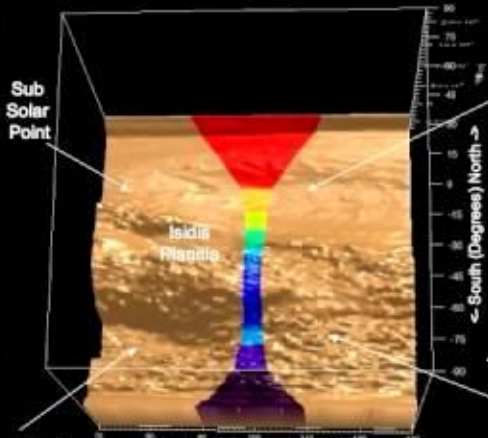
Water vapor abundances



1
00:00:05,180 --> 00:00:03,379
okay I think we're ready to go can

2
00:00:12,230 --> 00:00:05,190
everyone hear me you can just wave if

3
00:00:14,270 --> 00:00:12,240
you can hear me hey I see a wave okay

4
00:00:17,000 --> 00:00:14,280
well I guess I'm leading this off I'm

5
00:00:20,330 --> 00:00:17,010
Carl filter I'm the director of the NASA

6
00:00:23,120 --> 00:00:20,340
Astrobiology Institute and I just wanted

7
00:00:27,560 --> 00:00:23,130
to welcome all of the students somewhat

8
00:00:29,990 --> 00:00:27,570
after the fact to the NAI I guess these

9
00:00:32,600 --> 00:00:30,000
presentations today are going to be all

10
00:00:34,069 --> 00:00:32,610
from students sitting around you Mike

11
00:00:37,310 --> 00:00:34,079
they're at Goddard who have been working

12
00:00:41,420 --> 00:00:37,320
with you and others on your team and I

13
00:00:43,850 --> 00:00:41,430

think all of the students know just how

14
00:00:47,270 --> 00:00:43,860
good a group of scientists you have to

15
00:00:50,930 --> 00:00:47,280
work with we are really really pleased

16
00:00:54,560 --> 00:00:50,940
to have you in the NAI for the summer

17
00:00:58,810 --> 00:00:54,570
the students and postdocs and graduate

18
00:01:01,220 --> 00:00:58,820
students that have been attracted into

19
00:01:03,830 --> 00:01:01,230
astrobiology are really just an

20
00:01:06,859 --> 00:01:03,840
impressive group of people and I have no

21
00:01:07,969 --> 00:01:06,869
doubt that you are all as well one of

22
00:01:11,030 --> 00:01:07,979
the most exciting things about

23
00:01:12,890 --> 00:01:11,040
astrobiology I think is the quality of

24
00:01:15,289 --> 00:01:12,900
the young researchers and students it

25
00:01:17,260 --> 00:01:15,299
attracts in so I'm looking forward to

26
00:01:18,980 --> 00:01:17,270
hearing some of your presentations

27
00:01:20,749 --> 00:01:18,990
unfortunately I'm only going to be able

28
00:01:23,510 --> 00:01:20,759
to stay for about 20 minutes and then I

29
00:01:25,700 --> 00:01:23,520
have to go off and give a talk to some

30
00:01:27,710 --> 00:01:25,710
visiting firemen from Washington where I

31
00:01:32,480 --> 00:01:27,720
spent 18 years before coming out here

32
00:01:36,219 --> 00:01:32,490
about a year ago so I'm looking forward

33
00:01:38,450 --> 00:01:36,229
to hearing at least a few of your talks

34
00:01:41,560 --> 00:01:38,460
hopefully maybe get a chance to meet you

35
00:01:43,219 --> 00:01:41,570
all sometime and I will turn it now over

36
00:01:48,830 --> 00:01:43,229
to Mike Mumma

37
00:01:52,069 --> 00:01:48,840
oh thanks very much Kyle it's a really

38
00:01:54,740 --> 00:01:52,079

nice pleasure to introduce these young

39
00:01:57,679 --> 00:01:54,750
people today to other members of the NAI

40
00:02:00,350 --> 00:01:57,689
and our associates we were very

41
00:02:02,569 --> 00:02:00,360
fortunate in having 10 exceptional

42
00:02:06,770 --> 00:02:02,579
students come to work with us this

43
00:02:09,199 --> 00:02:06,780
summer under the internship program the

44
00:02:11,460 --> 00:02:09,209
Goddard Center for astrobiology this is

45
00:02:13,259 --> 00:02:11,470
our fourth summer doing

46
00:02:16,199 --> 00:02:13,269
we started the first as a pilot program

47
00:02:18,119 --> 00:02:16,209
and we hope to continue us for many

48
00:02:20,399 --> 00:02:18,129
years to come

49
00:02:22,759 --> 00:02:20,409
without going into any greater depth

50
00:02:26,429 --> 00:02:22,769
we'll introduce each student

51
00:02:28,830 --> 00:02:26,439
individually and then after the

52
00:02:30,960 --> 00:02:28,840
presentation with that Dustin's research

53
00:02:35,009 --> 00:02:30,970
is complete we'll ask for any questions

54
00:02:38,910 --> 00:02:35,019
from the distributed audience first and

55
00:02:41,670 --> 00:02:38,920
also locally so let me just say that the

56
00:02:45,000 --> 00:02:41,680
program today is is organized in the

57
00:02:48,149 --> 00:02:45,010
context of time temporal evolution of

58
00:02:50,869 --> 00:02:48,159
material from the natal cloud core and

59
00:02:53,759 --> 00:02:50,879
the photo planetary disc on towards

60
00:02:56,460 --> 00:02:53,769
analyses of comets and meteorites then

61
00:03:00,020 --> 00:02:56,470
on to evolve bodies in particular Mars

62
00:03:04,170 --> 00:03:00,030
and also the moon and finally the

63
00:03:05,729 --> 00:03:04,180

horizon of exoplanet research so there

64
00:03:09,839 --> 00:03:05,739
should be something in this seminar

65
00:03:14,369 --> 00:03:09,849
today for anyone at any one of the NAI

66
00:03:16,920 --> 00:03:14,379
sites tuned in to find of interest so

67
00:03:19,860 --> 00:03:16,930
let's get started our first speaker is

68
00:03:23,550 --> 00:03:19,870
Ariel Lewis from Eckerd College in

69
00:03:26,849 --> 00:03:23,560
Florida and her mentors here at Goddard

70
00:03:29,599 --> 00:03:26,859
this summer were Marlon Moore and Reggie

71
00:03:33,599 --> 00:03:29,609
Hudson working she'd been working in the

72
00:03:36,330 --> 00:03:33,609
radiation processing lab and Isis talk

73
00:03:39,150 --> 00:03:36,340
today about carbonic acid and its

74
00:03:42,300 --> 00:03:39,160
significance to astrobiology so Ariel

75
00:03:43,770 --> 00:03:42,310
take it away okay um as dr. mama said my

76
00:03:45,300 --> 00:03:43,780
name is Ariel Lewis I'm from Eckerd

77
00:03:47,909 --> 00:03:45,310
College and I've been working in the

78
00:03:51,539 --> 00:03:47,919
cosmic ice lab for the last ten weeks

79
00:03:53,430 --> 00:03:51,549
and my project is on carbonic acid it's

80
00:03:55,379 --> 00:03:53,440
a determination of vapor pressure and

81
00:03:58,890 --> 00:03:55,389
energy of sublimation and the

82
00:04:00,240 --> 00:03:58,900
significance to astrobiology some brief

83
00:04:03,629 --> 00:04:00,250
background for those of you who don't

84
00:04:05,180 --> 00:04:03,639
know carbonic acid is h2 co3 and you can

85
00:04:07,439 --> 00:04:05,190
see the structure right up here and

86
00:04:09,360 --> 00:04:07,449
terrestrially it's fairly abundant

87
00:04:12,000 --> 00:04:09,370
anywhere that water and co2 are

88
00:04:14,339 --> 00:04:12,010

equilibrium from carbonic acid for

89
00:04:18,330 --> 00:04:14,349
example the oceans even human blood and

90
00:04:20,009 --> 00:04:18,340
soda pop but since this is NASA we are

91
00:04:22,560 --> 00:04:20,019
obviously more interested in carbonic

92
00:04:24,320 --> 00:04:22,570
acid on the extra-terrestrial level and

93
00:04:25,969 --> 00:04:24,330
so

94
00:04:27,950 --> 00:04:25,979
one of the ways that carbonic acid is

95
00:04:31,100 --> 00:04:27,960
formed is actually by the irradiation of

96
00:04:32,839 --> 00:04:31,110
water and carbon dioxide ice so anywhere

97
00:04:34,399 --> 00:04:32,849
that water and carbon dioxide ice can be

98
00:04:36,920 --> 00:04:34,409
found there's the potential for carbonic

99
00:04:39,499 --> 00:04:36,930
acid so anywhere you see on this table

100
00:04:41,779 --> 00:04:39,509
that's white is somewhere that both

101
00:04:44,180 --> 00:04:41,789
water and car and carbon dioxide ice has

102
00:04:48,770 --> 00:04:44,190
been found and so holds potential for

103
00:04:50,450 --> 00:04:48,780
carbonic acid and one of the places that

104
00:04:53,450 --> 00:04:50,460
was in white is Callisto one of the

105
00:04:55,730 --> 00:04:53,460
moons of Jupiter and this in red is one

106
00:04:58,730 --> 00:04:55,740
of the spectrums that we took in our lab

107
00:05:03,529 --> 00:04:58,740
and in comparison to spectra taken from

108
00:05:06,770 --> 00:05:03,539
a spacecraft and this 4.25 4.27 peak is

109
00:05:10,670 --> 00:05:06,780
actually carbon dioxide but this 3.88

110
00:05:12,800 --> 00:05:10,680
peak is still as of yet unidentified and

111
00:05:15,589 --> 00:05:12,810
there is the real potential for that to

112
00:05:17,209 --> 00:05:15,599
be a harmonic acid peak the sense it's

113
00:05:22,550 --> 00:05:17,219

only one peak identification we

114
00:05:24,290 --> 00:05:22,560
obviously can't be sure from that and in

115
00:05:26,839 --> 00:05:24,300
the lab as I said you can form a

116
00:05:29,480 --> 00:05:26,849
carbonic acid through irradiation of

117
00:05:31,279 --> 00:05:29,490
water and carbon dioxide ice but you can

118
00:05:33,649 --> 00:05:31,289
also form it through acid-base injection

119
00:05:36,260 --> 00:05:33,659
which is the method I use for this

120
00:05:38,870 --> 00:05:36,270
experiment and you take the acid and

121
00:05:43,249 --> 00:05:38,880
bases up into this needle inject them

122
00:05:46,189 --> 00:05:43,259
into the spectrometer here and then you

123
00:05:52,550 --> 00:05:46,199
can rotate the cryo head and take a

124
00:05:54,800 --> 00:05:52,560
spectra through the window the reactants

125
00:05:58,219 --> 00:05:54,810
that I use for this were hydrobromic

126
00:05:59,779 --> 00:05:58,229
acid and potassium bicarbonate in order

127
00:06:02,689 --> 00:05:59,789
to make carbonic acid as you can see the

128
00:06:04,839 --> 00:06:02,699
spectrum down here are some different

129
00:06:07,730 --> 00:06:04,849
lis different and the carbonic acid is

130
00:06:11,029 --> 00:06:07,740
the telltale sign of the carbonic acid

131
00:06:14,659 --> 00:06:11,039
spectra is this 13 15 1700 Peaks right

132
00:06:18,379 --> 00:06:14,669
here so this is what the raw data looks

133
00:06:19,640 --> 00:06:18,389
like we synthesize the carbonic acid and

134
00:06:21,619 --> 00:06:19,650
then heat it up to a specific

135
00:06:24,200 --> 00:06:21,629
temperature and let it a meal and to

136
00:06:26,809 --> 00:06:24,210
expect your every 12 minutes and then

137
00:06:28,490 --> 00:06:26,819
I'd take the 1300 peak and the 1500 peak

138
00:06:31,610 --> 00:06:28,500

and integrate these two peaks and see

139
00:06:34,159 --> 00:06:31,620
how they changed over time and then I

140
00:06:35,300 --> 00:06:34,169
take those raw band areas multiply them

141
00:06:37,330 --> 00:06:35,310
by 2.303

142
00:06:39,820 --> 00:06:37,340
in order to account for

143
00:06:43,120 --> 00:06:39,830
logarithmic scale and divided by the a

144
00:06:45,640 --> 00:06:43,130
value and then plot this which is the

145
00:06:47,760 --> 00:06:45,650
column density versus time and the slope

146
00:06:50,200 --> 00:06:47,770
of those lines is the sublimation flux

147
00:06:52,719 --> 00:06:50,210
then you can take the sublimation flux

148
00:06:56,230 --> 00:06:52,729
and the sublimation flux is equal to the

149
00:06:59,050 --> 00:06:56,240
vapor pressure over 2 pi MKT to the one

150
00:07:00,460 --> 00:06:59,060
half where m is the molecular mass K is

151
00:07:02,409 --> 00:07:00,470
the Boltzmann constant and T is a

152
00:07:03,969 --> 00:07:02,419
variable temperature so you can find the

153
00:07:08,490 --> 00:07:03,979
vapor pressure purely from knowing the

154
00:07:10,719 --> 00:07:08,500
band areas from the IR spectrum and so

155
00:07:11,980 --> 00:07:10,729
afternoon various temperatures this is

156
00:07:17,280 --> 00:07:11,990
the vapor pressure versus temperature

157
00:07:21,219 --> 00:07:17,290
graph that I just determined from 240 to

158
00:07:22,990 --> 00:07:21,229
255 take the big pressure for carbonic

159
00:07:24,690 --> 00:07:23,000
acid was determined to be one point five

160
00:07:27,879 --> 00:07:24,700
four times 10 to the negative twelve

161
00:07:29,200 --> 00:07:27,889
times temperature to minus three point

162
00:07:31,779 --> 00:07:29,210
six seven times 10 to the negative 10

163
00:07:33,879 --> 00:07:31,789

and there was actually enough data to

164
00:07:35,830 --> 00:07:33,889
even do a heat of sublimation which is

165
00:07:37,810 --> 00:07:35,840
the natural log of vapor pressure versus

166
00:07:39,370 --> 00:07:37,820
one over temperature and the heat of

167
00:07:45,040 --> 00:07:39,380
sublimation is equal to the slope of

168
00:07:48,969 --> 00:07:45,050
that line times the gas constant R 8.314

169
00:07:50,650 --> 00:07:48,979
joules per Kelvin mole and the heat of

170
00:07:52,240 --> 00:07:50,660
sublimation for carbonic acid is

171
00:07:54,940 --> 00:07:52,250
determined to be sixty six point three

172
00:07:57,790 --> 00:07:54,950
kilojoules per mole which is logical

173
00:07:59,469 --> 00:07:57,800
considering we have also heats of

174
00:08:01,420 --> 00:07:59,479
sublimation for acetic acid and formic

175
00:08:04,480 --> 00:08:01,430
acid which are very similar to qur'anic

176
00:08:07,629 --> 00:08:04,490
acid and there 62 and 68 kilojoules per

177
00:08:10,000 --> 00:08:07,639
mole respectively so in conclusion

178
00:08:13,540 --> 00:08:10,010
carbonic acid is all around us but it's

179
00:08:14,920 --> 00:08:13,550
very hard to isolate it's very likely

180
00:08:17,260 --> 00:08:14,930
present in space that we haven't found

181
00:08:19,960 --> 00:08:17,270
it yet the vapor pressure can be term

182
00:08:21,820 --> 00:08:19,970
determined from IR spectra the vapor

183
00:08:23,469 --> 00:08:21,830
pressure of carbonic acid is less than

184
00:08:26,050 --> 00:08:23,479
that of water which is significant

185
00:08:27,909 --> 00:08:26,060
because that means that carbonic acid

186
00:08:29,580 --> 00:08:27,919
can stay around longer than water and

187
00:08:30,790 --> 00:08:29,590
could potentially protect water

188
00:08:33,159 --> 00:08:30,800

subsurface

189
00:08:35,380 --> 00:08:33,169
on anywhere that carbonic acid is formed

190
00:08:36,790 --> 00:08:35,390
and knowing the pressure of carbonic

191
00:08:39,760 --> 00:08:36,800
acid will aid in predicting where the

192
00:08:41,800 --> 00:08:39,770
molecule might be found and I'd like to

193
00:08:44,050 --> 00:08:41,810
acknowledge dr. Mora and dr. Hudson dr.

