
AbSciCon
2019

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

2
00:00:12,810 --> 00:00:09,110
[Applause]

3
00:00:14,190 --> 00:00:12,820
hey everyone um i said i'm annaliese

4
00:00:16,890 --> 00:00:14,200
Meyer and from the University of

5
00:00:18,210 --> 00:00:16,900
Victoria just up the coast in BC thanks

6
00:00:20,760 --> 00:00:18,220
that can be news for a great session so

7
00:00:22,050 --> 00:00:20,770
far today I'll be discussing rare earth

8
00:00:24,419 --> 00:00:22,060
element distributions in the Allegra

9
00:00:25,859 --> 00:00:24,429
trophic gyre of the Sargasso Sea so

10
00:00:27,630 --> 00:00:25,869
that's the subtropical North Atlantic

11
00:00:29,759 --> 00:00:27,640
and their influence on aerobic bacteria

12
00:00:32,130 --> 00:00:29,769
Lilith Anna trophy we developed this

13
00:00:33,720 --> 00:00:32,140

project over the past a year as a

14
00:00:35,069 --> 00:00:33,730
collaboration between university of

15
00:00:37,080 --> 00:00:35,079
victoria and the bermuda institute of

16
00:00:40,110 --> 00:00:37,090
ocean science which yes is a great place

17
00:00:42,450 --> 00:00:40,120
to do fieldwork so over the past couple

18
00:00:43,979 --> 00:00:42,460
of field seasons thank you we've been

19
00:00:45,389 --> 00:00:43,989
looking at the vertical distribution of

20
00:00:47,069 --> 00:00:45,399
rare elements throughout the entire

21
00:00:50,580 --> 00:00:47,079
water column at the bermuda Atlantic

22
00:00:52,619 --> 00:00:50,590
time study series station or bats which

23
00:00:54,630 --> 00:00:52,629
is about 4.5 kilometers water depth

24
00:00:56,430 --> 00:00:54,640
we've also been looking at the dissolved

25
00:00:59,250 --> 00:00:56,440
methane profiles dissolved nitrous oxide

26
00:01:00,810 --> 00:00:59,260
profiles and begun to assess the genetic

27
00:01:04,530 --> 00:01:00,820
and metabolic properties of marine

28
00:01:07,170 --> 00:01:04,540
methyl it rose and MANET rose now

29
00:01:10,320 --> 00:01:07,180
hopping over to land this is solfatara

30
00:01:12,060 --> 00:01:10,330
and Italy it's a geothermal normal site

31
00:01:14,460 --> 00:01:12,070
where a methyl is that a film Hugh Mario

32
00:01:15,719 --> 00:01:14,470
lick'em Sol V was first discovered and

33
00:01:18,210 --> 00:01:15,729
the interesting thing about this

34
00:01:20,280 --> 00:01:18,220
organism is that it required direct mud

35
00:01:22,289 --> 00:01:20,290
pot water from this region of Italy to

36
00:01:24,359 --> 00:01:22,299
allow its growth and there was some

37
00:01:25,530 --> 00:01:24,369
confusion about why exactly this was and

38
00:01:27,630 --> 00:01:25,540

it eventually was narrowed down to the

39
00:01:29,639 --> 00:01:27,640
presence of lanthanides in the water and

40
00:01:32,340 --> 00:01:29,649
that this marked this organism

41
00:01:34,469 --> 00:01:32,350
discovered by pol 8l as the first

42
00:01:38,880 --> 00:01:34,479
organism to acquire rare earth elements

43
00:01:41,670 --> 00:01:38,890
for life so they managed to grow this

44
00:01:44,039 --> 00:01:41,680
continuous bill my god continuously in

45
00:01:46,560 --> 00:01:44,049
culture using lanthanide supplemented

46
00:01:48,510 --> 00:01:46,570
tap water if I added tap water to my

47
00:01:52,080 --> 00:01:48,520
cultures I'd probably be fired but you

48
00:01:55,740 --> 00:01:52,090
know there you have it so this was only

49
00:01:57,149 --> 00:01:55,750
found at 2007 and before 1985 there

50
00:01:58,950 --> 00:01:57,159
wasn't any sort of speculation that

51
00:02:01,859 --> 00:01:58,960
biogeochemical cycling of rare earth

52
00:02:03,779 --> 00:02:01,869
elements and might exist whatsoever in

53
00:02:05,609 --> 00:02:03,789
1985 debarred I'll propose that maybe

54
00:02:07,109 --> 00:02:05,619
there was passive scavenging of rare

55
00:02:09,150 --> 00:02:07,119
earth elements onto biological particles

56
00:02:10,590 --> 00:02:09,160
in the water column but any sort of

57
00:02:14,430 --> 00:02:10,600
