



AbGradCon 2018

1
00:00:00,260 --> 00:00:10,900

[Music]

2
00:00:16,820 --> 00:00:14,510

hi there so my name is Chloe Stanton I

3
00:00:20,029 --> 00:00:16,830

just finished my first year of grad

4
00:00:21,739 --> 00:00:20,039

school at Penn State University but

5
00:00:23,749 --> 00:00:21,749

today I'm going to talk about a project

6
00:00:26,239 --> 00:00:23,759

that I did here at Georgia Tech with Dan

7
00:00:30,169 --> 00:00:26,249

glass there's an undergrad I actually

8
00:00:32,060 --> 00:00:30,179

just finished this project and we

9
00:00:33,890 --> 00:00:32,070

literally just got the reviews back from

10
00:00:35,990 --> 00:00:33,900

the authors like yesterday and I'm not

11
00:00:39,410 --> 00:00:36,000

even that upset so I'm kind of like in a

12
00:00:40,819 --> 00:00:39,420

good mood right now I'm sorry I know a

13
00:00:45,049 --> 00:00:40,829

lot of you guys have heard the spiel

14

00:00:47,750 --> 00:00:45,059

already many times before but you're

15

00:00:50,240 --> 00:00:47,760

right here again so I'd like to set the

16

00:00:54,049 --> 00:00:50,250

stage first by talking about luminosity

17

00:00:56,000 --> 00:00:54,059

and early Earth and how we perceive

18

00:00:59,060 --> 00:00:56,010

climate to have changed throughout

19

00:01:00,680 --> 00:00:59,070

Earth's history so early Earth

20

00:01:02,509 --> 00:01:00,690

experience what we called the faint

21

00:01:06,020 --> 00:01:02,519

young Sun paradox and that is because

22

00:01:08,360 --> 00:01:06,030

luminosity was much dimmer in early

23

00:01:12,260 --> 00:01:08,370

Earth history so if I have the timeline

24

00:01:14,510 --> 00:01:12,270

here on the x-axis well that begs axis

25

00:01:17,240 --> 00:01:14,520

is the timeline of Earth's history and

26
00:01:19,190 --> 00:01:17,250
on these Y axes I have temperature and

27
00:01:21,440 --> 00:01:19,200
solar luminosity

28
00:01:22,760 --> 00:01:21,450
this changes throughout time in a way

29
00:01:25,700 --> 00:01:22,770
that we can proceed with these

30
00:01:27,800 --> 00:01:25,710
relationships here so the bold line here

31
00:01:30,319 --> 00:01:27,810
is just luminosity increasing through

32
00:01:32,660 --> 00:01:30,329
time and this translates to temperature

33
00:01:34,130 --> 00:01:32,670
also increasing through time the bottom

34
00:01:35,780 --> 00:01:34,140
line here is the effective temperature

35
00:01:37,580 --> 00:01:35,790
of the earth and how it would increase

36
00:01:40,850 --> 00:01:37,590
if there was no greenhouse effect on

37
00:01:42,950 --> 00:01:40,860
earth CS represents the line with a

38
00:01:44,480 --> 00:01:42,960

modern greenhouse atmosphere what

39

00:01:47,780 --> 00:01:44,490

temperature we would expect throughout

40

00:01:50,300 --> 00:01:47,790

Earth's history now we have a problem

41

00:01:52,609 --> 00:01:50,310

because early life evolved during the

42

00:01:57,319 --> 00:01:52,619

Archean at some point I'm not gonna say

43

00:01:59,690 --> 00:01:57,329

a number and the problem that we see

44

00:02:01,700 --> 00:01:59,700

here is even with a modern greenhouse we

45

00:02:04,279 --> 00:02:01,710

weren't reaching the point of liquid

46

00:02:06,770 --> 00:02:04,289

water due to low luminosity on

47

00:02:09,650 --> 00:02:06,780

earth so we have a paradox here and

48

00:02:11,690 --> 00:02:09,660

there's been some proposed solutions to

49

00:02:14,150 --> 00:02:11,700

this paradox namely greenhouse

50

00:02:17,000 --> 00:02:14,160

atmospheres first proposed was carbon

51
00:02:17,780 --> 00:02:17,010
dioxide and then methane but today I'd

52
00:02:19,729 --> 00:02:17,790
like to spend the time

53
