Mineralogy

T = 30-45°C

Natroalunite, amorphous silica, plagioclase, cristobalite, pyroxene, goethite

1
00:00:11,379 --> 00:00:09,610
Thank You Sonny and thank you also for

2
00:00:13,240 --> 00:00:11,389
for giving a brief introduction at least

3
00:00:16,029 --> 00:00:13,250
showing two beautiful pictures of those

4
00:00:19,359 --> 00:00:16,039
minerals at the beginning in your talk

5
00:00:24,040 --> 00:00:19,369
and how did it advanced already that was

6
00:00:25,900 --> 00:00:24,050
weird so again I'm wire grace I'm at

7
00:00:27,520 --> 00:00:25,910
cu-boulder I'm gonna be talking about

8
00:00:29,770 --> 00:00:27,530
these alien aight jarrow site minerals

9
00:00:32,709 --> 00:00:29,780
if you're like I don't know what these

10
00:00:36,150 --> 00:00:32,719
are don't worry i will explain what they

11
00:00:38,800 --> 00:00:36,160
are and why you should care about them

12
00:00:41,770 --> 00:00:38,810
so this story starts on Mars where in

13
00:00:44,050 --> 00:00:41,780

2004 opportunity identified the mineral

14
00:00:45,670 --> 00:00:44,060
Jerry site at its landing site here

15
00:00:47,740 --> 00:00:45,680
you're seeing opportunity looking back

16
00:00:50,139 --> 00:00:47,750
at its big balloon thing that it used to

17
00:00:52,299 --> 00:00:50,149
safely land and this was a really

18
00:00:54,190 --> 00:00:52,309
exciting discovery we we knew that there

19
00:00:55,990 --> 00:00:54,200
were tons of sulfates on Mars we'd seen

20
00:00:57,370 --> 00:00:56,000
them from orbiters and it'd been

21
00:00:59,170 --> 00:00:57,380
hypothesized that some of those sulfites

22
00:01:01,870 --> 00:00:59,180
were formed through acid sulphate

23
00:01:04,209 --> 00:01:01,880
alteration by the discovery of Jerry

24
00:01:06,550 --> 00:01:04,219
site pretty much cinch that Jerry site

25
00:01:08,740 --> 00:01:06,560
requires pretty much acid sulphate

26
00:01:10,959 --> 00:01:08,750
alteration to foreign and as the name

27
00:01:13,779 --> 00:01:10,969
implies acid sulphate alteration

28
00:01:17,080 --> 00:01:13,789
involves very low pH and a lot of sulfur

29
00:01:19,649 --> 00:01:17,090
to alter that starting material in the

30
00:01:24,459 --> 00:01:19,659
case of Mars that's basalt pretty much

31
00:01:27,550 --> 00:01:24,469
and so juris I man what gave away the

32
00:01:29,559 --> 00:01:27,560
punch line Jerris i means that the

33
00:01:31,359 --> 00:01:29,569
environment early Mars would have had to

34
00:01:33,279 --> 00:01:31,369
have been very acidic we're talking a pH

35
00:01:35,919 --> 00:01:33,289
of three or less at the sites where

36
00:01:37,749 --> 00:01:35,929
Jerry site was found it also means that

37
00:01:39,669 --> 00:01:37,759
the environment has to be pretty water

38
00:01:41,980 --> 00:01:39,679

limited otherwise it would continue to

39
00:01:43,989 --> 00:01:41,990
react and form minerals like hematite I

40
00:01:46,779 --> 00:01:43,999
now also has to be a pretty highly

41
00:01:49,300 --> 00:01:46,789
oxidizing environment and very

42
00:01:51,969 --> 00:01:49,310
significantly for astrobiology purposes

43
00:01:54,519 --> 00:01:51,979
Jerry's like can be made my by microbes

44
00:01:58,889 --> 00:01:54,529
microbes can get involved with oxidation

45
00:02:02,399 --> 00:01:58,899
of iron and sulfur this was a pretty

46
00:02:04,870 --> 00:02:02,409
deciding discovery but if you recall is

47
00:02:12,309 --> 00:02:04,880
how are the slides advancing without my

48
00:02:16,960 --> 00:02:12,319
touching them that's oh weird okay so

49
00:02:18,650 --> 00:02:16,970
that's good to know so we've got a le

50
00:02:21,330 --> 00:02:18,660
night injury site or

51
