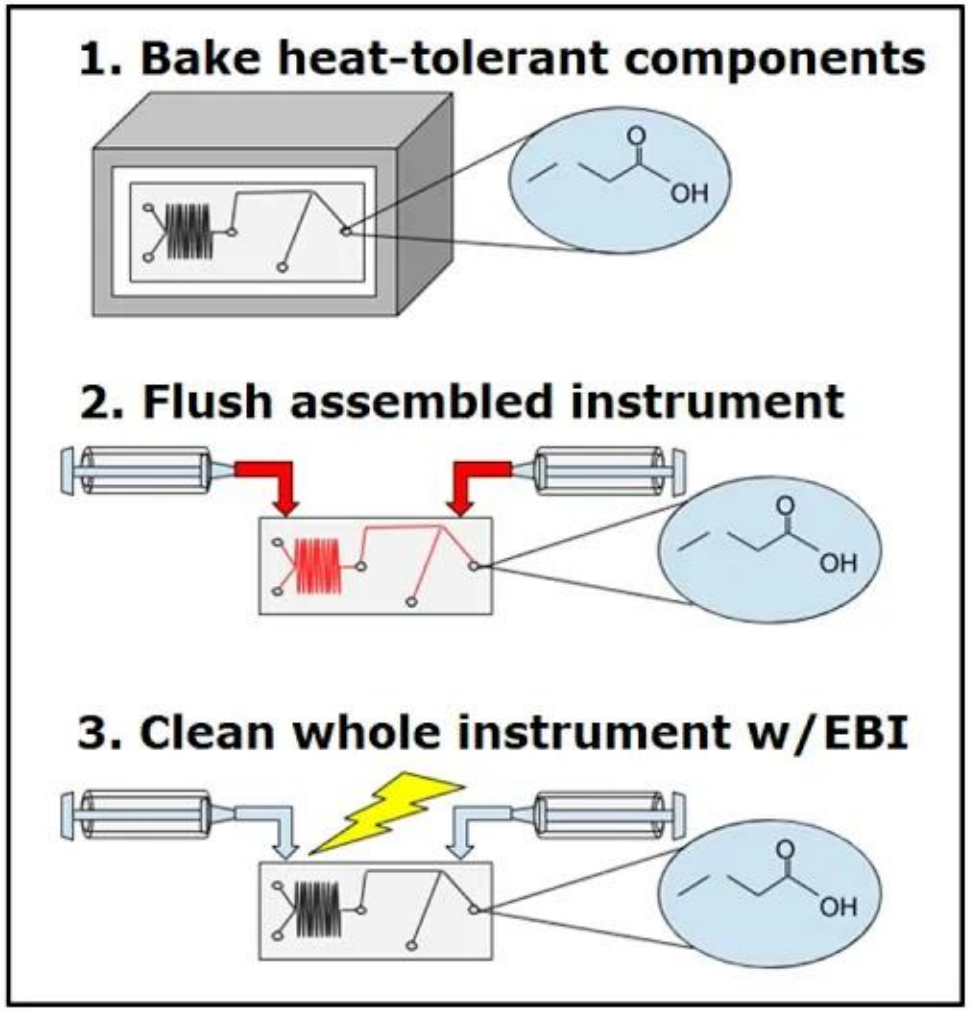
Electron Beam Irradiation: potential decontamination solution

- Potential: final, whole-instrument decontamination step
- *Enhance* (not replace) traditional cleaning



