206  
00:08:50,100 --> 00:08:47,860  
these are the peptides that we observe

207  
00:08:53,699 --> 00:08:50,110  
over times different samples which have

208  
00:08:56,490 --> 00:08:53,709  
been taken in case of the absence of the

209  
00:08:59,290 --> 00:08:56,500  
amphiphilic material we see that we form

210  
00:09:02,380 --> 00:08:59,300  
a relatively large portion of trimer

211  
00:09:05,020 --> 00:09:02,390  
smaller quantities but larger varieties

212  
00:09:07,690 --> 00:09:05,030  
of tetra mares and hardly any panda

213  
00:09:09,190 --> 00:09:07,700

mares or hexamers in case of the

214

00:09:10,240 --> 00:09:09,200

experiment with the vesicles it looks

215

00:09:14,380 --> 00:09:10,250

completely different

216

00:09:16,450 --> 00:09:14,390

the tetra mares are mostly disappeared

217

00:09:18,250 --> 00:09:16,460

except for at the end of the experiment

218

00:09:20,800 --> 00:09:18,260

looks a bit different we don't know why

219

00:09:23,470 --> 00:09:20,810

but what's really striking is that we

220

00:09:25,450 --> 00:09:23,480

get a lot of pain tamir's hexa mares and

221

00:09:27,760 --> 00:09:25,460

also much longer chains which have not

222

00:09:32,140 --> 00:09:27,770

included in this graph and when looking

223

00:09:34,540 --> 00:09:32,150

at the longer chains at Paynter mares

224

00:09:37,180 --> 00:09:34,550

and hexamers we very often find that

225

00:09:39,310 --> 00:09:37,190

they have allies in a positively charged

226

00:09:41,440 --> 00:09:39,320

lysine at the head group and more or

227

00:09:45,240 --> 00:09:41,450

less hydrophobic ones at the other ends

228

00:09:47,890 --> 00:09:45,250

of the chain and if I label these

229

00:09:50,650 --> 00:09:47,900

peptides here or the red ones now fall

230

00:09:55,180 --> 00:09:50,660

into this category then we see that they

231

00:09:56,860 --> 00:09:55,190

may occur exit occasionally in the first

232

00:09:59,560 --> 00:09:56,870

experiment but in the second experiment

233

00:10:02,320 --> 00:09:59,570

they really accumulate so we believe we

234

00:10:04,630 --> 00:10:02,330

have this accumulation effect we also

235

00:10:06,280 --> 00:10:04,640

have varied the reaction conditions for

236

00:10:08,230 --> 00:10:06,290

example in the evolution experiment we

237

00:10:11,860 --> 00:10:08,240

have after one and a half weeks removed

238

00:10:14,740 --> 00:10:11,870

the alpha files or thereby vesicles then

239

00:10:16,710 --> 00:10:14,750

we see a slightly different picture here

240

00:10:19,750 --> 00:10:16,720

but still we see the accumulation of

241

00:10:23,230 --> 00:10:19,760

amphiphilic peptides so believe we have

242

00:10:26,320 --> 00:10:23,240

this integration and this accumulation

243

00:10:28,030 --> 00:10:26,330

step which is visualized here but we can

244

00:10:32,110 --> 00:10:28,040

have more when the peptides get longer

245

00:10:34,540 --> 00:10:32,120

they actually add a they get the

246

00:10:36,550 --> 00:10:34,550

property of stabilizing or they may get

247

00:10:38,440 --> 00:10:36,560

the property of stabilizing the vesicles

248

00:10:40,750 --> 00:10:38,450

especially when they are longer than six

249

00:10:42,550 --> 00:10:40,760

hundred seven units eight units they may

250

00:10:44,680 --> 00:10:42,560

stabilize this mythical and when they do

251  
00:10:46,390 --> 00:10:44,690  
that and there's a mutual advantage for

252  
00:10:48,850 --> 00:10:46,400  
the peptide as well as for the vesicle

253  
00:10:51,520 --> 00:10:48,860  
and that means those peptides will get a

254  
00:10:54,520 --> 00:10:51,530  
much stronger selectional advantage as

255  
00:10:56,890 --> 00:10:54,530  
opposed to the others and it can go even

256  
00:10:58,810 --> 00:10:56,900  
further can go to this state which are

257  
00:11:00,510 --> 00:10:58,820  
called functional because there we

258  
00:11:03,220 --> 00:11:00,520  
developed or the vesicle may develop

259  
00:11:05,170 --> 00:11:03,230  
survival strategies may survival

260  
00:11:05,950 --> 00:11:05,180  
functions for example when the vesicles

261  
00:11:08,020 --> 00:11:05,960  
been formed

262  
00:11:09,790 --> 00:11:08,030  
there's osmotic pressure due to the

263  
00:11:10,960 --> 00:11:09,800

concentration gradient between the