00:02:22,710 --> 00:02:21,340
members of a mineral group if you recall

52
00:02:24,570 --> 00:02:22,720
I mentioned that i'm talking about both

53
00:02:27,810 --> 00:02:24,580
of them today and they've got this

54
00:02:31,200 --> 00:02:27,820
mineral formula where we've got a

55
00:02:32,970 --> 00:02:31,210
potassium or sodium any cation really

56
00:02:35,070 --> 00:02:32,980
can go in that a site these are the two

57
00:02:37,110 --> 00:02:35,080
that matter here aluminum or iron in

58
00:02:39,960 --> 00:02:37,120
that piece site and then we got some

59
00:02:42,390 --> 00:02:39,970
sulfate and hydroxide and in that a site

60
00:02:44,850 --> 00:02:42,400
if it's a sodium then it's we're going

61
00:02:47,010 --> 00:02:44,860
to call it natural something if it's

62
00:02:48,810 --> 00:02:47,020
then that be site if it's iron then

63
00:02:50,670 --> 00:02:48,820

that's got juris that means it's jer

64
00:02:53,160 --> 00:02:50,680
site and if it's aluminum that means

65
00:02:57,270 --> 00:02:53,170
it's all a night and these definitions

66
00:02:59,640 --> 00:02:57,280
work pretty well because for most of

67
00:03:01,170 --> 00:02:59,650
history where you didn't really find

68
00:03:02,700 --> 00:03:01,180
anything that was intermediate between

69
00:03:04,050 --> 00:03:02,710
these we were only finding the end

70
00:03:06,600 --> 00:03:04,060
members where that be site was either

71
00:03:09,770 --> 00:03:06,610
all jeer site or that be site was all

72
00:03:14,490 --> 00:03:09,780
aluminum however that changed recently

73
00:03:17,040 --> 00:03:14,500
when Tom McCullum and others went to

74
00:03:18,900 --> 00:03:17,050
cerro negro and he actually found stuff

75
00:03:21,210 --> 00:03:18,910
that was intermediate between these end

76
00:03:24,540 --> 00:03:21,220
members so what I'm showing you here is

77
00:03:26,640 --> 00:03:24,550
a plot from his 2013 paper you've got

78
00:03:29,880 --> 00:03:26,650
women imper formula unit on x axis

79
00:03:31,620 --> 00:03:29,890
you've got iron per formula unit on the

80
00:03:35,640 --> 00:03:31,630
y-axis and I just noticed that he

81
00:03:38,400 --> 00:03:35,650
misspelled formula in this paper and and

82
00:03:40,410 --> 00:03:38,410
I didn't notice and and in the gray

83
00:03:41,550 --> 00:03:40,420
boxes great triangles you see kind of

84
00:03:44,610 --> 00:03:41,560
literature group so these are the

85
00:03:46,500 --> 00:03:44,620
classic alia night classic Jerry site

86
00:03:48,990 --> 00:03:46,510
and then these six samples from Sarah

87
00:03:51,090 --> 00:03:49,000
negra that he's showing you most of them

88
00:03:53,610 --> 00:03:51,100

fall in those great triangles but two of

89
00:03:55,740 --> 00:03:53,620
them the blue triangle and the red

90
00:03:58,260 --> 00:03:55,750
circles actually kind of span that

91
00:04:00,240 --> 00:03:58,270
intermediate range and why this matters

92
00:04:02,190 --> 00:04:00,250
is that when he looked at these with

93
00:04:03,960 --> 00:04:02,200
mössbauer which is the instrument the

94
00:04:06,890 --> 00:04:03,970
opportunity has that they used

95
00:04:08,820 --> 00:04:06,900
identified to recite these all look

96
00:04:11,550 --> 00:04:08,830
indistinguishable from Jerry site

97
00:04:13,380 --> 00:04:11,560
mössbauer only looks at iron and if

98
00:04:14,820 --> 00:04:13,390
you've got iron in your le night it's

99
00:04:17,060 --> 00:04:14,830
going to look the same it's jaress I

100
00:04:19,740 --> 00:04:17,070
even if that's only a little bit of iron

101
00:04:23,070 --> 00:04:19,750
so this lead is some of the following

102
00:04:24,210 --> 00:04:23,080
questions first off now we found what

103