194
00:08:46,090 --> 00:08:44,060
dr. Cooper for working with me in the

195
00:08:48,650 --> 00:08:46,100
lab Steve Brown Tom Ward and Eugene

196
00:08:58,610 --> 00:08:48,660
gerashenko Corinne AVN's the

197
00:09:00,680 --> 00:08:58,620
I don't have that so I think we'll turn

198
00:09:04,150 --> 00:09:00,690
first to our colleagues outside of

199
00:09:07,069 --> 00:09:04,160
Goddard remote sites and one wishes to

200
00:09:07,819 --> 00:09:07,079
make a comment or ask the question

201
00:09:10,249 --> 00:09:07,829
please

202
00:09:11,900 --> 00:09:10,259
go ahead and do so hey this is Carl I

203
00:09:13,790 --> 00:09:11,910
just want to say how impressed we all

204
00:09:15,999 --> 00:09:13,800
here at nai central were with the

205
00:09:25,160 --> 00:09:16,009
professionalism of that presentation

206
00:09:29,929 --> 00:09:25,170
congratulations from Penn State or

207
00:09:31,280 --> 00:09:29,939
Carnegie anybody else online if not

208
00:09:32,240 --> 00:09:31,290
we'll go ahead and turn the comments

209
00:09:34,579 --> 00:09:32,250
here in the audience for questions

210
00:09:37,910 --> 00:09:34,589
anybody here at Goddard want to raise an

211
00:09:38,749 --> 00:09:37,920
issue or raise a hand clap again I have

212
00:09:40,490 --> 00:09:38,759
a question

213
00:09:44,600 --> 00:09:40,500

does this mean I should never drink

214
00:09:51,889 --> 00:09:44,610
carbonated beverages again no cokes no

215
00:09:54,980 --> 00:09:51,899
Pepsi okay well thanks very much let's

216
00:09:57,499 --> 00:09:54,990
move on to Steve madding steve is from

217
00:09:59,840 --> 00:09:57,509
the university of maryland and has been

218
00:10:04,370 --> 00:09:59,850
working here this summer with Joe Newt

219
00:10:07,009 --> 00:10:04,380
and Natasha Johnson and he'll describe

220
00:10:09,730 --> 00:10:07,019
his research on a more cosine silicate

221
00:10:21,970 --> 00:10:09,740
grains as catalysts for organic

222
00:10:25,370 --> 00:10:24,230
all right my name is Steve Manning from

223
00:10:27,740 --> 00:10:25,380
the University of Maryland College Park

224
00:10:29,870 --> 00:10:27,750
and this summer I worked on amorphous

225
00:10:32,090 --> 00:10:29,880
iron silicate grains as catalysts for

226
00:10:35,270 --> 00:10:32,100
organics the solar nebula worked under

227
00:10:36,860 --> 00:10:35,280
dr. Jimmy first and background the sole

228
00:10:38,360 --> 00:10:36,870
previous research has shown that the

229
00:10:40,520 --> 00:10:38,370
solar nebula can act in an organic

230
00:10:42,710 --> 00:10:40,530
chemical factory interstellar dust and

231
00:10:44,690 --> 00:10:42,720
Amorphis iron silicates dominate the

232
00:10:46,970 --> 00:10:44,700
solar nebula and the many active sites

233
00:10:49,130 --> 00:10:46,980
on the surface of these gusts allow the

234
00:10:51,740 --> 00:10:49,140
abundant gases hydrogen nitrogen and

235
00:10:56,330 --> 00:10:51,750
carbon monoxide to react on the surface

236
00:10:58,310 --> 00:10:56,340
and as more reactions occur surface

237
00:11:00,200 --> 00:10:58,320
generates an organic residue catalyst

238
00:11:03,110 --> 00:11:00,210

and this is cycled throughout this so uh

239
00:11:04,970 --> 00:11:03,120
so in nebulae and bring organics and

240
00:11:07,700 --> 00:11:04,980
meteorites to areas they may not have

241
00:11:09,620 --> 00:11:07,710
been able to form otherwise and this is

242
00:11:11,510 --> 00:11:09,630
a closer look at the synthesis that I

243
00:11:14,090 --> 00:11:11,520
will be working with its dust Frankie

244
00:11:17,750 --> 00:11:14,100
it's a dust grain catalysis and you can

245
00:11:19,390 --> 00:11:17,760
see in the top three of up here that the

246
00:11:22,460 --> 00:11:19,400
a more precise silicate grains allow the

247
00:11:25,490 --> 00:11:22,470
the free-flowing gases to react on the

248
00:11:28,070 --> 00:11:25,500
surface and as more and more gases treat

249
00:11:30,110 --> 00:11:28,080
under the surface an organic residue

250
00:11:33,230 --> 00:11:30,120
forms and more advanced organics develop

251
00:11:35,270 --> 00:11:33,240
on the surface and previous hypotheses

252
00:11:37,550 --> 00:11:35,280
were that as these silicate grains get

253
00:11:39,530 --> 00:11:37,560
coated like number six year completely

254
00:11:42,440 --> 00:11:39,540
in organics that they couldn't perform

255
00:11:44,810 --> 00:11:42,450
efficient catalysis any longer and the

256
00:11:46,640 --> 00:11:44,820
reactions were effectively stopped but

257
00:11:48,620 --> 00:11:46,650
recent research by Newton Hill has shown

258
00:11:51,830 --> 00:11:48,630
that reaction rates are actually may be

259
00:11:55,700 --> 00:11:51,840
increasing as res gases are passed over

260
00:11:57,050 --> 00:11:55,710
these organic residue catalysts and so

261
00:11:58,670 --> 00:11:57,060
my job two summers to conduct

262
00:12:00,410 --> 00:11:58,680
experiments to determine the catalytic

263
00:12:03,200 --> 00:12:00,420

rates of these carbonaceous deposits on

264
00:12:04,850 --> 00:12:03,210
the iron silicate and compare them to

265
00:12:06,260 --> 00:12:04,860
the rates of the actual iron silicates

266
00:12:08,660 --> 00:12:06,270
themselves in the laboratory environment

267
00:12:10,250 --> 00:12:08,670
and it's important astrobiology because

268
00:12:12,440 --> 00:12:10,260
it helps determine rates performing

269
00:12:14,210 --> 00:12:12,450
important and maybe possible prebiotic

270
00:12:16,790 --> 00:12:14,220
organics and solar nebula and this

271
00:12:18,500 --> 00:12:16,800
diagram here is of the setup that I was

272
00:12:20,720 --> 00:12:18,510
using it's a closed system that we would

273
00:12:24,740 --> 00:12:20,730
put in 75 for carbon monoxide nitrogen

274
00:12:27,020 --> 00:12:24,750
and 550 for hydrogen close it off and

275
00:12:28,310 --> 00:12:27,030
cycle through with a bellows pump and as

276
00:12:31,100 --> 00:12:28,320
it flowed through the system it would

277
00:12:33,650 --> 00:12:31,110
pass the reheated finger with the iron

278
00:12:35,210 --> 00:12:33,660
silicate grains and

279
00:12:37,610 --> 00:12:35,220
reactions would happen and they would

280
00:12:40,100 --> 00:12:37,620
flow through the system to the IR

281
00:12:41,989 --> 00:12:40,110
spectrum there are FTIR spectrometer

282
00:12:45,259 --> 00:12:41,999
here and then every run after a few days

283
00:12:47,439 --> 00:12:45,269
of taking spectra we would chuck out the

284
00:12:50,809 --> 00:12:47,449
pressure to zero and then put in a new

285
00:12:53,239 --> 00:12:50,819
group of gases so that we can measure

286
00:12:55,699 --> 00:12:53,249
the rates in each turn and what we found

287
00:12:56,989 --> 00:12:55,709
out is that the most significant changes

288
00:12:58,939 --> 00:12:56,999

happen in the first two hours of the

289
00:13:01,549 --> 00:12:58,949
experiment and as the grains became

290
00:13:03,920 --> 00:13:01,559
coated with the residue carbon dioxide

291
00:13:05,900 --> 00:13:03,930
reacted faster to produce more organic

292
00:13:08,030 --> 00:13:05,910
products and the increase in rate and

293
00:13:10,549 --> 00:13:08,040
greater economies you can see here that

294
00:13:12,679 --> 00:13:10,559
the blue line represents the first run

295
00:13:15,499 --> 00:13:12,689
and the reactants are taking longer to

296
00:13:17,600 --> 00:13:15,509
react and less of them reacting then the

297
00:13:20,269 --> 00:13:17,610
further along reactions which they

298
00:13:23,869 --> 00:13:20,279
haven't faster and more of it gets

299
00:13:25,939 --> 00:13:23,879
reacted and next I did in the mouse's of

300
00:13:27,650 --> 00:13:25,949
the catalytic process and at the top

301
00:13:30,860 --> 00:13:27,660
here it's a graph of the product methane

302
00:13:33,499 --> 00:13:30,870
and as you can see again all the groups

303
00:13:35,119 --> 00:13:33,509
all of the runs together and the first

304
00:13:36,769 --> 00:13:35,129
one here at the bottom was the first run

305
00:13:38,600 --> 00:13:36,779
with just the clean grains and it's

306
00:13:41,179 --> 00:13:38,610
taking longer and making West product

307
00:13:42,410 --> 00:13:41,189
than successive successive runs once

308
00:13:44,869 --> 00:13:42,420
they were going to coating has developed

309
00:13:47,329 --> 00:13:44,879
so I picked an arbitrary point on this

310
00:13:48,949 --> 00:13:47,339
graph one point on this case to figure

311
00:13:52,519 --> 00:13:48,959
out the amount of time it took for each

312
00:13:54,350 --> 00:13:52,529
run to reach that level and I came up

313
00:13:56,540 --> 00:13:54,360

with graphs like this at the bottom and

314
00:13:59,419 --> 00:13:56,550
it's a product it's a approximation of

315
00:14:01,699 --> 00:13:59,429
the rates and more looking deeper into

316
00:14:03,530 --> 00:14:01,709
that we found that each of these graphs

317
00:14:05,179 --> 00:14:03,540
show two important features and the

318
00:14:07,160 --> 00:14:05,189
first is right here they all showed an

319
00:14:09,919 --> 00:14:07,170
initial drop at the beginning and that

320
00:14:12,350 --> 00:14:09,929
represents quickly changing rates of the

321
00:14:14,360 --> 00:14:12,360
iron silica catalyst being coated and

322
00:14:16,759 --> 00:14:14,370
then about the third or fourth round on

323
00:14:18,980 --> 00:14:16,769
they had a much faster steady rate that

324
00:14:20,389 --> 00:14:18,990
represents the catalysis from now on

325
00:14:22,569 --> 00:14:20,399
with your gamma coating that had

326
00:14:25,249 --> 00:14:22,579
developed on the top of the grains and

327
00:14:27,110 --> 00:14:25,259
similar plots we made like this for

328
00:14:29,360 --> 00:14:27,120
three hundred five hundred resaw seus so

329
00:14:30,710 --> 00:14:29,370
with three temperatures on the plots

330
00:14:33,559 --> 00:14:30,720
like that we could make an Iranian squat

331
00:14:35,749 --> 00:14:33,569
and determine relative activation

332
00:14:37,790 --> 00:14:35,759
energies for each reactant product when

333
00:14:40,460 --> 00:14:37,800
we took the natural log of time to reach

334
00:14:42,439 --> 00:14:40,470
an arbitrary point on either catalyst

335
00:14:45,530 --> 00:14:42,449
iron silicates in this case and residues

336
00:14:48,759 --> 00:14:45,540
in this case and the slope of the

337
00:14:51,100 --> 00:14:48,769
proximation times gas constant is the

338
00:14:53,960 --> 00:14:51,110

activation energy that we will employ

339
00:14:56,870 --> 00:14:53,970
and what we found is it in the first two

340
00:14:58,999 --> 00:14:56,880
here two products CN + ch4 they had a

341
00:15:00,980 --> 00:14:59,009
lower activation energy with the residue

342
00:15:03,530 --> 00:15:00,990
catalyst then with the original iron set

343
00:15:06,050 --> 00:15:03,540
so key catalyst showing that all of

344
00:15:08,050 --> 00:15:06,060
these are relative approximations it

345
00:15:11,439 --> 00:15:08,060
still gives a good indication that

346
00:15:14,090 --> 00:15:11,449
calestous was having faster and is more

347
00:15:16,009 --> 00:15:14,100
as if as a better way to do it on more

348
00:15:17,900 --> 00:15:16,019
favorable reaction and once the residues

349
00:15:19,249 --> 00:15:17,910
are formed but with the reactants it was

350
00:15:21,769 --> 00:15:19,259
the opposite which can be expected

351
00:15:22,990 --> 00:15:21,779
because this is the carbon dioxide was

352
00:15:25,129 --> 00:15:23,000
the first thing we could measure and

353
00:15:26,930 --> 00:15:25,139
they were put on to clean grains that

354
00:15:29,389 --> 00:15:26,940
was easier to deposit just carbon

355
00:15:31,430 --> 00:15:29,399
monoxide and clean range then to compete

356
00:15:34,309 --> 00:15:31,440
with the products that would be in by

357
00:15:35,600 --> 00:15:34,319
this stage and conclusion we came to

358
00:15:37,370 --> 00:15:35,610
where the iron silicate grains provide

359
00:15:38,920 --> 00:15:37,380
an initial catalytic surface organic

360
00:15:41,480 --> 00:15:38,930
compound production from carbon dioxide

361
00:15:43,040 --> 00:15:41,490
nitrogen and hydrogen and the

362
00:15:45,079 --> 00:15:43,050
carbonaceous coating forms on the

363
00:15:46,220 --> 00:15:45,089

silicates after repeated exposure about

364
00:15:48,110 --> 00:15:46,230
the second or third flush of the

365
00:15:49,790 --> 00:15:48,120
reactive gas system system and the

366
00:15:51,559 --> 00:15:49,800
organic coating formed but did not stop

367
00:15:53,150 --> 00:15:51,569
the catalysis the rate was actually even

368
00:15:55,340 --> 00:15:53,160
greater than that from the Queen so with

369
00:15:57,410 --> 00:15:55,350
the grain and most important parts at

370
00:15:59,030 --> 00:15:57,420
the bottom here at the catalytic nature

371
00:16:00,829 --> 00:15:59,040
of the organic coating I'll ask for the

372
00:16:02,240 --> 00:16:00,839
production of important and possible

373
00:16:04,189 --> 00:16:02,250
prebiotic organics throughout the solar

374
00:16:06,410 --> 00:16:04,199
nebula even after these South Koreans

375
00:16:07,759 --> 00:16:06,420
have become coated since the coating is

376
00:16:09,860 --> 00:16:07,769
actually a better catalyst than the

377
00:16:12,110 --> 00:16:09,870
original grains which was original

378
00:16:14,559 --> 00:16:12,120
hypothesis when these are some future

379
00:16:23,870 --> 00:16:14,569
directions and acknowledgments moving

380
00:16:26,269 --> 00:16:23,880
working towards it well thanks very much

381
00:16:29,059 --> 00:16:26,279
to Steve let's go first to our remote

382
00:16:31,059 --> 00:16:29,069
colleagues if any questions or comments

383
00:16:37,310 --> 00:16:31,069
from online sites

384
00:16:40,490 --> 00:16:37,320
now's the time hi can you hear me

385
00:16:46,280 --> 00:16:40,500
but Menard at Penn State okay I just

386
00:16:48,980 --> 00:16:46,290
wanted to ask him he reported CN is at

387
00:16:52,400 --> 00:16:48,990
CN radical that you were detecting or

388
00:16:54,620 --> 00:16:52,410

HCN the piece that we were looking at it

389
00:16:59,110 --> 00:16:54,630
was in the original two thousand to work

390
00:17:01,850 --> 00:16:59,120
with this it was just a cyanide

391
00:17:04,610 --> 00:17:01,860
derivative or we looked in the area of

392
00:17:06,170 --> 00:17:04,620
where cm peach will be found and so we

393
00:17:07,850 --> 00:17:06,180
can't we didn't have a GCMs or way to

394
00:17:13,329 --> 00:17:07,860
figure out exactly they're in these so

395
00:17:17,540 --> 00:17:13,339
we it was just seeing organic compounds

396
00:17:20,300 --> 00:17:17,550
okay how did you measure the CM compound

397
00:17:23,030 --> 00:17:20,310
we had an approximate dr. Hugo had

398
00:17:25,030 --> 00:17:23,040
earlier Denny's and decided on some

399
00:17:28,069 --> 00:17:25,040
Peaks that would be good to look at on

400
00:17:30,980 --> 00:17:28,079
the one of the areas of the CNP

401
00:17:32,510 --> 00:17:30,990
he had marked off and we used that from

402
00:17:34,190 --> 00:17:32,520
one who use the his research so I could

403
00:17:36,230 --> 00:17:34,200
keep the consistent because he decided

404
00:17:44,930 --> 00:17:36,240
they said that would be a good spot

405
00:17:46,520 --> 00:17:44,940
there anyone else online okay no but

406
00:17:50,660 --> 00:17:46,530
around the rim anybody knew got her wish

407
00:17:52,940 --> 00:17:50,670
to ask questions or make comments I just

408
00:17:55,280 --> 00:17:52,950
wanted to comment that I think this is

409
00:17:58,220 --> 00:17:55,290
very interesting and potentially quite

410
00:18:00,470 --> 00:17:58,230
important work because everyone who

411
00:18:02,240 --> 00:18:00,480
thinks about coded interstellar drains

412
00:18:05,870 --> 00:18:02,250
that fall into the nebula thinks about

413
00:18:08,330 --> 00:18:05,880

thick coatings of ices and organics and

414
00:18:10,340 --> 00:18:08,340
this refused that this happens naturally

415
00:18:12,200 --> 00:18:10,350
in the laboratory you know I start with

416
00:18:13,940 --> 00:18:12,210
a fresh silicon surface each time to

417
00:18:16,310 --> 00:18:13,950
keep building it up its fascinated with

418
00:18:18,710 --> 00:18:16,320
once they yeah yeah that's pretty good

419
00:18:21,890 --> 00:18:18,720
did you say what iron silicate you were

420
00:18:24,830 --> 00:18:21,900
working with a more his iron silicate

421
00:18:28,010 --> 00:18:24,840
smokes made in the lab here these are

422
00:18:31,460 --> 00:18:28,020
the interstellar analogs Joe yeah and

423
00:18:34,430 --> 00:18:31,470
that and gotta gesture here I'm going to

424
00:18:37,400 --> 00:18:34,440
be making yeah okay good

425
00:18:38,480 --> 00:18:37,410
thanks very much Steve next we're going

426
00:18:41,480 --> 00:18:38,490
to move on to

427
00:18:44,930 --> 00:18:41,490
macroscopic bodies we're going to begin

428
00:18:45,410 --> 00:18:44,940
with Cara Rehan it was a student at Iona

429
00:18:48,290 --> 00:18:45,420
College

430
00:18:51,230 --> 00:18:48,300
we worked here under with Mike de Santi

431
00:18:53,450 --> 00:18:51,240
as her mentor and we'll talk today about

432
00:18:58,280 --> 00:18:53,460
the chemical composition of Comet Q to

433
00:19:00,260 --> 00:18:58,290
mak holes so Cara take it away my name

434
00:19:02,419 --> 00:19:00,270
is Kara Hahn and I worked the Sun with

435
00:19:05,630 --> 00:19:02,429
dr. Michael de Santi on the organic

436
00:19:08,390 --> 00:19:05,640
composition of how my acute teaching

437
00:19:10,640 --> 00:19:08,400
methods comments are thought to have

438
00:19:12,440 --> 00:19:10,650

delivered water in the first organics to

439
00:19:15,260 --> 00:19:12,450
early Earth during the late heavy

440
00:19:17,390 --> 00:19:15,270
bombardment and by studying them we can

441
00:19:18,860 --> 00:19:17,400
begin to learn the chemical conditions

442
00:19:20,540 --> 00:19:18,870
of the proto solar nebula

443
00:19:23,180 --> 00:19:20,550
and also what they may have delivered to

444
00:19:28,280 --> 00:19:26,360
comet kyouto what is a long period Oort

445
00:19:31,610 --> 00:19:28,290
cloud comment that was observed on two

446
00:19:33,590 --> 00:19:31,620
different dates and comets are form for

447
00:19:34,880 --> 00:19:33,600
multiple icy comet pessimal so by

448
00:19:36,350 --> 00:19:34,890
observing Island two different dates

449
00:19:39,290 --> 00:19:36,360
were actually observing the different

450
00:19:44,180 --> 00:19:39,300
comet s levels and this is a test of

451
00:19:47,360 --> 00:19:44,190
their hetero or homogeneity data are

452
00:19:50,210 --> 00:19:47,370
taking at kept - on Mauna Kea Hawaii

453
00:19:51,799 --> 00:19:50,220
with the nurse sect and nurse f is in a

454
00:19:53,990 --> 00:19:51,809
shell granting spectrometer that we can

455
00:19:56,960 --> 00:19:54,000
place filters perpendicular to the a

456
00:19:58,730 --> 00:19:56,970
shell grade oh and on sue can select

457
00:20:02,780 --> 00:19:58,740
wavelength regions that want to focus on

458
00:20:04,940 --> 00:20:02,790
to the chip this isn't a scale and we

459
00:20:08,720 --> 00:20:04,950
resolved the coma instead of the nucleus

460
00:20:11,780 --> 00:20:08,730
but data are taken with four frames with

461
00:20:14,150 --> 00:20:11,790
the comment in two positions in an ABB

462
00:20:16,070 --> 00:20:14,160