264

00:11:12,730 --> 00:11:10,970

inside and the out

265

00:11:14,650 --> 00:11:12,740

this osmotic pressure shortens the

266

00:11:16,720 --> 00:11:14,660

lifetime now if there are channels in

267

00:11:19,259 --> 00:11:16,730

this concentration gradient can release

268

00:11:22,090 --> 00:11:19,269

then of course there's an additional

269

00:11:24,189 --> 00:11:22,100

rate of survival due to that so these

270

00:11:27,129 --> 00:11:24,199

mechanisms get selected they get

271

00:11:30,009 --> 00:11:27,139

continuously selected during this 1,500

272

00:11:33,670 --> 00:11:30,019

generations that we create so that means

273

00:11:37,180 --> 00:11:33,680

we get additional effects here of course

274

00:11:39,370 --> 00:11:37,190

we have looked at these peptides here

275

00:11:42,160 --> 00:11:39,380

especially the longest ones which seem

276

00:11:44,019 --> 00:11:42,170

to accumulate relatively fast this one

277

00:11:46,000 --> 00:11:44,029

we were most interested in because it

278

00:11:49,439 --> 00:11:46,010

accumulated at a relatively high rate

279

00:11:52,360 --> 00:11:49,449

and we were having this peptide

280

00:11:54,670 --> 00:11:52,370

synthesized commercially and then we

281

00:11:55,329 --> 00:11:54,680

added it to a larger portions of these

282

00:11:56,800 --> 00:11:55,339

vesicles

283

00:11:59,350 --> 00:11:56,810

and try to find out what the effect

284

00:12:01,150 --> 00:11:59,360

would be of that peptide on the

285

00:12:03,490 --> 00:12:01,160

properties of the vesicles we found

286

00:12:05,920 --> 00:12:03,500

three things we found first that the

287

00:12:10,120 --> 00:12:05,930

peptide reduces the vesicle size by

288

00:12:11,620 --> 00:12:10,130

approximately 50% the vesicle sorry the

289

00:12:14,740 --> 00:12:11,630

peptide increases the vesicle

290

00:12:16,509 --> 00:12:14,750

permeability by 90% and the peptide

291

00:12:19,090 --> 00:12:16,519

increases the vesicle stability the

292

00:12:21,870 --> 00:12:19,100

half-life time is increased by a factor

293

00:12:24,790 --> 00:12:21,880

of 6 and we interpret that now as

294

00:12:27,449 --> 00:12:24,800

survival strategies for the vesicle with

295

00:12:30,340 --> 00:12:27,459

the last issue that's obvious after

296

00:12:33,730 --> 00:12:30,350

vesicles thermodynamic stable it has

297

00:12:35,829 --> 00:12:33,740

more chances to survive second one could

298

00:12:38,079 --> 00:12:35,839

be the effect that an increase of the

299

00:12:40,480 --> 00:12:38,089

vesicle membrane permeability would

300

00:12:43,870 --> 00:12:40,490

reduce the osmotic pressure effect and

301  
00:12:46,420 --> 00:12:43,880  
would hereby relax the the force which

302  
00:12:48,129 --> 00:12:46,430  
could destroy the vesicles and even the

303  
00:12:50,439 --> 00:12:48,139  
first one may be a survival strategy

304  
00:12:53,350 --> 00:12:50,449  
because smaller vesicles have better

305  
00:12:56,319 --> 00:12:53,360  
chances to survive shear or to survive

306  
00:12:59,500 --> 00:12:56,329  
bubbling okay so we believe at this

307  
00:13:01,960 --> 00:12:59,510  
point we are we actually have functional

308  
00:13:04,000 --> 00:13:01,970  
vesicles which actually have developed

309  
00:13:05,740 --> 00:13:04,010  
by themselves and at this point of

310  
00:13:07,809 --> 00:13:05,750  
course we are looking for more the

311  
00:13:09,340 --> 00:13:07,819  
experiments are ongoing especially the

312  
00:13:12,610 --> 00:13:09,350  
analyses are ongoing

313  
00:13:14,079 --> 00:13:12,620

they are quite demanding okay this is a

314

00:13:16,269 --> 00:13:14,089

summary at the end let me briefly

315

00:13:18,100 --> 00:13:16,279

mention the other persons involved this

316

00:13:21,130 --> 00:13:18,110

is Oliver Schmitz who is doing the

317

00:13:24,790 --> 00:13:21,140

analyses with his coworkers this is Ivor

318

00:13:26,829 --> 00:13:24,800

who is giving us input on the geological

319

00:13:29,230 --> 00:13:26,839

side and this is mafia Davila with just

320

00:13:31,420 --> 00:13:29,240

on maternal leave since half a year

321

00:13:33,460 --> 00:13:31,430

which gives me myself the chance to work

322

00:13:36,910 --> 00:13:33,470

on the high-pressure apparatus which is