00:04:26,100 --> 00:04:24,220
i'm gonna be calling iron-rich alley

104
00:04:28,050 --> 00:04:26,110
night you could call it aluminum rich

105
00:04:30,390 --> 00:04:28,060
Jerris aight for consistency this is

106
00:04:31,480 --> 00:04:30,400
what i'm calling it the rest of the talk

107
00:04:34,450 --> 00:04:31,490
and if we

108
00:04:36,070 --> 00:04:34,460
at several sites in Nicaragua is the

109
00:04:37,990 --> 00:04:36,080
common alteration product are we going

110
00:04:42,400 --> 00:04:38,000
to find it at other sites are we going

111
00:04:44,740 --> 00:04:42,410
to find it perhaps on Mars and if we do

112
00:04:46,960 --> 00:04:44,750
find it on Mars what does that mean for

113
00:04:48,279 --> 00:04:46,970

the environment on ancient Mars I told

114
00:04:50,020 --> 00:04:48,289
you what Jerry site meant for their

115
00:04:53,439 --> 00:04:50,030
ancient environment how to have very low

116
00:04:56,589 --> 00:04:53,449
pH highly oxidizing pretty water limited

117
00:04:59,439 --> 00:04:56,599
but we don't know well I will tell you

118
00:05:04,120 --> 00:04:59,449
what it would mean if it's Irish alley

119
00:05:06,309 --> 00:05:04,130
night instead and lastly how can we

120
00:05:08,439 --> 00:05:06,319
distinguish between Jerry site and Ally

121
00:05:10,390 --> 00:05:08,449
night and these intermediate species on

122
00:05:13,360 --> 00:05:10,400
Mars using instruments that are online

123
00:05:18,520 --> 00:05:13,370
Mars now or will be on Mars and in your

124
00:05:20,379 --> 00:05:18,530
future whoops so to answer these

125
00:05:23,140 --> 00:05:20,389
questions I'm going to show you some

126
00:05:25,480 --> 00:05:23,150
results from three different volcanic

127
00:05:28,719 --> 00:05:25,490
analogs for ancient Mars he so cerro

128
00:05:36,939 --> 00:05:28,729
negro and nicaragua polis and turrialba

129
00:05:39,279 --> 00:05:36,949
in costa rica and a lot of the data i'm

130
00:05:41,469 --> 00:05:39,289
going to show you comes from xrd Thank

131
00:05:44,379 --> 00:05:41,479
You svet for giving a brief introduction

132
00:05:45,939 --> 00:05:44,389
to that and we've got this beautiful

133
00:05:47,800 --> 00:05:45,949
field instrument on the left this is

134
00:05:49,089 --> 00:05:47,810
called the terra that can actually come

135
00:05:50,499 --> 00:05:49,099
out to the field you're seeing it in

136
00:05:52,540 --> 00:05:50,509
this image actually within the turrialba

137
00:05:54,990 --> 00:05:52,550
crater and this was specifically

138
00:05:57,700 --> 00:05:55,000

designed to be analogous to come in on

139
00:05:59,170 --> 00:05:57,710
MSL so it's analogous to the xrd

140
00:06:04,059 --> 00:05:59,180
instrument that is currently right now

141
00:06:05,709 --> 00:06:04,069
on curiosity and so I'm going to show

142
00:06:08,260 --> 00:06:05,719
you some different temperature and pH

143
00:06:10,480 --> 00:06:08,270
regimes that kind of identify their

144
00:06:12,070 --> 00:06:10,490
president pretty much all three of these

145
00:06:13,390 --> 00:06:12,080
different volcanic analogs at several

146
00:06:16,140 --> 00:06:13,400
different sites within these volcanic

147
00:06:19,450 --> 00:06:16,150
analogs in this first site where you see

148
00:06:21,820 --> 00:06:19,460
me at cerro negro i'm zooming in on what

149
00:06:24,159 --> 00:06:21,830
i'm looking at as well as at turrialba

150
00:06:27,279 --> 00:06:24,169
if we've got a temperature of about 80

151
00:06:29,589 --> 00:06:27,289
100 degrees Celsius ph of 2 or less we

152
00:06:31,300 --> 00:06:29,599
seal of silica minerals cristobalite is

153
00:06:34,480 --> 00:06:31,310
a high-temperature version of quartz

