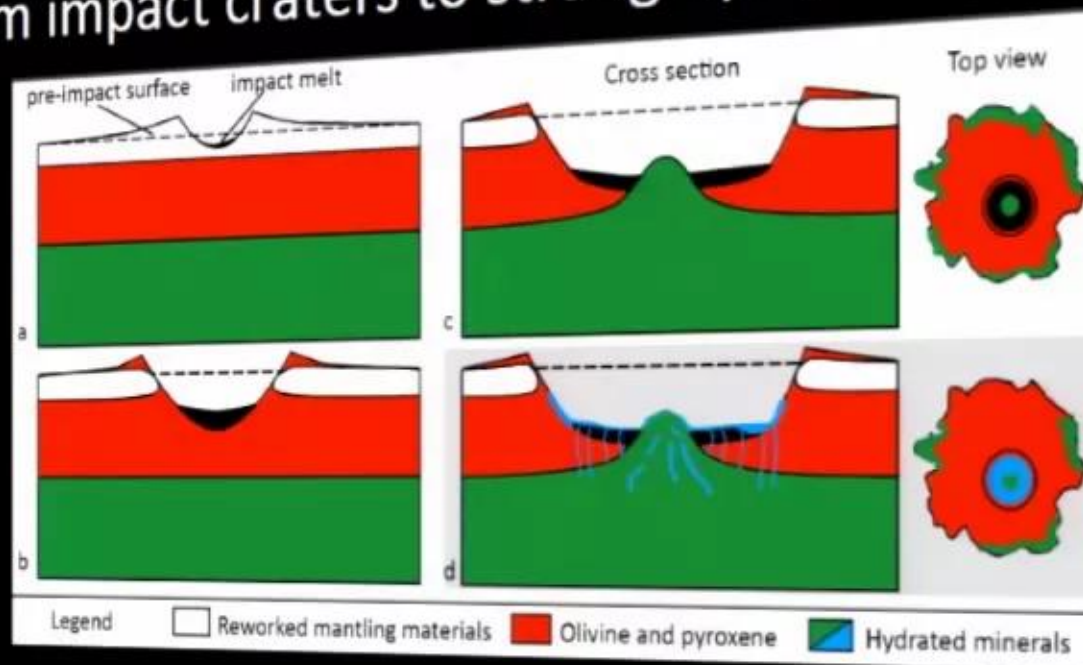


From impact craters to stratigraphy



(Modified from Ernst et al., 2010)

- a) **Ejecta = surroundings:** Crater too small to penetrate the surface layer (mantling layer) can be used to constrain the minimum thickness of this layer.
- b) **Ejecta ≠ surrounding:** Crater that penetrates through the top layer constrains the maximum thickness of the top layer and reveals underlying materials
- c) **Ejecta ≠ surroundings & different material exposed in central peak:** Crater reveals third stratigraphic layer in a central structure, constrains the thickness of second layer.
- d) **Hydrothermal alteration case:** More intense alteration on crater floor and crater walls than ejecta blanket