a pattern and this is for fainter

463
00:20:20,900 --> 00:20:16,080

objects with brighter objects we not

464
00:20:23,120 --> 00:20:20,910
offset chips this is in a frame in

465
00:20:25,430 --> 00:20:23,130
respective Shella Graham and on the left

466
00:20:28,310 --> 00:20:25,440
is the wavelength and frequency ranges

467
00:20:31,070 --> 00:20:28,320
observed in each order and the right is

468
00:20:33,320 --> 00:20:31,080
are the molecules routinely observed in

469
00:20:35,000 --> 00:20:33,330
each of those orders the apartments of

470
00:20:37,210 --> 00:20:35,010
nurse Becky and crossed its birth is

471
00:20:40,040 --> 00:20:37,220
that all these molecules observed

472
00:20:42,140 --> 00:20:40,050
simultaneously which decreases the

473
00:20:44,090 --> 00:20:42,150
systematic error and also allows us to

474
00:20:46,310 --> 00:20:44,100
compare them to water which is very

475
00:20:50,180 --> 00:20:46,320
abundant on comets and use it as a

476
00:20:51,919 --> 00:20:50,190
baseline and by subtracting a B frame

477
00:20:56,330 --> 00:20:51,929
from this we can see a lot more features

478
00:20:58,640 --> 00:20:56,340
in contrast and at the top is around all

479
00:21:00,020 --> 00:20:58,650
the orders are the a and B beams and

480
00:21:04,100 --> 00:21:00,030
those are actually the dust continuing

481
00:21:07,220 --> 00:21:04,110
with the comment the bright lines on the

482
00:21:09,770 --> 00:21:07,230
are the comedy mission and sense NIRSPEC

483
00:21:12,799 --> 00:21:09,780
is groundbaits you also get atmospheres

484
00:21:15,710 --> 00:21:12,809
absorptions within the orders we're

485
00:21:18,320 --> 00:21:15,720
going to focus on 23 just to look at it

486
00:21:21,049 --> 00:21:18,330
closer and it's bright so the comment

487
00:21:24,340 --> 00:21:21,059
lines are easy to see after cleaning and

488
00:21:26,900 --> 00:21:24,350

spectrally aligning the data we get this

489
00:21:29,330 --> 00:21:26,910
straightened spectral order which we can

490
00:21:32,299 --> 00:21:29,340
extract a spectrum from to get rid of

491
00:21:34,160 --> 00:21:32,309
the atmospheric absorption lines we we

492
00:21:36,320 --> 00:21:34,170
apply a synthetic atmosphere of

493
00:21:38,180 --> 00:21:36,330
georgians model and align it with immune

494
00:21:41,419 --> 00:21:38,190
commentary continuum which is the blue

495
00:21:43,730 --> 00:21:41,429
stars and subtracted out the Ridgid the

496
00:21:45,409 --> 00:21:43,740
residual left is the comment spectrum

497
00:21:49,130 --> 00:21:45,419
and right here you're looking at the our

498
00:21:51,740 --> 00:21:49,140
branches methane up here this is named

499
00:21:54,440 --> 00:21:51,750
and just as comparison to another order

500
00:21:56,960 --> 00:21:54,450
in a different filter and another metric

501
00:22:01,940 --> 00:21:56,970
higher carbon is this is the Q branch of

502
00:22:04,310 --> 00:22:01,950
ethane right here and we use fluorescent

503
00:22:07,460 --> 00:22:04,320
models to a lot of the data this is

504
00:22:09,440 --> 00:22:07,470
order 16 and my Hilter it's carbon

505
00:22:11,570 --> 00:22:09,450
monoxide and water in order to study

506
00:22:16,070 --> 00:22:11,580
carbon monoxide we have to get rid of

507
00:22:18,620 --> 00:22:16,080
these water contributions behind the co

508
00:22:22,669 --> 00:22:18,630
line so to see what I write here so we

509
00:22:25,280 --> 00:22:22,679
apply a predicted fluorescence emissions

510
00:22:27,350 --> 00:22:25,290
model of water to the spectra and

511
00:22:31,220 --> 00:22:27,360
subtract it out so it relaxes just

512
00:22:33,409 --> 00:22:31,230
contributions from the co emissions we

513
00:22:35,180 --> 00:22:33,419

use the license model again to drive

514
00:22:37,549 --> 00:22:35,190
many of our principal measurements for

515
00:22:41,090 --> 00:22:37,559
comets and since those emission lines

516
00:22:43,909 --> 00:22:41,100
are temperature dependent by finding a

517
00:22:46,460 --> 00:22:43,919
best at fluorescence model that best

518
00:22:49,520 --> 00:22:46,470
fits with the predicted data we can get

519
00:22:53,390 --> 00:22:49,530
a rotational temperature and the ratio

520
00:22:56,120 --> 00:22:53,400
of the observed line flux to the

521
00:22:58,100 --> 00:22:56,130
predicted model is proportional to the

522
00:22:59,840 --> 00:22:58,110
production rate so we can drive

523
00:23:01,880 --> 00:22:59,850
production rates which is the rate that

524
00:23:04,909 --> 00:23:01,890
molecules are released from the nucleus

525
00:23:06,890 --> 00:23:04,919
into the coma and the mixing ratio is

526
00:23:08,720 --> 00:23:06,900
the percent abundance of the production

527
00:23:11,049 --> 00:23:08,730
rates relative to water or of the

528
00:23:13,850 --> 00:23:11,059
molecules relative to water

529
00:23:16,899 --> 00:23:13,860
now this is the results from November of

530
00:23:19,599 --> 00:23:16,909
2004 and each section refers

531
00:23:21,580 --> 00:23:19,609
to the different filters and the water

532
00:23:24,099 --> 00:23:21,590
production rates in each of those

533
00:23:25,509 --> 00:23:24,109
filters were the values to calculate the

534
00:23:28,479 --> 00:23:25,519
mixing ratios in each of their

535
00:23:30,779 --> 00:23:28,489
respective filters this is a little busy

536
00:23:35,289 --> 00:23:30,789
but mainly we focus on the mixing ratios

537
00:23:37,539 --> 00:23:35,299
and this is the November data compared

538
00:23:39,789 --> 00:23:37,549

to the January data the mixing ratios

539
00:23:43,479 --> 00:23:39,799
and you can see that over the results

540
00:23:45,999 --> 00:23:43,489
that we have they agree within 1 Sigma

541
00:23:51,639 --> 00:23:46,009
so it implies that Q to Z nucleus is

542
00:23:54,009 --> 00:23:51,649
homogeneous and I like to thank dr. D

543
00:23:58,930 --> 00:23:54,019
fancy dr. Bohr Evans blown away with for

544
00:24:07,119 --> 00:23:58,940
helping me out of all the interns thank

545
00:24:09,519 --> 00:24:07,129
you ok thanks very much kara so let's go

546
00:24:15,909 --> 00:24:09,529
first to our remote colleagues and call

547
00:24:17,649 --> 00:24:15,919
for questions from the remote sites okay

548
00:24:20,169 --> 00:24:17,659
how about your Goddard anybody yet

549
00:24:23,950 --> 00:24:20,179
Goddard wish to make a comment or ask a

550
00:24:26,710 --> 00:24:23,960
question well I was kind of curious as

551
00:24:34,060 --> 00:24:26,720
to why in January three molecules were

552
00:24:36,070 --> 00:24:34,070
missing on this comparison so as you

553
00:24:37,330 --> 00:24:36,080
were just showing a tube molecules that

554
00:24:38,919 --> 00:24:37,340
have been measured by other people

555
00:24:41,409 --> 00:24:38,929
whereas you had done all the work in

556
00:24:43,690 --> 00:24:41,419
November's as I understand it yeah

557
00:24:50,469 --> 00:24:43,700
January was done by dr. von Shyvana

558
00:24:53,169 --> 00:24:50,479
mm-hmm I know okay thanks very much well

559
00:24:54,879 --> 00:24:53,179
there's a question here Josh Turner just

560
00:24:57,879 --> 00:24:54,889
wondering with it that you're talking

561
00:24:59,099 --> 00:24:57,889
about Q branch a branch of that thing or

562
00:25:00,339 --> 00:24:59,109
something like that what was the

563
00:25:05,469 --> 00:25:00,349

question

564
00:25:09,369 --> 00:25:05,479
oh here's wondering what the Q branch of

565
00:25:14,409 --> 00:25:09,379
a thing was molecules that have those

566
00:25:17,529 --> 00:25:14,419
overall vibrational lines and molecules

567
00:25:19,839 --> 00:25:17,539
that aren't linear have P branches Q

568
00:25:27,440 --> 00:25:19,849
branches and are branches and it's just

569
00:25:33,600 --> 00:25:31,520
um without our and kilos referred

570
00:25:37,350 --> 00:25:33,610
changes and different quantum numbers

571
00:25:39,420 --> 00:25:37,360
and hue branches refresh ones that step

572
00:25:44,130 --> 00:25:39,430
up to the finish I remember after the

573
00:25:45,900 --> 00:25:44,140
rotation transition keep that question

574
00:25:48,210 --> 00:25:45,910
and next Summerlin Cara comes back

575
00:25:50,870 --> 00:25:48,220
through secondary school answer this in

576
00:25:55,260 --> 00:25:50,880
great detail

577
00:25:57,270 --> 00:25:55,270
ok anyone else actually Cara what you

578
00:25:59,100 --> 00:25:57,280
the work you have done addresses a

579
00:26:01,860 --> 00:25:59,110
fundamental question of commentary

580
00:26:04,050 --> 00:26:01,870
science which is are they all

581
00:26:06,600 --> 00:26:04,060
homogeneous internally or do some

582
00:26:09,420 --> 00:26:06,610
contain comet Izumo formed in different

583
00:26:11,310 --> 00:26:09,430
regions at the protoplanetary disk yeah

584
00:26:14,580 --> 00:26:11,320
so I think this is a very interesting

585
00:26:17,060 --> 00:26:14,590
result that you've presented ok thanks

586
00:26:21,750 --> 00:26:17,070
very much we're going to move on to

587
00:26:25,110 --> 00:26:21,760
meteorites James Doty who is a currently

588
00:26:27,390 --> 00:26:25,120

a student at Rice University and has

589
00:26:29,790 --> 00:26:27,400
been working here with Jason Morgan and

590
00:26:32,640 --> 00:26:29,800
Danny Glavine will discuss search for

591
00:26:35,910 --> 00:26:32,650
purines and pyrimidines in carbonaceous

592
00:26:39,390 --> 00:26:35,920
meteorites and I would comment that the

593
00:26:43,380 --> 00:26:39,400
boat the next two talks James and Josh's

594
00:26:45,330 --> 00:26:43,390
were done with the new astrobiology

595
00:26:48,540 --> 00:26:45,340
analytical lab that was funded in part

596
00:26:51,960 --> 00:26:48,550
through the NAI grant but also in large

597
00:26:52,650 --> 00:26:51,970
part through Goddard cost-sharing and

598
00:26:55,650 --> 00:26:52,660
anyway

599
00:26:58,620 --> 00:26:55,660
take it away James thank you dr. mundo

600
00:27:00,930 --> 00:26:58,630
as you said I'm Jim Daly and go to rice

601
00:27:02,220 --> 00:27:00,940
it's in Houston Texas I'm going to be

602
00:27:04,650 --> 00:27:02,230
talking to you a little bit about era

603
00:27:08,120 --> 00:27:04,660
aromatics and carbonaceous meteorites

604
00:27:11,370 --> 00:27:08,130
specifically cm to type meteorites

605
00:27:14,520 --> 00:27:11,380
alright here's the overview of the

606
00:27:17,580 --> 00:27:14,530
carbon cycle in our universe and you've

607
00:27:20,940 --> 00:27:17,590
heard talks from my colleagues earlier

608
00:27:22,470 --> 00:27:20,950
and the processing that goes along and

609
00:27:23,670 --> 00:27:22,480
gets incorporated in the comments and

610
00:27:27,270 --> 00:27:23,680
then eventually some of this material

611
00:27:29,220 --> 00:27:27,280
will you've delivered earth a good idea

612
00:27:31,730 --> 00:27:29,230
of the kind of organics that get

613
00:27:35,280 --> 00:27:31,740

delivered through things like Murchison

614
00:27:36,899 --> 00:27:35,290
come in meteorites and so our question

615
00:27:39,119 --> 00:27:36,909
is to answer

616
00:27:42,119 --> 00:27:39,129
what kind of organics and in this lab in

617
00:27:43,619 --> 00:27:42,129
mind is more specifically aromatic

618
00:27:48,210 --> 00:27:43,629
compounds such as purines and

619
00:27:50,460 --> 00:27:48,220
pyrimidines okay as far as a their

620
00:27:52,589 --> 00:27:50,470
importance to astrobiology periods of

621
00:27:54,239 --> 00:27:52,599
prunings are ubiquitous to the life that

622
00:27:56,099 --> 00:27:54,249
we have here on earth they are

623
00:27:57,299 --> 00:27:56,109
incorporated into the informational

624
00:28:00,749 --> 00:27:57,309
molecules in life

625
00:28:03,210 --> 00:28:00,759
they're used in catalysis and also in

626
00:28:05,279 --> 00:28:03,220
the origin of life the RNA and pre RNA

627
00:28:08,190 --> 00:28:05,289
worlds we it is hypothesized that they

628
00:28:11,869 --> 00:28:08,200
are crucial those types of life to get

629
00:28:14,430 --> 00:28:11,879
started so the traditional protocol for

630
00:28:17,310 --> 00:28:14,440
getting these compounds out of

631
00:28:22,549 --> 00:28:17,320
meteorites required a long painful

632
00:28:24,719 --> 00:28:22,559
process that involved many solvents and

633
00:28:28,200 --> 00:28:24,729
contamination and we would only get

634
00:28:31,889 --> 00:28:28,210
about a 45 percent recovery rate Danny

635
00:28:33,839 --> 00:28:31,899
flavin got his PhD developing a

636
00:28:36,509 --> 00:28:33,849
sublimation product protocol which is

637
00:28:38,899 --> 00:28:36,519
much simpler takes about a day and has a

638
00:28:41,399 --> 00:28:38,909

much higher average recovery rate

639
00:28:43,109 --> 00:28:41,409
sublimation is very easy you take your

640
00:28:45,779 --> 00:28:43,119
meteorite extract you grind it up and

641
00:28:48,269 --> 00:28:45,789
you make formic acid extract that's

642
00:28:50,070 --> 00:28:48,279
basically just making a coffee out of it

643
00:28:51,930 --> 00:28:50,080
you boil it in the formic pak-trak

644
00:28:54,779 --> 00:28:51,940
place the extract at Bottomly

645
00:28:57,629 --> 00:28:54,789
sublimation tube evacuate it and place

646
00:28:59,909 --> 00:28:57,639
liquid nitrogen in a coal finger at

647
00:29:01,739 --> 00:28:59,919
reduced pressure and elevated

648
00:29:04,080 --> 00:29:01,749
temperature the compounds of interest

649
00:29:06,089 --> 00:29:04,090
the organic ones sublime and the

650
00:29:10,320 --> 00:29:06,099
minerals that interfere with our

651
00:29:12,599 --> 00:29:10,330
analysis are left behind this is how we

652
00:29:17,099 --> 00:29:12,609
do our analysis we use a separation

653
00:29:19,560 --> 00:29:17,109
using HPLC which merely separates out

654
00:29:21,989 --> 00:29:19,570
compounds based on solubility we then

655
00:29:23,430 --> 00:29:21,999
pass them to two detectors one is the UV

656
00:29:25,769 --> 00:29:23,440
absorbance detector and the other is at

657
00:29:28,139 --> 00:29:25,779
a time of flight mass spectrometer the

658
00:29:29,519 --> 00:29:28,149
mass spectrometer we use uses a soft

659
00:29:32,310 --> 00:29:29,529
ionization technique there's

660
00:29:36,839 --> 00:29:32,320
electrospray ionization which gives us

661
00:29:39,869 --> 00:29:36,849
the mass of the parent ion plus one

662
00:29:41,700 --> 00:29:39,879
proton and this gives us very little

663
00:29:46,169 --> 00:29:41,710

fragmentation pattern so what we get is

664
00:29:48,820 --> 00:29:46,179
a the molecular formula of our compound

665
00:29:50,590 --> 00:29:48,830
no structural information

666
00:29:52,150 --> 00:29:50,600
let's take a moment to familiarize

667
00:29:55,270 --> 00:29:52,160
ourselves with what our data looks like

668
00:29:58,060 --> 00:29:55,280
on the bottom trace we have relative

669
00:30:00,010 --> 00:29:58,070
absorbance versus vertex time and then

670
00:30:03,250 --> 00:30:00,020
the preceding the chromatograms on top

671
00:30:05,350 --> 00:30:03,260
are traces of mats in UV absorbance each

672
00:30:07,270 --> 00:30:05,360
peak corresponds to one specific

673
00:30:11,010 --> 00:30:07,280
compound that is looting off of the

674
00:30:13,930 --> 00:30:11,020
column above a masked race tracks when

675
00:30:18,040 --> 00:30:13,940
ions of certain mass are coming to the

676
00:30:19,750 --> 00:30:18,050
detector so in UV you can see that some

677
00:30:23,020 --> 00:30:19,760
of the compounds overlap but this

678
00:30:26,710 --> 00:30:23,030
ambiguity can be resolved by using their

679
00:30:28,660 --> 00:30:26,720
specific masks also at each time we can

680
00:30:31,810 --> 00:30:28,670
see that there is a mass spectrum and

681
00:30:35,740 --> 00:30:31,820
this is shows you how you can see the

682
00:30:38,920 --> 00:30:35,750
mass of adding and then adding one c-13

683
00:30:41,140 --> 00:30:38,930
and with two super kings we ran our

684
00:30:43,180 --> 00:30:41,150
analysis with three meteorites Murchison

685
00:30:47,220 --> 00:30:43,190
landed in Australia

686
00:30:49,870 --> 00:30:47,230
Lulla aah both landed in Antarctica

687
00:30:52,360 --> 00:30:49,880
initially we identified xanthine uracil

688
00:30:55,180 --> 00:30:52,370

and guanine in these meteorites and alh

689
00:30:58,090 --> 00:30:55,190
is good to note is depleted in UV

690
00:31:00,280 --> 00:30:58,100
absorbing organics this corresponds well

691
00:31:03,700 --> 00:31:00,290
with a study on the amino acids in alh

692
00:31:06,690 --> 00:31:03,710
as compared to these two and they were a

693
00:31:09,520 --> 00:31:06,700
Lakes was depleted in the amino acids

694
00:31:12,970 --> 00:31:09,530
these are all very good comparisons

695
00:31:16,750 --> 00:31:12,980
amongst these meteorites because they're

696
00:31:18,670 --> 00:31:16,760
all the same Petra logical grid okay

697
00:31:21,340 --> 00:31:18,680
here's that same plot you saw for the

698
00:31:23,770 --> 00:31:21,350
standard but for Murchison and while you

699
00:31:25,200 --> 00:31:23,780
can see that there the compounds for my

700
00:31:27,640 --> 00:31:25,210
standard don't appear to be in their

701
00:31:29,230 --> 00:31:27,650
compounds of the same mass that is the

702
00:31:31,210 --> 00:31:29,240
same molecular formula but different

703
00:31:33,130 --> 00:31:31,220
retention time thus speaking to a

704
00:31:35,500 --> 00:31:33,140
difference in chemistry or a difference

705
00:31:38,170 --> 00:31:35,510
in the way the atoms are arranged in the

706
00:31:41,230 --> 00:31:38,180
molecule shows us that there are many

707
00:31:44,380 --> 00:31:41,240
possible isomers of my standards in this

708
00:31:48,760 --> 00:31:44,390
so we go about identifying these is to

709
00:31:51,550 --> 00:31:48,770
expand the library we with the help of

710
00:31:55,600 --> 00:31:51,560
dr. Henderson Cleese at Carnegie and in

711
00:31:57,460 --> 00:31:55,610
here at Goddard we were able to amass a

712
00:31:59,680 --> 00:31:57,470
larger library of these aromatic

713
00:32:00,940 --> 00:31:59,690

compounds so to go through a little

714
00:32:02,680 --> 00:32:00,950
process of how we take

715
00:32:06,760 --> 00:32:02,690
we're going to pick one group

716
00:32:10,540 --> 00:32:06,770
naphthalene and focusing on the oxidized

717
00:32:12,970 --> 00:32:10,550
natural and oxidized a place if you just

718
00:32:14,230 --> 00:32:12,980
put one hydroxy group on you there are

719
00:32:15,640 --> 00:32:14,240
two isomers

720
00:32:17,890 --> 00:32:15,650
they were predicted to be in

721
00:32:21,790 --> 00:32:17,900
carbonaceous chondrites and they have a

722
00:32:23,260 --> 00:32:21,800
positive mass of 145 so you go to the

723
00:32:26,170 --> 00:32:23,270
data from the meteorite that you

724
00:32:28,900 --> 00:32:26,180
collected and look for mass 145 and

725
00:32:30,910 --> 00:32:28,910
there's a promising peak then you run

726
00:32:33,880 --> 00:32:30,920
the standard and under the conditions

727
00:32:36,130 --> 00:32:33,890
that we ran our standards that we did

728
00:32:38,020 --> 00:32:36,140
not get any ionization the small people

729
00:32:41,440 --> 00:32:38,030
see there is actually a c-13 peak of

730
00:32:43,990 --> 00:32:41,450
another compound so under the procedures

731
00:32:48,130 --> 00:32:44,000
for the extraction of the meteorites I

732
00:32:51,580 --> 00:32:48,140
can say that there are there's no

733
00:32:54,100 --> 00:32:51,590