1
00:00:03,750 --> 00:00:02,869
hi everyone thanks for tuning in to my

2
00:00:05,829 --> 00:00:03,760
talk today

3
00:00:07,670 --> 00:00:05,839
my name is denise buckner i'm a phd

4
00:00:09,190 --> 00:00:07,680
student at the university of florida

5
00:00:11,030 --> 00:00:09,200
and today i'll be presenting some of my

6
00:00:12,549 --> 00:00:11,040
research on the assessment of electron

7
00:00:14,150 --> 00:00:12,559
beam radiation as a lipid

8
00:00:16,150 --> 00:00:14,160
decontamination technique for light

9
00:00:18,230 --> 00:00:16,160
detection instruments

10
00:00:19,830 --> 00:00:18,240
as an overview first i'll discuss lipid

11
00:00:20,950 --> 00:00:19,840
biomarkers and their application for

12
00:00:22,630 --> 00:00:20,960
life detection

13
00:00:24,390 --> 00:00:22,640

then i'll introduce my group's novel

14
00:00:25,990 --> 00:00:24,400
life detection instrument the extractor

15
00:00:28,790 --> 00:00:26,000
for chemical analysis of lipid

16
00:00:30,070 --> 00:00:28,800
biomarkers in regolith or excalibur

17
00:00:32,150 --> 00:00:30,080
then i'll discuss the importance of

18
00:00:33,670 --> 00:00:32,160
decontamination and introduce electron

19
00:00:34,950 --> 00:00:33,680
beam of radiation as a potential

20
00:00:36,470 --> 00:00:34,960
solution

21
00:00:38,150 --> 00:00:36,480
then i'll explain the experiments we

22
00:00:39,830 --> 00:00:38,160
conducted and the results

23
00:00:41,510 --> 00:00:39,840
as a preview we found that the technique

24
00:00:43,430 --> 00:00:41,520
was not effective at removing lipid

25
00:00:45,270 --> 00:00:43,440
contaminants of interest

26
00:00:47,590 --> 00:00:45,280
finally i'll discuss my next steps and

27
00:00:49,590 --> 00:00:47,600
future research

28
00:00:51,590 --> 00:00:49,600
in the search for extraterrestrial life

29
00:00:52,790 --> 00:00:51,600
lipid biomarkers are organics of special

30
00:00:54,549 --> 00:00:52,800
interest

31
00:00:56,470 --> 00:00:54,559
lipids are universal to all life as we

32
00:00:58,229 --> 00:00:56,480
know it primarily for building membranes

33
00:01:00,470 --> 00:00:58,239
that protect and segregate biological

34
00:01:02,869 --> 00:01:00,480
materials from the external environment

35
00:01:04,710 --> 00:01:02,879
cellular life requires encapsulation and

36
00:01:06,390 --> 00:01:04,720
amphiphilic fatty acids are the organic

37
00:01:07,830 --> 00:01:06,400
molecules that fulfill this structural

38
00:01:09,429 --> 00:01:07,840

role

39
00:01:11,109 --> 00:01:09,439
lipids can form both biotically and

40
00:01:12,550 --> 00:01:11,119
abiotically and have been detected

41
00:01:14,390 --> 00:01:12,560
throughout the solar system

42
00:01:15,749 --> 00:01:14,400
particularly in carbonaceous meteorites

43
00:01:17,350 --> 00:01:15,759
delivered to earth and mars throughout

44
00:01:19,510 --> 00:01:17,360
both planets histories

45
00:01:21,109 --> 00:01:19,520
for reference fatty acids make up over

46
00:01:23,350 --> 00:01:21,119
sixty percent of the soluble organics

47
00:01:25,510 --> 00:01:23,360
found in carbonaceous meteorites

48
00:01:26,950 --> 00:01:25,520
additionally small simple hydrocarbons

49
00:01:28,870 --> 00:01:26,960
and chlorinated molecules have been

50
00:01:30,789 --> 00:01:28,880
detected on mars by the sample analysis

51
00:01:31,590 --> 00:01:30,799
of mars instrument onboard the curiosity

52
00:01:33,270 --> 00:01:31,600
rover

53
00:01:34,630 --> 00:01:33,280