1
00:00:12,350 --> 00:00:09,620
okay so i think sony for giving us a

2
00:00:14,900 --> 00:00:12,360
very well-rounded background information

3
00:00:17,590 --> 00:00:14,910
about Mars and the early like went

4
00:00:19,849 --> 00:00:17,600
through most of my background sighs but

5
00:00:25,250 --> 00:00:19,859
we're going to like go through them

6
00:00:27,019 --> 00:00:25,260
again so welcome to Mars this is I'm

7
00:00:28,310 --> 00:00:27,029
going to talk about my project on

8
00:00:31,550 --> 00:00:28,320
protein Mars Northern Plains

9
00:00:33,200 --> 00:00:31,560
stratigraphy with impact craters so my

10
00:00:37,250 --> 00:00:33,210
name is Lou pan I'm from California

11
00:00:40,340 --> 00:00:37,260
Institute of Technology and right here

12
00:00:43,330 --> 00:00:40,350
you're looking at a visible image of a

13
00:00:47,930 --> 00:00:43,340

kind of stretched image of Mars and uh

14

00:00:50,180 --> 00:00:47,940

and the notes the northern things are

15

00:00:52,760 --> 00:00:50,190

this like darker regions this is acid

16

00:00:56,299 --> 00:00:52,770

idea and this is where we are going to

17

00:00:58,250 --> 00:00:56,309

look at today so one of the striking

18

00:01:01,250 --> 00:00:58,260

feature about Mars where you look at

19

00:01:04,280 --> 00:01:01,260

this top our feet is the hemispheric

20

00:01:06,440 --> 00:01:04,290

dichotomy and the Staten Island is the

21

00:01:08,420 --> 00:01:06,450

average elevation of the southern

22

00:01:11,359 --> 00:01:08,430

highlands is about five kilometers

23

00:01:13,280 --> 00:01:11,369

higher than the northern lowlands and

24

00:01:16,609 --> 00:01:13,290

you can see is also very heavily

25

00:01:19,940 --> 00:01:16,619

cratered because it has a which wich

26

00:01:21,800 --> 00:01:19,950

lead lead to our understanding of the

27

00:01:25,640 --> 00:01:21,810

Southern Highlands being very ancient

28

00:01:27,010 --> 00:01:25,650

engage they are not just different on

29

00:01:28,940 --> 00:01:27,020

the surface they also have a

30

00:01:31,880 --> 00:01:28,950

intrinsically different crustal

31

00:01:35,030 --> 00:01:31,890

thickness the northern things are our

32

00:01:38,300 --> 00:01:35,040

much thinner have a much thinner crust

33

00:01:41,330 --> 00:01:38,310

the Anderson a Highlands but what's more

34

00:01:43,760 --> 00:01:41,340

interesting about above Mars is that a

35

00:01:45,710 --> 00:01:43,770

recent in the recent decades there are

36

00:01:47,740 --> 00:01:45,720

thousands of our crafts of hydrated

37

00:01:50,870 --> 00:01:47,750

minerals detected on the surface of Mars

38

00:01:53,780 --> 00:01:50,880

including iron magnesium phyllosilicates

39

00:01:55,910 --> 00:01:53,790

hydrated silica chlorides carbonates and

40

00:01:57,560 --> 00:01:55,920

sulfates but you can see most of the

41

00:02:00,109 --> 00:01:57,570

hydrated minerals are concentrated in

42

00:02:02,359 --> 00:02:00,119

the south and highland area and only a

43

00:02:05,959 --> 00:02:02,369

few spots are detected in the northern

44

00:02:08,990 --> 00:02:05,969

plains and this also leads to a new

45

00:02:12,920 --> 00:02:09,000

understanding of the chronology of Mars

46

00:02:13,760 --> 00:02:12,930

so we have divided from the from crate

47

00:02:16,010 --> 00:02:13,770

accounts

48

00:02:18,080 --> 00:02:16,020

the understanding of major events in

49

00:02:20,060 --> 00:02:18,090

Martian history people have divided

50

00:02:22,640 --> 00:02:20,070

Martian history into three main epochs

51
00:02:26,030 --> 00:02:22,650
so the oldest being the NARC Ian and

52
00:02:28,250 --> 00:02:26,040
then hesperian an Amazonian age and from

53
00:02:32,000 --> 00:02:28,260
the mineralogy side we find that most

54
00:02:34,760 --> 00:02:32,010
criminals before fine are related to the

55