naphthols present but maybe under better

734
00:32:56,050 --> 00:32:54,110
techniques you might see them in

735
00:32:58,210 --> 00:32:56,060
conclusion are the sublimation is

736
00:33:01,480 --> 00:32:58,220
improved in the older extraction

737
00:33:05,320 --> 00:33:01,490
procedure we are able to detect

738
00:33:07,870 --> 00:33:05,330

biologically relevant nuclear bases the

739
00:33:09,850 --> 00:33:07,880
MS trace shows that there's many

740
00:33:11,440 --> 00:33:09,860
interesting things that we need to

741
00:33:14,620 --> 00:33:11,450
pursue to identify these other compounds

742
00:33:16,060 --> 00:33:14,630
and it is interesting to note that the

743
00:33:18,040 --> 00:33:16,070
functionalized aromatics and meteorites

744
00:33:20,740 --> 00:33:18,050
are not well studied so this is it is an

745
00:33:22,630 --> 00:33:20,750
important to understand the chemistry on

746
00:33:25,420 --> 00:33:22,640
the parent body and what got delivered

747
00:33:34,090 --> 00:33:25,430
to earth for the origin of why and I

748
00:33:36,430 --> 00:33:34,100
will turn it back over to dr. Moore all

749
00:33:39,190 --> 00:33:36,440
right so that's pretty interesting stuff

750
00:33:40,840 --> 00:33:39,200
and I'm really pleased that you

751
00:33:43,090 --> 00:33:40,850
mentioned our collaboration with

752
00:33:46,570 --> 00:33:43,100
Carnegie particular since Carnegie's

753
00:33:48,520 --> 00:33:46,580
online no just teasing there is a very

754
00:33:52,510 --> 00:33:48,530
vigorous collaboration going on between

755
00:33:53,110 --> 00:33:52,520
the analytic biology groups at Carnegie

756
00:33:56,320 --> 00:33:53,120
anakata

757
00:34:00,029 --> 00:33:56,330
let me call for questions first or

758
00:34:07,510 --> 00:34:05,350
hi Bob and I are at Penn State again did

759
00:34:11,589 --> 00:34:07,520
you run a control where you didn't do

760
00:34:13,960 --> 00:34:11,599
the hydrolysis with formic acid and just

761
00:34:19,139 --> 00:34:13,970
heated the samples to blind the sample

762
00:34:21,159 --> 00:34:19,149
without treatment by formic acid water I

763
00:34:24,040 --> 00:34:21,169

personally have not done that experiment

764
00:34:27,720 --> 00:34:24,050
but I believe Daniel Glavine has in the

765
00:34:29,980 --> 00:34:27,730
past not on these meteorites but has

766
00:34:32,849 --> 00:34:29,990
assumed you're speaking to the thermal

767
00:34:36,700 --> 00:34:32,859
degradation of the product and

768
00:34:39,570 --> 00:34:36,710
determined that that that was not me -

769
00:34:43,389 --> 00:34:39,580
the fact that you can get these sort of

770
00:34:47,830 --> 00:34:43,399
nucleobases purines and pyrimidines by

771
00:34:52,089 --> 00:34:47,840
hydrolysis of HCN polymer and so i'm

772
00:34:54,339 --> 00:34:52,099
wondering whether there might be ACN

773
00:34:59,200 --> 00:34:54,349
polymer present and therefore you would

774
00:35:02,470 --> 00:34:59,210
get you would need to submit the solid

775
00:35:06,700 --> 00:35:02,480
to hydrolysis in order to see those to

776
00:35:12,339 --> 00:35:06,710
break down the ACN polymer we have not

777
00:35:15,700 --> 00:35:12,349
done those for these meteorites I don't

778
00:35:17,200 --> 00:35:15,710
see down your Jason in the room so I

779
00:35:20,680 --> 00:35:17,210
think we're going to have to refer that

780
00:35:24,880 --> 00:35:20,690
question ginger don't you get back to

781
00:35:26,650 --> 00:35:24,890
Bob tomorrow if you're online Bob you

782
00:35:31,960 --> 00:35:26,660
can send you an email on that will

783
00:35:33,400 --> 00:35:31,970
clarify that okay Nate yeah thanks okay

784
00:35:35,500 --> 00:35:33,410
Bob in fact you have my email address

785
00:35:39,160 --> 00:35:35,510
once you send me yours I don't think I

786
00:35:39,670 --> 00:35:39,170
have it but we'll do everything okay

787
00:35:42,160 --> 00:35:39,680
thanks

788
00:35:44,460 --> 00:35:42,170

yeah I got to come down there yeah we

789
00:35:47,320 --> 00:35:44,470
really want to see you here actually

790
00:35:50,230 --> 00:35:47,330
okay great okay any questions here at

791
00:35:52,510 --> 00:35:50,240
Goddard or clarifications where did

792
00:35:54,280 --> 00:35:52,520
these meteorites come from tell me where

793
00:36:00,780 --> 00:35:54,290
they were found but we're in space did

794
00:36:03,910 --> 00:36:00,790
they come from right their origin from

795
00:36:06,060 --> 00:36:03,920
planets from I believe they were most

796
00:36:13,740 --> 00:36:06,070
likely asteroids but I'm not

797
00:36:14,790 --> 00:36:13,750
this okay no Mars meteorites these were

798
00:36:18,210 --> 00:36:14,800
not Mars meteorites

799
00:36:19,350 --> 00:36:18,220
that's we don't I don't think so I'm

800
00:36:20,790 --> 00:36:19,360
fairly sure that they're not Mars

801
00:36:25,100 --> 00:36:20,800
meteorites they would have told me that

802
00:36:27,960 --> 00:36:25,110
anything yeah tell me again further

803
00:36:31,830 --> 00:36:27,970
comment the change made which is correct

804
00:36:34,650 --> 00:36:31,840
but the other zone of the asteroid belt

805
00:36:36,420 --> 00:36:34,660
is carbon-rich so these probably came

806
00:36:39,480 --> 00:36:36,430
from that outer zone somewhere between

807
00:36:41,850 --> 00:36:39,490
four au and crepes four and a half au

808
00:36:43,470 --> 00:36:41,860
whereas the inner asteroids generally

809
00:36:48,270 --> 00:36:43,480
tend to be Stoney's occasionally

810
00:36:50,130 --> 00:36:48,280
metallic asteroids meteorites hi all

811
00:36:54,120 --> 00:36:50,140
right thanks very much Jim let's go on

812
00:36:57,350 --> 00:36:54,130
to Josh Stern josh is a student from

813
00:37:00,530 --> 00:36:57,360

Brown University again working with

814
00:37:03,030 --> 00:37:00,540
Jason and Aimee primarily on

815
00:37:05,610 --> 00:37:03,040
urbanization which is a fancy word he's

816
00:37:08,790 --> 00:37:05,620
going to explain of Karluk silicon

817
00:37:10,770 --> 00:37:08,800
hydric oxalic acids with Karl

818
00:37:16,020 --> 00:37:10,780
fluorescent tags and I wanted to come to

819
00:37:19,260 --> 00:37:16,030
pronounce the name of the tag so Josh go

820
00:37:21,960 --> 00:37:19,270
ahead when ready okay so I'm Josh Stern

821
00:37:25,590 --> 00:37:21,970
title of my talk is derivatives ation of

822
00:37:31,190 --> 00:37:25,600
some carboxylic and hydroxy acids with

823
00:37:33,750 --> 00:37:31,200
the Karl fluorescent tag dbgap why so

824
00:37:36,840 --> 00:37:33,760
you know proteins and terrestrial

825
00:37:40,470 --> 00:37:36,850
biology are overwhelmingly left-handed

826
00:37:44,280 --> 00:37:40,480
made up of left-handed amino acids an

827
00:37:47,850 --> 00:37:44,290
example so a left-handed amino acid is

828
00:37:49,920 --> 00:37:47,860
an example of a chiral object like this

829
00:37:52,670 --> 00:37:49,930
this right-handed desk and this

830
00:37:56,490 --> 00:37:52,680
left-handed desk and that's because the

831
00:37:58,340 --> 00:37:56,500
right-handed desk if you reflected you

832
00:38:01,080 --> 00:37:58,350
can't superimpose it on its mirror image

833
00:38:04,440 --> 00:38:01,090
an example of an a Carl object would be

834
00:38:06,930 --> 00:38:04,450
this chair reflect that and you can

835
00:38:09,330 --> 00:38:06,940
superimpose on its mirror image another

836
00:38:12,720 --> 00:38:09,340
example of an a Carl object is the

837
00:38:14,370 --> 00:38:12,730
molecule of lyric acid this is

838
00:38:17,340 --> 00:38:14,380

superimposable on its mirror image and

839
00:38:18,109 --> 00:38:17,350
then another example of a chiral object

840
00:38:20,960 --> 00:38:18,119
is the

841
00:38:22,549 --> 00:38:20,970
acid ISIL valine reflect that it will

842
00:38:29,089 --> 00:38:22,559
not be superimposable on its mirror

843
00:38:31,579 --> 00:38:29,099
image so there's a question of why are

844
00:38:35,499 --> 00:38:31,589
the amino acids that that were made of

845
00:38:37,670 --> 00:38:35,509
left handed and not right-handed and

846
00:38:40,480 --> 00:38:37,680
being able to answer this question will

847
00:38:45,109 --> 00:38:40,490
help us explain the origin of life and

848
00:38:48,009 --> 00:38:45,119
one one clue perhaps is that there's

849
00:38:49,849 --> 00:38:48,019
there's been studies of meteorites and

850
00:38:52,700 --> 00:38:49,859
carbonaceous chondrites and they've

851
00:38:54,680 --> 00:38:52,710
found an excess of left-handed I so

852
00:38:56,569 --> 00:38:54,690
valine significant excess in the

853
00:38:59,809 --> 00:38:56,579
meteorites so we're interested in

854
00:39:02,450 --> 00:38:59,819
studying meteorites and the way we've

855
00:39:03,529 --> 00:39:02,460
studied them is using or one way to

856
00:39:06,259 --> 00:39:03,539
study them is using high-performance

857
00:39:07,460 --> 00:39:06,269
liquid chromatography you can you can

858
00:39:08,870 --> 00:39:07,470
what you can do is you can take the

859
00:39:11,509 --> 00:39:08,880
amino acids in the meteorite and then

860
00:39:15,769 --> 00:39:11,519
attach a fluorescent molecule to that

861
00:39:17,539 --> 00:39:15,779
acid to the amino acid and then and then

862
00:39:19,249 --> 00:39:17,549
put in the chrome target breeding

863
00:39:22,130 --> 00:39:19,259

machines separate the compound separate

864
00:39:25,220 --> 00:39:22,140
the various amino acids and then run it

865
00:39:28,309 --> 00:39:25,230
through this fluorescence detector what

866
00:39:31,039 --> 00:39:28,319
that'll do is if you know if you have a

867
00:39:32,839 --> 00:39:31,049
high high fluorescence measurement then

868
00:39:36,319 --> 00:39:32,849
that is proportional to the amount of

869
00:39:38,539 --> 00:39:36,329
amino acid present and so by this method

870
00:39:41,029 --> 00:39:38,549
you can measure the abundance of each

871
00:39:44,690 --> 00:39:41,039
chirality of amino acids and various

872
00:39:46,880 --> 00:39:44,700
amino acids and so the way we driven

873
00:39:48,140 --> 00:39:46,890
ties we tagged primarily in medians

874
00:39:50,299 --> 00:39:48,150
that's that's the way that we attach

875
00:39:51,650 --> 00:39:50,309
this fluorescent tag to it one thing

876
00:39:53,479 --> 00:39:51,660
that I'm not going to focus on very much

877
00:39:55,400 --> 00:39:53,489
that I did this summer was I looked at

878
00:39:57,440 --> 00:39:55,410
the decay of amino acids that are

879
00:40:01,309 --> 00:39:57,450
derivatives with this fluorescence okay

880
00:40:04,420 --> 00:40:01,319
and the C tag and this is useful for

881
00:40:06,769 --> 00:40:04,430
kind of knowing how how long can do

882
00:40:09,109 --> 00:40:06,779
derivatives the amino acids stay around

883
00:40:12,799 --> 00:40:09,119
how viable are they over time at

884
00:40:15,789 --> 00:40:12,809
negative 86 degrees Celsius but what I

885
00:40:18,910 --> 00:40:15,799
focused most of my summer on was

886
00:40:22,339 --> 00:40:18,920
developing a different way to Rivet eyes

887
00:40:25,009 --> 00:40:22,349
carboxylic acids and which can be

888
00:40:26,749 --> 00:40:25,019

applied to amino acids and using a

889
00:40:28,489 --> 00:40:26,759
different fluorescent tag a different

890
00:40:30,890 --> 00:40:28,499
reaction so what this does is this is

891
00:40:33,289 --> 00:40:30,900
this is a fluorescent I know

892
00:40:37,579 --> 00:40:33,299
fluorescent molecules abbreviated our

893
00:40:40,010 --> 00:40:37,589
DVD of UI and you combine that with four

894
00:40:42,109 --> 00:40:40,020
in this case Balearic acid it's got a

895
00:40:44,240 --> 00:40:42,119
carboxyl group right here

896
00:40:48,500 --> 00:40:44,250
and this is a non amino acid I'll

897
00:40:52,460 --> 00:40:48,510
explain that in a minute on the the N on

898
00:40:55,370 --> 00:40:52,470
the on the tag bonds to the carbon in

899
00:40:57,140 --> 00:40:55,380
this carboxyl group in the the O H goes

900
00:41:00,950 --> 00:40:57,150
away and so you end up with this

901
00:41:03,799 --> 00:41:00,960
derivative Larrick acid this reaction

902
00:41:06,769 --> 00:41:03,809
also works if I want to do a hydroxy

903
00:41:08,839 --> 00:41:06,779
acid hydroxy acid right here but it also

904
00:41:11,450 --> 00:41:08,849
has this carboxyl group so you can put

905
00:41:14,839 --> 00:41:11,460
that with the DBA py and you'll get a

906
00:41:17,690 --> 00:41:14,849
derivative hydroxy acid and then it also

907
00:41:19,250 --> 00:41:17,700
should work with an amino acid because

908
00:41:20,990 --> 00:41:19,260
the amino acid also has a core box of

909
00:41:24,500 --> 00:41:21,000
your P R and so the same thing will

910
00:41:25,730 --> 00:41:24,510
occurr have River ties I Sylvanian so

911
00:41:28,309 --> 00:41:25,740
this would be a really great technique

912
00:41:30,410 --> 00:41:28,319
to make happen because you can study

913
00:41:35,299 --> 00:41:30,420

amino acids hydroxy acids and carboxylic

914
00:41:37,819 --> 00:41:35,309
acid and the reason why we're interested

915
00:41:39,440 --> 00:41:37,829
in studying hydroxy acids is this is

916
00:41:41,960 --> 00:41:39,450
kind of busy but just focus on these two

917
00:41:44,569 --> 00:41:41,970
boxes here this is the structure

918
00:41:46,519 --> 00:41:44,579
synthesis and it's thought to be process

919
00:41:48,500 --> 00:41:46,529
happens on meteorites and then this is a

920
00:41:50,660 --> 00:41:48,510
parallel reaction that occurs that forms

921
00:41:52,730 --> 00:41:50,670
the hydroxy acid equivalent of an amino

922
00:41:54,109 --> 00:41:52,740
acid and so that's why we want to study

923
00:41:58,609 --> 00:41:54,119
hydroxy acids it'll help us to learn

924
00:42:01,519 --> 00:41:58,619
about amino acids and so this is this is

925
00:42:04,309 --> 00:42:01,529
what my date will look like this bottom

926
00:42:06,289 --> 00:42:04,319
graph here is retention time versus

927
00:42:08,900 --> 00:42:06,299
fluorescence intensity and then these

928
00:42:12,519 --> 00:42:08,910
three top graphs are retention time

929
00:42:16,000 --> 00:42:12,529
versus mass intensity so each each peak

930
00:42:19,359 --> 00:42:16,010
corresponds to a distinct compound and

931
00:42:22,490 --> 00:42:19,369
so so this peak right here is unreacted

932
00:42:24,230 --> 00:42:22,500
DVD APY there's a huge excess of it and

933
00:42:25,970 --> 00:42:24,240
we're confident that really is a due

934
00:42:28,400 --> 00:42:25,980
date why because we see the massed peak

935
00:42:30,470 --> 00:42:28,410
we see the mask peak in this window

936
00:42:34,670 --> 00:42:30,480
because you're only counting when it's

937
00:42:37,190 --> 00:42:34,680
between this brain you're 312 3.12 12.4

938
00:42:39,200 --> 00:42:37,200

and then also this is the peak for

939
00:42:41,150 --> 00:42:39,210
derivatives of lauric acid and we're

940
00:42:43,069 --> 00:42:41,160
confident about that because we see the

941
00:42:45,499 --> 00:42:43,079
mask peak at the mask

942
00:42:47,599 --> 00:42:45,509
as work acid and this is an unknown

943
00:42:50,209 --> 00:42:47,609
compound and we know that the masses 649

944
00:42:54,739 --> 00:42:50,219
we think that it's a contaminant in our

945
00:42:56,359 --> 00:42:54,749
catalysts so these graphs here are the

946
00:42:59,449 --> 00:42:56,369
same as the one before it's just using a

947
00:43:01,519 --> 00:42:59,459
hydroxy s at this time so here this is

948
00:43:03,949 --> 00:43:01,529
this peak is dvd-a py the fluorescent

949
00:43:06,969 --> 00:43:03,959
tag and then I haven't shown that on the

950
00:43:10,309 --> 00:43:06,979
mass but these two small Peaks are

951
00:43:12,109 --> 00:43:10,319
derivatives hydroxy acid more confident

952
00:43:16,849 --> 00:43:12,119
that because you can see you can see the

953
00:43:18,799 --> 00:43:16,859
peak in the mass data and then this is

954
00:43:23,719 --> 00:43:18,809
also an unexplained peak I don't have

955
00:43:25,819 --> 00:43:23,729
time to go into and so basically we've

956
00:43:27,529 --> 00:43:25,829
had mixed success with these efforts to

957
00:43:28,819 --> 00:43:27,539
derivatives carboxylic acids when you're

958
00:43:30,890 --> 00:43:28,829
when you're studying meteorites you

959
00:43:33,469 --> 00:43:30,900
really want to have a very low detection

960
00:43:35,479 --> 00:43:33,479
limit because it's precious sample and

961
00:43:38,029 --> 00:43:35,489
because you don't have many amino acids

962
00:43:40,160 --> 00:43:38,039
inside the actual meteorite so we want

963
00:43:42,410 --> 00:43:40,170

starting concentration of the acid in

964
00:43:44,420 --> 00:43:42,420
this window you know 10 to the minus 6

965
00:43:45,279 --> 00:43:44,430
10 to minus 10 molar and this is where I

966
00:43:47,930 --> 00:43:45,289
am right now

967
00:43:49,519 --> 00:43:47,940
so there's definitely long ways to go

968
00:43:51,890 --> 00:43:49,529
and I'm in communication with the author

969
00:43:54,259 --> 00:43:51,900
of the original procedure who developed

970
00:43:56,209 --> 00:43:54,269
it for using medicine and so we have

971
00:43:58,249 --> 00:43:56,219
some ideas and hopefully we'll go

972
00:43:59,630 --> 00:43:58,259
somewhere with that and I just like to

973
00:44:01,880 --> 00:43:59,640
acknowledge my mentor dr. Jason's

974
00:44:03,410 --> 00:44:01,890
working as well as mr. Jim Doty who

975
00:44:04,849 --> 00:44:03,420
really spent a lot of time teaching me

976
00:44:12,219 --> 00:44:04,859
about all the instruments in the lab and

977
00:44:16,609 --> 00:44:14,390
thank you very much Josh it's quite an

978
00:44:19,309 --> 00:44:16,619
interesting thing I must say the first

979
00:44:21,199 --> 00:44:19,319
time I got a really heard a really clear

980
00:44:23,689 --> 00:44:21,209
and concise and understandable

981
00:44:27,859 --> 00:44:23,699
explanation of the relation between the

982
00:44:29,779 --> 00:44:27,869
mass spectra and the type of play equal

983
00:44:32,359 --> 00:44:29,789
time evolution spectra is really quite

984
00:44:34,670 --> 00:44:32,369
nice to me well it's so let's turn first

985
00:44:36,289 --> 00:44:34,680
through our colleagues that online and

986
00:44:46,410 --> 00:44:36,299
see if I've got any questions out there

987
00:44:52,530 --> 00:44:49,210
all right anybody here at Goddard we

988
00:44:57,730 --> 00:44:52,540

should to ask a question make a comment

989
00:45:01,240 --> 00:44:57,740
see if you weld them all okay thanks

990
00:45:05,050 --> 00:45:01,250
very much okay we're going to now turn

991
00:45:08,410 --> 00:45:05,060
to saw the work going on on evolved

992
00:45:11,380 --> 00:45:08,420
bodies in particular planets and as many

993
00:45:13,600 --> 00:45:11,390
of you online have heard the Goddard

994
00:45:15,790 --> 00:45:13,610
team is heavily involved in analyses of

995
00:45:18,160 --> 00:45:15,800
Mars atmosphere and involved in

996
00:45:19,870 --> 00:45:18,170
biomarker gases but today you're going

997
00:45:24,130 --> 00:45:19,880
to hear a little bit different spin on

998
00:45:26,620 --> 00:45:24,140
that first there will be two talks the

999
00:45:29,770 --> 00:45:26,630
first one by Nadia rod Eva from

1000
00:45:32,980 --> 00:45:29,780
Connecticut College who will talk on the

1001
00:45:37,180 --> 00:45:32,990
spectral analysis of ours Specter

1002
00:45:41,080 --> 00:45:37,190
acquired in the 121.4 micron region her

1003
00:45:43,870 --> 00:45:41,090