but further exploration is needed to

54
00:01:35,830 --> 00:01:34,640
better understand what lipids could

55
00:01:37,109 --> 00:01:35,840
exist on mars

56
00:01:38,870 --> 00:01:37,119
and what the source of those lipids

57
00:01:41,109 --> 00:01:38,880
could be

58
00:01:42,469 --> 00:01:41,119
lipid sphere origin diagnostic molecular

59
00:01:44,310 --> 00:01:42,479
features and patterns

60
00:01:46,550 --> 00:01:44,320
mean that the confirmation of individual

61
00:01:47,990 --> 00:01:46,560
molecules and patterns and distributions

62
00:01:49,590 --> 00:01:48,000
of lipids within a sample

63
00:01:50,950 --> 00:01:49,600

can indicate whether those compounds

64
00:01:51,990 --> 00:01:50,960
were synthesized biotically or

65
00:01:53,510 --> 00:01:52,000
abiotically

66
00:01:55,910 --> 00:01:53,520
a potential key to detecting

67
00:01:57,910 --> 00:01:55,920
extraterrestrial life

68
00:02:00,149 --> 00:01:57,920
lipids are also recalcitrant and robust

69
00:02:01,670 --> 00:02:00,159
molecules that can persist for billions

70
00:02:02,230 --> 00:02:01,680
of years in the terrestrial geologic

71
00:02:04,069 --> 00:02:02,240
record

72
00:02:05,990 --> 00:02:04,079
which is orders of magnitude longer than

73
00:02:08,309 --> 00:02:06,000
other biomarkers like dna

74
00:02:09,270 --> 00:02:08,319
proteins and amino acid and antiomeric

75
00:02:10,949 --> 00:02:09,280
excess

76
00:02:12,949 --> 00:02:10,959
if life arose on mars during its most

77
00:02:13,589 --> 00:02:12,959
habitable epochs about 3 billion years

78
00:02:15,510 --> 00:02:13,599
ago

79
00:02:17,589 --> 00:02:15,520
lipid biomarkers could represent some of

80
00:02:20,630 --> 00:02:17,599
the only remaining molecular evidence of

81
00:02:22,550 --> 00:02:20,640
that life preserved there today

82
00:02:24,550 --> 00:02:22,560
to search for lipid biomarkers on mars

83
00:02:25,990 --> 00:02:24,560
and beyond we are building the extractor

84
00:02:28,470 --> 00:02:26,000
for chemical analysis of lipid

85
00:02:29,830 --> 00:02:28,480
biomarkers in regolith or excalibur

86
00:02:31,750 --> 00:02:29,840
this instrument will replicate and

87
00:02:33,190 --> 00:02:31,760
automate what chemistry lipid extraction

88
00:02:34,710 --> 00:02:33,200

and analysis techniques

89
00:02:36,710 --> 00:02:34,720
that have been successfully used in

90
00:02:37,589 --> 00:02:36,720
terrestrial laboratories for over 70

91
00:02:39,030 --> 00:02:37,599
years

92
00:02:43,430 --> 00:02:39,040
streamlining and scaling them for

93
00:02:46,710 --> 00:02:45,270
this image shows excalibur's sample

94
00:02:48,869 --> 00:02:46,720
processing steps

95
00:02:50,390 --> 00:02:48,879
first excalibur will accept a 50 gram

96
00:02:52,070 --> 00:02:50,400
regulator ice sample

97
00:02:53,670 --> 00:02:52,080
then convince or crush the sample to

98
00:02:55,589 --> 00:02:53,680
reduce particle size

99
00:02:57,190 --> 00:02:55,599
at this point any volatile organics will

100
00:02:58,630 --> 00:02:57,200
be cold trapped and sent to an evolved

101
00:03:00,630 --> 00:02:58,640
gas analyzer

102
00:03:02,149 --> 00:03:00,640
back to the sample lipids will then be

103
00:03:04,149 --> 00:03:02,159
extracted from the regolith via

104
00:03:06,229 --> 00:03:04,159
agitation and organic solvents

105
00:03:08,070 --> 00:03:06,239
and the mineral residue filtered out

106
00:03:09,670 --> 00:03:08,080
leaving behind a mixture of pure lipids

107
00:03:11,509 --> 00:03:09,680