00:02:38,600 --> 00:02:34,770
oldest terrains so people believe that

56
00:02:42,230 --> 00:02:38,610
these clay minerals represent early warm

57
00:02:46,280 --> 00:02:42,240
and wet Mars climates that transitioned

58
00:02:48,710 --> 00:02:46,290
into a more acidic acidic atmosphere

59
00:02:51,620 --> 00:02:48,720
with a lot of volcanism period in the

60
00:02:54,380 --> 00:02:51,630
Hesperian there where the sulfate

61
00:02:56,930 --> 00:02:54,390
mineralogy dominates the surface and

62
00:02:58,610 --> 00:02:56,940
when you move to the amazonian you don't

63
00:03:02,630 --> 00:02:58,620

see a lot of hydrating minerals they are

64

00:03:06,080 --> 00:03:02,640

mostly a hydrate anhydrous ferric oxide

65

00:03:09,770 --> 00:03:06,090

that our correspondent to the Martian

66

00:03:11,210 --> 00:03:09,780

surface we see it today but today I'm

67

00:03:13,280 --> 00:03:11,220

going to talk mainly talk about the

68

00:03:16,370 --> 00:03:13,290

northern plains of Mars if you have a

69

00:03:18,320 --> 00:03:16,380

red book Martian like they landed here

70

00:03:21,620 --> 00:03:18,330

in acid idea where I'm going to talk

71

00:03:23,390 --> 00:03:21,630

about so the note we don't know very

72

00:03:27,260 --> 00:03:23,400

much about the notes and things we don't

73

00:03:31,160 --> 00:03:27,270

have such such thousands of outcrops of

74

00:03:33,890 --> 00:03:31,170

hydrated minerals and there what we know

75

00:03:36,290 --> 00:03:33,900

about Northern Plains is like this so

76

00:03:39,350 --> 00:03:36,300

from the noachian age we know there are

77

00:03:41,180 --> 00:03:39,360

there is a heavily cratered basement in

78

00:03:44,140 --> 00:03:41,190

the northern things this is inferred

79

00:03:48,170 --> 00:03:44,150

from the quasi circular depressions or

80

00:03:50,090 --> 00:03:48,180

they call it ghost craters that are dead

81

00:03:53,120 --> 00:03:50,100

people found using the topography data

82

00:03:55,280 --> 00:03:53,130

and these Curt this is an important

83

00:03:56,900 --> 00:03:55,290

discovery because this tells us that I

84

00:03:59,030 --> 00:03:56,910

caught me between the Santa Highlands

85

00:04:01,100 --> 00:03:59,040

and Northern Plains are set very early

86

00:04:03,620 --> 00:04:01,110

on in Martian history and the Northern

87

00:04:05,620 --> 00:04:03,630

Plains is has a very different surface

88

00:04:08,840 --> 00:04:05,630

environment because there are later

89

00:04:10,970 --> 00:04:08,850

sediments and vocal like settlements and

90

00:04:14,510 --> 00:04:10,980

lava flows deposited into the nose of

91

00:04:16,250 --> 00:04:14,520

things and a major question about the

92

00:04:18,349 --> 00:04:16,260

north and things is that people

93

00:04:21,620 --> 00:04:18,359

suggested they could have been a global

94

00:04:24,530 --> 00:04:21,630

ocean existed somewhere you later

95

00:04:26,540 --> 00:04:24,540

knocking or early hesperian and this has

96

00:04:27,410 --> 00:04:26,550

been argued better enforce but we still

97

00:04:30,860 --> 00:04:27,420

do not have them

98

00:04:32,810 --> 00:04:30,870

evidence for such a notion to exist when

99

00:04:35,030 --> 00:04:32,820

we move to the Amazonia age there are

100

00:04:37,940 --> 00:04:35,040

not so much going on in the northern

101
00:04:40,280 --> 00:04:37,950
plains except for the polar deposits due

102
00:04:43,490 --> 00:04:40,290
to the radical obliquity changes of Mars

103
00:04:45,470 --> 00:04:43,500
and also there are some surface geologic

104
00:04:47,890 --> 00:04:45,480
features like this one so this little

105
00:04:51,320 --> 00:04:47,900
conical feature our hypothesis

106
00:04:55,810 --> 00:04:51,330
hypothesized to be a mud volcano that

107
00:04:59,480 --> 00:04:55,820
involve some volatile activities so

108
00:05:01,160 --> 00:04:59,490