mentor is Geronimo Villanueva was an MPP

1004
00:45:47,110 --> 00:45:43,880
postdoc here take it away

1005
00:45:48,700 --> 00:45:47,120
Thanks hi I'm Nigel Radovan I the summer

1006
00:45:51,610 --> 00:45:48,710
I worked on analyzing the Martian

1007
00:45:54,130 --> 00:45:51,620
atmosphere in the 1.11 for my green

1008
00:45:56,410 --> 00:45:54,140
spectral region Mars is one of the four

1009
00:45:58,090 --> 00:45:56,420
inner solar system planets and these

1010
00:45:59,980 --> 00:45:58,100
planets are characterized with an

1011
00:46:02,410 --> 00:45:59,990
atmosphere that contains mostly carbon

1012
00:46:04,360 --> 00:46:02,420
dioxide and nitrogen in contrast the

1013
00:46:06,670 --> 00:46:04,370

jovian planets contain mostly hydrogen

1014
00:46:08,440 --> 00:46:06,680
and helium in their atmosphere however

1015
00:46:10,720 --> 00:46:08,450
each of the planets from the inner solar

1016
00:46:14,170 --> 00:46:10,730
system planets Mars and Earth contain

1017
00:46:16,810 --> 00:46:14,180
hydrogen and as there is water Mars is

1018
00:46:18,340 --> 00:46:16,820
smaller and lighter than the earth and

1019
00:46:20,820 --> 00:46:18,350
that's why the pressure on its surface

1020
00:46:22,900 --> 00:46:20,830
is very small six to eight millibars

1021
00:46:25,930 --> 00:46:22,910
that's why there is no liquid water

1022
00:46:28,540 --> 00:46:25,940
ponds and water can exist on this

1023
00:46:30,610 --> 00:46:28,550
vaporized and the water vapor is only

1024
00:46:33,430 --> 00:46:30,620
point of three percent of the atmosphere

1025
00:46:35,650 --> 00:46:33,440
the data it processed was taken with the

1026
00:46:37,750 --> 00:46:35,660
Keck telescope in Hawaii and the

1027
00:46:41,080 --> 00:46:37,760
Davidson was taken along a split that

1028
00:46:43,540 --> 00:46:41,090
covers a small region of Mars there are

1029
00:46:46,120 --> 00:46:43,550
three main filters under spec three and

1030
00:46:48,940 --> 00:46:46,130
white and KL and I process data from

1031
00:46:51,220 --> 00:46:48,950
their spec three and my NIRSPEC reason

1032
00:46:53,620 --> 00:46:51,230
absorption spectra that's right you can

1033
00:46:54,740 --> 00:46:53,630
see gasps whines and from copper or

1034
00:46:58,130 --> 00:46:54,750
solar lines

1035
00:47:00,230 --> 00:46:58,140
while the my filter is the radiance

1036
00:47:03,290 --> 00:47:00,240
spectrum that's why there are now on

1037
00:47:05,420 --> 00:47:03,300
solar lines after analyzing the data

1038
00:47:07,730 --> 00:47:05,430

also retrieve the terrestrial lines

1039
00:47:11,109 --> 00:47:07,740
present in the spectrum due to the fact

1040
00:47:13,910 --> 00:47:11,119
that cactus is a ground-based telescope

1041
00:47:15,470 --> 00:47:13,920
first entirely the process the data had

1042
00:47:18,230 --> 00:47:15,480
to read the image that was taken from

1043
00:47:20,960 --> 00:47:18,240
Keck to where frequencies is along the

1044
00:47:24,230 --> 00:47:20,970
x-axis and glide situations along the y

1045
00:47:27,320 --> 00:47:24,240
axis and so the latitude changes with

1046
00:47:29,000 --> 00:47:27,330
every wrong every order has different

1047
00:47:31,910 --> 00:47:29,010
frequency and first I crawled the

1048
00:47:34,849 --> 00:47:31,920
desired order and then I had to clean

1049
00:47:37,849 --> 00:47:34,859
about pixels which are wide outs that I

1050
00:47:41,240 --> 00:47:37,859
had to replace with neighboring of black

1051
00:47:42,920 --> 00:47:41,250
dots after that I had to straighten the

1052
00:47:44,930 --> 00:47:42,930
position horizontally the spectra

1053
00:47:48,310 --> 00:47:44,940
because so initially the spectra is

1054
00:47:52,099 --> 00:47:48,320
tilted to one side because of anamorphic

1055
00:47:53,960 --> 00:47:52,109
anamorphic optics after that I had to

1056
00:47:55,730 --> 00:47:53,970
make sure the lines with a model in

1057
00:47:58,520 --> 00:47:55,740
order to obtain the frequency solution

1058
00:48:00,320 --> 00:47:58,530
and finally I had a transponder in

1059
00:48:02,300 --> 00:48:00,330
calibrated spectrum that I used in

1060
00:48:05,030 --> 00:48:02,310
another program to retrieve the

1061
00:48:07,790 --> 00:48:05,040
topographic view of Mars where a blue is

1062
00:48:10,400 --> 00:48:07,800
low altitude and red is high altitude

1063
00:48:12,290 --> 00:48:10,410

and this is the subsolar point and this

1064
00:48:15,710 --> 00:48:12,300
is the exact position of where the data

1065
00:48:17,540 --> 00:48:15,720
was taken I use the software developed

1066
00:48:19,700 --> 00:48:17,550
here the astrobiologists enter a color

1067
00:48:21,770 --> 00:48:19,710
field to gain the geometrical parameters

1068
00:48:23,900 --> 00:48:21,780
for every row to remove the lure

1069
00:48:26,990 --> 00:48:23,910
constellar lines and finally to obtain

1070
00:48:29,570 --> 00:48:27,000
the balances of gases this is the graph

1071
00:48:32,180 --> 00:48:29,580
I obtained after processing every order

1072
00:48:34,250 --> 00:48:32,190
and in black you can see the absorb

1073
00:48:35,829 --> 00:48:34,260
spectra in blue you can see the model

1074
00:48:39,050 --> 00:48:35,839
and the difference is plotted here

1075
00:48:42,740 --> 00:48:39,060
wherever always are the current latitude

1076
00:48:45,290 --> 00:48:42,750
and in green you can see known alliance

1077
00:48:48,109 --> 00:48:45,300
this is a steel tube and this is the

1078
00:48:52,190 --> 00:48:48,119
solar line this is a water line and in

1079
00:48:55,550 --> 00:48:52,200
red you can see the model I process data

1080
00:48:57,410 --> 00:48:55,560
from respect to setting which is to one

1081
00:49:00,770 --> 00:48:57,420
point four to one point for my account

1082
00:49:02,950 --> 00:49:00,780
and I found water carbon dioxide Auto

1083
00:49:06,560 --> 00:49:02,960
single Delta and solar wines

1084
00:49:07,890 --> 00:49:06,570
after that I plotted all the data and in

1085
00:49:11,069 --> 00:49:07,900
black you can see you

1086
00:49:13,829 --> 00:49:11,079
spectrum red is the model and blue is

1087
00:49:16,410 --> 00:49:13,839
the residual spectrum which is only real

1088
00:49:18,990 --> 00:49:16,420

marginalized and solar lines here you

1089
00:49:20,970 --> 00:49:19,000
can see water once in the solar line in

1090
00:49:23,460 --> 00:49:20,980
hundred fifty seven I found to you two

1091
00:49:27,390 --> 00:49:23,470
with an isotope 626 solar and water

1092
00:49:29,819 --> 00:49:27,400
lines I know you're 58 I also found you

1093
00:49:34,019 --> 00:49:29,829
to be lightest of 626 water and solar

1094
00:49:36,960 --> 00:49:34,029
lines and earlier 60 or has Auto wines

1095
00:49:38,789 --> 00:49:36,970
and solar lines after that I process

1096
00:49:40,799 --> 00:49:38,799
data from the M white setting which is

1097
00:49:43,529 --> 00:49:40,809
from four point six to five point four

1098
00:49:46,680 --> 00:49:43,539
microns and found carbon dioxide water

1099
00:49:49,500 --> 00:49:46,690
carbon dioxide and oxygen and again I

1100
00:49:52,380 --> 00:49:49,510
quoted the data in both orders I found

1101
00:49:55,109 --> 00:49:52,390
water and carbon dioxide flying through

1102
00:49:58,980 --> 00:49:55,119
the carbon dioxide has an idol as a top

1103
00:50:01,920 --> 00:49:58,990
636 after that I had to calculate and

1104
00:50:04,410 --> 00:50:01,930
plot the water vapor column first I had

1105
00:50:06,870 --> 00:50:04,420
to calculate the total air mass due to

1106
00:50:09,299 --> 00:50:06,880
the fact that frozen solar rays to reach

1107
00:50:12,299 --> 00:50:09,309
the Martian surface and then the race

1108
00:50:13,440 --> 00:50:12,309
reached the earth in order to flow the

1109
00:50:15,839 --> 00:50:13,450
water vapor calm

1110
00:50:19,140 --> 00:50:15,849
I had to calculate the line area which

1111
00:50:21,990 --> 00:50:19,150
depends on the and the area depends on

1112
00:50:23,640 --> 00:50:22,000
the water column the total air mass and

1113
00:50:25,950 --> 00:50:23,650

the model line density which is

1114
00:50:28,980 --> 00:50:25,960
temperature dependent and the water

1115
00:50:32,549 --> 00:50:28,990
vapor column is equal to the water

1116
00:50:35,640 --> 00:50:32,559
balance across them and the surface

1117
00:50:38,190 --> 00:50:35,650
pressure whatever miles depends on the

1118
00:50:40,410 --> 00:50:38,200
altitude and also in the season on Mars

1119
00:50:43,099 --> 00:50:40,420
on the left you can see a part of the

1120
00:50:46,230 --> 00:50:43,109
water vapor column versus altitude and

1121
00:50:48,420 --> 00:50:46,240
you can easily see that the water vapor

1122
00:50:51,450 --> 00:50:48,430
column in the northern hemisphere is

1123
00:50:53,099 --> 00:50:51,460
much higher than the southern here you

1124
00:50:56,339 --> 00:50:53,109
can see the same dependence where in the

1125
00:50:59,010 --> 00:50:56,349
red I bought it has the highest snow

1126
00:51:02,250 --> 00:50:59,020
water vapor column and in purple the

1127
00:51:03,779 --> 00:51:02,260
lowest the water vapor column on the

1128
00:51:06,510 --> 00:51:03,789
subsolar point is in the northern

1129
00:51:08,910 --> 00:51:06,520
hemisphere and that's why it is summer

1130
00:51:09,870 --> 00:51:08,920
in the Northern Hemisphere and water

1131
00:51:13,559 --> 00:51:09,880
vapor but

1132
00:51:15,329 --> 00:51:13,569
column is highest here also you can see

1133
00:51:18,089 --> 00:51:15,339
that the right here in the southern

1134
00:51:19,859 --> 00:51:18,099
hemisphere the water vapor column

1135
00:51:21,180 --> 00:51:19,869
increases this is due to the fact that

1136
00:51:23,280 --> 00:51:21,190
this area

1137
00:51:25,410 --> 00:51:23,290
right next to the Hellas Basin which has

1138
00:51:27,720 --> 00:51:25,420

a very low altitude that's why the

1139
00:51:30,150 --> 00:51:27,730
pressure there is very high and the

1140
00:51:32,040 --> 00:51:30,160
water vapor column is high the same

1141
00:51:34,640 --> 00:51:32,050
dependence is observed in the northern

1142
00:51:38,670 --> 00:51:34,650
lowlands due to all altitude and

1143
00:51:40,410 --> 00:51:38,680
emulation Highlands the altitude is very

1144
00:51:44,040 --> 00:51:40,420
high and that's why the pressure is low

1145
00:51:46,920 --> 00:51:44,050
and the water vapor column is low this

1146
00:51:49,319 --> 00:51:46,930
the data I analyzed the summer is going

1147
00:51:51,690 --> 00:51:49,329
to be used in an infrared survey and

1148
00:51:54,120 --> 00:51:51,700
that's the future work that I need to

1149
00:51:57,870 --> 00:51:54,130
analyze unknown features in the spectrum

1150
00:52:00,650 --> 00:51:57,880
also to process more orders and datasets

1151
00:52:04,770 --> 00:52:00,660
in order to find them isotopic water

1152
00:52:06,690 --> 00:52:04,780
creation to find the pH of water and I

1153
00:52:09,359 --> 00:52:06,700
would like to thank you thank the

1154
00:52:12,300 --> 00:52:09,369
astrobiology center here at Goddard my

1155
00:52:20,339 --> 00:52:12,310
mentor dr. Villanueva dr. Mona Torre and

1156
00:52:22,440 --> 00:52:20,349
all in tears okay thank you very much

1157
00:52:24,210 --> 00:52:22,450
that's quite interesting you know maybe

1158
00:52:26,250 --> 00:52:24,220
you could before we go to the remote

1159
00:52:30,300 --> 00:52:26,260
side maybe you could explain why the

1160
00:52:32,190 --> 00:52:30,310
blue and red points on that one slide

1161
00:52:34,620 --> 00:52:32,200
you showed towards the end are different

1162
00:52:36,480 --> 00:52:34,630
widths quite different widths there I'm

1163
00:52:38,670 --> 00:52:36,490

not sure yes it's because of for the

1164
00:52:40,950 --> 00:52:38,680
slit so the split is not fair along the

1165
00:52:44,370 --> 00:52:40,960
left and the right and the rift

1166
00:52:45,930 --> 00:52:44,380
increases in the north and south parts

1167
00:52:50,359 --> 00:52:45,940
and that's why does that be the

1168
00:52:55,980 --> 00:52:53,370
coordinates it's because of the optics

1169
00:53:00,270 --> 00:52:55,990
of the telescope and because of the

1170
00:53:03,000 --> 00:53:00,280
because Mars is wrong okay thanks very

1171
00:53:04,680 --> 00:53:03,010
much let's go to our remotes colleagues

1172
00:53:05,160 --> 00:53:04,690
first and see if any questions from the

1173
00:53:11,520 --> 00:53:05,170
online

1174
00:53:14,730 --> 00:53:11,530
teams ok anyone here at Goddard wish to

1175
00:53:17,640 --> 00:53:14,740
ask a question or make a comment what

1176
00:53:19,170 --> 00:53:17,650
they were these taken this is my agenda

1177
00:53:21,329 --> 00:53:19,180
second mm 1:30

1178
00:53:23,130 --> 00:53:21,339
okay so would have been late summer in

1179
00:53:27,970 --> 00:53:23,140
in the northern hemisphere

1180
00:53:33,810 --> 00:53:27,980
yeah I guess yeah the motorcade through

1181
00:53:39,940 --> 00:53:33,820
remotely good good okay we can hear that

1182
00:53:43,920 --> 00:53:39,950
okay good thank you anyone else okay

1183
00:53:46,300 --> 00:53:43,930
thanks very much look forward to the

1184
00:53:50,589 --> 00:53:46,310
comparison with the results of the next

1185
00:53:52,180 --> 00:53:50,599
talk I did really good next we'll hear

1186
00:53:54,790 --> 00:53:52,190
from Justin news MA

1187
00:53:57,910 --> 00:53:54,800
it was a student from the college of new

1188
00:54:00,819 --> 00:53:57,920

jersey working this summer under the

1189
00:54:01,870 --> 00:54:00,829
mentorship of joint mentorship myself

1190
00:54:05,980 --> 00:54:01,880
and Geronimo

1191
00:54:08,260 --> 00:54:05,990
Villanueva on a another aspect of the

1192
00:54:09,630 --> 00:54:08,270
same data set but emphasizing a

1193
00:54:13,120 --> 00:54:09,640
different species

1194
00:54:14,530 --> 00:54:13,130
just Justin take it away hi I'm Justin

1195
00:54:15,910 --> 00:54:14,540
his mom from the College in New Jersey

1196
00:54:17,560 --> 00:54:15,920
this summer I was working on the

1197
00:54:19,390 --> 00:54:17,570
analysis and Martian carbon dioxide

1198
00:54:20,290 --> 00:54:19,400
utilizing high resolution spectroscopic

1199
00:54:22,329 --> 00:54:20,300
data

1200
00:54:26,710 --> 00:54:22,339
I was working under mostly dr. Geronimo

1201
00:54:29,140 --> 00:54:26,720
Villanueva uh this is very similar data

1202
00:54:31,300 --> 00:54:29,150
set as to what Naja was working with are

1203
00:54:32,980 --> 00:54:31,310
actually the same data set using from

1204
00:54:36,700 --> 00:54:32,990
the Keck to observatory looking at

1205
00:54:38,410 --> 00:54:36,710
transmittance data specifically over

1206
00:54:40,059 --> 00:54:38,420
here working from an ER spectra filter

1207
00:54:43,359 --> 00:54:40,069
from one point one to one point four

1208
00:54:47,140 --> 00:54:43,369
microns the orders that I analyzed are

1209
00:54:52,089 --> 00:54:47,150
the ones in these red boxes these five

1210
00:54:54,700 --> 00:54:52,099
of them we in this I found mostly h2o

1211
00:54:56,740 --> 00:54:54,710
co2 was the two strongest as well as a

1212
00:54:58,990 --> 00:54:56,750
large number of Fraunhofer also known as

1213
00:55:00,609 --> 00:54:59,000

solar lines in particular i'm going to

1214
00:55:03,370 --> 00:55:00,619
be focusing on this order right here

1215
00:55:08,319 --> 00:55:03,380
order 63 as it has a very strong co2

1216
00:55:10,150 --> 00:55:08,329
presence first looking at co2 and

1217
00:55:11,980 --> 00:55:10,160
specifically we're looking at things we

1218
00:55:14,349 --> 00:55:11,990
can learn about pressure with co2 for

1219
00:55:15,970 --> 00:55:14,359
the purpose of this talk it's very

1220
00:55:18,099 --> 00:55:15,980
important to look at the geometry of

1221
00:55:22,150 --> 00:55:18,109
Mars so here we have a topographic image

1222
00:55:23,890 --> 00:55:22,160
of the Mars as it was oriented of where

1223
00:55:25,960 --> 00:55:23,900
in red is high altitude and

1224
00:55:28,059 --> 00:55:25,970
correspondingly low pressure while a

1225
00:55:30,760 --> 00:55:28,069
blue represents a low altitude and

1226
00:55:32,500 --> 00:55:30,770
that's a high pressure so we have our

1227
00:55:34,420 --> 00:55:32,510
subsolar point is here this is where the

1228
00:55:36,420 --> 00:55:34,430
Sun is directly overhead we're about two

1229
00:55:39,160 --> 00:55:36,430
hours from it's working two p.m. and

1230
00:55:41,520 --> 00:55:39,170
this is where our slit is it's a very

1231
00:55:43,860 --> 00:55:41,530
small longitudinal range but we get

1232
00:55:45,690 --> 00:55:43,870
a lot of latitude all the way from the

1233
00:55:47,880 --> 00:55:45,700
north to south covered such that if we

1234
00:55:50,460 --> 00:55:47,890
just left our slit position there and

1235
00:55:51,930 --> 00:55:50,470
let Mars rotate under it over one

1236
00:55:54,660 --> 00:55:51,940
Martian day we could map out the entire

1237
00:55:58,170 --> 00:55:54,670
planet like this so we're going to be

1238
00:55:59,730 --> 00:55:58,180

looking at in this slit the co2 how much

1239
00:56:02,660 --> 00:55:59,740
we have and corresponding that to

1240
00:56:05,010 --> 00:56:02,670
pressure and we should potentially see a

1241
00:56:06,660 --> 00:56:05,020
increase in pressure in the lowlands

1242
00:56:08,640 --> 00:56:06,670
where there's a lower altitude higher

1243
00:56:09,900 --> 00:56:08,650
pressure and also near the Hellas Basin

1244
00:56:13,230 --> 00:56:09,910
as there should be a higher pressure

1245
00:56:14,820 --> 00:56:13,240
there now first I have to take the data

1246
00:56:18,510 --> 00:56:14,830
and process it it starts off very

1247
00:56:20,070 --> 00:56:18,520
slanted and it really is meaningless at

1248
00:56:22,650 --> 00:56:20,080
this point so after propping it and

1249
00:56:24,300 --> 00:56:22,660
cleaning we have to we want to make it a

1250
00:56:26,400 --> 00:56:24,310
straight image like this such that we

1251
00:56:29,160 --> 00:56:26,410
can say the Rose our y-axis represents

1252
00:56:31,020 --> 00:56:29,170
the latitude and on our x-axis we have

1253
00:56:33,210 --> 00:56:31,030
frequency we can actually say that this

1254
00:56:36,690 --> 00:56:33,220
line here corresponds this frequency and

1255
00:56:38,610 --> 00:56:36,700
so on down here we actually have a image

1256
00:56:39,780 --> 00:56:38,620
representation of a spectral solution

1257
00:56:43,260 --> 00:56:39,790
where in different colors represent

1258
00:56:45,030 --> 00:56:43,270
different latitudes so since all of the

1259
00:56:47,220 --> 00:56:45,040
colors and lines are very close this is

1260
00:56:49,620 --> 00:56:47,230
a good straightening solution if there

1261
00:56:50,850 --> 00:56:49,630
was a large spread and you see different

1262
00:56:54,120 --> 00:56:50,860
colors all over the place that means

1263
00:56:56,250 --> 00:56:54,130

it's not very straight there we have to

1264
00:56:59,850 --> 00:56:56,260
analyze the data our weight up on top

1265
00:57:02,250 --> 00:56:59,860
here is the actual data from the order

1266
00:57:05,280 --> 00:57:02,260
we're looking at and the blue is a

1267
00:57:08,460 --> 00:57:05,290
telluric model or an earth model that

1268
00:57:10,350 --> 00:57:08,470
was generated which using such as the

1269
00:57:11,550 --> 00:57:10,360
precipitable water and solar factors we

1270
00:57:13,470 --> 00:57:11,560
created theoretical model and we