154
00:06:36,850 --> 00:06:34,490
amorphous silica we see some sulfates

155
00:06:38,980 --> 00:06:36,860
like gypsum and naturally night wink

156
00:06:41,800 --> 00:06:38,990
wink as well as some sulfur that hasn't

157
00:06:43,990 --> 00:06:41,810
been fully oxidized again I'm drawing

158
00:06:45,020 --> 00:06:44,000
attention to that natural la night and

159
00:06:46,910 --> 00:06:45,030
if you call natural just

160
00:06:49,160 --> 00:06:46,920
it's got sodium in front instead

161
00:06:51,230 --> 00:06:49,170
potassium and i'm going to call those

162
00:06:53,690 --> 00:06:51,240
sites hot in acidic and my computer is

163
00:06:56,510 --> 00:06:53,700

going on without me the next site is a

164
00:06:59,060 --> 00:06:56,520
kind of site has 50 100 agrees celsius

165
00:07:00,530 --> 00:06:59,070
ph maybe three to five so we're going a

166
00:07:04,940 --> 00:07:00,540
little down and temperature a little up

167
00:07:06,830 --> 00:07:04,950
in PH these sites have gypsum a sulfate

168
00:07:09,140 --> 00:07:06,840
amorphous silica Christobel I again

169
00:07:11,570 --> 00:07:09,150
you're also seeing plagioclase which is

170
00:07:12,710 --> 00:07:11,580
a mineral from that starting basalt so

171
00:07:15,590 --> 00:07:12,720
that stuff that hasn't gone fully

172
00:07:17,690 --> 00:07:15,600
altered as well as hematite so an iron

173
00:07:20,840 --> 00:07:17,700
oxide again I'm going to draw attention

174
00:07:23,000 --> 00:07:20,850
to that naturally night and although

175
00:07:25,700 --> 00:07:23,010
this is obviously relative I'm going to

176
00:07:28,190 --> 00:07:25,710
call this moderate for for these kinds

177
00:07:30,890 --> 00:07:28,200
of sites us moderate the next kind of

178
00:07:32,300 --> 00:07:30,900
site we're talking about even lower

179
00:07:35,570 --> 00:07:32,310
temperatures things you might actually

180
00:07:38,570 --> 00:07:35,580
be able to tolerate here naturally night

181
00:07:39,920 --> 00:07:38,580
is actually the most dominant mineral so

182
00:07:41,810 --> 00:07:39,930
I've just been showing you in fact

183
00:07:44,810 --> 00:07:41,820
actually the most dominant minerals that

184
00:07:47,300 --> 00:07:44,820
are found in twenty-five percent more of

185
00:07:49,310 --> 00:07:47,310
the samples from these sites and here

186
00:07:51,560 --> 00:07:49,320
naturally night is just the most

187
00:07:53,450 --> 00:07:51,570
dominant of all we're also seeing some

188
00:07:56,470 --> 00:07:53,460

peroxide which is another like

189
00:07:59,600 --> 00:07:56,480
plagioclase mineral and basalt ger tight

190
00:08:01,910 --> 00:07:59,610
which is another iron oxide and I'm

191
00:08:04,880 --> 00:08:01,920
actually suming in on this a patch of

192
00:08:07,220 --> 00:08:04,890
natural ally night there with my um with

193
00:08:09,550 --> 00:08:07,230
my little knife next to it and I'm

194
00:08:13,370 --> 00:08:09,560
calling these dome edge or crater rim

195
00:08:15,500 --> 00:08:13,380
and the last time going to briefly talk

196
00:08:18,170 --> 00:08:15,510
about is kind of flu via lat wash site

197
00:08:19,790 --> 00:08:18,180
so these are sites that we basically are

198
00:08:21,260 --> 00:08:19,800
just seeing stuff that rain has just

199
00:08:23,900 --> 00:08:21,270
kind of brought down to the central

200
00:08:26,420 --> 00:08:23,910
crater um and it's just kind of float in

201
00:08:28,460 --> 00:08:26,430
there so again naturally nighy is most

202
00:08:30,080 --> 00:08:28,470
dominant here we also have seen clays or

203
00:08:32,330 --> 00:08:30,090
forming here with all that nice water

204
00:08:35,950 --> 00:08:32,340
I'm still investigating which kinds of