today our project is to look at you used

109
00:05:03,460 --> 00:05:01,170
chiasm data to look at the Northern

110
00:05:05,690 --> 00:05:03,470
Plains and try to see if we can also

111
00:05:08,270 --> 00:05:05,700
understand these important questions

112
00:05:10,130 --> 00:05:08,280
whether they're there has being a

113
00:05:13,910 --> 00:05:10,140

sustained global ocean in the northern

114

00:05:16,340 --> 00:05:13,920

things has serving recent groundwater

115

00:05:18,470 --> 00:05:16,350

organized activities and more generally

116

00:05:22,730 --> 00:05:18,480

what is the stratigraphy of the north of

117

00:05:24,260 --> 00:05:22,740

things itself so by chris I mean the

118

00:05:26,420 --> 00:05:24,270

compaq reconnaissance imaging

119

00:05:28,700 --> 00:05:26,430

spectrometer for mars so this is a

120

00:05:31,220 --> 00:05:28,710

visible near infrared spectrometer on

121

00:05:34,100 --> 00:05:31,230

board mars reconnaissance orbiter and it

122

00:05:37,850 --> 00:05:34,110

has been orbiting mars for more than a

123

00:05:41,270 --> 00:05:37,860

decade i think and we obtain information

124

00:05:44,030 --> 00:05:41,280

like this from chris so x axis

125

00:05:47,720 --> 00:05:44,040

wavelength and why it is reflectance and

126

00:05:51,100 --> 00:05:47,730

from the difference spectra of fun of

127

00:05:54,950 --> 00:05:51,110

the surface in the visible near-infrared

128

00:05:57,620 --> 00:05:54,960

wavelengths range we can get electronic

129

00:06:01,040 --> 00:05:57,630

transitions like this from the mafic

130

00:06:04,220 --> 00:06:01,050

minerals and also vibrational transition

131

00:06:07,970 --> 00:06:04,230

transition bands that are sharper and

132

00:06:10,490 --> 00:06:07,980

more in word in the longer wavelengths

133

00:06:13,390 --> 00:06:10,500

and these represent water formed winners

134

00:06:17,150 --> 00:06:13,400

like smacked eyes or hydrated silica or

135

00:06:20,440 --> 00:06:17,160

we can get these continuum slopes they

136

00:06:24,380 --> 00:06:20,450

represent an alteration rind or coating

137

00:06:26,420 --> 00:06:24,390

so what we are going to do is to

138

00:06:28,760 --> 00:06:26,430

specifically look at the impact craters

139

00:06:30,980 --> 00:06:28,770

in the Northern Plains because the

140

00:06:33,950 --> 00:06:30,990

Northern Plains as I said we don't have

141

00:06:36,170 --> 00:06:33,960

too much exposure of hydrogen rose

142

00:06:38,270 --> 00:06:36,180

because it's mostly covered and there is

143

00:06:40,700 --> 00:06:38,280

some alteration on the surface so we

144

00:06:41,090 --> 00:06:40,710

don't detect it's very hard to detect

145

00:06:43,430 --> 00:06:41,100

those

146

00:06:44,690 --> 00:06:43,440

David's in the north and things that's

147

00:06:47,510 --> 00:06:44,700

why we're going through the impact

148

00:06:50,120 --> 00:06:47,520

craters you can see from inner panel a

149

00:06:52,310 --> 00:06:50,130

through c impact craters of different

150

00:06:55,810 --> 00:06:52,320

sizes can penetrate through different

151

00:06:58,670 --> 00:06:55,820

layers in a stratigraphy and uh and

152

00:07:01,190 --> 00:06:58,680

expose all these mineralogy on the

153

00:07:03,650 --> 00:07:01,200

surface you can see the deepest mineral

154

00:07:06,800 --> 00:07:03,660

the deepest layer exposed in the central

155

00:07:10,700 --> 00:07:06,810

peak and in the proximal in the distal

156

00:07:13,760 --> 00:07:10,710

area of the dejected blanket there is

157

00:07:15,920 --> 00:07:13,770

one complicating factor about hydrated

158

00:07:20,600 --> 00:07:15,930

minerals is that these could have formed

159

00:07:24,530 --> 00:07:20,610

after the impacts when if when there is

160

00:07:26,570 --> 00:07:24,540

a hydrocele role when there's a there

161