1271
00:57:15,540 --> 00:57:13,480
subtract that from our data so now we

1272
00:57:19,130 --> 00:57:15,550
have left is the residuals which is our

1273
00:57:22,650 --> 00:57:19,140
Mars component and the Fraunhofer lines

1274
00:57:25,650 --> 00:57:22,660
now we generate this on the bottom this

1275
00:57:28,350 --> 00:57:25,660
is retrieval the right is a retrieval on

1276
00:57:31,110 --> 00:57:28,360
the theoretical lines it should be in

1277
00:57:34,800 --> 00:57:31,120
our range here were looking at from 8200

1278
00:57:36,480 --> 00:57:34,810
to 8320 wave numbers and we have the

1279
00:57:40,050 --> 00:57:36,490
strongest lines are all co2 so all of

1280
00:57:44,190 --> 00:57:40,060
these red lines you see are co2 and up

1281
00:57:45,450 --> 00:57:44,200
here is our data again and after we

1282
00:57:47,010 --> 00:57:45,460
removed fringing a bunch of other

1283
00:57:48,720 --> 00:57:47,020
effects and then we look we see if we

1284
00:57:50,400 --> 00:57:48,730
can the lines it's theoretically be

1285
00:57:52,380 --> 00:57:50,410
there we match them up to our real lines

1286
00:57:54,140 --> 00:57:52,390
and we put these green marks to indicate

1287
00:57:56,420 --> 00:57:54,150
all the lines that are actually there

1288
00:57:58,339 --> 00:57:56,430

also we mark off this is a solar line

1289
00:58:00,710 --> 00:57:58,349
there's a line here but there's no red

1290
00:58:02,450 --> 00:58:00,720
we also mark off pull areas in cases

1291
00:58:04,579 --> 00:58:02,460
where there's so many lines that

1292
00:58:06,769 --> 00:58:04,589
trademark individual ones is not very

1293
00:58:09,049 --> 00:58:06,779
realistic and this gives us practically

1294
00:58:10,819 --> 00:58:09,059
a now fingerprint of our Martian gases

1295
00:58:13,430 --> 00:58:10,829
we can look at this we see what lines

1296
00:58:14,870 --> 00:58:13,440
are there and how much how strong these

1297
00:58:16,759 --> 00:58:14,880
lines are and we can learn a lot about

1298
00:58:19,609 --> 00:58:16,769
what we're looking at such as in this

1299
00:58:20,900 --> 00:58:19,619
case Woking at co2 six to six but

1300
00:58:23,450 --> 00:58:20,910
there's not familiar with that

1301
00:58:26,239 --> 00:58:23,460
terminology that means oxygen 16 carbon

1302
00:58:28,099 --> 00:58:26,249
12 oxygen 16 and also we can look at

1303
00:58:33,920 --> 00:58:28,109
down here we have some information about

1304
00:58:36,470 --> 00:58:33,930
the co2 bands that are in this or next

1305
00:58:38,690 --> 00:58:36,480
form at the the data to make it a little

1306
00:58:41,539 --> 00:58:38,700
bit more readable and to designate

1307
00:58:43,849 --> 00:58:41,549
Syntel these we have our co2 lines for

1308
00:58:45,410 --> 00:58:43,859
different orders this is once again this

1309
00:58:46,849 --> 00:58:45,420
is the order 63 what we were looking at

1310
00:58:48,620 --> 00:58:46,859
before and now you can see these are our

1311
00:58:52,249 --> 00:58:48,630
co2 lines versus these are these solar

1312
00:58:54,079 --> 00:58:52,259
lines and these two orders the solar

1313
00:58:56,660 --> 00:58:54,089

lines were very strong such that we only

1314
00:58:58,880 --> 00:58:56,670
really can see what we at least believed

1315
00:59:00,170 --> 00:58:58,890
to be solar lines although in checking

1316
00:59:03,160 --> 00:59:00,180
this against solar atlas some of these

1317
00:59:06,680 --> 00:59:03,170
lines are unknown so this is not a total

1318
00:59:08,660 --> 00:59:06,690
useless data per se because well we

1319
00:59:10,249 --> 00:59:08,670
don't see the gases we're looking for we

1320
00:59:12,170 --> 00:59:10,259
have unknowns here whether they weren't

1321
00:59:14,509 --> 00:59:12,180
in the Atlas there's a hole in the Atlas

1322
00:59:18,620 --> 00:59:14,519
or something so this can later be looked

1323
00:59:20,839 --> 00:59:18,630
at now as for why I'm looking at co2

1324
00:59:22,579 --> 00:59:20,849
well co2 makes up the majority of the

1325
00:59:25,640 --> 00:59:22,589
Martian atmosphere its abundance is more

1326
00:59:27,079 --> 00:59:25,650
than 95% so as such it demonstrates

1327
00:59:28,339 --> 00:59:27,089
major atmospheric properties such as

1328
00:59:30,410 --> 00:59:28,349
surface pressure and atmospheric

1329
00:59:32,089 --> 00:59:30,420
temperature and even can represent the

1330
00:59:35,239 --> 00:59:32,099
general circulation of the atmosphere we

1331
00:59:36,680 --> 00:59:35,249
can see like by looking at where the co2

1332
00:59:39,920 --> 00:59:36,690
is where it's going we can learn a lot

1333
00:59:42,380 --> 00:59:39,930
about what's going on on Mars now here I

1334
00:59:45,440 --> 00:59:42,390
have this is a image of Mars nearby the

1335
00:59:48,410 --> 00:59:45,450
slit there's the Hellas Basin and the

1336
00:59:50,680 --> 00:59:48,420
slit once again it takes on this curved

1337
00:59:53,420 --> 00:59:50,690
appearance due to the projection of our

1338
00:59:54,650 --> 00:59:53,430

rectangular slit onto a circle surface

1339
00:59:56,930 --> 00:59:54,660
which is now being made into a flat

1340
00:59:58,549 --> 00:59:56,940
image so it kind of curves and distorts

1341
01:00:00,700 --> 00:59:58,559
a little bit and we get more area in the

1342
01:00:04,320 --> 01:00:00,710
north and south than near the equator

1343
01:00:07,290 --> 01:00:04,330
but what we have is this is mapping out

1344
01:00:10,380 --> 01:00:07,300
the pressure we took from the 8200 to

1345
01:00:12,300 --> 01:00:10,390
8220 wave number range and summed up all

1346
01:00:13,950 --> 01:00:12,310
of the co2 lines we had there and a few

1347
01:00:17,220 --> 01:00:13,960
calculations involving air mass and

1348
01:00:19,710 --> 01:00:17,230
everything and now we have the absolute

1349
01:00:23,670 --> 01:00:19,720
surface pressure in millibars going from

1350
01:00:26,130 --> 01:00:23,680
6 millibars where it's blue up to 10

1351
01:00:28,080 --> 01:00:26,140
millibars here where it's red now we

1352
01:00:30,000 --> 01:00:28,090
have it graphically and color here and

1353
01:00:31,500 --> 01:00:30,010
if we take a look we see more pressure

1354
01:00:33,330 --> 01:00:31,510
up in the north and the south which

1355
01:00:35,720 --> 01:00:33,340
matches our predictions due to the lower

1356
01:00:37,980 --> 01:00:35,730
altitude we see an increase we have this

1357
01:00:39,600 --> 01:00:37,990
position right here is higher than the

1358
01:00:41,820 --> 01:00:39,610
surrounding ones of the pressure and we

1359
01:00:43,590 --> 01:00:41,830
have a peak due to its proximity tell us

1360
01:00:46,290 --> 01:00:43,600
basic once again fitting our predictions

1361
01:00:48,210 --> 01:00:46,300
so the data matches well with what we'd

1362
01:00:51,150 --> 01:00:48,220
expect by topography so we can feel

1363
01:00:55,890 --> 01:00:51,160

fairly certain that this data is correct

1364
01:00:58,590 --> 01:00:55,900
and we're looking at a good results so

1365
01:01:00,540 --> 01:00:58,600
two quick conclusions of the data was

1366
01:01:02,610 --> 01:01:00,550
calibrated with very high precision we

1367
01:01:04,920 --> 01:01:02,620
have a high signal-to-noise ratio by

1368
01:01:06,180 --> 01:01:04,930
studying and removing many in frontal

1369
01:01:08,790 --> 01:01:06,190
effects such as spectral friend

1370
01:01:10,110 --> 01:01:08,800
electronic ground offset the absolute

1371
01:01:11,610 --> 01:01:10,120
atmospheric service pressure was

1372
01:01:13,470 --> 01:01:11,620
retrieved with high confidence and

1373
01:01:16,020 --> 01:01:13,480
follows sample topographic features we

1374
01:01:17,700 --> 01:01:16,030
found what we expected many molecular

1375
01:01:19,020 --> 01:01:17,710
features were identified though some are

1376
01:01:21,150 --> 01:01:19,030
still unknown and could be related to

1377
01:01:22,890 --> 01:01:21,160
bio signatures we have a lot of the

1378
01:01:24,390 --> 01:01:22,900
solar lines where identified but some of

1379
01:01:26,190 --> 01:01:24,400
them we aren't sure they could be so

1380
01:01:29,700 --> 01:01:26,200
aligned it could be another gas that we

1381
01:01:30,870 --> 01:01:29,710
weren't looking for and the data

1382
01:01:32,490 --> 01:01:30,880
presented here will be part of a

1383
01:01:34,470 --> 01:01:32,500
comprehensive infrared survey of the

1384
01:01:44,340 --> 01:01:34,480
Martian spectrum these are just some

1385
01:01:46,050 --> 01:01:44,350
acknowledgments ok first let's go to the

1386
01:01:49,970 --> 01:01:46,060
remote colleagues if anyone out there

1387
01:01:57,030 --> 01:01:54,900
any games Boulder wherever ok nobody's

1388
01:02:00,480 --> 01:01:57,040

shutting anyone here wish to make a

1389
01:02:05,210 --> 01:02:00,490
comment a question about the solar atlas

1390
01:02:07,770 --> 01:02:05,220
which one did you use um the Solar Ellis

1391
01:02:10,500 --> 01:02:07,780
I'm not gonna remember the exact name I

1392
01:02:12,540 --> 01:02:10,510
believe it's by Wallace is one of the

1393
01:02:14,460 --> 01:02:12,550
names that's coming to mind I could

1394
01:02:15,540 --> 01:02:14,470
actually show it to you since you're

1395
01:02:17,799 --> 01:02:15,550
right here on site actually have you

1396
01:02:20,709 --> 01:02:17,809
look right inside there you want to take

1397
01:02:22,660 --> 01:02:20,719
yeah she could be there so that has

1398
01:02:25,209 --> 01:02:22,670
blanks in it yeah there are certain

1399
01:02:26,949 --> 01:02:25,219
blanks in some areas in other spots we

1400
01:02:29,739 --> 01:02:26,959
actually had mines where they just had a

1401
01:02:31,569 --> 01:02:29,749
flat soil right where those high

1402
01:02:35,319 --> 01:02:31,579
atmospheric absorption I don't know

1403
01:02:37,269 --> 01:02:35,329
yeah I guess the utmost spectra if you

1404
01:02:41,469 --> 01:02:37,279
look at doesn't go down that far away

1405
01:02:44,349 --> 01:02:41,479
like mm yeah let's cut off the 2.5

1406
01:02:48,489 --> 01:02:44,359
microns I think it would be nice that

1407
01:02:51,099 --> 01:02:48,499
the applet really would like the soda

1408
01:02:54,370 --> 01:02:51,109
can I just have a general comment it's

1409
01:02:57,489 --> 01:02:54,380
interesting to point out that both the

1410
01:03:00,599 --> 01:02:57,499
water from Nadia's talking co2 follow

1411
01:03:03,749 --> 01:03:00,609
both the topographic and a latitudinal

1412
01:03:06,429 --> 01:03:03,759
variation over all the interesting

1413
01:03:08,849 --> 01:03:06,439

interesting comparison of courses the

1414
01:03:11,979 --> 01:03:08,859
degree to which they had symmetry

1415
01:03:15,939 --> 01:03:11,989
compared in each and that's part of the

1416
01:03:19,239 --> 01:03:15,949
study of course sees a cup slide without

1417
01:03:21,219 --> 01:03:19,249
there no we did not have to compare it

1418
01:03:22,359 --> 01:03:21,229
with such as mixing ratios in such data

1419
01:03:24,459 --> 01:03:22,369
right

1420
01:03:26,529 --> 01:03:24,469
well I thought I noticed that Nadia's

1421
01:03:28,660 --> 01:03:26,539
water was still increasing towards the

1422
01:03:30,429 --> 01:03:28,670
North Pole whereas your co2 is heading

1423
01:03:32,349 --> 01:03:30,439
over yeah that's right and this might

1424
01:03:35,979 --> 01:03:32,359
suggest that enhancement of water vapor

1425
01:03:39,069 --> 01:03:35,989
in the extreme north at this season

1426
01:03:41,439 --> 01:03:39,079
which is late summer that's right nobody

1427
01:03:44,559 --> 01:03:41,449
waits summer and it's like today it's

1428
01:03:48,099 --> 01:03:44,569
very humid in late summer there's the

1429
01:03:52,169 --> 01:03:48,109
other side of the wait winter so tune in

1430
01:03:58,329 --> 01:03:55,900
let me ask you a ringer here for in your

1431
01:04:00,759 --> 01:03:58,339
co2 spectra you had a nice picket fence

1432
01:04:03,339 --> 01:04:00,769
of lines but we progressing to the right

1433
01:04:05,469 --> 01:04:03,349
foot that's just how quick look at that

1434
01:04:05,949 --> 01:04:05,479
again no I'm not that one that's too

1435
01:04:08,109 --> 01:04:05,959
crowded

1436
01:04:10,089 --> 01:04:08,119
that one right there nice picket fence

1437
01:04:11,709 --> 01:04:10,099
going off to the right there but the

1438
01:04:14,650 --> 01:04:11,719

left there's some big bright thing on

1439
01:04:18,309 --> 01:04:14,660
the left where's that third letter what

1440
01:04:20,529 --> 01:04:18,319
is that that is a band head I didn't go

1441
01:04:23,410 --> 01:04:20,539
too much in depth on to the band's but

1442
01:04:26,890 --> 01:04:23,420
we have right here for example this is

1443
01:04:28,689 --> 01:04:26,900
one co2 been or actually it keeps going

1444
01:04:29,970 --> 01:04:28,699
but these are what the lines that I

1445
01:04:33,870 --> 01:04:29,980
identified from the band

1446
01:04:35,760 --> 01:04:33,880
it is a Sigma Sigma so we don't have a Q

1447
01:04:37,680 --> 01:04:35,770
but it's centered right here over here

1448
01:04:40,950 --> 01:04:37,690
is our key branch and over here is our

1449
01:04:44,070 --> 01:04:40,960
our branch and with the our branch it as

1450
01:04:45,330 --> 01:04:44,080
it progresses compacts and it gets

1451
01:04:46,890 --> 01:04:45,340
closer and closer to the lines and then

1452
01:04:49,080 --> 01:04:46,900
eventually they turn back on themselves

1453
01:04:50,849 --> 01:04:49,090
and this bent head it's a large number

1454
01:04:53,930 --> 01:04:50,859
of lines kind of all grouped together

1455
01:04:57,570 --> 01:04:53,940
and it creates one big strong co2 line

1456
01:05:02,270 --> 01:04:57,580
very good good thank you very much okay

1457
01:05:06,330 --> 01:05:02,280
let's move on to discussions on lunar on

1458
01:05:10,620 --> 01:05:06,340
the work that is being done by Heidi

1459
01:05:14,480 --> 01:05:10,630
Owens from Auburn University on aspect

1460
01:05:19,880 --> 01:05:14,490
related to future work on this science

1461
01:05:22,920 --> 01:05:19,890
surface analysis lab on Mars Heidi I

1462
01:05:28,440 --> 01:05:22,930
should say her mentor was Jenna inroad

1463
01:05:32,040 --> 01:05:28,450

who was by the way actually a an

1464
01:05:35,070 --> 01:05:32,050
astrobiology postdoc at Carnegie for two

1465
01:05:39,660 --> 01:05:35,080
years after getting her PhD at Ken Penn

1466
01:05:41,670 --> 01:05:39,670
State since she's a alumna of the NAI

1467
01:05:45,020 --> 01:05:41,680
from release the past seven years and

1468
01:05:47,520 --> 01:05:45,030
now here permanently as a staff member

1469
01:05:49,170 --> 01:05:47,530
all right like you said my name is Heidi

1470
01:05:51,840 --> 01:05:49,180
Ahn's and I go to Auburn University in

1471
01:05:53,849 --> 01:05:51,850
Alabama I worked with Jen Ivan bread and

1472
01:05:55,920 --> 01:05:53,859
the rest of the Sam team on the organic

1473
01:05:57,660 --> 01:05:55,930
analysis of Mars analog samples and

1474
01:05:59,730 --> 01:05:57,670
instrument calibration for field tests

1475
01:06:01,530 --> 01:05:59,740
in small Berkshire Sam and for those of

1476
01:06:02,970 --> 01:06:01,540
you that know Sam stands for the sample

1477
01:06:06,900 --> 01:06:02,980
analysis at Mars it's going to be going

1478
01:06:10,260 --> 01:06:06,910
on the Mars Science Lab in 2009 some

1479
01:06:13,050 --> 01:06:10,270
backgrounds am a stands for the Arctic

1480
01:06:14,849 --> 01:06:13,060
Mars analog Fahlberg expedition and the

1481
01:06:17,310 --> 01:06:14,859
basic idea is to analyze and collect

1482
01:06:19,470 --> 01:06:17,320
soil samples that live in a in a remote

1483
01:06:21,720 --> 01:06:19,480
environment and you can see small Bart

1484
01:06:23,460 --> 01:06:21,730
in the picture it's north of Norway in

1485
01:06:25,859 --> 01:06:23,470
the Arctic Circle so it's extremely cold

1486
01:06:27,480 --> 01:06:25,869
and extremely remote and they wanted to

1487
01:06:29,250 --> 01:06:27,490
bring back some samples and see if our

1488
01:06:30,570 --> 01:06:29,260

field and our lab instruments can detect

1489
01:06:33,060 --> 01:06:30,580
any organics in the rocks that we

1490
01:06:35,010 --> 01:06:33,070
brought back so I've been working with

1491
01:06:37,440 --> 01:06:35,020
the gPMs which stands for gas

1492
01:06:39,180 --> 01:06:37,450
chromatograph mass spectrometer and it

1493
01:06:41,070 --> 01:06:39,190
separates compounds based on structure

1494
01:06:43,530 --> 01:06:41,080
and molecular weight and insert a good

1495
01:06:45,660 --> 01:06:43,540
analogy for this to be balls being blown

1496
01:06:48,690 --> 01:06:45,670
rant for example if he has a ping-pong

1497
01:06:51,270 --> 01:06:48,700
ball a bowling ball and a football the

1498
01:06:52,800 --> 01:06:51,280
ones as a pom pom balls can be the most

1499
01:06:55,380 --> 01:06:52,810
simple and the lightest weight so it

1500
01:06:57,750 --> 01:06:55,390
will go it will reach the end first it's

1501
01:06:59,220 --> 01:06:57,760
similar you know if you apply that to a

1502
01:07:00,930 --> 01:06:59,230
gas chromatograph as it's going through

1503
01:07:02,580 --> 01:07:00,940
a column the lighter and simpler

1504
01:07:04,160 --> 01:07:02,590
compounds are going to go through faster

1505
01:07:06,360 --> 01:07:04,170
and quicker and hit the detector first

1506
01:07:07,800 --> 01:07:06,370
so the first thing you see on a

1507
01:07:10,320 --> 01:07:07,810
chromatogram which is what you get from

1508
01:07:13,170 --> 01:07:10,330
a GCMs the light compounds are going to

1509
01:07:14,520 --> 01:07:13,180
arrive first and the heavier more

1510
01:07:17,880 --> 01:07:14,530
complex ones are going to arrive later

1511
01:07:20,760 --> 01:07:17,890
in each of these Peaks represents a

1512
01:07:22,200 --> 01:07:20,770
different compound and on the x-axis you

1513
01:07:24,900 --> 01:07:22,210

can see that the retention time in

1514
01:07:26,850 --> 01:07:24,910
minutes so yeah each of these Peaks

1515
01:07:28,560 --> 01:07:26,860
represents different compounds and if

1516
01:07:30,240 --> 01:07:28,570
you analyze one of these Peaks if we

1517
01:07:31,800 --> 01:07:30,250
chose that one each one would produce

1518
01:07:34,350 --> 01:07:31,810
its own mass spectra which looks like

1519
01:07:36,120 --> 01:07:34,360
this on the x-axis you have the

1520
01:07:38,910 --> 01:07:36,130
mass-to-charge ratio or the molecular

1521
01:07:40,740 --> 01:07:38,920
weight and they have its own unique

1522
01:07:43,140 --> 01:07:40,750
signature for each compound and you can

1523
01:07:45,780 --> 01:07:43,150
identify which compound it is based on

1524
01:07:50,040 --> 01:07:45,790
how it looks or which numbers you see

1525
01:07:52,950 --> 01:07:50,050
and just analyzing that even libraries

1526
01:07:54,210 --> 01:07:52,960
um so I've been working with an

1527
01:07:56,220 --> 01:07:54,220
instrument called the grip in this

1528
01:07:57,960 --> 01:07:56,230
summer it's a field instrument and it's

1529
01:07:59,670 --> 01:07:57,970
very convenient for field use it's

1530
01:08:02,100 --> 01:07:59,680
around 80 pounds it's less than a two

1531
01:08:03,450 --> 01:08:02,110
foot cube but the problem with it being

1532
01:08:05,730 --> 01:08:03,460
field instrument is that it's less

1533
01:08:07,950 --> 01:08:05,740
sensitive so it doesn't you know produce

1534
01:08:09,870 --> 01:08:07,960