suspended in solvent

108
00:03:14,149 --> 00:03:11,519
the resulting lipid extract will then be

109
00:03:14,949 --> 00:03:14,159
concentrated 2500 times to improve

110
00:03:16,550 --> 00:03:14,959
signal

111
00:03:18,070 --> 00:03:16,560
then sent to a suite of coupled

112
00:03:20,149 --> 00:03:18,080
analytical instruments for detailed

113
00:03:22,070 --> 00:03:20,159

molecular characterization

114
00:03:24,309 --> 00:03:22,080
these could include a gas chromatograph

115
00:03:27,190 --> 00:03:24,319
mass spectrometer or gcms

116
00:03:30,789 --> 00:03:27,200
a thermochemolysis gcms or a laser

117
00:03:32,949 --> 00:03:30,799
desorption ionization mass spectrometer

118
00:03:34,869 --> 00:03:32,959
however if excalibur is to effectively

119
00:03:36,149 --> 00:03:34,879
detect lipids decontamination is

120
00:03:38,149 --> 00:03:36,159
essential

121
00:03:39,750 --> 00:03:38,159
lipid biomarkers are abundant on earth

122
00:03:41,670 --> 00:03:39,760
but may be low in abundance in an

123
00:03:43,350 --> 00:03:41,680
extraterrestrial sample

124
00:03:46,309 --> 00:03:43,360
since excalibur will concentrate the

125
00:03:47,910 --> 00:03:46,319
lipid extract 2500 times

126
00:03:49,190 --> 00:03:47,920
any terrestrial lipids that end up in

127
00:03:50,309 --> 00:03:49,200
the aliquot will also become

128
00:03:52,949 --> 00:03:50,319
concentrated

129
00:03:54,869 --> 00:03:52,959
and sent to the analytical instruments

130
00:03:56,710 --> 00:03:54,879
those instruments coupling to excalibur

131
00:03:59,350 --> 00:03:56,720
have ultra low limits of detection

132
00:04:00,949 --> 00:03:59,360
with picota femtomole sensitivities so

133
00:04:03,270 --> 00:04:00,959
even trace amounts of contamination

134
00:04:05,270 --> 00:04:03,280
could present a significant problem

135
00:04:07,030 --> 00:04:05,280
further compounding the issue recent

136
00:04:08,390 --> 00:04:07,040
studies on contamination in spacecraft

137
00:04:10,149 --> 00:04:08,400
assembly clean rooms

138
00:04:11,509 --> 00:04:10,159

show that up to 10 to the fifth viable

139
00:04:13,190 --> 00:04:11,519
cells per square meter

140
00:04:15,270 --> 00:04:13,200
add up to 10 to the eighth total cells

141
00:04:16,949 --> 00:04:15,280
per square meter remain on hardware

142
00:04:19,590 --> 00:04:16,959
surfaces post cleaning

143
00:04:20,710 --> 00:04:19,600
this translates to roughly 500 picomoles

144
00:04:23,510 --> 00:04:20,720
of fatty acid

145
00:04:25,430 --> 00:04:23,520
per square meter finally traditional

146
00:04:27,990 --> 00:04:25,440
decontamination techniques approved by

147
00:04:30,070 --> 00:04:28,000
nasa for planetary protection purposes

148
00:04:31,830 --> 00:04:30,080
leveraged in clean rooms or applied in

149
00:04:33,590 --> 00:04:31,840
organic chemistry laboratories

150
00:04:35,110 --> 00:04:33,600
are either ineffective at sufficiently

151
00:04:37,189 --> 00:04:35,120
removing lipid contaminants

152
00:04:38,950 --> 00:04:37,199
or are effective at removing lipid

153
00:04:40,310 --> 00:04:38,960
contaminants but are incompatible with

154
00:04:42,230 --> 00:04:40,320
sensitive materials

155
00:04:44,950 --> 00:04:42,240
used to construct excalibur and other

156
00:04:46,870 --> 00:04:44,960
life detection instruments

157
00:04:48,710 --> 00:04:46,880
to address this issue we investigated

158
00:04:49,909 --> 00:04:48,720
electron nemo radiation as a potential

159
00:04:51,590 --> 00:04:49,919
solution

