



1
00:00:18,260 --> 00:00:15,829
for a 90-day mission I remember when we

2
00:00:21,040 --> 00:00:18,270
landed we're excited we have three

3
00:00:24,710 --> 00:00:21,050
months to explore this region around our

4
00:00:27,560 --> 00:00:24,720
landing site and we basically blown the

5
00:00:29,450 --> 00:00:27,570
doors off that you know for six years

6
00:00:31,490 --> 00:00:29,460
now we've been doing classic field

7
00:00:33,500 --> 00:00:31,500
geology on Mars learning about the

8
00:00:35,479 --> 00:00:33,510
planet and its ancient past and it's

9
00:00:37,400 --> 00:00:35,489
been there been powerful revelations

10
00:00:39,560 --> 00:00:37,410
that have come well after that prime

11
00:00:41,510 --> 00:00:39,570
mission this experience of spirit is

12
00:00:43,250 --> 00:00:41,520
something that I've really kind of

13
00:00:44,630 --> 00:00:43,260

integrated into my whole identity you

14

00:00:46,279 --> 00:00:44,640

know this has become part of what I do

15

00:00:47,810 --> 00:00:46,289

and it looked at the very beginning of

16

00:00:49,279 --> 00:00:47,820

the mission like this was going to be

17

00:00:51,529 --> 00:00:49,289

something that I got to do for very

18

00:00:53,660 --> 00:00:51,539

brief time for three months and that was

19

00:00:55,790 --> 00:00:53,670

terrific and it was meek and was special

20

00:00:57,529 --> 00:00:55,800

i was really looking forward to it and I

21

00:01:00,139 --> 00:00:57,539

never in my wildest imagination believed

22

00:01:02,150 --> 00:01:00,149

it was going to go on here's Spirit

23

00:01:04,729 --> 00:01:02,160

really has had to have a lot of spirit

24

00:01:06,500 --> 00:01:04,739

to to keep going it's been the little

25

00:01:08,090 --> 00:01:06,510

Rover that could in a way it's had to

26

00:01:10,789 --> 00:01:08,100

work very hard for all of its

27

00:01:13,070 --> 00:01:10,799

discoveries two years into the mission

28

00:01:15,020 --> 00:01:13,080

so well past the prime mission the right

29

00:01:16,789 --> 00:01:15,030

front wheel stopped working and the

30

00:01:18,980 --> 00:01:16,799

wheel isn't spin so when we drive we

31

00:01:21,410 --> 00:01:18,990

drive backwards dragging that wheel and

32

00:01:23,149 --> 00:01:21,420

it would cut a furrow and so it actually

33

00:01:25,100 --> 00:01:23,159

turned out to be yet another scientific

34

00:01:27,260 --> 00:01:25,110

instrument or scientific investigation

35

00:01:28,999 --> 00:01:27,270

because it now trenched as we would

36

00:01:31,670 --> 00:01:29,009

drive along revealing was just beneath

37

00:01:33,920 --> 00:01:31,680

the surface one thing that we seem to be

38

00:01:37,880 --> 00:01:33,930

finding almost anywhere we're digging

39

00:01:39,770 --> 00:01:37,890

trench are these widespread deposits of

40

00:01:42,050 --> 00:01:39,780

various kinds of salts and minerals they

41

00:01:44,390 --> 00:01:42,060

look this brilliant white or yellow and

42

00:01:46,670 --> 00:01:44,400

the color images and that's because

43

00:01:49,820 --> 00:01:46,680

they're either sulphur or silica or

44

00:01:51,770 --> 00:01:49,830

salts of various kinds and the really

45

00:01:54,080 --> 00:01:51,780

important thing about these minerals and

46

00:01:57,290 --> 00:01:54,090

salts in particular is that that the

47

00:01:59,270 --> 00:01:57,300

only way they form is with water so the

48

00:02:01,820 --> 00:01:59,280

fact that we're finding these salts is

49

00:02:05,600 --> 00:02:01,830

real evidence that there was hot water

50

00:02:07,609 --> 00:02:05,610

over a very widespread area not just a

51
00:02:09,139 --> 00:02:07,619
little isolated pockets Mars really

52
00:02:11,720 --> 00:02:09,149
could have been a place that supported