00:02:23,509 --> 00:02:19,739
I'm talking about nitrous oxide as a

54
00:02:25,610 --> 00:02:23,519
potential mediator for this effect so in

55
00:02:27,289 --> 00:02:25,620
order to talk about nitrous oxide I'd

56
00:02:28,880 --> 00:02:27,299
like to focus specifically on the

57
00:02:32,360 --> 00:02:28,890
Proterozoic because it has a very

58
00:02:34,099 --> 00:02:32,370
interesting redox environment again the

59
00:02:36,259 --> 00:02:34,109
timeline of Earth history but now these

60
00:02:38,960 --> 00:02:36,269
while keys are related to the oxygen

61
00:02:41,539 --> 00:02:38,970
content of Earth's atmosphere the

62
00:02:43,580 --> 00:02:41,549
Proterozoic is boxed off here and oxygen

63
00:02:45,289 --> 00:02:43,590

is shown to be increased at least to

64

00:02:46,009 --> 00:02:45,299

some degree during this period in Earth

65

00:02:50,750 --> 00:02:46,019

history

66

00:02:52,699 --> 00:02:50,760

however the oceans were hypothesized to

67

00:02:55,460 --> 00:02:52,709

remain relatively anoxic sand and thus

68

00:02:58,190 --> 00:02:55,470

were very iron rich prior to this

69

00:03:02,330 --> 00:02:58,200

neoproterozoic an option that we heard

70

00:03:03,589 --> 00:03:02,340

about earlier today so this is important

71

00:03:06,319 --> 00:03:03,599

for one particular reason

72

00:03:09,140 --> 00:03:06,329

nitrous oxide photo dissociates a very

73

00:03:11,449 --> 00:03:09,150

low oxygen content because there is no

74

00:03:13,789 --> 00:03:11,459

ozone shield to protect nitrous oxide

75

00:03:15,920 --> 00:03:13,799

from catalysis so when we're talking

76

00:03:17,330 --> 00:03:15,930

about nitrous oxide and early Earth it's

77

00:03:19,009 --> 00:03:17,340

important that we have some kind of

78

00:03:22,819 --> 00:03:19,019

oxygen protection to protect some

79

00:03:24,920 --> 00:03:22,829

nitrous oxide from breaking apart so we

80

00:03:28,250 --> 00:03:24,930

proposed a new model for the Proterozoic

81

00:03:34,369 --> 00:03:28,260

nitrogen cycle and we have a background

82

00:03:37,099 --> 00:03:34,379

here of 0.12 0.001 to 0.1 p al oxygen

83

00:03:39,140 --> 00:03:37,109

and atmosphere we have micromolar to low

84

00:03:42,289 --> 00:03:39,150

millimolar iron in the oceans and these

85

00:03:45,469 --> 00:03:42,299

are just drawn from the literature in

86

00:03:48,319 --> 00:03:45,479

this regime i have also an axis for the

87

00:03:52,879 --> 00:03:48,329

nitrogen oxygen state oxidation state

88

00:03:55,309 --> 00:03:52,889

for these species again this is just the

89

00:03:58,399 --> 00:03:55,319

Potala sis here in the atmosphere that

90

00:04:00,199 --> 00:03:58,409

you can have at low oxygen first nitrous

91

00:04:02,979 --> 00:04:00,209

oxide will be broken down to nitrogen

92

00:04:06,110 --> 00:04:02,989

gas however

93

00:04:08,300 --> 00:04:06,120

abus koukin during the time at

94

00:04:10,550 --> 00:04:08,310

University of Washington hypothesized

95

00:04:12,740 --> 00:04:10,560

that NIST had evolved by this time in

96

00:04:14,330 --> 00:04:12,750

Earth's history so nitrogen fixation

97

00:04:18,499 --> 00:04:14,340

could have been important during this

98

00:04:20,689 --> 00:04:18,509

time also others have proposed that the

99

00:04:22,370 --> 00:04:20,699

Arabic nitrogen cycle had also been

100

00:04:24,680 --> 00:04:22,380

kicking to some degree during this time

101
00:04:26,600 --> 00:04:24,690
nurses 3 as well producing a bunch of

102
00:04:30,320 --> 00:04:26,610
different bioavailable intermediates

103
00:04:31,460 --> 00:04:30,330
for the nitrogen cycle these species all

104
00:04:33,890 --> 00:04:31,470
could have translated

105