active metabolic role for these

58
00:02:15,960 --> 00:02:14,440
organisms wasn't even in the picture so

59
00:02:18,960 --> 00:02:15,970
I'll run quickly through the biochemical

60
00:02:20,339 --> 00:02:18,970
basis for rare earth element requirement

61
00:02:20,850 --> 00:02:20,349
from matheno trophy before getting into

62
00:02:22,620 --> 00:02:20,860
the results

63
00:02:26,040 --> 00:02:22,630

implications of this research for

64
00:02:28,520 --> 00:02:26,050
astrobiology some Spanish groups oxidize

65
00:02:31,530 --> 00:02:28,530
methane through a multi-step pathway and

66
00:02:33,990 --> 00:02:31,540
the either assimilated into biomass or

67
00:02:35,670 --> 00:02:34,000
dissimulate it into co2 through a couple

68
00:02:38,130 --> 00:02:35,680
different pathways that distinguish the

69
00:02:39,570 --> 00:02:38,140
types of meth addict rows each oxidation

70
00:02:41,460 --> 00:02:39,580
step produces Quinn tones and electron

71
00:02:44,220 --> 00:02:41,470
carriers to provide reducing power for

72
00:02:45,120 --> 00:02:44,230
ATP generation so this is a multi-step

73
00:02:47,960 --> 00:02:45,130
pathway but I'm just going to be

74
00:02:50,190 --> 00:02:47,970
focusing on methanol dehydrogenase today

75
00:02:52,440 --> 00:02:50,200
so this protein is the x-ray

76
00:02:54,630 --> 00:02:52,450
crystallography structure of one subunit

77
00:02:57,090 --> 00:02:54,640
of the Holmwood I'm Eric XO xf methanol

78
00:02:59,960 --> 00:02:57,100
dehydrogenase isoform from the

79
00:03:02,699 --> 00:02:59,970
previously mentioned med pot organism as

80
00:03:05,910 --> 00:03:02,709
you can see this version uses a pqq

81
00:03:09,270 --> 00:03:05,920
cofactor and a cerium ion in its active

82
00:03:10,530 --> 00:03:09,280
site other method i trophic species have

83
00:03:12,300 --> 00:03:10,540
been noted to use other rare earth

84
00:03:14,130 --> 00:03:12,310
elements but what I particularly want

85
00:03:16,050 --> 00:03:14,140
you to note here is that it's only the

86
00:03:18,300 --> 00:03:16,060
light rare earth elements so cerium

87
00:03:23,160 --> 00:03:18,310
lanthanum occasionally europium that

88
00:03:28,170 --> 00:03:23,170

have ever been observed so there is some

89
00:03:30,150 --> 00:03:28,180
confusion as to why this is and - and -

90
00:03:32,250 --> 00:03:30,160
why these rare earth elements are at all

91
00:03:34,710 --> 00:03:32,260
incorporated into these organisms before

92
00:03:38,039 --> 00:03:34,720
2007 the only eisah form of methanol

93
00:03:39,390 --> 00:03:38,049
dehydrogenase known used calcium in its

94
00:03:43,350 --> 00:03:39,400
active site which is pretty commonly

95
00:03:44,820 --> 00:03:43,360
used in metallo enzymes and is very

96
00:03:47,280 --> 00:03:44,830
abundant in both the ocean and other

97
00:03:49,979 --> 00:03:47,290
other environments it's thought that

98
00:03:51,509 --> 00:03:49,989
perhaps rare earth elements and as they

99
00:03:52,949 --> 00:03:51,519
are better loose Lewis acids than

100
00:03:54,479 --> 00:03:52,959
calcium might provide more efficient

101
00:03:56,220 --> 00:03:54,489
catalysts but it's still unclear as to

102
00:03:58,770 --> 00:03:56,230
the regulation of these two isoforms and

103
00:04:04,020 --> 00:03:58,780
in most meth ana toast both isoforms are

104
00:04:06,150 --> 00:04:04,030
found so to set the stage for a sampling

105
00:04:08,460 --> 00:04:06,160
I have to put some section plots of the

106
00:04:11,759 --> 00:04:08,470
transect between Bermuda and Puerto Rico

107
00:04:16,229 --> 00:04:11,769
from September 2018 so as you can see

108
00:04:18,509 --> 00:04:16,239
it's fairly oxic and stream lycée Lyon

109
00:04:20,520 --> 00:04:18,519
warm and extremely little dig of trophic

110
00:04:24,659 --> 00:04:20,530
and this red arrow here just indicates

111
00:04:28,770 --> 00:04:24,669
the location of bats these plots are all

112
00:04:32,580 --> 00:04:28,780
interrelated from CTD data so bottle

113