160
00:04:53,350 --> 00:04:51,600
electron fema radiation is a technique

161
00:04:54,629 --> 00:04:53,360
that's widely used for sterilization and

162
00:04:56,550 --> 00:04:54,639
decontamination

163
00:04:57,670 --> 00:04:56,560

in food medical device and wastewater

164
00:04:59,189 --> 00:04:57,680
treatment industries

165
00:05:00,710 --> 00:04:59,199
and is sometimes used to sterilize

166
00:05:01,590 --> 00:05:00,720
spacecraft for planetary protection

167
00:05:02,870 --> 00:05:01,600
compliance

168
00:05:05,189 --> 00:05:02,880
but has not been applied to life

169
00:05:06,870 --> 00:05:05,199
detection hardware in particular

170
00:05:08,550 --> 00:05:06,880
electron fema radiation works by

171
00:05:10,790 --> 00:05:08,560
generating and focusing a stream of high

172
00:05:12,469 --> 00:05:10,800
energy electrons onto materials

173
00:05:14,390 --> 00:05:12,479
undergoing sterilization

174
00:05:15,830 --> 00:05:14,400
decontamination is achieved in less than

175
00:05:17,590 --> 00:05:15,840
60 seconds

176
00:05:19,029 --> 00:05:17,600
the beam delivers tunable controlled

177
00:05:20,790 --> 00:05:19,039
doses that can penetrate up to 10

178
00:05:22,550 --> 00:05:20,800
centimeters through cardboard glass and

179
00:05:23,990 --> 00:05:22,560
other packaging materials

180
00:05:25,990 --> 00:05:24,000
potentially reaching trapped or

181
00:05:27,670 --> 00:05:26,000
encapsulated contaminants

182
00:05:30,150 --> 00:05:27,680
these electrons can kill microbes and

183
00:05:31,909 --> 00:05:30,160
destroy some organics via radiolysis

184
00:05:33,350 --> 00:05:31,919
through direct hits to molecules and by

185
00:05:34,950 --> 00:05:33,360
generating radicals

186
00:05:36,830 --> 00:05:34,960
but effects on molecular lipid

187
00:05:38,790 --> 00:05:36,840
contaminants had not previously been

188
00:05:40,550 --> 00:05:38,800

investigated

189
00:05:41,749 --> 00:05:40,560
so the goal of our study was to test

190
00:05:43,350 --> 00:05:41,759
this technique as a final

191
00:05:44,950 --> 00:05:43,360
decontamination step

192
00:05:46,710 --> 00:05:44,960
that could be applied to the assembled

193
00:05:48,629 --> 00:05:46,720
excalibur instrument

194
00:05:49,830 --> 00:05:48,639
the intention was to enhance but not

195
00:05:52,230 --> 00:05:49,840
replace traditional

196
00:05:53,590 --> 00:05:52,240
cleaning for example the figure on the

197
00:05:55,110 --> 00:05:53,600
right shows how electron beam of

198
00:05:57,110 --> 00:05:55,120
radiation could factor into the

199
00:05:58,950 --> 00:05:57,120
excalibur cleaning plan

200
00:06:00,309 --> 00:05:58,960
first heat tolerant components would be

201
00:06:01,670 --> 00:06:00,319
baked to the highest allowable

202
00:06:03,590 --> 00:06:01,680
temperatures

203
00:06:04,790 --> 00:06:03,600
then throughout assembly the instrument

204
00:06:06,309 --> 00:06:04,800
would be frequently flushed with

205
00:06:07,510 --> 00:06:06,319
solvents to remove any introduced

206
00:06:09,270 --> 00:06:07,520
contaminants

207
00:06:11,189 --> 00:06:09,280
these same solvents could also be used

208
00:06:12,710 --> 00:06:11,199
to pre-clean components that were unable

209
00:06:14,150 --> 00:06:12,720
to be baked

210
00:06:16,230 --> 00:06:14,160
finally once the assembly of the

211
00:06:18,150 --> 00:06:16,240
instrument is complete excalibur could

212
00:06:21,350 --> 00:06:18,160
then undergo a radiation to destroy

213