00:04:37,310 --> 00:04:33,900
through circulation into anoxic waters

106
00:04:38,990 --> 00:04:37,320
that covered most of Earth's ocean and

107
00:04:42,140 --> 00:04:39,000
these could have been removed back to

108
00:04:43,840 --> 00:04:42,150
nitrogen gas through an amok or through

109
00:04:46,150 --> 00:04:43,850
a more familiar denitrification

110
00:04:48,140 --> 00:04:46,160
involving several different ear media's

111
00:04:50,360 --> 00:04:48,150
now an interesting feature of

112
00:04:53,030 --> 00:04:50,370
denitrification during the Proterozoic

113
00:04:54,650 --> 00:04:53,040

is that we had low copper concentrations

114

00:04:56,870 --> 00:04:54,660

in the Proterozoic ocean

115

00:04:59,810 --> 00:04:56,880

which may have limited this last step in

116

00:05:03,680 --> 00:04:59,820

denitrification inhibiting conversion of

117

00:05:05,690 --> 00:05:03,690

nitrous oxide to nitrogen gas I'd like

118

00:05:07,730 --> 00:05:05,700

to focus on this top though specifically

119

00:05:10,610 --> 00:05:07,740

for an abiotic form of denitrification

120

00:05:13,310 --> 00:05:10,620

called femur denitrification this is a

121

00:05:15,320 --> 00:05:13,320

subsequent translation of these nitrogen

122

00:05:18,200 --> 00:05:15,330

intermediates back to nitrous oxide gas

123

00:05:20,780 --> 00:05:18,210

using different metals today I'd like to

124

00:05:26,750 --> 00:05:20,790

focus just on iron though and just on

125

00:05:28,190 --> 00:05:26,760

this last step so for this project I set

126

00:05:30,230 --> 00:05:28,200

out to document the rate of this

127

00:05:32,090 --> 00:05:30,240

reaction shown here shown to be

128

00:05:35,270 --> 00:05:32,100

thermodynamically favorable and modern

129

00:05:38,240 --> 00:05:35,280

conditions and I set out to determine

130

00:05:40,130 --> 00:05:38,250

the exact variables involved in the rate

131

00:05:42,230 --> 00:05:40,140

law of documenting nitrous oxide

132

00:05:45,890 --> 00:05:42,240

production as a function of each

133

00:05:47,840 --> 00:05:45,900

variable in this equation here the way I

134

00:05:51,020 --> 00:05:47,850

did this was I set out with an anoxic

135

00:05:53,420 --> 00:05:51,030

chamber incubated sterile anoxic

136

00:05:55,400 --> 00:05:53,430

seawater with variable amounts of iron -

137

00:05:57,440 --> 00:05:55,410

and synthetic nitric oxide

138

00:05:59,330 --> 00:05:57,450

I removed the headspace from these

139

00:06:01,730 --> 00:05:59,340

bottles regularly and measured the

140

00:06:06,140 --> 00:06:01,740

nitrous oxide produced over time using

141

00:06:08,270 --> 00:06:06,150

gas chromatography some of the data from

142

00:06:11,090 --> 00:06:08,280

these experiments is shown here so a

143

00:06:13,430 --> 00:06:11,100

single substrate you only see very

144

00:06:16,510 --> 00:06:13,440

little very minimal nitrous oxide on the

145

00:06:18,980 --> 00:06:16,520

y-axis produced over time on the x-axis

146

00:06:21,710 --> 00:06:18,990

however if we start increasing the

147

00:06:24,080 --> 00:06:21,720

reactant concentration holding nitric

148

00:06:26,240 --> 00:06:24,090

oxide constant here you see increased

149

00:06:29,390 --> 00:06:26,250

nitrous oxide production as we increase

150

00:06:31,700 --> 00:06:29,400

iron concentrations as well then holding

151

00:06:33,800 --> 00:06:31,710

iron constant you see the same effect if

152

00:06:37,430 --> 00:06:33,810

you increase nitric oxide concentrations

153

00:06:39,680 --> 00:06:37,440

as well this translate back to the rate

154

00:06:42,020 --> 00:06:39,690

law by plotting in a special way so here

155

00:06:44,960 --> 00:06:42,030