00:04:34,490 --> 00:04:32,590

data was used to calibrate these now to

114
00:04:36,590 --> 00:04:34,500
zoom in on fluorescence

115
00:04:38,330 --> 00:04:36,600
this green over here arrow here

116
00:04:40,640 --> 00:04:38,340
highlights the deep chlorophyll max and

117
00:04:43,100 --> 00:04:40,650
that's generally where we expect to find

118
00:04:44,960 --> 00:04:43,110
the most photosynthetic biomass however

119
00:04:48,200 --> 00:04:44,970
we expect to find meth Anna Torv sitting

120
00:04:49,640 --> 00:04:48,210
slightly lower around 300 meters there's

121
00:04:51,590 --> 00:04:49,650
higher nutrient concentrations there

122
00:04:53,540 --> 00:04:51,600
lower oxygen levels which is preferred

123
00:04:54,890 --> 00:04:53,550
by type 1 with Anna tros and most

124
00:04:57,020 --> 00:04:54,900
importantly it's welat of the euphotic

125
00:04:58,730 --> 00:04:57,030
zone mini-myth anna tropes are light

126
00:05:02,540 --> 00:04:58,740
inhibited so this is a pretty strict

127
00:05:04,580 --> 00:05:02,550
requirement now the location of both the

128
00:05:07,820 --> 00:05:04,590
chlorophyll Max and the Masada toph max

129
00:05:12,170 --> 00:05:07,830
will vary seasonally primarily due to

130
00:05:14,270 --> 00:05:12,180
the deep storm mixing in the winter so

131
00:05:16,850 --> 00:05:14,280
this makes a layer shown by this black

132
00:05:18,770 --> 00:05:16,860
line here drives the mixed layer much

133
00:05:21,140 --> 00:05:18,780
deeper in the winter and summer

134
00:05:23,450 --> 00:05:21,150
stratification shallows it quite

135
00:05:25,640 --> 00:05:23,460
dramatically

136
00:05:28,550 --> 00:05:25,650
so this deep winter storm mixing will

137
00:05:31,940 --> 00:05:28,560
drive the methane concentrations from

138
00:05:33,920 --> 00:05:31,950

atmospheric exchange deeper probably

139
00:05:36,680 --> 00:05:33,930
also allowing the Madonna crows to sit a

140
00:05:37,820 --> 00:05:36,690
little bit deeper deeper so now that

141
00:05:39,620 --> 00:05:37,830
we've gone over the dissolved gas

142
00:05:40,880 --> 00:05:39,630
chemistry of this area we'll dig into

143
00:05:43,250 --> 00:05:40,890
the depth of the matter which is the

144
00:05:44,900 --> 00:05:43,260
earth element distributions so all of

145
00:05:47,080 --> 00:05:44,910
our samples were collected in geo traces

146
00:05:49,190 --> 00:05:47,090
clean bottles so that's essentially a

147
00:05:50,570 --> 00:05:49,200
several month cleaning process to

148
00:05:53,510 --> 00:05:50,580
prevent any sort of trace metal

149
00:05:55,790 --> 00:05:53,520
contamination then pre concentrated on a

150
00:05:57,110 --> 00:05:55,800
chelating resin column the functional

151
00:05:58,700 --> 00:05:57,120
groups are pictured here it works

152
00:06:02,500 --> 00:05:58,710
equally well for trace metals and rare

153
00:06:04,850 --> 00:06:02,510
earth elements and analyzed with icp-ms

154
00:06:07,279 --> 00:06:04,860
so we got profiles that looked pretty

155
00:06:08,960 --> 00:06:07,289
consistently like this i've only

156
00:06:10,580 --> 00:06:08,970
highlighted the rare earth elements of

157
00:06:13,820 --> 00:06:10,590
particular interest to us in these

158
00:06:15,590 --> 00:06:13,830
profiles so that's lanthanum and cerium

159
00:06:18,230 --> 00:06:15,600
and contrasted them against a heavy

160
00:06:19,700 --> 00:06:18,240
earth element you have terbium so you

161
00:06:23,090 --> 00:06:19,710
can see that your turbine has quite a

162
00:06:24,860 --> 00:06:23,100
static profile whereas both cerium and

163
00:06:28,100 --> 00:06:24,870

lanthanum exhibit this drawdown feature

164
00:06:30,320 --> 00:06:28,110
sitting around 300 meters so cerium does

165
00:06:32,540 --> 00:06:30,330
can show continue to drop and that's due

166
00:06:34,430 --> 00:06:32,550
to its nature as a redox species so any

167
00:06:37,010 --> 00:06:34,440
sort of nutrient like effects of cerium

168
00:06:39,590 --> 00:06:37,020
are masked by this redox profile however