00:06:23,590 --> 00:06:21,360

any residual lipids

214
00:06:25,029 --> 00:06:23,600
so for this study we first selected five

215
00:06:27,189 --> 00:06:25,039
target lipids to test

216
00:06:29,110 --> 00:06:27,199
shown on the left including a saturated

217
00:06:32,390 --> 00:06:29,120
and unsaturated fatty acid

218
00:06:34,469 --> 00:06:32,400
and n-alkane cholesterol and cholesterol

219
00:06:36,070 --> 00:06:34,479
these molecules were selected for their

220
00:06:38,710 --> 00:06:36,080
astrobiological relevance and

221
00:06:40,150 --> 00:06:38,720
contamination potential

222
00:06:42,469 --> 00:06:40,160
we took our selected lipids and

223
00:06:44,390 --> 00:06:42,479
deposited them individually into glass

224
00:06:45,909 --> 00:06:44,400
vials and sealed them each under high

225
00:06:47,590 --> 00:06:45,919
purity nitrogen

226
00:06:49,350 --> 00:06:47,600
we then sent the lipid samples to

227
00:06:51,029 --> 00:06:49,360
undergo a radiation at stereotech

228
00:06:53,670 --> 00:06:51,039
sterilization facility

229
00:06:56,070 --> 00:06:53,680
at doses of either zero kilograms 50

230
00:06:58,150 --> 00:06:56,080
kilograms or 100 kilograms

231
00:06:59,430 --> 00:06:58,160
following a radiation we use gcms to

232
00:07:01,350 --> 00:06:59,440
analyze the lipids

233
00:07:03,670 --> 00:07:01,360
quantify breakdown and identify

234
00:07:05,270 --> 00:07:03,680
radiolytic products

235
00:07:06,870 --> 00:07:05,280
we expected that the five lipids would

236
00:07:07,589 --> 00:07:06,880
be effectively degraded following

237
00:07:09,350 --> 00:07:07,599
treatment

238
00:07:11,350 --> 00:07:09,360

but we actually observed no substantial

239
00:07:13,189 --> 00:07:11,360
reduction in the standards

240
00:07:14,870 --> 00:07:13,199
this graph illustrates the abundance of

241
00:07:16,150 --> 00:07:14,880
each lipid relative to starting

242
00:07:19,029 --> 00:07:16,160
concentration

243
00:07:20,390 --> 00:07:19,039
after 500 kilograms and 100 kilograms of

244
00:07:21,909 --> 00:07:20,400
radiation

245
00:07:24,150 --> 00:07:21,919
you can see that the concentration is

246
00:07:25,029 --> 00:07:24,160
close to 100 for all five of the lipids

247
00:07:26,950 --> 00:07:25,039
at each dose

248
00:07:28,710 --> 00:07:26,960
which indicates that no significant

249
00:07:31,110 --> 00:07:28,720
degradation occurred

250
00:07:32,710 --> 00:07:31,120
the pink line representing palmitic acid

251
00:07:33,589 --> 00:07:32,720
shows that lipid abundance for this

252
00:07:36,230 --> 00:07:33,599
compound

253
00:07:38,150 --> 00:07:36,240
decreased to approximately 79 following

254
00:07:39,909 --> 00:07:38,160
100 kilograms of irradiation

255
00:07:41,990 --> 00:07:39,919
but no corresponding reduction was

256
00:07:44,710 --> 00:07:42,000
observed for the palmitic acid samples

257
00:07:46,629 --> 00:07:44,720
that were irradiated at 50 kilograms

258
00:07:47,830 --> 00:07:46,639
likewise the green line representing

259
00:07:49,670 --> 00:07:47,840
cholesterol

260
00:07:52,790 --> 00:07:49,680
shows that the abundance for this

261
00:07:55,110 --> 00:07:52,800
compound decreased to approximately 84

262
00:07:56,790 --> 00:07:55,120
following a radiation at 50 kilograms

263
00:07:58,710 --> 00:07:56,800

but no corresponding reduction

264
00:08:01,110 --> 00:07:58,720
was observed for the cholesterol samples

265
00:08:02,710 --> 00:08:01,120
that were radiated at 100 kilograms

266
00:08:04,150 --> 00:08:02,720