I've gotten two plots just pulled from

156

00:06:45,320 --> 00:06:44,970

this same data color coordinated if I

157

00:06:47,300 --> 00:06:45,330

plot

158

00:06:49,969 --> 00:06:47,310

the log of the initial reactant

159

00:06:52,610 --> 00:06:49,979

concentration on the x axis and on the y

160

00:06:56,330 --> 00:06:52,620

axis the log of the initial rate I see a

161

00:06:58,100 --> 00:06:56,340

linear relationship shown here and the

162

00:06:59,749 --> 00:06:58,110

slopes of these relationships

163

00:07:01,999 --> 00:06:59,759

corresponds to the order of reaction

164

00:07:04,999 --> 00:07:02,009

with respect to each of these reactants

165

00:07:07,850 --> 00:07:05,009

and then I can plug in to this rate law

166

00:07:09,439 --> 00:07:07,860

that I derived here the pH was found to

167

00:07:12,140 --> 00:07:09,449

be constant throughout these reactions

168

00:07:15,770 --> 00:07:12,150

so I dropped the proton and then I can

169

00:07:17,510 --> 00:07:15,780

solve for this reactant constant K here

170

00:07:20,270 --> 00:07:17,520

and we have a complete rate law for this

171

00:07:21,230 --> 00:07:20,280

reaction but this is important for a

172

00:07:24,279 --> 00:07:21,240

couple reasons

173

00:07:26,629 --> 00:07:24,289

because we can determine essentially a

174

00:07:29,059 --> 00:07:26,639

theoretical nitrous oxide production

175

00:07:30,890 --> 00:07:29,069

rate in any environment but we have to

176

00:07:33,740 --> 00:07:30,900

understand things about the reactant

177

00:07:35,570 --> 00:07:33,750

concentrations first so we understand a

178

00:07:39,740 --> 00:07:35,580

bit about iron in modern and ancient

179

00:07:41,959 --> 00:07:39,750

react environment so in modern OMGs or

180

00:07:45,020 --> 00:07:41,969

oxygen minimum zone you see very minimal

181

00:07:47,330 --> 00:07:45,030

iron concentration but there have been

182

00:07:49,040 --> 00:07:47,340

modeling studies shown that Proterozoic

183

00:07:52,189 --> 00:07:49,050

iron concentrations could have been up

184

00:07:55,459 --> 00:07:52,199

to 10 millimolar or even more based on

185

00:07:58,219 --> 00:07:55,469

certain studies nitric oxide is a little

186

00:08:01,059 --> 00:07:58,229

bit harder to constrain it's actually

187

00:08:04,580 --> 00:08:01,069

not commonly measured even in the modern

188

00:08:07,219 --> 00:08:04,590

but we do see picomolar 2 nano molar

189

00:08:09,499 --> 00:08:07,229

levels in modern environment so we

190

00:08:12,230 --> 00:08:09,509

translate that to equivalent load nano

191

00:08:13,760 --> 00:08:12,240

molar levels in the clitoral so what

192

00:08:17,059 --> 00:08:13,770

does this mean for the nitrous oxide

193

00:08:20,659 --> 00:08:17,069

flux currently our flux is around 17

194

00:08:23,450 --> 00:08:20,669

tera grams per year and this translates

195

00:08:26,589 --> 00:08:23,460

to a mixing ratio of about 300 ppb and

196

00:08:28,969 --> 00:08:26,599

that appears and I set out using these

197

00:08:30,589 --> 00:08:28,979

reactant concentrations to think about

198

00:08:35,420 --> 00:08:30,599

what this meant for the Proterozoic in

199

00:08:37,790 --> 00:08:35,430

different environments so I used this

200

00:08:40,370 --> 00:08:37,800

rate law in tandem with a couple

201
00:08:43,969 --> 00:08:40,380
assumptions first of all we assumed that

202
00:08:46,130 --> 00:08:43,979
there was a 10 meter thick smoke line in

203
00:08:48,949 --> 00:08:46,140
pretty rizzo ik oceans in which ecology

204
00:08:51,650 --> 00:08:48,959
nitrification occurred and that this

205
00:08:53,900 --> 00:08:51,660
ocean covered 70% of Earth's surface and