169
00:06:42,050 --> 00:06:39,600
lanthanum does exhibit a shockingly

170
00:06:43,850 --> 00:06:42,060
nutrient like profile especially if you

171
00:06:46,920 --> 00:06:43,860
view it from 300 meters down rather than

172
00:06:48,420 --> 00:06:46,930
from the surface as as usual

173
00:06:50,850 --> 00:06:48,430
this behavior was conserved throughout

174
00:06:52,350 --> 00:06:50,860
our entire autumn time series we did get

175
00:06:55,020 --> 00:06:52,360
an interesting mid-depth intrusion in

176
00:06:57,270 --> 00:06:55,030
lanthanum that appeared on october and

177
00:06:58,469 --> 00:06:57,280
persisted into november we're still

178
00:07:00,689 --> 00:06:58,479
looking into that with sediment wrapped

179
00:07:01,950 --> 00:07:00,699
data but it's likely a water mass

180
00:07:03,270 --> 00:07:01,960
movement in fact rather than micro

181
00:07:06,659 --> 00:07:03,280
billion mediated so we're not gonna dig

182
00:07:08,760 --> 00:07:06,669
too deeply into it today now things get

183
00:07:10,439 --> 00:07:08,770
really interesting when we normalized

184
00:07:12,390 --> 00:07:10,449
the light birth elements to a heavier

185
00:07:14,700 --> 00:07:12,400
rare earth element so in this case we've

186
00:07:16,830 --> 00:07:14,710
taken lanthanum see it cerium and

187
00:07:19,770 --> 00:07:16,840
neodymium and normalize them to the you

188
00:07:21,719 --> 00:07:19,780

terbium profile so this deep profile

189
00:07:23,219 --> 00:07:21,729
becomes a lot more static indicating

190
00:07:25,379 --> 00:07:23,229
what happens in the deep is likely

191
00:07:27,960 --> 00:07:25,389
conserved across the entire lanthanides

192
00:07:30,480 --> 00:07:27,970
sweet and not microbe alia mediated but

193
00:07:32,040 --> 00:07:30,490
that 300-meter proof drawdown feature

194
00:07:36,180 --> 00:07:32,050
that I called your attention to earlier

195
00:07:38,100 --> 00:07:36,190
becomes even more pronounced so this

196
00:07:40,560 --> 00:07:38,110
light worth element drawdown effect has

197
00:07:41,610 --> 00:07:40,570
been observed before by Alan Shiller a

198
00:07:44,490 --> 00:07:41,620
tile in the wake of the Deepwater

199
00:07:46,800 --> 00:07:44,500
Horizon blowout so these red dots here

200
00:07:50,370 --> 00:07:46,810
are from early May 2010 the blue

201
00:07:53,790 --> 00:07:50,380
triangles from late May 2010 and the

202
00:07:55,620 --> 00:07:53,800
yellow diamonds from October 2011 but a

203
00:07:59,070 --> 00:07:55,630
year and a half after the accident when

204
00:08:03,360 --> 00:07:59,080
the when the water column returned to

205
00:08:05,279 --> 00:08:03,370
normal huh so you can see that lanthanum

206
00:08:06,689 --> 00:08:05,289
is preferentially drawn down around

207
00:08:09,839 --> 00:08:06,699
1,100 meters and that's where there's

208
00:08:12,240 --> 00:08:09,849
this intrusion of natural gas Schiller a

209
00:08:13,890 --> 00:08:12,250
tile did also note that xox F methanol

210
00:08:16,710 --> 00:08:13,900
dehydrogenase was being expressed

211
00:08:19,469 --> 00:08:16,720
particularly in this area so that's the

212
00:08:22,290 --> 00:08:19,479
cerium or lanthanum bearing isoform of

213
00:08:24,210 --> 00:08:22,300

methanol hydrogenase so that's

214
00:08:29,580 --> 00:08:24,220
indicating that this methane oxidized

215
00:08:30,570 --> 00:08:29,590
oxidation is driving this drawdown so

216
00:08:33,870 --> 00:08:30,580
this drawdown bares a striking

217
00:08:36,360 --> 00:08:33,880
similarity to that drawdown feature that

218
00:08:38,430 --> 00:08:36,370
were noting in our in our rare earth

219
00:08:40,769 --> 00:08:38,440
element profiles and just note that this

220
00:08:42,990 --> 00:08:40,779
scale has changed in in these depth

221
00:08:45,630 --> 00:08:43,000
profiles so as the deepwater horizon

222
00:08:47,220 --> 00:08:45,640
drawdown around 1,100 meters was caused

223
00:08:49,260 --> 00:08:47,230
by this methane oxidation this gives us

224
00:08:50,820 --> 00:08:49,270