205
00:08:37,880 --> 00:08:35,960
clays that's work in progress as I speak

206
00:08:39,380 --> 00:08:37,890
unfortunately though we don't know

207
00:08:40,760 --> 00:08:39,390
exactly where these may be from they

208
00:08:43,250 --> 00:08:40,770
could have been washed down from any

209
00:08:45,500 --> 00:08:43,260
part of the crater rim but it's so cool

210
00:08:48,590 --> 00:08:45,510
that naturally night is most dominant

211
00:08:50,810 --> 00:08:48,600
here so I'm going to quickly tell you

212
00:08:53,150 --> 00:08:50,820
this formula which basically just says

213
00:08:55,670 --> 00:08:53,160

that fe number is the percentage of iron

214
00:08:57,020 --> 00:08:55,680
in that beast site that's all you need

215
00:08:58,140 --> 00:08:57,030
to know here so that least I can have

216
00:09:02,670 --> 00:08:58,150
aluminum and or

217
00:09:05,640 --> 00:09:02,680
iron and fe number is how much iron so

218
00:09:07,710 --> 00:09:05,650
I'm showing you here now a plot of those

219
00:09:09,540 --> 00:09:07,720
three different three of those different

220
00:09:12,270 --> 00:09:09,550
environments I showed you the honda

221
00:09:14,640 --> 00:09:12,280
civic which is ph less than two or equal

222
00:09:17,280 --> 00:09:14,650
less than or equal to 2 temperature 80

223
00:09:21,240 --> 00:09:17,290
to 100 Celsius that moderate conditions

224
00:09:23,550 --> 00:09:21,250
which is pH is 325 and temperature about

225
00:09:24,780 --> 00:09:23,560
50 to 100 degrees Celsius and that dome

226
00:09:27,150 --> 00:09:24,790
edge with kind of an even lower

227
00:09:31,050 --> 00:09:27,160
temperature I'm showing you the fe

228
00:09:34,170 --> 00:09:31,060
number four samples from to those

229
00:09:35,580 --> 00:09:34,180
volcanic sites turrialba and po s that i

230
00:09:39,900 --> 00:09:35,590
determined with either electron

231
00:09:41,280 --> 00:09:39,910
microprobe and p or the SEM EDS and here

232
00:09:43,260 --> 00:09:41,290
you're seeing that some of these are

233
00:09:44,580 --> 00:09:43,270
really concentrated either pretty close

234
00:09:47,220 --> 00:09:44,590
to zero so pretty close to the

235
00:09:49,080 --> 00:09:47,230
literature values of value night or for

236
00:09:52,650 --> 00:09:49,090
some of them it kind of spans a huge

237
00:09:54,840 --> 00:09:52,660
range so that iron concentration can be

238
00:09:58,110 --> 00:09:54,850

anywhere from zero to even higher than

239
00:09:59,730 --> 00:09:58,120
20 in some of these samples um and what

240
00:10:00,960 --> 00:09:59,740
you actually knows if you notice that

241
00:10:04,110 --> 00:10:00,970
there's got like different kinds of

242
00:10:06,810 --> 00:10:04,120
shading in a sense the translucency it's

243
00:10:09,720 --> 00:10:06,820
like a fifty percent translucent so the

244
00:10:12,330 --> 00:10:09,730
more concentrated the color that more

245
00:10:15,390 --> 00:10:12,340
like the more data like for that site

246
00:10:18,330 --> 00:10:15,400
and to kind of show you what this looks

247
00:10:20,550 --> 00:10:18,340
like in an actual grain this is an image

248
00:10:23,220 --> 00:10:20,560
from the SEM and you're seeing a giant

249
00:10:24,900 --> 00:10:23,230
old grain of naturally night and all

250
00:10:26,880 --> 00:10:24,910
that great stuff is just regular old

251
00:10:28,740 --> 00:10:26,890
naturally night but the kind of white

252
00:10:31,920 --> 00:10:28,750
streak through the middle that's

253
00:10:33,300 --> 00:10:31,930
iron-rich alley night so it's you know

254
00:10:35,100 --> 00:10:33,310
it's compositionally still naturally

255
00:10:37,410 --> 00:10:35,110
night but it's got a lot more iron and