206
00:08:56,329 --> 00:08:53,910
then we cap things with the nitrogen

207
00:08:58,269 --> 00:08:56,339
fixation rate so the nitrogen fixation

208
00:08:59,980 --> 00:08:58,279
rate in the modern environment is

209
00:09:03,759 --> 00:08:59,990
hundreds of 200 tare grams of nitrogen

210
00:09:06,759 --> 00:09:03,769
per year and we assumed that all of this

211
00:09:08,679 --> 00:09:06,769
fixed nitrogen in the Proterozoic would

212
00:09:11,889 --> 00:09:08,689
convert to n 2o through Kimura

213
00:09:14,499 --> 00:09:11,899

denitrification so using our rate law

214

00:09:16,809 --> 00:09:14,509

we've made this thing you're here so we

215

00:09:18,999 --> 00:09:16,819

have the nitric oxide concentration the

216

00:09:21,730 --> 00:09:19,009

first reactant on the y axis and then

217

00:09:24,460 --> 00:09:21,740

iron the second reactant on the x axis

218

00:09:26,889 --> 00:09:24,470

and then the contours represent the flux

219

00:09:30,549 --> 00:09:26,899

of n_2 you can get out using our rate

220

00:09:33,009 --> 00:09:30,559

law the the dashed lines represent this

221

00:09:37,329 --> 00:09:33,019

nitrogen fixation rate of 100 to 200

222

00:09:38,980 --> 00:09:37,339

teragrams and given these dashed lines

223

00:09:41,049 --> 00:09:38,990

we would assume that this could happen

224

00:09:45,009 --> 00:09:41,059

in environments with lone animal or NO

225

00:09:46,660 --> 00:09:45,019

and low millimolar iron which we think

226

00:09:49,920 --> 00:09:46,670

could have been possible in the

227

00:09:53,019 --> 00:09:49,930

Proterozoic based on our previous study

228

00:09:55,660 --> 00:09:53,029

so this is cool now we know how fast the

229

00:09:57,160 --> 00:09:55,670

intro is being made but how much and

230

00:09:59,470 --> 00:09:57,170

what did that mean for the climate and

231

00:10:01,210 --> 00:09:59,480

the car was doing so we set out to do

232

00:10:03,730 --> 00:10:01,220

some photochemical modeling so this is a

233

00:10:07,240 --> 00:10:03,740

complex figure but all we have here on

234

00:10:09,850 --> 00:10:07,250

the x-axis is that flux out from our

235

00:10:12,309 --> 00:10:09,860

kinetic model and then on the y-axis we

236

00:10:14,889 --> 00:10:12,319

have the atmospheric concentration of

237

00:10:16,660 --> 00:10:14,899

n_2o how much actually is retained in the

238

00:10:18,369 --> 00:10:16,670

atmosphere and this changes at the

239

00:10:21,490 --> 00:10:18,379

function of oxygen due to that fatah

240

00:10:25,420 --> 00:10:21,500

lysis and that point there represents

241

00:10:26,889 --> 00:10:25,430

our current modern state but we targeted

242

00:10:28,960 --> 00:10:26,899

depending on the oxygen concentration

243

00:10:31,990 --> 00:10:28,970

that you think was present during the

244

00:10:34,629 --> 00:10:32,000

Proterozoic this regime for how much

245

00:10:37,259 --> 00:10:34,639

into oh and how much flux of into oh we

246

00:10:39,759 --> 00:10:37,269

could have during a fritter is oh it

247

00:10:42,340 --> 00:10:39,769

pumping this into a climate model that

248

00:10:45,460 --> 00:10:42,350

was previously completed by Roberson at

249

00:10:47,319 --> 00:10:45,470

all we wanted to see how much this would

250

00:10:50,019 --> 00:10:47,329

translate in terms of temperature and

251
00:10:52,269 --> 00:10:50,029
warming during the clitoris oeq so here

252
00:10:53,470 --> 00:10:52,279
this figure before I put any lines on it

253
00:10:56,739 --> 00:10:53,480
I'd like to just talk about it a little

254
00:10:57,939 --> 00:10:56,749
bit on the x-axis we have the mixing

255
00:11:00,759 --> 00:10:57,949
ratio of n_{2o}

256