as many results as a lab instrument it's

1535
01:08:12,600 --> 01:08:09,880
also an ion trap mass spectrometer which

1536
01:08:14,970 --> 01:08:12,610
is it's different because there's a

1537
01:08:16,559 --> 01:08:14,980
bunch of ions that are running around

1538
01:08:18,150 --> 01:08:16,569

loose inside the instrument so it will

1539
01:08:19,500 --> 01:08:18,160
attach itself to the compounds as

1540
01:08:22,020 --> 01:08:19,510
they're fragmenting and going through

1541
01:08:24,329 --> 01:08:22,030
the going through the column so I'm a

1542
01:08:25,829 --> 01:08:24,339
slightly different results in the in the

1543
01:08:27,809 --> 01:08:25,839
data than a quadrupole mass spectrometer

1544
01:08:30,000 --> 01:08:27,819
which is what most of our lab

1545
01:08:31,320 --> 01:08:30,010
instruments are and also the instrument

1546
01:08:35,660 --> 01:08:31,330
that they're planning on sending to Mars

1547
01:08:38,340 --> 01:08:35,670
in 2009 so because of these differences

1548
01:08:40,170 --> 01:08:38,350
our libraries do not match up so if I

1549
01:08:42,300 --> 01:08:40,180
try and match my data that I got from

1550
01:08:44,160 --> 01:08:42,310
the Griffin with the National mist

1551
01:08:47,700 --> 01:08:44,170
library then it's going to be different

1552
01:08:49,200 --> 01:08:47,710
so my project was wanting to create an

1553
01:08:51,870 --> 01:08:49,210
internal libraries and some known

1554
01:08:53,340 --> 01:08:51,880
standards by running running these

1555
01:08:54,190 --> 01:08:53,350
standards on the group and identifying

1556
01:08:56,860 --> 01:08:54,200
this con

1557
01:08:58,660 --> 01:08:56,870
and creating this library and that way

1558
01:09:00,490 --> 01:08:58,670
they could take this library just a

1559
01:09:03,430 --> 01:09:00,500
small bard because we're going back this

1560
01:09:04,690 --> 01:09:03,440
this summer the end or the fall and

1561
01:09:06,970 --> 01:09:04,700
they're going to use this library to

1562
01:09:09,430 --> 01:09:06,980
compare it their samples that they run

1563
01:09:11,050 --> 01:09:09,440

there based on what I've done we also

1564
01:09:13,210 --> 01:09:11,060
wanted to compare the field instrument

1565
01:09:14,950 --> 01:09:13,220
the Griffin to the lab instrument the

1566
01:09:16,660 --> 01:09:14,960
Griffin are the Finnegan and find

1567
01:09:18,310 --> 01:09:16,670
patterns on how they differ so they can

1568
01:09:21,850 --> 01:09:18,320
compare that when they bring it back and

1569
01:09:24,160 --> 01:09:21,860
run those samples in the you know I

1570
01:09:26,380 --> 01:09:24,170
guess the fall I also wanted to analyze

1571
01:09:28,000 --> 01:09:26,390
data and results that from a natural

1572
01:09:30,910 --> 01:09:28,010
sample that I brought that from Svalbard

1573
01:09:33,280 --> 01:09:30,920
last year so here's a snapshot of the

1574
01:09:34,510 --> 01:09:33,290
lot of the library I created you can see

1575
01:09:36,910 --> 01:09:34,520
that there's a chemical name and now

1576
01:09:39,010 --> 01:09:36,920
it's kind of small a formula molecular

1577
01:09:42,030 --> 01:09:39,020
weight and each each entry has its own

1578
01:09:43,900 --> 01:09:42,040
spectra and these are a list of the

1579
01:09:48,580 --> 01:09:43,910
standards I've run in a few of the

1580
01:09:50,050 --> 01:09:48,590
samples so you can read those and the

1581
01:09:51,730 --> 01:09:50,060
library is pretty helpful if you have

1582
01:09:53,980 --> 01:09:51,740
your chromatogram and you don't know

1583
01:09:55,450 --> 01:09:53,990
what is in it you pick a peak that you

1584
01:09:58,930 --> 01:09:55,460
want to analyze which is displayed here

1585
01:10:01,570 --> 01:09:58,940
and this is its own chromatograph or its

1586
01:10:04,330 --> 01:10:01,580
own mass spectra and you can match it to

1587
01:10:06,250 --> 01:10:04,340
the library that we've created and in

1588
01:10:08,230 --> 01:10:06,260

this case it's 95 percent sure that its

1589
01:10:09,700 --> 01:10:08,240
decade and decane spectra is right here

1590
01:10:11,860 --> 01:10:09,710
so you can kind of visually see it and

1591
01:10:17,050 --> 01:10:11,870
match it up patellas with the library

1592
01:10:18,910 --> 01:10:17,060
itself um so diesel dolomite is a sample

1593
01:10:21,280 --> 01:10:18,920
that they brought back from slobber last

1594
01:10:23,740 --> 01:10:21,290
year and it was kind of interesting

1595
01:10:25,420 --> 01:10:23,750
because dolomite is when it's formed it

1596
01:10:27,790 --> 01:10:25,430
doesn't usually contain organics or

1597
01:10:29,500 --> 01:10:27,800
anything at that time so it when they

1598
01:10:30,940 --> 01:10:29,510
smell diesel diesel is an indication

1599
01:10:33,460 --> 01:10:30,950
that there's organics in the rock so

1600
01:10:34,930 --> 01:10:33,470
it's kind of interesting and it caught

1601
01:10:37,060 --> 01:10:34,940
their attention and what's interesting

1602
01:10:38,530 --> 01:10:37,070
on this is as they ran it through the

1603
01:10:41,350 --> 01:10:38,540
Griffin you can see that there's big

1604
01:10:43,270 --> 01:10:41,360
Peaks here which are very pattern

1605
01:10:45,310 --> 01:10:43,280
they're States pretty evenly so you can

1606
01:10:46,930 --> 01:10:45,320
kinda see this might be an indication

1607
01:10:49,690 --> 01:10:46,940
that there's some kind of something

1608
01:10:51,400 --> 01:10:49,700
going on there and one that analyzed it

1609
01:10:53,860 --> 01:10:51,410
I saw that all of the big Peaks are

1610
01:10:56,290 --> 01:10:53,870
alkanes or hydrocarbon chains which you

1611
01:10:58,030 --> 01:10:56,300
know is kind of weird because you can't

1612
01:11:00,610 --> 01:10:58,040
you don't usually find organics and in a

1613
01:11:02,140 --> 01:11:00,620

dolomite sample so the red numbers

1614
01:11:03,970 --> 01:11:02,150
indicates the masses the molecular

1615
01:11:05,420 --> 01:11:03,980
weights so as you can see the general

1616
01:11:08,570 --> 01:11:05,430
trend is that it's going up with

1617
01:11:12,310 --> 01:11:08,580
would indicate you know which also helps

1618
01:11:16,640 --> 01:11:12,320
to include or helps to satisfy the

1619
01:11:18,170 --> 01:11:16,650
conclusion that they're trying to say

1620
01:11:20,570 --> 01:11:18,180
but they're going and they're getting

1621
01:11:22,610 --> 01:11:20,580
more complex as they got there and so

1622
01:11:25,070 --> 01:11:22,620
the sample was also run on the Finnegan

1623
01:11:26,240 --> 01:11:25,080
which is the lab instrument and it looks

1624
01:11:28,040 --> 01:11:26,250
slightly different than the Griffin

1625
01:11:30,410 --> 01:11:28,050
sample mainly because there's a lot more

1626
01:11:32,150 --> 01:11:30,420
Peaks that are smaller down if you zoom

1627
01:11:34,370 --> 01:11:32,160
in you'll see a lot of the same things

1628
01:11:38,450 --> 01:11:34,380
and once I analyzed those I saw a lot

1629
01:11:40,010 --> 01:11:38,460
more aromatics and PAHs then the

1630
01:11:42,710 --> 01:11:40,020
hydrocarbon so I thought that was kind

1631
01:11:45,290 --> 01:11:42,720
of interesting and again the molecular

1632
01:11:46,430 --> 01:11:45,300
weights are listed there so the

1633
01:11:48,500 --> 01:11:46,440
comparison of the Griffin in the

1634
01:11:50,480 --> 01:11:48,510
Finnegan this is just one sample from

1635
01:11:52,280 --> 01:11:50,490
the diesel dolomite that we found the 92

1636
01:11:53,810 --> 01:11:52,290
is a junk peak on the Griffin so you can

1637
01:11:58,040 --> 01:11:53,820
kind of ignore that but you can see here

1638
01:12:00,920 --> 01:11:58,050

that there's a 140 and a 139 and 169 and

1639
01:12:02,960 --> 01:12:00,930
a 168 for the masses and this is you

1640
01:12:04,430 --> 01:12:02,970
know because of the Griffin is an ion

1641
01:12:06,770 --> 01:12:04,440
trap net spectrometer so you're going to

1642
01:12:08,800 --> 01:12:06,780
see one more than the Finnegan and all

1643
01:12:12,050 --> 01:12:08,810
the results and that was pretty typical

1644
01:12:13,640 --> 01:12:12,060
that's just one comparison so overall

1645
01:12:15,710 --> 01:12:13,650
conclusions and why it's important for

1646
01:12:17,180 --> 01:12:15,720
astrobiology we did find out that the

1647
01:12:19,220 --> 01:12:17,190
internal library that I created does

1648
01:12:20,930 --> 01:12:19,230
work we were able to identify compounds

1649
01:12:22,220 --> 01:12:20,940
and natural samples and what really

1650
01:12:24,080 --> 01:12:22,230
caught the attention of all the

1651
01:12:25,760 --> 01:12:24,090
scientists is that organics were

1652
01:12:28,250 --> 01:12:25,770
detected in a rock that not typically

1653
01:12:29,780 --> 01:12:28,260
known for being organic rich so they're

1654
01:12:31,430 --> 01:12:29,790
going back to solve our this year and

1655
01:12:33,110 --> 01:12:31,440
doing some more analyses and figuring

1656
01:12:34,670 --> 01:12:33,120
out where these organics originated if

1657
01:12:37,660 --> 01:12:34,680
they're modern or ancient and whether

1658
01:12:40,130 --> 01:12:37,670
they come from biotic or abiotic sources

1659
01:12:41,510 --> 01:12:40,140
so I just like to thank NASA Goddard and

1660
01:12:44,270 --> 01:12:41,520
the Ghatak Center for astrobiology

1661
01:12:53,000 --> 01:12:44,280
and my mentor and a lot of other people

1662
01:12:55,670 --> 01:12:53,010
I worked with before we go to the remote

1663
01:12:57,650 --> 01:12:55,680

sites let me quickly ask I noticed that

1664
01:13:00,080 --> 01:12:57,660
and I think it was the Griffin mass spec

1665
01:13:02,780 --> 01:13:00,090
you had three peaks in Hitchin peaks at

1666
01:13:06,500 --> 01:13:02,790
Mass 254 that one

1667
01:13:07,879 --> 01:13:06,510
yeah two months peaks of 254 right and

1668
01:13:10,189 --> 01:13:07,889
presumably they

1669
01:13:11,750 --> 01:13:10,199
they're isomers of the same right

1670
01:13:13,580 --> 01:13:11,760
they're just different structures mainly

1671
01:13:15,260 --> 01:13:13,590
it like you can see the two methyl hefty

1672
01:13:16,430 --> 01:13:15,270
decane and seven methyl have detecting

1673
01:13:18,470 --> 01:13:16,440
that which means that that methyl group

1674
01:13:20,090 --> 01:13:18,480
is at a different spot in structure so

1675
01:13:21,770 --> 01:13:20,100
that's why it's alluding a different

1676
01:13:26,030 --> 01:13:21,780
time with the octave that that game is

1677
01:13:27,950 --> 01:13:26,040
really not one of the methyl this it's a

1678
01:13:30,350 --> 01:13:27,960
strength right it's just it just grew

1679
01:13:32,000 --> 01:13:30,360
each structure is gonna be different in

1680
01:13:34,300 --> 01:13:32,010
how it comes out and it just depends on

1681
01:13:36,979 --> 01:13:34,310
you know whether it's shorter or longer

1682
01:13:40,939 --> 01:13:36,989
but then I didn't notice the same mass

1683
01:13:44,060 --> 01:13:40,949
peak in the next spectrum 54 and you

1684
01:13:45,470 --> 01:13:44,070
didn't cover that range um well I didn't

1685
01:13:47,270 --> 01:13:45,480
have a chance to analyze every single

1686
01:13:48,649 --> 01:13:47,280
one of these little Peaks I just you

1687
01:13:50,899 --> 01:13:48,659
know got the big ones for the main part

1688
01:13:52,550 --> 01:13:50,909

but if I go back I'm sure I can find out

1689
01:13:54,950 --> 01:13:52,560
why would the amplitudes be so different

1690
01:13:56,660 --> 01:13:54,960
between the two uh well the

1691
01:13:59,300 --> 01:13:56,670
difference.we random it's slightly

1692
01:14:02,149 --> 01:13:59,310
different temperatures the griffon I

1693
01:14:04,100 --> 01:14:02,159
think was at 900 degrees Celsius and the

1694
01:14:06,140 --> 01:14:04,110
Finnegan was at 1,100 degrees Celsius

1695
01:14:07,580 --> 01:14:06,150
and the aromatics in the pH should come

1696
01:14:11,270 --> 01:14:07,590
off at a higher temperature than the

1697
01:14:13,490 --> 01:14:11,280
alkanes so that there might be more of

1698
01:14:14,180 --> 01:14:13,500
abundance and we in that aromatics in

1699
01:14:16,490 --> 01:14:14,190
the Finnegan

1700
01:14:22,580 --> 01:14:16,500
so it just they're probably still in

1701
01:14:24,590 --> 01:14:22,590
there this is only organic chakra okay

1702
01:14:30,229 --> 01:14:24,600
let's go to the remote sites ask anyone

1703
01:14:32,090 --> 01:14:30,239
out there has questions for Heidi why it

1704
01:14:36,439 --> 01:14:32,100
again okay how about locally anybody

1705
01:14:40,910 --> 01:14:36,449
here at Goddard good answer the question

1706
01:14:44,450 --> 01:14:40,920
perfectly anticipated them all except

1707
01:14:47,200 --> 01:14:44,460
for mine all right thanks

1708
01:14:50,149 --> 01:14:47,210
next we're going to actually turn to a

1709
01:14:52,040 --> 01:14:50,159
bit about the lunar record which is

1710
01:14:54,939 --> 01:14:52,050
actually critical for understanding

1711
01:14:58,580 --> 01:14:54,949
early Earth as some of you appreciate

1712
01:15:00,590 --> 01:14:58,590
Lauren Loudoun is working with Richard

1713
01:15:02,660 --> 01:15:00,600

Walker professor in geosciences at the

1714
01:15:06,830 --> 01:15:02,670
University of Maryland there was a co I

1715
01:15:10,520 --> 01:15:06,840
and mentor Kauai on our team and a

1716
01:15:14,439 --> 01:15:10,530
mentor this program and with Igor hotel

1717
01:15:16,970 --> 01:15:14,449
is also in the same group but at the UM

1718
01:15:18,209 --> 01:15:16,980
and they'll talk Lauren's going to tell

1719
01:15:21,959 --> 01:15:18,219
us about some of these working

1720
01:15:24,150 --> 01:15:21,969
in fact belts in sub-sector of five 500

1721
01:15:25,500 --> 01:15:24,160
dr. Nina hi my name is Lauren Loudon I

1722
01:15:27,090 --> 01:15:25,510
go to Keene State College in New

1723
01:15:29,130 --> 01:15:27,100
Hampshire and my project was

1724
01:15:30,810 --> 01:15:29,140
fingerprinting late accretion a study of

1725
01:15:32,610 --> 01:15:30,820
the lunar impact mount seven six oh five

1726
01:15:34,560 --> 01:15:32,620
five in the background there you see a

1727
01:15:36,540 --> 01:15:34,570
picture of the Serrano Titus basin which

1728
01:15:39,360 --> 01:15:36,550
was the sample site for the Apollo 17

1729
01:15:41,070 --> 01:15:39,370
missions and what we were concerned

1730
01:15:42,570 --> 01:15:41,080
about is the composition of the

1731
01:15:44,370 --> 01:15:42,580
impacting objects that were involved in

1732
01:15:46,680 --> 01:15:44,380
late accretion particularly those from

1733
01:15:48,900 --> 01:15:46,690
the late heavy bombardment which

1734
01:15:51,150 --> 01:15:48,910
occurred about 3.9 billion years before

1735
01:15:52,709 --> 01:15:51,160
present it has been suggested that the

1736
01:15:55,050 --> 01:15:52,719
late heavy bombardment delivered

1737
01:15:56,550 --> 01:15:55,060
prebiotic organics and water to the

1738
01:15:58,950 --> 01:15:56,560

earth and there is still much

1739
01:16:00,330 --> 01:15:58,960
controversy over what type of objects

1740
01:16:03,600 --> 01:16:00,340
were bombarding us whether or not they

1741
01:16:05,100 --> 01:16:03,610
were asked for it's comets or both we

1742
01:16:07,020 --> 01:16:05,110
look at lunar impact melt britches

1743
01:16:09,270 --> 01:16:07,030
because they are the only objects in the

1744
01:16:12,450 --> 01:16:09,280
solar system which record discrete

1745
01:16:15,420 --> 01:16:12,460
impacting events we also like to look at

1746
01:16:18,959 --> 01:16:15,430
them because the record of impacts on

1747
01:16:20,459 --> 01:16:18,969
the moon is much more preserved than it

1748
01:16:23,130 --> 01:16:20,469
is on earth because there is no plate

1749
01:16:25,140 --> 01:16:23,140
tectonics or weathering so they have a

1750
01:16:26,280 --> 01:16:25,150
better record of what the bombardment

1751
01:16:29,400 --> 01:16:26,290
history was during the late heavy

1752
01:16:31,380 --> 01:16:29,410
bombardment we looked at highly sideral

1753
01:16:34,229 --> 01:16:31,390
file elements in three two hundred

1754
01:16:37,080 --> 01:16:34,239
milligrams subsamples of brescia 7605 v

1755
01:16:39,090 --> 01:16:37,090
we looked at isotopic abundance and

1756
01:16:41,850 --> 01:16:39,100
ratios of rhenium osmium iridium

1757
01:16:43,500 --> 01:16:41,860
ruthenium platinum and palladium we did

1758
01:16:45,930 --> 01:16:43,510
the analysis by doing a high pressure

1759
01:16:48,030 --> 01:16:45,940
temperature digestion and then we

1760
01:16:50,550 --> 01:16:48,040
followed by osmium extraction and then

1761
01:16:52,380 --> 01:16:50,560
anion exchange chemistry to free up the

1762
01:16:55,050 --> 01:16:52,390
remaining highly sideral file elements

1763
01:16:56,880 --> 01:16:55,060

the osmium extracts were analyzed on

1764
01:16:59,490 --> 01:16:56,890
thermal thermal ionization mass

1765
01:17:01,200 --> 01:16:59,500
spectrometers and the remaining highly

1766
01:17:05,100 --> 01:17:01,210
silver files were done by inductively

1767
01:17:06,870 --> 01:17:05,110
coupled plasma mass spectrometry here

1768
01:17:08,729 --> 01:17:06,880
are some results this is a graph that

1769
01:17:10,950 --> 01:17:08,739
shows iridium versus the other highly

1770
01:17:12,810 --> 01:17:10,960
sideral file element these graphs are a

1771
01:17:15,150 --> 01:17:12,820
good representation of two component

1772
01:17:17,130 --> 01:17:15,160
mixing in this case mixing between an

1773
01:17:19,650 --> 01:17:17,140
impacting object and the lunar crust

1774
01:17:21,420 --> 01:17:19,660
iridium is believed to be an extremely

1775
01:17:23,040 --> 01:17:21,430
low abundance in the lunar crust so it

1776
01:17:25,260 --> 01:17:23,050
makes a good denominator to plot the

1777
01:17:27,270 --> 01:17:25,270
other highly sideral file elements again

1778
01:17:29,070 --> 01:17:27,280
the two most important things about

1779
01:17:29,919 --> 01:17:29,080
these graphs are the slopes of the

1780
01:17:33,169 --> 01:17:29,929
regression

1781
01:17:34,819 --> 01:17:33,179
represent the ratio of other highly

1782
01:17:37,370 --> 01:17:34,829
highly sideral file elements say

1783
01:17:39,439 --> 01:17:37,380
platinum to iridium in the impacting

1784
01:17:41,600 --> 01:17:39,449
object the y-intercepts over here

1785
01:17:44,359 --> 01:17:41,610
represent the amount of highly certified

1786
01:17:46,879 --> 01:17:44,369
London's in the lunar component what's

1787
01:17:49,699 --> 01:17:46,889
interesting here also is the a book via

1788
01:17:52,279 --> 01:17:49,709

the enrichment of palladium platinum and

1789
01:17:54,259 --> 01:17:52,289
ruthenium to osmium and rhenium which

1790
01:17:56,350 --> 01:17:54,269
almost had zero intercepts which is

1791
01:17:59,600 --> 01:17:56,360
interesting from a geological standpoint

1792
01:18:02,229 --> 01:17:59,610
here we have a graph of 187 osmium over

1793
01:18:05,629 --> 01:18:02,239
188 osmium versus platinum and iridium

1794
01:18:07,910 --> 01:18:05,639
these are the known data for chondrites

1795
01:18:12,199 --> 01:18:07,920
the carbonaceous ordinary and enstatite

1796
01:18:15,799 --> 01:18:12,209
and the 187 osmium 2088 osmium ratios in

1797
01:18:18,049 --> 01:18:15,809
the apollo samples represent the 187

1798
01:18:20,629 --> 01:18:18,059
rhenium to 188 osmium ratios in the

1799
01:18:23,799 --> 01:18:20,639
impacting objects the X error bars in

1800