256
00:10:39,960 --> 00:10:37,420
that rather than aluminum entirely and

257
00:10:42,000 --> 00:10:39,970
it's be site and that has an Fe number

258
00:10:44,940 --> 00:10:42,010
in the center kind of the the most iron

259
00:10:46,740 --> 00:10:44,950
rich of about sixteen so kind of the big

260
00:10:48,960 --> 00:10:46,750
takeaway from this is that fe number

261
00:10:51,000 --> 00:10:48,970
varies between and even within grains

262
00:10:53,010 --> 00:10:51,010
from the same sample there's a lot of

263
00:10:56,010 --> 00:10:53,020

very building and where that iron is

264
00:10:57,330 --> 00:10:56,020
locating but then the question is how

265
00:11:01,350 --> 00:10:57,340
does that affect whether we're going to

266
00:11:04,380 --> 00:11:01,360
be able to identify it with instruments

267
00:11:06,180 --> 00:11:04,390
that we have on Mars so now I'm going to

268
00:11:09,720 --> 00:11:06,190
briefly talk a little bit more oops

269
00:11:11,850 --> 00:11:09,730
about xrd which is just that it uses

270
00:11:14,340 --> 00:11:11,860
Bragg's law essentially

271
00:11:16,980 --> 00:11:14,350
we send in an x-ray with cobalt or

272
00:11:19,380 --> 00:11:16,990
copper so we know the lambda the

273
00:11:20,970 --> 00:11:19,390
wavelength it comes out a certain angle

274
00:11:22,829 --> 00:11:20,980
from the angle we can determine the

275
00:11:25,319 --> 00:11:22,839
spacing between the mineral layers so

276
00:11:27,000 --> 00:11:25,329
minerals are crystalline solids so

277
00:11:28,889 --> 00:11:27,010
they've got characteristic spacing that

278
00:11:31,949 --> 00:11:28,899
we can use to kind of understand the

279
00:11:33,750 --> 00:11:31,959
mineral and determine what mineral is so

280
00:11:35,220 --> 00:11:33,760
I'm still showing you that formula and

281
00:11:38,160 --> 00:11:35,230
essentially what i'm showing you several

282
00:11:41,100 --> 00:11:38,170
natural ally nights standards plotted up

283
00:11:43,530 --> 00:11:41,110
here and based on their fe number and

284
00:11:45,480 --> 00:11:43,540
although obviously it's very small

285
00:11:48,540 --> 00:11:45,490
differences we're talking angstroms here

286
00:11:51,960 --> 00:11:48,550
there is a significant variation and

287
00:11:54,360 --> 00:11:51,970
increase with fe number of that spacing

288
00:11:56,040 --> 00:11:54,370

between the mineral layers so this is

289
00:11:58,530 --> 00:11:56,050
something that curiosity could actually

290
00:12:00,269 --> 00:11:58,540
do this is something that chem and data

291
00:12:02,340 --> 00:12:00,279
will give us that we can actually

292
00:12:04,230 --> 00:12:02,350
determine if we're looking at a pure

293
00:12:05,460 --> 00:12:04,240
jerry site or we're looking at something

294
00:12:07,710 --> 00:12:05,470
that's intermediate something that's

295
00:12:10,139 --> 00:12:07,720
between alley night and jer site so to

296
00:12:12,540 --> 00:12:10,149
talk briefly about the implications yes

297
00:12:14,460 --> 00:12:12,550
i nurture natural a night was found at

298
00:12:18,210 --> 00:12:14,470
pretty much all of these different sites

299
00:12:20,850 --> 00:12:18,220
um furthermore that iron rich al unite

300
00:12:23,310 --> 00:12:20,860
was forming at peaches of up to five and

301
00:12:25,439 --> 00:12:23,320
jer site if you recall was forming only

302
00:12:27,420 --> 00:12:25,449
at peaches of maybe up to three maybe

303
00:12:28,829 --> 00:12:27,430
four from generous so that means

304
00:12:33,150 --> 00:12:28,839
something different about the ancient

305
00:12:36,509 --> 00:12:33,160
environmental conditions and lastly we

306
00:12:39,630 --> 00:12:36,519