00:11:03,790 --> 00:11:00,769
which translates to the y-axis on this

257
00:11:05,350 --> 00:11:03,800
first figure on the x-axis or on the

258
00:11:08,139 --> 00:11:05,360
y-axis on the second figure we have

259
00:11:10,449 --> 00:11:08,149
surface temperature in Kelvin as a

260
00:11:11,530 --> 00:11:10,459
result from this climate model and all

261
00:11:13,030 --> 00:11:11,540
lines on this

262
00:11:15,249 --> 00:11:13,040
are gonna correspond to a background

263
00:11:18,819 --> 00:11:15,259

near monitoring greenhouse of carbon

264

00:11:21,340 --> 00:11:18,829

dioxide and methane and here I'm just

265

00:11:23,379 --> 00:11:21,350

kind of bookended a couple important

266

00:11:26,910 --> 00:11:23,389

values that we think could have been

267

00:11:29,259 --> 00:11:26,920

possible as a minimum and a maximum for

268

00:11:32,230 --> 00:11:29,269

potential Proterozoic nitrous oxide

269

00:11:33,720 --> 00:11:32,240

concentration exam this year and what

270

00:11:36,040 --> 00:11:33,730

this means in terms of temperature

271

00:11:37,509 --> 00:11:36,050

depends on when in the Proterozoic we're

272

00:11:40,090 --> 00:11:37,519

speaking about because the Proterozoic

273

00:11:42,249 --> 00:11:40,100

is a really long time so in the early

274

00:11:43,569 --> 00:11:42,259

Proterozoic moon Asti was much lower so

275

00:11:46,269 --> 00:11:43,579

we experienced lower surface

276

00:11:48,340 --> 00:11:46,279

temperatures in the late Proterozoic it

277

00:11:50,740 --> 00:11:48,350

was higher so this relationship between

278

00:11:54,249 --> 00:11:50,750

the into a mixing ratio and temperature

279

00:11:56,530 --> 00:11:54,259

change throughout this time period but

280

00:12:00,069 --> 00:11:56,540

during this time period with a

281

00:12:02,470 --> 00:12:00,079

background into 0.125 ppm which we could

282

00:12:05,319 --> 00:12:02,480

expect given our assumptions and our

283

00:12:07,449 --> 00:12:05,329

modeling calculation we do see a

284

00:12:11,410 --> 00:12:07,459

significant level of warming just from

285

00:12:14,230 --> 00:12:11,420

nitrous oxide so just to conclude and

286

00:12:16,389 --> 00:12:14,240

wrap-up this the climate modeling that

287

00:12:18,250 --> 00:12:16,399

we've done assumes that we can get up to

288

00:12:20,550 --> 00:12:18,260

five degrees of warming from nitrous

289

00:12:22,870 --> 00:12:20,560

oxide just from chemo denitrification

290

00:12:25,180 --> 00:12:22,880

but we have built in a couple

291

00:12:26,829 --> 00:12:25,190

assumptions into these calculations I

292

00:12:28,569 --> 00:12:26,839

think have a little bit of wiggle room

293

00:12:31,030 --> 00:12:28,579

and I think it's really exciting to

294

00:12:32,920 --> 00:12:31,040

start thinking about how this affects

295

00:12:35,769 --> 00:12:32,930

the rest of the ancient nitrogen cycle

296

00:12:37,629 --> 00:12:35,779

and in turn how further ancient nitrogen

297

00:12:40,420 --> 00:12:37,639

cycle studies could affect you know

298

00:12:42,340 --> 00:12:40,430

denitrification for example we don't

299

00:12:45,069 --> 00:12:42,350

have very good constraints on ancient

300

00:12:46,780 --> 00:12:45,079

nitric oxide concentrations could have

301
00:12:50,019 --> 00:12:46,790
been much higher considering the ocean

302
00:12:52,059 --> 00:12:50,029
was primarily anoxic also if ancient

303
00:12:55,329 --> 00:12:52,069
nitrogen fixation was faster than it is

304
00:12:58,150 --> 00:12:55,339
today this is the possibility this would

305
00:13:01,150 --> 00:12:58,160
also change our calculations in the same

306
00:13:03,490 --> 00:13:01,160
sense if it was slower this would change