01:18:28,729 --> 01:18:23,809
this graph represent the range of osmium

1801
01:18:31,009 --> 01:18:28,739
ratio in the impacting object and the y

1802
01:18:33,589 --> 01:18:31,019
axis bars represent the two sigma error

1803
01:18:37,279 --> 01:18:33,599
for the regression line as you can see

1804
01:18:38,540 --> 01:18:37,289
here the 7 605 5 sample plots within the

1805
01:18:40,430 --> 01:18:38,550
range of ordinary and enstatite

1806
01:18:42,020 --> 01:18:40,440
chondrites and it also overlaps the data

1807
01:18:44,330 --> 01:18:42,030
for seven three two one five and two

1808
01:18:48,199 --> 01:18:44,340
five five which is another breccia from

1809
01:18:50,060 --> 01:18:48,209
the Apollo 17 sample or sets aside also

1810
01:18:51,949 --> 01:18:50,070
like to point out up here that this is

1811
01:18:55,160 --> 01:18:51,959
an Apollo 14 sample and two other Apollo

1812
01:18:57,229 --> 01:18:55,170
17 samples that diverge pretty far from

1813
01:18:59,959 --> 01:18:57,239

the known chondritic values of highly

1814
01:19:01,580 --> 01:18:59,969
sideral file element data here's a plot

1815
01:19:05,959 --> 01:19:01,590
of ruthenium over iridium versus

1816
01:19:09,109 --> 01:19:05,969
platinum and iridium again the 7605

1817
01:19:10,310 --> 01:19:09,119
sample plots within the range of some of

1818
01:19:12,379 --> 01:19:10,320
the primitive chondrites

1819
01:19:14,060 --> 01:19:12,389
it also overlaps again with the breccia

1820
01:19:16,399 --> 01:19:14,070
seven three two one five and two five

1821
01:19:17,750 --> 01:19:16,409
five the overlapping with Wretch's seven

1822
01:19:19,089 --> 01:19:17,760
three two one five and two five five

1823
01:19:21,290 --> 01:19:19,099
visas to believe that there is

1824
01:19:23,660 --> 01:19:21,300
incorporation of the same impacting

1825
01:19:25,640 --> 01:19:23,670
object or two different impacting

1826
01:19:27,020 --> 01:19:25,650
objects with very similar compositions

1827
01:19:29,419 --> 01:19:27,030
which is possible again

1828
01:19:31,520 --> 01:19:29,429
these samples up here the apollo 14 and

1829
01:19:33,620 --> 01:19:31,530
the two remaining Apollo 17 samples

1830
01:19:36,979 --> 01:19:33,630
diverge from the known chondritic values

1831
01:19:39,439 --> 01:19:36,989
which is a very interesting time we also

1832
01:19:41,449 --> 01:19:39,449
brought a two hundred milligrams sub

1833
01:19:42,520 --> 01:19:41,459
sample of the Apollo 17 bread sugar

1834
01:19:45,400 --> 01:19:42,530
sorry

1835
01:19:47,290 --> 01:19:45,410
Bechet easy astrobiology analytical lab

1836
01:19:49,210 --> 01:19:47,300
here at Goddard Space Flight Center to

1837
01:19:52,330 --> 01:19:49,220
be analyzed for complex organics under

1838
01:19:53,800 --> 01:19:52,340

the supervision of dr. Danny Glavine we

1839
01:19:56,350 --> 01:19:53,810
did the analysis following his

1840
01:19:59,290 --> 01:19:56,360
extraction procedures in his 2006 paper

1841
01:20:02,050 --> 01:19:59,300
what we found was that the most abundant

1842
01:20:04,420 --> 01:20:02,060
aiming was EA CA which is a nylon

1843
01:20:06,430 --> 01:20:04,430
contaminate possibly from the sample

1844
01:20:08,290 --> 01:20:06,440
bags at Johnson Space Flight Center the

1845
01:20:10,630 --> 01:20:08,300
second most abundant aiming was glycine

1846
01:20:12,370 --> 01:20:10,640
and that could either be terrestrial

1847
01:20:15,700 --> 01:20:12,380
contamination or from the acid

1848
01:20:18,160 --> 01:20:15,710
hydrolysis of HCN another thing to point

1849
01:20:20,710 --> 01:20:18,170
out is the DL ratios on the right-hand

1850
01:20:22,480 --> 01:20:20,720
column which were higher than expected

1851
01:20:24,400 --> 01:20:22,490
if the source was terrestrial

1852
01:20:26,860 --> 01:20:24,410
contamination but they are not

1853
01:20:29,740 --> 01:20:26,870
inconsistent with bacterially degraded

1854
01:20:32,320 --> 01:20:29,750
organic and that are organic and that

1855
01:20:35,080 --> 01:20:32,330
was all according to Danny Glavine in

1856
01:20:37,000 --> 01:20:35,090
conclusion Brett j76 fi5 is most similar

1857
01:20:40,360 --> 01:20:37,010
to ordinary and enstatite chondrites on

1858
01:20:42,220 --> 01:20:40,370
the plots of 187th 188th osmium versus

1859
01:20:43,930 --> 01:20:42,230
platinum and iridium but it also

1860
01:20:45,730 --> 01:20:43,940
overlaps as you guys saw on the other

1861
01:20:48,670 --> 01:20:45,740
graph with some of the carbonaceous

1862
01:20:50,440 --> 01:20:48,680
chondrites it overlaps with the highly

1863
01:20:52,690 --> 01:20:50,450

literal file element data for the after

1864
01:20:55,690 --> 01:20:52,700
night samples so we can conclude that

1865
01:20:57,430 --> 01:20:55,700
some of the impactor is there's more

1866
01:21:00,670 --> 01:20:57,440
than one impact are involved or in

1867
01:21:02,770 --> 01:21:00,680
conclusion of the same impacting object

1868
01:21:04,330 --> 01:21:02,780
within the melts some impact melts have

1869
01:21:05,650 --> 01:21:04,340
highly pseudo file element signatures

1870
01:21:08,650 --> 01:21:05,660
which diverge from known chondritic

1871
01:21:10,600 --> 01:21:08,660
values the organic analysis only yielded

1872
01:21:12,750 --> 01:21:10,610
my new trace levels of amino acids and

1873
01:21:15,280 --> 01:21:12,760
no non protein amino acids of

1874
01:21:17,740 --> 01:21:15,290
extraterrestrial origin were identified

1875
01:21:20,140 --> 01:21:17,750
and I just like to thank everybody here

1876
01:21:22,000 --> 01:21:20,150
at Goddard for helping this work go on

1877
01:21:30,550 --> 01:21:22,010
and the isotope geochemistry laboratory

1878
01:21:32,950 --> 01:21:30,560
at the University of Maryland well

1879
01:21:37,530 --> 01:21:32,960
gather this is you've got a mixing line

1880
01:21:40,540 --> 01:21:37,540
for your isotopic ratios several ways

1881
01:21:43,750 --> 01:21:40,550
this for example right there it sure

1882
01:21:45,850 --> 01:21:43,760
looks like a mixing line so true well it

1883
01:21:47,770 --> 01:21:45,860
could yeah but I also found out that

1884
01:21:48,970 --> 01:21:47,780
since we use iridium purposes the

1885
01:21:51,130 --> 01:21:48,980
denominators that might not necessarily

1886
01:21:53,980 --> 01:21:51,140
be the true as far as this can be

1887
01:21:55,699 --> 01:21:53,990
interpreted I'm not too short on exactly

1888
01:21:56,569 --> 01:21:55,709

what I mean

1889
01:21:59,179 --> 01:21:56,579
I don't know if it necessarily

1890
01:22:01,279 --> 01:21:59,189
represents two-component mixing like it

1891
01:22:03,619 --> 01:22:01,289
did in the other death and I think the

1892
01:22:06,020 --> 01:22:03,629
important because iridium again is the

1893
01:22:09,459 --> 01:22:06,030
denominator on both sides of you access

1894
01:22:11,659 --> 01:22:09,469
sir and I had something to do with that

1895
01:22:15,619 --> 01:22:11,669
but there definitely does look to be a

1896
01:22:18,879 --> 01:22:15,629
trend between the Apollo samples and NWA

1897
01:22:20,239 --> 01:22:18,889
for a 2 and the primitive con grades

1898
01:22:23,029 --> 01:22:20,249
okay

1899
01:22:26,379 --> 01:22:23,039
turn to the colleagues online if you've

1900
01:22:31,279 --> 01:22:26,389
got any questions outside anybody from

1901
01:22:33,319 --> 01:22:31,289
Boulder range okay inside got hurt

1902
01:22:37,069 --> 01:22:33,329
anyone here wish to ask a question make

1903
01:22:39,979 --> 01:22:37,079
a comment no well I had a question

1904
01:22:42,080 --> 01:22:39,989
another one on the amino acids could you

1905
01:22:45,350 --> 01:22:42,090
flip to that slide again yes stop go

1906
01:22:47,330 --> 01:22:45,360
back I thought the glutamic had an

1907
01:22:49,939 --> 01:22:47,340
unusual oh it's neat well not always a

1908
01:22:52,790 --> 01:22:49,949
messy but mainly you know I'll type boot

1909
01:22:54,500 --> 01:22:52,800
on it yeah because it was it was on the

1910
01:22:57,500 --> 01:22:54,510
L line and I thought that meant you were

1911
01:23:00,080 --> 01:22:57,510
seeing an excess of the quite surprising

1912
01:23:01,100 --> 01:23:00,090
it's not what you're saying okay thanks

1913
01:23:05,029 --> 01:23:01,110

very much thank you

1914
01:23:08,209 --> 01:23:05,039
all right and then finally to go beyond

1915
01:23:12,169 --> 01:23:08,219
our solar system to the new frontier of

1916
01:23:13,969 --> 01:23:12,179
exoplanets Kamin Todorov from

1917
01:23:17,509 --> 01:23:13,979
connecticut college who's working here

1918
01:23:19,189 --> 01:23:17,519
his mentor Greg Deming will address the

1919
01:23:22,520 --> 01:23:19,199
question of measuring the temperature of

1920
01:23:27,439 --> 01:23:22,530
an exoplanet using data from I believe

1921
01:23:29,810 --> 01:23:27,449
Spitzer um my name is coming to the moon

1922
01:23:33,859 --> 01:23:29,820
um I'm from Connecticut Connaughton yes

1923
01:23:36,169 --> 01:23:33,869
my mentor is dr. Deming um my project

1924
01:23:38,299 --> 01:23:36,179
was to try to measure the temperature of

1925
01:23:42,799 --> 01:23:38,309
an extrasolar planet transiting

1926
01:23:45,939 --> 01:23:42,809
exoplanet um were you interested in

1927
01:23:52,399 --> 01:23:45,949
transiting extrasolar planets because

1928
01:23:54,889 --> 01:23:52,409
they are them they offer us the rare

1929
01:23:59,000 --> 01:23:54,899
opportunity to see the planet go to go

1930
01:24:04,909 --> 01:23:59,010
in front of its own star which give us

1931
01:24:07,159 --> 01:24:04,919
the opportunity to measure and to

1932
01:24:08,160 --> 01:24:07,169
calculate many more features of the

1933
01:24:12,990 --> 01:24:08,170
planet not only

1934
01:24:16,650 --> 01:24:13,000
a math and this constructor planet arm

1935
01:24:19,770 --> 01:24:16,660
from the star the first extrasolar

1936
01:24:24,240 --> 01:24:19,780
planet and the one I will third is HD

1937
01:24:27,780 --> 01:24:24,250
209 profit 8p it was discovered in 1981

1938
01:24:30,950 --> 01:24:27,790

on Steam um it's a little bigger than

1939
01:24:34,520 --> 01:24:30,960
Jupiter but if you know less massive and

1940
01:24:40,010 --> 01:24:34,530
it's really close to the R star and

1941
01:24:47,430 --> 01:24:45,840
the interesting the part of the orbit

1942
01:24:49,590 --> 01:24:47,440
that I was mostly interested was the

1943
01:24:53,030 --> 01:24:49,600
secondary transit and this is when the

1944
01:24:56,880 --> 01:24:53,040
planet actually goes behind the star

1945
01:24:59,340 --> 01:24:56,890
then we can detect a small infrared drop

1946
01:25:01,950 --> 01:24:59,350
brightness which is due to the fact that

1947
01:25:06,959 --> 01:25:01,960
we don't see the light coming from the

1948
01:25:09,030 --> 01:25:06,969
star anymore the planet is brightest in

1949
01:25:12,390 --> 01:25:09,040
the infrared and therefore we looked at

1950
01:25:16,140 --> 01:25:12,400
the infrared region because there the

1951
01:25:19,939 --> 01:25:16,150
drop produced will be deeper and then we

1952
01:25:22,770 --> 01:25:19,949
just made about 900 images from the star

1953
01:25:25,020 --> 01:25:22,780
over time and then reporting the

1954
01:25:30,180 --> 01:25:25,030
brightest if you start over time hoping

1955
01:25:32,459 --> 01:25:30,190
to see the Eclipse um we use the IRS

1956
01:25:35,540 --> 01:25:32,469
will be covering from Spitzer Space

1957
01:25:39,600 --> 01:25:35,550
Telescope it's a 16 it centers on the 16

1958
01:25:41,870 --> 01:25:39,610
microns so exceed infrared arm and then

1959
01:25:45,300 --> 01:25:41,880
we come to the photos kind of leans back

1960
01:25:49,530 --> 01:25:45,310
we use aperture photometry so we just

1961
01:25:50,040 --> 01:25:49,540
add integrated a part with a quick serve

1962
01:25:55,709 --> 01:25:50,050
box

1963
01:25:59,459 --> 01:25:55,719

sometimes under star then um but this

1964
01:26:03,450 --> 01:25:59,469
the this fiber felt pixel box also

1965
01:26:06,180 --> 01:26:03,460
includes the background radiation and

1966
01:26:08,370 --> 01:26:06,190
then therefore we had to estimate the

1967
01:26:13,680 --> 01:26:08,380
background radiation so for all the 900

1968
01:26:16,680 --> 01:26:13,690
images we made the plot of the pixel

1969
01:26:19,439 --> 01:26:16,690
value of how the people of every pixel

1970
01:26:21,189 --> 01:26:19,449
in the image versus the number of pixels

1971
01:26:24,400 --> 01:26:21,199
that have a valid

1972
01:26:29,229 --> 01:26:24,410
and then we fitted a gaussian and we can

1973
01:26:32,520 --> 01:26:29,239
see the most the the most most pixels

1974
01:26:36,870 --> 01:26:32,530
would have a certain value and this is

1975
01:26:39,340 --> 01:26:36,880
our best estimate for the background

1976
01:26:42,910 --> 01:26:39,350
then we subtracted the background from

1977
01:26:45,010 --> 01:26:42,920
the aperture in signal and we plotted

1978
01:26:47,320 --> 01:26:45,020
versus time this is time in days

1979
01:26:50,979 --> 01:26:47,330
actually Julian date - it's a big number

1980
01:26:54,610 --> 01:26:50,989
and this is relative intensity and we

1981
01:26:57,610 --> 01:26:54,620
see this strange pattern which we call

1982
01:27:00,250 --> 01:26:57,620
around we believe this is instrumental

1983
01:27:02,740 --> 01:27:00,260
in fact it's we think this is due to

1984
01:27:09,189 --> 01:27:02,750
electron traps and the individual pixels

1985
01:27:12,370 --> 01:27:09,199
on the Spitzer CCD so we corrected that

1986
01:27:16,720 --> 01:27:12,380
by fitting a baseline which we

1987
01:27:21,100 --> 01:27:16,730
subtracted and we were able to see that

1988
01:27:25,080 --> 01:27:21,110

um these are all the nine hundred points

1989
01:27:28,360 --> 01:27:25,090
and you can definitely see their clips

1990
01:27:33,040 --> 01:27:28,370
the clip step is about point four to

1991
01:27:37,810 --> 01:27:33,050
four percent and the x-axis is just

1992
01:27:41,260 --> 01:27:37,820
phase of the clips this is a little

1993
01:27:44,919 --> 01:27:41,270
clearer plot of the same thing here

1994
01:27:49,780 --> 01:27:44,929
every dot represents an average of ten

1995
01:27:51,939 --> 01:27:49,790
neighboring points from the previous

1996
01:27:54,010 --> 01:27:51,949
plot so it's a little clearer to see

1997
01:28:00,390 --> 01:27:54,020
then you can actually see the error bars

1998
01:28:03,250 --> 01:28:00,400
um this are eclipsed depth represent

1999
01:28:07,000 --> 01:28:03,260
corresponds to about 1100 degrees Kelvin

2000
01:28:08,560 --> 01:28:07,010
for the planet at 16 microns uh and

2001
01:28:11,470 --> 01:28:08,570
obviously this is too hot for liquid

2002
01:28:13,060 --> 01:28:11,480
water but the same technique isn't very

2003
01:28:17,880 --> 01:28:13,070
interesting because you can actually

2004
01:28:20,410 --> 01:28:17,890
apply it to earth size transiting

2005
01:28:23,470 --> 01:28:20,420
exoplanets which are not yet discovered

2006
01:28:26,470 --> 01:28:23,480
but hopefully in future they will be and

2007
01:28:29,080 --> 01:28:26,480
of course then the infrared drop of

2008
01:28:31,419 --> 01:28:29,090
brightness of the secondary clips will

2009
01:28:33,700 --> 01:28:31,429
be a lot smaller therefore we need a

2010
01:28:45,490 --> 01:28:33,710
bigger IR telescope for instance

2011
01:28:48,370 --> 01:28:45,500
James but thank you okay we'll give our

2012
01:28:52,030 --> 01:28:48,380
chances first chance to our colleagues

2013
01:28:55,200 --> 01:28:52,040

online as before anyone out there wish

2014
01:29:01,330 --> 01:28:55,210
to make a comment or it has question

2015
01:29:04,180 --> 01:29:01,340
okay anybody here Goddard I was actually

2016
01:29:05,770 --> 01:29:04,190
quite intrigued by this I mean where do

2017
01:29:12,220 --> 01:29:05,780
you think we'll get this larger infrared

2018
01:29:14,800 --> 01:29:12,230
telescope well best of in space because

2019
01:29:18,280 --> 01:29:14,810
that the sphere is not round it's quite

2020
01:29:21,040 --> 01:29:18,290
themselves into IR um so this project

2021
01:29:23,800 --> 01:29:21,050
for the James Webb Space Telescope which

2022
01:29:27,880 --> 01:29:23,810
we should hopefully be able to arm do

2023
01:29:30,450 --> 01:29:27,890
that now could you go back to slides I

2024
01:29:32,920 --> 01:29:30,460
think it was so not one right there okay

2025
01:29:35,500 --> 01:29:32,930
you know when I look at this I almost

2026
01:29:38,020 --> 01:29:35,510
see structure within the minimum area

2027
01:29:40,390 --> 01:29:38,030
peak right on the left there yeah it

2028
01:29:43,030 --> 01:29:40,400
don't have structure these two our we're

2029
01:29:43,600 --> 01:29:43,040
not entirely sure what are these yet are

2030
01:29:48,250 --> 01:29:43,610
we

2031
01:29:50,860 --> 01:29:48,260
the future I mean an improvement person

2032
01:29:54,220 --> 01:29:50,870
might even symmetrize the data about the

2033
01:29:59,800 --> 01:29:54,230
midpoint bend them and then write a

2034
01:30:01,600 --> 01:29:59,810
paper about it I'll kiss you with you

2035
01:30:03,580 --> 01:30:01,610
get briefed to improvement in the in the

2036
01:30:05,680 --> 01:30:03,590
circle noise on that little hump right

2037
01:30:09,340 --> 01:30:05,690
but we think it's instrumental effect

2038
01:30:11,200 --> 01:30:09,350

but we don't know what is the reason for

2039
01:30:13,630 --> 01:30:11,210
that so we'll update it to be that way

2040
01:30:16,479 --> 01:30:13,640
when what the - having the

2041
01:30:18,040 --> 01:30:16,489
derivation of your temperature I'm not

2042
01:30:20,979 --> 01:30:18,050
sure there will be series you can

2043
01:30:25,390 --> 01:30:20,989
prefect although my biggest error is

2044
01:30:29,500 --> 01:30:25,400
actually and fitting the baseline but

2045
01:30:32,770 --> 01:30:29,510
these two remain whatever base - did so

2046
01:30:36,060 --> 01:30:32,780
I'm not sure that the impact on the

2047
01:30:39,100 --> 01:30:36,070
depth did you do is that significant

2048
01:30:42,220 --> 01:30:39,110
okay thank you very much what is it

2049
01:30:48,430 --> 01:30:42,230
surface temperature of the star I it's

2050
01:30:54,319 --> 01:30:51,169
any other question you Comus they're

2051
01:30:55,819 --> 01:30:54,329
good that concludes the funnel talks but

2052
01:31:02,989 --> 01:30:55,829
and I'd like to offer a round of

2053
01:31:04,910 --> 01:31:02,999
applause and I have one more aside from

2054
01:31:09,200 --> 01:31:04,920
all the mentors most of whom are here

2055
01:31:10,850 --> 01:31:09,210
today for the interns are particularly

2056
01:31:13,580 --> 01:31:10,860
grateful to one other person in this

2057
01:31:16,609 --> 01:31:13,590
room who is sitting here modestly

2058
01:31:19,399 --> 01:31:16,619
smiling and I'm referring to Corey Edie

2059
01:31:29,660 --> 01:31:19,409
and if you pan over to the right there

2060
01:31:32,600 --> 01:31:29,670
Cory for I don't think it's too much to

2061
01:31:34,100 --> 01:31:32,610
say that without Corey's attendant help

2062
01:31:36,430 --> 01:31:34,110
this would not have been nearly

2063
01:31:38,689 --> 01:31:36,440

successfully works this summer and on

2064
01:31:42,439 --> 01:31:38,699
look forward to many summers to come

2065
01:31:45,040 --> 01:31:42,449
thanks very much that's it for today

2066
01:31:48,080 --> 01:31:45,050
thanks very much for coming people and