00:07:29,240 --> 00:07:26,580

there are impact induced hydro summer

162

00:07:31,780 --> 00:07:29,250

activities formed because of the impact

163

00:07:36,380 --> 00:07:31,790

these have been proposed for Mars and

164

00:07:38,330 --> 00:07:36,390

possibly they did exist for Mars in in

165

00:07:41,240 --> 00:07:38,340

certain ages when there's liquid water

166

00:07:44,840 --> 00:07:41,250

around so we have to look out for such

167

00:07:48,100 --> 00:07:44,850

hydrated minerals in post crater post

168

00:07:51,410 --> 00:07:48,110

crater formation hydrothermal activities

169

00:07:55,910 --> 00:07:51,420

so that's the main idea here I'm showing

170

00:07:57,920 --> 00:07:55,920

the map of the detections of mafic

171

00:08:00,470 --> 00:07:57,930

minerals and hydrating murals in large

172

00:08:02,870 --> 00:08:00,480

craters so all of the white dots are

173

00:08:07,940 --> 00:08:02,880

crazy larger than 30 kilometers and

174

00:08:10,400 --> 00:08:07,950

these are but most of these do not have

175

00:08:13,460 --> 00:08:10,410

create some coverage so within Acidalia

176

00:08:15,500 --> 00:08:13,470

Planitia we have surveyed all of the

177

00:08:18,560 --> 00:08:15,510

image all of the credits with chrism

178

00:08:21,340 --> 00:08:18,570

coverages and found some some of them

179

00:08:25,130 --> 00:08:21,350

have both metric and hydrogen minnows

180

00:08:28,910 --> 00:08:25,140

their previous works they looked at

181

00:08:31,130 --> 00:08:28,920

these area and found several found me 50

182

00:08:33,409 --> 00:08:31,140

nodes in small craters in Australia and

183

00:08:35,300 --> 00:08:33,419

hydrated minerals in nine of the large

184

00:08:38,659 --> 00:08:35,310

craters in within the Northern Plains

185

00:08:41,420 --> 00:08:38,669

but today we're going to show you a

186

00:08:44,180 --> 00:08:41,430

complete survey of these northern plains

187

00:08:45,980 --> 00:08:44,190

data set and integrates both metric and

188

00:08:48,020 --> 00:08:45,990

hydrated signatures and try to

189

00:08:51,590 --> 00:08:48,030

understand their relative stratigraphic

190

00:08:54,079 --> 00:08:51,600

relationship and play some some loose

191

00:08:54,790 --> 00:08:54,089

constraints on what this recovery looks

192

00:08:58,309 --> 00:08:54,800

like

193

00:09:01,699 --> 00:08:58,319

and so these are some preliminary

194

00:09:04,670 --> 00:09:01,709

results from our daily of lanesha 61

195

00:09:07,460 --> 00:09:04,680

chris targeted images have been studied

196

00:09:09,710 --> 00:09:07,470

and 44 are detected with my pic minnows

197

00:09:13,249 --> 00:09:09,720

and 25 with hydrating you know

198

00:09:15,559 --> 00:09:13,259

detections so on this map all of the

199

00:09:17,990 --> 00:09:15,569

stars represent craters larger than 30

200

00:09:20,090 --> 00:09:18,000

kilometers and all of the tasks surface

201
00:09:22,249 --> 00:09:20,100
and smaller ones so there are even

202
00:09:25,939 --> 00:09:22,259
smaller craters that are not shown on

203
00:09:27,590 --> 00:09:25,949
this map you can see have like there is

204
00:09:30,850 --> 00:09:27,600
a general trend that the larger craters

205
00:09:33,499 --> 00:09:30,860
show more of a hydrating minnows so i'm

206
00:09:35,509 --> 00:09:33,509
here i have divided into you i'm

207
00:09:38,749 --> 00:09:35,519
magnesium fellows the case and other

208
00:09:40,850 --> 00:09:38,759
hydrated faces because to identify i'm

209
00:09:43,490 --> 00:09:40,860
magnesium phallus okay see you need to

210
00:09:46,490 --> 00:09:43,500
find the 2.3 micron absorption

211
00:09:48,829 --> 00:09:46,500
absorption which are generally very weak

212
00:09:51,829 --> 00:09:48,839
in the north of things so sometimes it

213
00:09:54,650 --> 00:09:51,839

did not see them and another observation

214