so we conclude that none of our five

267
00:08:07,189 --> 00:08:04,160
standards are consistently or

268
00:08:09,430 --> 00:08:07,199
substantially degraded

269
00:08:11,589 --> 00:08:09,440
however while we observe no substantial

270
00:08:13,350 --> 00:08:11,599
reduction in overall lipid abundance

271
00:08:15,350 --> 00:08:13,360
numerous minor breakdown products were

272
00:08:17,350 --> 00:08:15,360
identified in the irradiated samples

273
00:08:18,469 --> 00:08:17,360
so some degradation or transformation is

274
00:08:20,309 --> 00:08:18,479
occurring

275
00:08:22,710 --> 00:08:20,319
radiolytic products include shorter or

276
00:08:24,469 --> 00:08:22,720
smaller molecules and recombinants

277
00:08:26,230 --> 00:08:24,479
in these two example chromatograms from

278
00:08:28,070 --> 00:08:26,240
the saturated and unsaturated fatty

279
00:08:29,270 --> 00:08:28,080
acids that were radiated at 100

280
00:08:31,189 --> 00:08:29,280
kilograms each

281
00:08:33,110 --> 00:08:31,199
we identified a homologous series of

282
00:08:34,550 --> 00:08:33,120
fatty acids and hydrocarbons

283
00:08:36,790 --> 00:08:34,560
of every chain length shorter than the

284
00:08:38,110 --> 00:08:36,800
parent compound these represent

285
00:08:39,269 --> 00:08:38,120
breakdown products that were either

286
00:08:40,709 --> 00:08:39,279
decarboxylated

287
00:08:42,310 --> 00:08:40,719
or cleaved at various points in the

288
00:08:44,470 --> 00:08:42,320

hydrocarbon tail

289
00:08:45,990 --> 00:08:44,480
we also identified recombinants which

290
00:08:47,110 --> 00:08:46,000
include some of the molecules

291
00:08:49,190 --> 00:08:47,120
illustrated here

292
00:08:50,630 --> 00:08:49,200
like the unsaturated fatty acid with one

293
00:08:52,150 --> 00:08:50,640
double bond that was formed after the

294
00:08:54,710 --> 00:08:52,160
saturated fatty acid

295
00:08:56,790 --> 00:08:54,720
with no double bonds was irradiated we

296
00:08:57,829 --> 00:08:56,800
also see short dicarboxylic acids and

297
00:08:59,509 --> 00:08:57,839
oxoaccidents

298
00:09:01,030 --> 00:08:59,519
which could represent fragments of two

299
00:09:02,470 --> 00:09:01,040
fatty acids that were cleaved and then

300
00:09:04,550 --> 00:09:02,480
combined together

301
00:09:06,150 --> 00:09:04,560
we also observe a pheron which appears

302
00:09:09,990 --> 00:09:06,160
to have formed via cyclization of the

303
00:09:12,070 --> 00:09:10,000
hydrocarbon tail around the carboxyland

304
00:09:14,389 --> 00:09:12,080
so what does this mean according to our

305
00:09:16,230 --> 00:09:14,399
results the 50 and 100 kilogram doses

306
00:09:18,070 --> 00:09:16,240
applied to the five lipid standards

307
00:09:19,750 --> 00:09:18,080
did not sufficiently destroy or remove

308
00:09:20,630 --> 00:09:19,760
the molecules under our experimental

309
00:09:22,949 --> 00:09:20,640
perimeters

310
00:09:24,630 --> 00:09:22,959
but some breakdown is apparent much

311
00:09:25,750 --> 00:09:24,640
higher doses could potentially be more

312
00:09:26,630 --> 00:09:25,760
effective at destroying lipid

313
00:09:28,470 --> 00:09:26,640

contaminants

314
00:09:30,070 --> 00:09:28,480
but those doses could also damage or

315
00:09:31,670 --> 00:09:30,080
degrade instrument hardware

316
00:09:32,949 --> 00:09:31,680
so we don't recommend using electron

317
00:09:35,190 --> 00:09:32,959
beam radiation as a lipid

318
00:09:36,790 --> 00:09:35,200