decent reason to believe that this

225
00:08:53,340 --> 00:08:50,830
drawdown is also caused by methane

226
00:08:56,490 --> 00:08:53,350
oxidation and the expression of this EXO

227
00:08:58,530 --> 00:08:56,500
xf gene so these are at wildly different

228
00:09:00,199 --> 00:08:58,540
depths and that reflects the control of

229
00:09:01,759 --> 00:09:00,209
methane concentration

230
00:09:04,100 --> 00:09:01,769
we're in getting those methane profiles

231
00:09:06,590 --> 00:09:04,110
ready for print so that we can actually

232
00:09:08,179 --> 00:09:06,600
correlate the rare earth element

233
00:09:11,359 --> 00:09:08,189
concentrations to the methane and the

234
00:09:12,859 --> 00:09:11,369
water column so the weight of this only

235
00:09:15,079 --> 00:09:12,869
comes when we can actually prove that

236
00:09:17,030 --> 00:09:15,089
it's methane oxidation causing this

237
00:09:19,040 --> 00:09:17,040
light rare earth element drawdown effect

238
00:09:20,960 --> 00:09:19,050

this portion of our research is still in

239
00:09:23,419 --> 00:09:20,970
our in its infancy but our preliminary

240
00:09:25,400 --> 00:09:23,429
methods for enriching communities with

241
00:09:27,679 --> 00:09:25,410
meth additives and methyl ropes have

242
00:09:30,410 --> 00:09:27,689
shown some success so far we've been

243
00:09:34,280 --> 00:09:30,420
purging cultures with methane and

244
00:09:35,720 --> 00:09:34,290
nitrogen and growing them up on solid

245
00:09:37,340 --> 00:09:35,730
supplemented seawater media under a

246
00:09:38,989 --> 00:09:37,350
methane mixed air atmosphere and that

247
00:09:41,509 --> 00:09:38,999
gave us enough growth to do some

248
00:09:42,889 --> 00:09:41,519
preliminary DNA extractions and PCR just

249
00:09:46,699 --> 00:09:42,899
to detect whether or not these genes are

250
00:09:49,879 --> 00:09:46,709
even present so we probe these methane

251
00:09:52,400 --> 00:09:49,889
cultures with primers designed to target

252
00:09:55,309 --> 00:09:52,410
the five main clades of EXO XF genes as

253
00:09:56,900 --> 00:09:55,319
defined by our date Alan 2015 and this

254
00:09:59,989 --> 00:09:56,910
gave us a decently strong signal from

255
00:10:03,410 --> 00:09:59,999
EXO xf 5 there was also smaller signals

256
00:10:04,460 --> 00:10:03,420
from EXO X F 1 & 2 but those were

257
00:10:07,129 --> 00:10:04,470
inconclusive so were gonna look a little

258
00:10:09,289 --> 00:10:07,139
further into that so this showed us that

259
00:10:11,389 --> 00:10:09,299
at the very least organisms carrying

260
00:10:13,100 --> 00:10:11,399
these EXO XF genes are present in the

261
00:10:15,319 --> 00:10:13,110
water column at where the sample was

262
00:10:18,230 --> 00:10:15,329
taken which is 300 meters whether or not

263
00:10:20,090 --> 00:10:18,240

this is being expressed in any abundance

264
00:10:21,949 --> 00:10:20,100
is still yet to be determined and we're

265
00:10:26,419 --> 00:10:21,959
looking into that but for a first step

266
00:10:27,980 --> 00:10:26,429
this was really promising so the final

267
00:10:29,600 --> 00:10:27,990
piece to discuss today's the use of this

268
00:10:32,030 --> 00:10:29,610
light worth element fractionation as a

269
00:10:33,679 --> 00:10:32,040
lasting metabolic signature so this is a

270
00:10:35,480 --> 00:10:33,689
principal component analysis for the

271
00:10:37,400 --> 00:10:35,490
molar ratios of lanthanum cerium and

272
00:10:39,819 --> 00:10:37,410
neodymium in samples of ancient

273
00:10:41,720 --> 00:10:39,829
hydrocarbon seeps from Fayette Alan 2009

274
00:10:44,179 --> 00:10:41,730
ranging in age from the middle devonian

275
00:10:47,419 --> 00:10:44,189
to the alig Essene i've also compared it

276
00:10:51,939 --> 00:10:47,429
to a variety of chongwu chondritic

277
00:10:54,049 --> 00:10:51,949
meteorites just to provide some scale

278
00:10:57,230 --> 00:10:54,059
chondritic meteorites are often used for

279
00:10:58,999 --> 00:10:57,240