00:09:56,780 --> 00:09:54,660

from this survey is that creators near

215

00:09:59,210 --> 00:09:56,790

these outflow channels generally have

216

00:10:01,999 --> 00:09:59,220

very weak detections so sometimes it's

217

00:10:06,170 --> 00:10:02,009

very hard to pinpoint there is a

218

00:10:08,300 --> 00:10:06,180

hydrated detection there and I have some

219

00:10:11,449 --> 00:10:08,310

examples of how we detect these minnows

220

00:10:14,120 --> 00:10:11,459

so this is on a left of showing the

221

00:10:17,749 --> 00:10:14,130

famous image of cannot see equator and

222

00:10:19,999 --> 00:10:17,759

davis creature and these these shapes on

223

00:10:22,699 --> 00:10:20,009

the image are the crease of footprints

224

00:10:25,579 --> 00:10:22,709

with the little dots showing what kind

225

00:10:27,410 --> 00:10:25,589

of mineral detections there is on the

226

00:10:30,199 --> 00:10:27,420

right i'm showing the spectra of

227

00:10:32,689 --> 00:10:30,209

different different minerals this panel

228

00:10:36,110 --> 00:10:32,699

is the hydrating we know with the 1.9

229

00:10:39,230 --> 00:10:36,120

water band and the 2.3 metal o.h bands

230

00:10:42,769 --> 00:10:39,240

these are like in davis critter is very

231

00:10:46,129 --> 00:10:42,779

weak base right above detection star

232

00:10:48,259 --> 00:10:46,139

showed in inoculator is more clear and

233

00:10:50,360 --> 00:10:48,269

you can see there's a 2.35 absorption

234

00:10:53,720 --> 00:10:50,370

future which is which is so close a

235

00:10:57,559 --> 00:10:53,730

match to chloride instead of the non

236

00:11:00,170 --> 00:10:57,569

tonight and staff nine samples and on

237

00:11:02,840 --> 00:11:00,180

the right panel the these broad

238

00:11:06,139 --> 00:11:02,850

absorptions represent iron in the mineral

239

00:11:07,940 --> 00:11:06,149

so these are all in spectra and drugs

240

00:11:09,860 --> 00:11:07,950

inspection

241

00:11:11,720 --> 00:11:09,870

what is cool about Davis crater though

242

00:11:13,520 --> 00:11:11,730

is that you did not only see these

243

00:11:15,860 --> 00:11:13,530

hydrated minerals in the central peak

244

00:11:18,290 --> 00:11:15,870

you also see them on the crater walls and

245

00:11:22,070 --> 00:11:18,300

the crater a chapter which is consistent

246

00:11:26,330 --> 00:11:22,080

with all the Creator created excavation

247

00:11:27,980 --> 00:11:26,340

models so as I said earlier we need to

248

00:11:31,010 --> 00:11:27,990

distinguish whether these hydrated

249

00:11:34,190 --> 00:11:31,020

minerals formed pre or after you put I'm

250

00:11:36,650 --> 00:11:34,200

running all the time okay so so here are

251
00:11:38,630 --> 00:11:36,660
just some beautiful images showing where

252
00:11:41,000 --> 00:11:38,640
these detections are made and can see

253
00:11:43,040 --> 00:11:41,010
them on the rocky regions where meter

254
00:11:46,640 --> 00:11:43,050
size boulders have been falling off

255
00:11:49,430 --> 00:11:46,650
these ridges and the same one here we

256
00:11:52,250 --> 00:11:49,440
have a layered mega block so this is a

257
00:11:55,760 --> 00:11:52,260
huge block in the central peak that is

258
00:11:57,830 --> 00:11:55,770
definitely I've lifted from depth so

259
00:12:00,410 --> 00:11:57,840
assuming we know that these minerals are

260
00:12:03,200 --> 00:12:00,420
excavated from depths we can calculate a

261
00:12:06,200 --> 00:12:03,210
maximum excavation depth from the size

262
00:12:08,660 --> 00:12:06,210
of these craters so in this figure the x

263
00:12:11,750 --> 00:12:08,670

axis is the crater rim to rim diameter

264

00:12:14,300 --> 00:12:11,760

and the y axis is the maximum excavation

265

00:12:16,430 --> 00:12:14,310

depths and different i'm not showing in

266

00:12:20,780 --> 00:12:16,440