can use xrd to distinguish between the

307
00:12:43,740 --> 00:12:39,640
alley night and the juror site species

308
00:12:46,650 --> 00:12:43,750
on Mars so lastly i'm currently using

309
00:12:49,170 --> 00:12:46,660
also some ramen data collected to try

310
00:12:52,920 --> 00:12:49,180
and see how the peaks are shifting

311
00:12:55,050 --> 00:12:52,930
relative to the SP number unfortunately

312
00:12:57,030 --> 00:12:55,060
each peak shift slightly differently so

313
00:12:59,759 --> 00:12:57,040

it's not quite straightforward as with

314
00:13:02,280 --> 00:12:59,769
xrd but that's something i'm working on

315
00:13:05,930 --> 00:13:02,290
figuring out and i'd like to take my

316
00:13:08,970 --> 00:13:05,940
advisor and these pair of pants I ruined

317
00:13:12,389 --> 00:13:08,980
when I sound a few Merle and it's going

318
00:13:19,090 --> 00:13:12,399
on to next slides but on and thank you

319
00:13:36,740 --> 00:13:24,770
any questions for Lara got one of them

320
00:13:39,680 --> 00:13:36,750
oh yes oh I will think about the suit

321
00:13:43,820 --> 00:13:39,690
man I to pace because the two years ago

322
00:13:46,250 --> 00:13:43,830
ms arigato several excited ADA from us

323
00:13:49,850 --> 00:13:46,260
but there is no Charles I day and all

324
00:13:52,580 --> 00:13:49,860
night but I'm respectable audible I on

325
00:13:57,100 --> 00:13:52,590
in surveys face what do you know to

326
00:14:00,350 --> 00:13:57,110
switch my knives what are you sorry oh

327
00:14:02,840 --> 00:14:00,360
do you know tsushima night Tamina pace

328
00:14:04,550 --> 00:14:02,850
short midnight a switchman I yeah I

329
00:14:08,120 --> 00:14:04,560
haven't heard of any schwert my night on

330
00:14:10,220 --> 00:14:08,130
Mars um I don't know if anyone has been

331
00:14:13,820 --> 00:14:10,230
short my night on Mars but to my

332
00:14:17,180 --> 00:14:13,830
knowledge that hasn't been because two

333
00:14:20,690 --> 00:14:17,190
years ago to ms arigato exide era from

334
00:14:23,720 --> 00:14:20,700
Mars surface but there's no jarosite and

335
00:14:27,980 --> 00:14:23,730
other night there is um so actually the

336
00:14:30,470 --> 00:14:27,990
roof had several um I we've had there's

337
00:14:33,830 --> 00:14:30,480
at least several papers now out on the

338
00:14:35,270 --> 00:14:33,840

xrd results they've done xrd and i want

339
00:14:36,770 --> 00:14:35,280
to say at least six sites on Mars some

340
00:14:41,570 --> 00:14:36,780
of those that data hasn't been published

341
00:14:45,370 --> 00:14:41,580
yet but I LPS sienna and a GU they

342
00:14:47,840 --> 00:14:45,380
shared that they found Jerris I at

343
00:14:52,160 --> 00:14:47,850
confidence Hills so that's at the base

344
00:14:53,930 --> 00:14:52,170
of Mount sharp on I'm eagerly waiting

345
00:14:55,520 --> 00:14:53,940
for that data be published so I can kind

346
00:14:57,140 --> 00:14:55,530
of an investigative all but further

347
00:14:58,610 --> 00:14:57,150
about whether that's Jerry site or ally

348
00:15:01,880 --> 00:14:58,620
night or something in between based on

349
00:15:04,310 --> 00:15:01,890
their xrd data I know it's gonna go up

350
00:15:07,790 --> 00:15:04,320
on whatever that PDS or whatever that

351
00:15:10,160 --> 00:15:07,800
website is um eventually so I'm really

352
00:15:11,960 --> 00:15:10,170
waiting that why is there I didn't see

353
00:15:14,030 --> 00:15:11,970
jealous Athena excited aerosol yeah

354
00:15:19,630 --> 00:15:14,040
that's renewed us that was presented at

355
00:15:27,350 --> 00:15:19,640
UM a GUI want to say this year um yeah

356
00:15:28,690 --> 00:15:27,360
thank you hey great talk and I have a

357