rare earth element normalization instead

280
00:11:02,030 --> 00:10:59,009
of the heavier elements that we've been

281
00:11:03,919 --> 00:11:02,040
using here and as you can see these oxic

282
00:11:05,900 --> 00:11:03,929
seeps highlighted sorry these anoxic

283
00:11:07,579 --> 00:11:05,910
seeps highlighted in red which were

284
00:11:09,439 --> 00:11:07,589
inferred from a negative cerium anomaly

285
00:11:12,560 --> 00:11:09,449
as well as the presence of amina Pentel

286
00:11:14,900 --> 00:11:12,570
which is a bacterial helping polyol that

287
00:11:17,750 --> 00:11:14,910
allows for the positive identification

288
00:11:22,220 --> 00:11:17,760

of aerobic madonna trophy these anoxic

289
00:11:24,800 --> 00:11:22,230
seep seep sites do group more or less

290
00:11:27,140 --> 00:11:24,810
away from the oxic seep sites and it

291
00:11:31,160 --> 00:11:27,150
seems to have to do with the enrichment

292
00:11:34,030 --> 00:11:31,170
of lanthanum in these rocks so our

293
00:11:36,710 --> 00:11:34,040
proposed explanation for this is that

294
00:11:38,480 --> 00:11:36,720
organisms which are performing aerobic

295
00:11:40,490 --> 00:11:38,490
Madonna trophy will selectively uptake

296
00:11:42,380 --> 00:11:40,500
lanthanum from the water column to

297
00:11:45,260 --> 00:11:42,390
perform or perform this aerobic method

298
00:11:46,910 --> 00:11:45,270
oxidation and once lanthanum is bound to

299
00:11:51,050 --> 00:11:46,920
these biological particles will be more

300
00:11:52,760 --> 00:11:51,060
easily buried and solidified as these as

301
00:11:58,610 --> 00:11:52,770
these reactions are occurring at the sea

302
00:12:00,320 --> 00:11:58,620
floor so to wrap things up if these as

303
00:12:01,670 --> 00:12:00,330
these rare earth elements are so

304
00:12:05,390 --> 00:12:01,680
insoluble in water

305
00:12:09,080 --> 00:12:05,400
why has this xoxox F gene been so

306
00:12:11,360 --> 00:12:09,090
prolific and so persistent why has it

307
00:12:13,400 --> 00:12:11,370
persisted through the evolution of

308
00:12:15,380 --> 00:12:13,410
Madonna trophy and it is noted to be

309
00:12:18,410 --> 00:12:15,390
present in almost Alma Thanatos that

310
00:12:21,410 --> 00:12:18,420
have been studied in in combination with

311
00:12:23,000 --> 00:12:21,420
the normal calcium bearing isoform some

312
00:12:25,660 --> 00:12:23,010
explanations we have thought of are that

313
00:12:28,070 --> 00:12:25,670

perhaps mechana crows originated in some

314
00:12:30,380 --> 00:12:28,080
some environment in which were elements

315
00:12:32,990 --> 00:12:30,390
were more abundant like perhaps certain

316
00:12:34,910 --> 00:12:33,000
hot springs or hydrothermal vents I'm

317
00:12:38,750 --> 00:12:34,920
not going to comment on which I think it

318
00:12:41,690 --> 00:12:38,760
is because it'll get me in trouble or

319
00:12:44,120 --> 00:12:41,700
perhaps and the xof gene was simply the

320
00:12:45,620 --> 00:12:44,130
first version of this isuh form and the

321
00:12:48,830 --> 00:12:45,630
ability to use the more abundant calcium

322
00:12:50,630 --> 00:12:48,840
evolved later if you'd like to talk

323
00:12:51,770 --> 00:12:50,640
about phylogeny please find me later

324
00:12:55,280 --> 00:12:51,780
because there's some interesting

325
00:12:57,080 --> 00:12:55,290
thoughts on that however the most

326
00:12:59,360 --> 00:12:57,090
interesting part of this research from

327
00:13:01,880 --> 00:12:59,370
my perspective is not only the insight

328
00:13:04,610 --> 00:13:01,890
that these organisms can give us on the

329
00:13:06,650 --> 00:13:04,620
marine methane cycle but the idea that

330
00:13:08,660 --> 00:13:06,660
this light worth element fractionation

331
00:13:10,520 --> 00:13:08,670
might be useful as a lasting metabolic

332
00:13:12,500 --> 00:13:10,530
signature throughout geologic time and

333
00:13:14,150 --> 00:13:12,510
the insight that the rollover earth

334
00:13:17,270 --> 00:13:14,160