each like these three lines are

267

00:12:24,620 --> 00:12:20,790

different models 444 crater scaling

268

00:12:26,930 --> 00:12:24,630

basically and you can see only critters

269

00:12:29,810 --> 00:12:26,940

larger than 20 kilometers are found with

270

00:12:32,570 --> 00:12:29,820

hydrated signals and these craters

271

00:12:36,620 --> 00:12:32,580

generally excavates depths from

272

00:12:38,630 --> 00:12:36,630

different than 1.5 kilometer so here is

273

00:12:40,790 --> 00:12:38,640

the summary and in the future we're

274

00:12:43,820 --> 00:12:40,800

going to complete the survey outside of

275

00:12:45,890 --> 00:12:43,830

acid area and build a builder complete

276

00:12:47,720 --> 00:12:45,900

database and place upper and lower

277

00:12:50,690 --> 00:12:47,730

bounds of the sequences of different

278

00:12:52,370 --> 00:12:50,700

layers and we hope to use this impact

279

00:12:55,280 --> 00:12:52,380

crater that we can decipher the changing

280

00:12:59,120 --> 00:12:55,290

acres history of Mars and better assess

281

00:13:01,700 --> 00:12:59,130

they have the ability and they have the

282

00:13:09,020 --> 00:13:01,710

ability of early Mars and how it changed

283

00:13:09,030 --> 00:13:23,770

so do we have any questions for Lou

284

00:13:27,800 --> 00:13:26,420

so I'm just wondering in the in the

285

00:13:30,560 --> 00:13:27,810

smaller craters you're saying that that

286

00:13:33,740 --> 00:13:30,570

that basically you don't you don't see

287

00:13:36,170 --> 00:13:33,750

these hydrated minerals right when you

288

00:13:37,760 --> 00:13:36,180

say hydrated minerals do just mean a no

289

00:13:41,240 --> 00:13:37,770

age group or do you mean basically

290

00:13:46,070 --> 00:13:41,250

minerals that have been altered by some

291

00:13:51,020 --> 00:13:46,080

sort of long standing waterbody like a

292

00:13:53,000 --> 00:13:51,030

clay or a or something so so in here

293

00:13:56,060 --> 00:13:53,010

when I say hydrated minerals I refer to

294

00:14:00,890 --> 00:13:56,070

the specific spectral class with the

295

00:14:04,850 --> 00:14:00,900

with h₂o band mean so so I think this

296

00:14:07,310 --> 00:14:04,860

represents a mineral with h₂o in the

297

00:14:09,950 --> 00:14:07,320

video structure so it can be a claim you

298

00:14:12,380 --> 00:14:09,960

know but it can be other like

299

00:14:14,750 --> 00:14:12,390

amorphous like amorphous silica or

300

00:14:17,570 --> 00:14:14,760

things like that that have the h₂o so

301

00:14:19,760 --> 00:14:17,580

it's a more broader range of you know

302

00:14:21,200 --> 00:14:19,770

okay because in the case of Gale Crater

303

00:14:24,170 --> 00:14:21,210

I understood there was actually like

304

00:14:26,360 --> 00:14:24,180

alteration type minerals I'm yeah so

305

00:14:27,950 --> 00:14:26,370

what I was curious about is one of these

306

00:14:31,280 --> 00:14:27,960

larger craters could potentially be

307

00:14:33,800 --> 00:14:31,290

larger water bodies and hold um you know

308

00:14:35,570 --> 00:14:33,810

not evaporate quite so quickly basically

309

00:14:37,490 --> 00:14:35,580

and be able to alter minerals over a

310

00:14:40,520 --> 00:14:37,500

longer standing period in such a

311

00:14:42,950 --> 00:14:40,530

you know then atmosphere where things

312

00:14:44,470 --> 00:14:42,960

would evaporate rather quickly so that

313

00:14:47,270 --> 00:14:44,480

was all I was curious about thank you

314

00:14:48,980 --> 00:14:47,280

that's definitely a possibility and

315

00:14:51,530 --> 00:14:48,990

that's why we're searching for like

316

00:14:53,720 --> 00:14:51,540

definite evidence for phyllosilicates

317

00:14:56,330 --> 00:14:53,730

and other criminals and from that you

318

00:15:03,380 --> 00:14:56,340

can you can infer how how much water