decontamination technique for excalibur

319
00:09:39,110 --> 00:09:36,800
or other lipid-based life detection

320
00:09:40,550 --> 00:09:39,120
instruments however the resilience of

321
00:09:42,070 --> 00:09:40,560
the lipids could suggest that these

322
00:09:43,829 --> 00:09:42,080
organics are a bit more resistant to

323
00:09:45,670 --> 00:09:43,839
radiation-induced degradation than we

324
00:09:47,430 --> 00:09:45,680
had initially expected

325
00:09:49,110 --> 00:09:47,440
this is astrobiologically relevant

326
00:09:49,990 --> 00:09:49,120
because understanding lipid degradation

327
00:09:52,070 --> 00:09:50,000
rates in planetary

328
00:09:53,269 --> 00:09:52,080
environments where surface radiation is

329
00:09:55,269 --> 00:09:53,279
higher than on earth

330
00:09:56,790 --> 00:09:55,279
is key for informing where and how deep

331
00:09:58,550 --> 00:09:56,800
to dig when searching for minimally

332
00:10:00,070 --> 00:09:58,560
altered lipids

333
00:10:02,310 --> 00:10:00,080
the results are especially relevant to

334
00:10:03,990 --> 00:10:02,320
europa a body that experiences high

335
00:10:06,550 --> 00:10:04,000
levels of electron radiation

336
00:10:07,910 --> 00:10:06,560
sourced from jupiter's magnetosphere to

337
00:10:10,069 --> 00:10:07,920
follow up on this research we're

338
00:10:11,509 --> 00:10:10,079

focusing on two sets of tasks

339
00:10:12,949 --> 00:10:11,519
first we're continuing to look for

340
00:10:14,550 --> 00:10:12,959
cleaning methods that can sufficiently

341
00:10:16,870 --> 00:10:14,560
remove lipid molecules

342
00:10:17,990 --> 00:10:16,880
without damaging excalibur hardware

343
00:10:20,870 --> 00:10:18,000
these include thermal

344
00:10:22,550 --> 00:10:20,880
chemical and laser-based methods second

345
00:10:24,470 --> 00:10:22,560
we hope to further explore the effects

346
00:10:26,069 --> 00:10:24,480
of radiation on lipid lifetimes

347
00:10:28,230 --> 00:10:26,079
in support of future life detection

348
00:10:29,990 --> 00:10:28,240
missions to mars and europa

349
00:10:32,069 --> 00:10:30,000
these analyses will include experiments

350
00:10:34,310 --> 00:10:32,079
that apply geologically relevant

351
00:10:36,389 --> 00:10:34,320
doses and types of radiation to analog

352
00:10:38,150 --> 00:10:36,399
samples made up of simulated martian

353
00:10:40,150 --> 00:10:38,160
regolith or european ice

354
00:10:41,910 --> 00:10:40,160
spiked with lipids so that lifetimes can

355
00:10:43,910 --> 00:10:41,920
be quantified and breakdown products

356
00:10:45,750 --> 00:10:43,920
predicted

357
00:10:47,590 --> 00:10:45,760
so finally i'd like to thank nasa ames

358
00:10:49,829 --> 00:10:47,600
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359
00:10:51,750 --> 00:10:49,839
with the center innovation funds grant

360
00:10:53,910 --> 00:10:51,760
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361
00:10:55,750 --> 00:10:53,920
for supporting me during my research

362
00:10:57,030 --> 00:10:55,760
the north dakota space grant consortium

363
00:10:58,310 --> 00:10:57,040

for providing you with research

364
00:10:59,910 --> 00:10:58,320
fellowship

365
00:11:01,190 --> 00:10:59,920
and the university of north dakota's

366
00:11:03,350 --> 00:11:01,200
department of space studies for

367
00:11:05,190 --> 00:11:03,360
facilitating my work

368
00:11:06,470 --> 00:11:05,200
so thanks again everybody for listening

369
00:11:08,230 --> 00:11:06,480
to my talk