elements played in meth and meth Anna

335
00:13:18,830 --> 00:13:17,280
trove meth Anna trove evolution might

336
00:13:21,160 --> 00:13:18,840
give us about the origin and

337
00:13:22,570 --> 00:13:21,170
colonization of life on Earth

338
00:13:26,650 --> 00:13:22,580

and with that I'd like to thank you for

339
00:13:28,540 --> 00:13:26,660
your time and note my appreciation for

340
00:13:29,889 --> 00:13:28,550
my collaborators Jay Cullen and Damon

341
00:13:31,449 --> 00:13:29,899
Grendel as well as everyone else who's

342
00:13:33,760 --> 00:13:31,459
helped me so much on this project and

343
00:13:35,949 --> 00:13:33,770
insert' and the canadian associates of

344
00:13:51,250 --> 00:13:35,959
bios for my funding and with that I'll

345
00:13:53,980 --> 00:13:51,260
take any questions have you started to

346
00:13:55,660 --> 00:13:53,990
do competition studies with these to see

347
00:13:57,850 --> 00:13:55,670
if there's any like preference do they

348
00:14:01,360 --> 00:13:57,860
always go for the calcium isoform if

349
00:14:05,470 --> 00:14:01,370
you've introduced both so it I just was

350
00:14:07,090 --> 00:14:05,480
wondering if you had you know any kind

351
00:14:10,570 --> 00:14:07,100
of direct competition where you could

352
00:14:14,050 --> 00:14:10,580
give ample metal availability to see if

353
00:14:15,670 --> 00:14:14,060
there's a preference biologically yeah

354
00:14:17,820 --> 00:14:15,680
so that's um that's in the works we

355
00:14:20,769 --> 00:14:17,830
haven't yet started that as we've just

356
00:14:23,170 --> 00:14:20,779
my last week in the lab was when we

357
00:14:25,810 --> 00:14:23,180
managed to get these actually growing

358
00:14:28,569 --> 00:14:25,820
properly we're going to be looking at

359
00:14:31,210 --> 00:14:28,579
particularly rate with these - with the

360
00:14:34,199 --> 00:14:31,220
expression of each enzyme so we're doing

361
00:14:36,730 --> 00:14:34,209
some heavy isotope analysis with

362
00:14:41,170 --> 00:14:36,740
provided methane and hopefully that'll

363
00:14:43,449 --> 00:14:41,180

give some idea of which is which is the

364
00:14:47,110 --> 00:14:43,459
preference and which enzyme is actually

365
00:14:48,940 --> 00:14:47,120
more efficient my intuition would lead

366
00:14:52,350 --> 00:14:48,950
to the rare earth element very isoform

367
00:14:54,430 --> 00:14:52,360
being more efficient given its

368
00:14:56,800 --> 00:14:54,440
characteristic has a stronger lewis acid

369
00:14:57,790 --> 00:14:56,810
but we'll see so we had one more

370
00:15:06,090 --> 00:14:57,800
question here the one in the back and

371
00:15:12,340 --> 00:15:09,190
thank you nice talk Annalise sounds

372
00:15:15,760 --> 00:15:12,350
great so there's been some work showing

373
00:15:18,550 --> 00:15:15,770
that certain groups of microbes will

374
00:15:21,040 --> 00:15:18,560
actually take up to lyrium but it's

375
00:15:22,570 --> 00:15:21,050
unclear kind of what its fate is so that

376
00:15:24,310 --> 00:15:22,580
I guess the first question is you've

377
00:15:26,290 --> 00:15:24,320
shown us some data on some of the some

378
00:15:28,090 --> 00:15:26,300
of the lanthanides have you been able to

379
00:15:30,610 --> 00:15:28,100
extend it and look at some of the other

380
00:15:33,280 --> 00:15:30,620
lanthanides or is that on your radar

381
00:15:34,930 --> 00:15:33,290
yes we've we've analyzed for the suite

382
00:15:37,000 --> 00:15:34,940
of sixteen lanthanides and chemically

383
00:15:39,120 --> 00:15:37,010
similar elements these were the ones

384
00:15:42,250 --> 00:15:39,130
that showed the most dramatic

385
00:15:44,710 --> 00:15:42,260
differences the heavier elements beyond

386
00:15:46,060 --> 00:15:44,720
europium really show more of the profile

387
00:15:47,410 --> 00:15:46,070
that I showed like you terbium that's

388
00:15:49,780 --> 00:15:47,420

pretty static throughout the water

389
00:15:52,060 --> 00:15:49,790