00:15:31,120 --> 00:15:28,700
question about the

358
00:15:37,300 --> 00:15:31,130
slight where you show different ion

359
00:15:42,400 --> 00:15:37,310
concentration in the three sides yeah

360
00:15:44,410 --> 00:15:42,410
okay um it looks like I only substitutes

361
00:15:46,900 --> 00:15:44,420
in the high temperature acidic

362
00:15:49,930 --> 00:15:46,910
environments a lot do you have an

363
00:15:51,370 --> 00:15:49,940

explanation you know I actually didn't

364
00:15:53,740 --> 00:15:51,380
really think about that that's it that's

365
00:15:55,810 --> 00:15:53,750
a good point on the other hand at the

366
00:15:58,090 --> 00:15:55,820
dome edge I know if you can tell but

367
00:16:01,180 --> 00:15:58,100
that that top point is like actually

368
00:16:02,680 --> 00:16:01,190
like I think five or six data points are

369
00:16:06,700 --> 00:16:02,690
kind of concentrating that top point

370
00:16:08,500 --> 00:16:06,710
which is about FB number 15 um so and

371
00:16:11,290 --> 00:16:08,510
that's it much lower temperature we're

372
00:16:12,880 --> 00:16:11,300
talking like 30 to 45 degrees Celsius so

373
00:16:16,570 --> 00:16:12,890
I don't know if there's any correlation

374
00:16:20,290 --> 00:16:16,580
there you know it would be interesting

375
00:16:23,080 --> 00:16:20,300
to find out why iron substitutes in le a

376
00:16:24,820 --> 00:16:23,090
night and that's stuff like something

377
00:16:29,140 --> 00:16:24,830
for further research to understand why

378
00:16:35,200 --> 00:16:29,150
that happens and if temperature and pH

379
00:16:39,640 --> 00:16:35,210
are involved in that even more yeah get

380
00:16:42,730 --> 00:16:39,650
one last question here hi good talker so

381
00:16:45,040 --> 00:16:42,740
I I to that question he shows a better

382
00:16:46,570 --> 00:16:45,050
relationship between Deanna composition

383
00:16:48,550 --> 00:16:46,580
you know you get excited pattern there

384
00:16:51,430 --> 00:16:48,560
are many Peaks right mm-hmm what a

385
00:16:55,030 --> 00:16:51,440
particular pika did you pick it up that

386
00:16:58,000 --> 00:16:55,040
a particular devalue do you know the how

387
00:17:00,280 --> 00:16:58,010
much particular yeah yeah let me try and

388
00:17:05,260 --> 00:17:00,290

remember which peak oh boy when I'm put

389
00:17:06,699 --> 00:17:05,270
this together um I think I mean I chose

390
00:17:08,800 --> 00:17:06,709
several different peaks and they all

391
00:17:11,650 --> 00:17:08,810
pretty much look the same no matter

392
00:17:13,360 --> 00:17:11,660
which one I chose the plot looks pretty

393
00:17:17,530 --> 00:17:13,370
similar I'm trying remember which

394
00:17:20,380 --> 00:17:17,540
specific one I chose I'm guessing i use

395
00:17:24,189 --> 00:17:20,390
the one that said it's about at 72 date

396
00:17:27,970 --> 00:17:24,199
of 17 40 site i'm using a copper xrd and

397
00:17:30,760 --> 00:17:27,980
about 18 for Ali night as I think the

398
00:17:33,370 --> 00:17:30,770
one I use because it was easy but you

399
00:17:35,830 --> 00:17:33,380
can also use the one that's around a 2

400
00:17:38,080 --> 00:17:35,840
theta of my gosh it's just continuing on

401
00:17:41,920 --> 00:17:38,090
still you can also use a one that's a 2

402
00:17:42,530 --> 00:17:41,930
theta of around 30 yeah there's several

403
00:17:44,720 --> 00:17:42,540
different piece

404
00:17:47,000 --> 00:17:44,730
genius right for publication you need a

405
00:17:48,890 --> 00:17:47,010
mega specific put a million decks over

406
00:17:50,810 --> 00:17:48,900
there so people can correlate to your

407
00:17:56,000 --> 00:17:50,820
data with other people today yeah right