307
00:13:05,800 --> 00:13:03,500
our calculations as well also it is

308
00:13:07,569 --> 00:13:05,810
likely that not all of this chemo or all

309
00:13:10,780 --> 00:13:07,579
of this fix nitrogen engages in chemo

310
00:13:12,759 --> 00:13:10,790
denitrification so we've presented one

311
00:13:15,069 --> 00:13:12,769
end member here conversely there's

312
00:13:17,769 --> 00:13:15,079
another end member in which no nitrogen

313
00:13:19,059 --> 00:13:17,779

is smutty nitrified also there are

314

00:13:20,889 --> 00:13:19,069

interesting caveats that we've only

315

00:13:25,190 --> 00:13:20,899

recently kind of thought about in terms

316

00:13:27,410 --> 00:13:25,200

of feedbacks with ancient oxygen

317

00:13:30,320 --> 00:13:27,420

in high oxygen environments nitrous

318

00:13:34,700 --> 00:13:30,330

oxide is broken down into nitric oxide

319

00:13:36,620 --> 00:13:34,710

which engages in a zone breakdown so

320

00:13:39,440 --> 00:13:36,630

there would be a feedback in which ozone

321

00:13:42,320 --> 00:13:39,450

protection would be scavenged even in

322

00:13:43,580 --> 00:13:42,330

high oxygen environments so I'm really

323

00:13:45,440 --> 00:13:43,590

excited about this project

324

00:13:50,270 --> 00:13:45,450

I'm excited some first submitted paper

325

00:13:52,610 --> 00:13:50,280

so I'm glad it's done if you guys have

326

00:13:55,280 --> 00:13:52,620

any questions just let me know and I'd

327

00:13:56,960 --> 00:13:55,290

like to thank my lab group it's good to

328

00:14:05,930 --> 00:13:56,970

see everybody and some of our funding

329

00:14:12,290 --> 00:14:05,940

sources as well alright questions for

330

00:14:15,350 --> 00:14:12,300

Chloe I'm just curious what is the sink

331

00:14:17,360 --> 00:14:15,360

of and cool in your model and how much

332

00:14:21,260 --> 00:14:17,370

how long was the residence time of

333

00:14:24,860 --> 00:14:21,270

entering your model yeah so that would

334

00:14:29,060 --> 00:14:24,870

be the Fatah Lass's just as soon as you

335

00:14:32,180 --> 00:14:29,070

release into oh and that McPhee R you're

336

00:14:32,870 --> 00:14:32,190

breaking it down into nitrogen gas here

337

00:14:35,510 --> 00:14:32,880

oh there we go

338

00:14:40,180 --> 00:14:35,520

so you've considered it in your model

339

00:14:43,280 --> 00:14:40,190

right yes that how long was the lifetime

340

00:14:45,140 --> 00:14:43,290

like it's very rapid but it depends on

341

00:14:48,610 --> 00:14:45,150

the oxygen concentration yeah that's why

342

00:14:54,620 --> 00:14:48,620

I must use yeah so I mean if you look

343

00:14:58,280 --> 00:14:54,630

like back all the way yeah so he looked

344

00:15:00,680 --> 00:14:58,290

here it depends greatly on how much

345

00:15:02,570 --> 00:15:00,690

oxygen you have so your residence time

346

00:15:04,660 --> 00:15:02,580

in changing with the concentration of

347

00:15:07,400 --> 00:15:04,670

oxygen

348

00:15:09,620 --> 00:15:07,410

hi thanks for the great talk um I was

349

00:15:12,110 --> 00:15:09,630

curious you had mentioned I forget

350

00:15:13,850 --> 00:15:12,120

exactly which reaction it was but metal

351

00:15:15,500 --> 00:15:13,860

limitation in a protozoa koushin

352

00:15:18,560 --> 00:15:15,510

potentially changing the rates of

353

00:15:20,150 --> 00:15:18,570

writing these biological processes and

354

00:15:23,270 --> 00:15:20,160

so I had a question specifically for a

355

00:15:25,010 --> 00:15:23,280

nitrogen fixation because yeah I guess

356

00:15:27,740 --> 00:15:25,020

presumably the Proterozoic ocean was

357

00:15:29,900 --> 00:15:27,750

also molybdenum limited and so maybe