column and all of the structural

390
00:15:55,270 --> 00:15:52,070
analysis that's been done on xox F genes

391
00:15:57,370 --> 00:15:55,280
that's our XF proteins have shown only

392
00:15:59,670 --> 00:15:57,380
lanthanum and cerium occasionally

393
00:16:03,010 --> 00:15:59,680
neodymium being used and one analysis

394
00:16:07,410 --> 00:16:03,020
artificially used europium and got a

395
00:16:09,940 --> 00:16:07,420
slightly lower rate but it did still

396
00:16:12,070 --> 00:16:09,950
catalyze but they have everyone's don't

397
00:16:15,150 --> 00:16:12,080
seem to use understood thank you thank

398
00:16:23,100 --> 00:16:21,000
I wanted to ask a question about how we

399
00:16:25,440 --> 00:16:23,110
think about the preservation of these

400
00:16:29,250 --> 00:16:25,450
genes that in the local environment seem

401
00:16:31,080 --> 00:16:29,260
to be strange and whether or not this

402
00:16:34,530 --> 00:16:31,090
should be providing us information about

403
00:16:36,300 --> 00:16:34,540
the sort of global suite of

404
00:16:38,250 --> 00:16:36,310
circumstances that organisms may be

405
00:16:40,230 --> 00:16:38,260
reflecting if we think about vent

406
00:16:42,540 --> 00:16:40,240
organisms we find that for instance mat

407
00:16:43,830 --> 00:16:42,550
formers and endosymbionts advents all

408
00:16:45,450 --> 00:16:43,840
around the world are more closely

409
00:16:48,270 --> 00:16:45,460
related to each other than they are to

410
00:16:50,070 --> 00:16:48,280
anything somewhere else and so I wonder

411
00:16:54,150 --> 00:16:50,080
if something slow like the complete

412
00:16:56,460 --> 00:16:54,160
abandonment of a gene might occur on

413
00:16:58,410 --> 00:16:56,470

time scale so much slower than organism

414
00:17:00,630 --> 00:16:58,420
sample environments all over the world

415
00:17:02,820 --> 00:17:00,640
that what we're seeing is an averaging

416
00:17:05,340 --> 00:17:02,830
over ecosystems of many different types

417
00:17:08,370 --> 00:17:05,350
even when we sample things that seem to

418
00:17:09,900 --> 00:17:08,380
be locally adapted is is that reasonable

419
00:17:13,040 --> 00:17:09,910
given what you know about these systems

420
00:17:16,140 --> 00:17:13,050
I would say that's a very good thought

421
00:17:19,439 --> 00:17:16,150
based on some very preliminary sequence

422
00:17:25,020 --> 00:17:19,449
analysis of these genes it does seem

423
00:17:28,890 --> 00:17:25,030
like they are being preserved fairly

424
00:17:30,870 --> 00:17:28,900
well there had there's been between xsf

425
00:17:33,180 --> 00:17:30,880
genes from many different environments

426
00:17:35,280 --> 00:17:33,190
the sequence similarity is quite

427
00:17:38,270 --> 00:17:35,290
shocking there's more sequence

428
00:17:41,390 --> 00:17:38,280
similarity between X Y X F genes of

429
00:17:46,500 --> 00:17:41,400
diverse organisms than there is between

430
00:17:48,870 --> 00:17:46,510
the very conserved MX a or calcium

431
00:17:53,580 --> 00:17:48,880
bearing isoform of the same organism so

432
00:17:56,970 --> 00:17:53,590
for context those two genes are over 15%

433
00:17:59,430 --> 00:17:56,980
sorry over 50% identical at the amino

434
00:18:01,980 --> 00:17:59,440
acid level and at the active site level

435
00:18:04,860 --> 00:18:01,990
there's only one amino acid different

436
00:18:06,630 --> 00:18:04,870
between calcium and whichever like where

437
00:18:10,590 --> 00:18:06,640
earth element is being used however

438
00:18:13,610 --> 00:18:10,600

between XO s F bearing isoforms that

439
00:18:16,020 --> 00:18:13,620
sequence identity jumps up to 80 percent

440
00:18:17,790 --> 00:18:16,030
so I would I would say at the moment

441
00:18:19,790 --> 00:18:17,800
it's hard to say whether or not we're

442
00:18:22,590 --> 00:18:19,800
getting a slow fading out of these genes

443
00:18:24,510 --> 00:18:22,600
versus some sort of other reason to

444
00:18:27,289 --> 00:18:24,520
maintain them but it's definitely