358

00:15:31,520 --> 00:15:29,910

that might have affected the rates right

359

00:15:33,500 --> 00:15:31,530

and that student fixation so I was

360

00:15:36,200 --> 00:15:33,510

wondering what your thoughts were so I

361

00:15:36,610 --> 00:15:36,210

think well I think all of these I kind

362

00:15:38,290 --> 00:15:36,620

of

363

00:15:39,820 --> 00:15:38,300

but I put them in really small font on

364

00:15:41,290 --> 00:15:39,830

purpose kind of get some of these

365

00:15:44,830 --> 00:15:41,300

studies they're a little bit skeptical

366

00:15:47,590 --> 00:15:44,840

in my eyes but if you look here Ava

367

00:15:50,860 --> 00:15:47,600

Dukan did this paper studying nitrogen

368

00:15:53,050 --> 00:15:50,870

fixation enzyme and she is particularly

369

00:15:55,210 --> 00:15:53,060

interested in alternative cofactors

370

00:15:57,400 --> 00:15:55,220

besides molybdenum and how that could

371

00:15:58,360 --> 00:15:57,410

have pertained to ancient enzymes in a

372

00:16:01,540 --> 00:15:58,370

nitrogen cycle

373

00:16:04,030 --> 00:16:01,550

so this one paper in particular hinges

374

00:16:06,100 --> 00:16:04,040

the entire nitrogen fixation crux on

375

00:16:08,590 --> 00:16:06,110

something else besides molybdenum is

376

00:16:12,190 --> 00:16:08,600

engaging with reaction so whether or not

377

00:16:15,820 --> 00:16:12,200

that's true I don't know I think there

378

00:16:17,410 --> 00:16:15,830

is definitely some isotope evidence that

379

00:16:22,090 --> 00:16:17,420

they're kind of hinging their argument

380

00:16:24,490 --> 00:16:22,100

upon there but I think again today we

381

00:16:25,510 --> 00:16:24,500

see mostly a molybdenum cofactor I think

382

00:16:27,220 --> 00:16:25,520

that's something that I'm going to think

383

00:16:31,630 --> 00:16:27,230

about when we talk before your somatic

384

00:16:46,500 --> 00:16:31,640

you'd like this thank you other

385

00:17:02,290 --> 00:16:53,070

could you go back to rape Grafton's rate

386

00:17:11,590 --> 00:17:02,300

which yes and so I know this is just a

387

00:17:15,820 --> 00:17:11,600

general chemistry question now so this

388

00:17:17,830 --> 00:17:15,830

is assuming first-order kinetics for

389

00:17:20,260 --> 00:17:17,840

each of these reactants so there's a

390

00:17:23,710 --> 00:17:20,270

little bit of there's a little bit of

391

00:17:26,590 --> 00:17:23,720

wiggle room here but this is essentially

392

00:17:28,480 --> 00:17:26,600

just kinetic models that you can run for

393

00:17:30,430 --> 00:17:28,490

different orders of reaction for each

394

00:17:33,340 --> 00:17:30,440

reactant and this is the one in which

395

00:17:35,410 --> 00:17:33,350

gives us a linear relationship so this

396

00:17:39,010 --> 00:17:35,420

is the one that we use so depending on

397

00:17:42,070 --> 00:17:39,020

how linear your data is is determining

398

00:17:47,260 --> 00:17:42,080

how you plot your data you've got the

399

00:17:49,810 --> 00:17:47,270

different order for these are called

400

00:17:51,880 --> 00:17:49,820

pseudo first order because they're not

401
00:17:54,610 --> 00:17:51,890
zero with order and they're not second

402
00:17:57,330 --> 00:17:54,620
order but they don't fall along the

403
00:18:02,350 --> 00:17:57,340
theoretical first order kinetics which

404
00:18:04,440 --> 00:18:02,360
almost nothing does but this is as close

405
00:18:06,370 --> 00:18:04,450
as you're gonna get in the real world I

406
00:18:06,960 --> 00:18:06,380
don't know does that answer your

407
00:18:15,940 --> 00:18:06,970
question

408
00:18:16,860 --> 00:18:15,950
Chloe all right if not let's thank her