53
00:02:14,449 --> 00:02:11,730
life and without these Rovers driving

54
00:02:16,550 --> 00:02:14,459
over these vast distances far beyond

55
00:02:18,380 --> 00:02:16,560
their expectations we would never have

56
00:02:20,600 --> 00:02:18,390
known that that's one of the great

57
00:02:23,030 --> 00:02:20,610
discoveries it's bear did well after its

58
00:02:25,550 --> 00:02:23,040
prime mission and as a result of one of

59
00:02:28,820 --> 00:02:25,560
the most serious mechanical failures

60
00:02:31,040 --> 00:02:28,830
we've had on either rope Mars is pretty

61
00:02:34,040 --> 00:02:31,050
harsh place we've had dust storms before

62
00:02:37,490 --> 00:02:34,050
we have really low power situations in

63
00:02:39,560 --> 00:02:37,500

winter we've had other small glitches

64

00:02:43,370 --> 00:02:39,570

that have caused us some tense moments

65

00:02:46,290 --> 00:02:43,380

but spirit seems to always find a way of

66

00:02:51,300 --> 00:02:46,300

turning some kind of adversity

67

00:02:56,740 --> 00:02:55,030

april of 2009 we were driving on the

68

00:02:58,330 --> 00:02:56,750

west side of home plate after we were

69

00:03:01,030 --> 00:02:58,340

unsuccessful in trying to go other ways

70

00:03:02,500 --> 00:03:01,040

around home plate and the rover broke

71

00:03:05,620 --> 00:03:02,510

through what I would describe as a

72

00:03:07,300 --> 00:03:05,630

perfectly camouflaged tiger trap and we

73

00:03:09,430 --> 00:03:07,310

were driving on terrain that we had

74

00:03:11,229 --> 00:03:09,440

successfully driven on before but

75

00:03:13,809 --> 00:03:11,239

suddenly the rover broke through a crust

76
00:03:16,030 --> 00:03:13,819
and was now embedded in some loose soft

77
00:03:18,190 --> 00:03:16,040
material it's almost like quicksand for

78
00:03:19,660 --> 00:03:18,200
the rover and with just five wheel

79
00:03:20,979 --> 00:03:19,670
spinning the only thing that was

80
00:03:24,009 --> 00:03:20,989
happening was the rover was sinking

81
00:03:27,880 --> 00:03:24,019
deeper into this material so we stopped

82
00:03:29,620 --> 00:03:27,890
and we did a very ambitious ground test

83
00:03:31,270 --> 00:03:29,630
campaign were built a sand box in the

84
00:03:33,550 --> 00:03:31,280
ground use one of our engineering Rovers

85
00:03:37,120 --> 00:03:33,560
and experimented with techniques to try

86
00:03:38,830 --> 00:03:37,130
to get the rover unstuck the reality is

87
00:03:40,390 --> 00:03:38,840
is it's very difficult with just a five

88
00:03:45,990 --> 00:03:40,400

wheel Rover to get it unstuck from this

89

00:03:51,220 --> 00:03:48,910

we have a very ambitious stationary

90

00:03:53,080 --> 00:03:51,230

science campaign for the rover I mean

91

00:03:55,449 --> 00:03:53,090

for six years we've been driving both

92

00:03:57,870 --> 00:03:55,459

Spirit and Opportunity not really taking

93

00:04:01,509 --> 00:03:57,880

any time to stop and smell the roses

94

00:04:03,850 --> 00:04:01,519

there's a lot of Lander science that one

95

00:04:06,580 --> 00:04:03,860

can do and we plan to do that with

96

00:04:08,199 --> 00:04:06,590

whispering spirits continued triumphs

97

00:04:09,699 --> 00:04:08,209

absolutely amaze me just the fact that

98

00:04:11,229 --> 00:04:09,709

we've had so much more of this mission

99

00:04:13,089 --> 00:04:11,239

than we ever thought we were going to

100

00:04:15,190 --> 00:04:13,099

have what these Rovers have done is that

101

00:04:18,219 --> 00:04:15,200

they have made Mars a familiar place

102

00:04:20,979 --> 00:04:18,229

Mars is now our neighborhood my team

103

00:04:23,770 --> 00:04:20,989

goes to work on Mars every day and that

104

00:04:25,659 --> 00:04:23,780

I think is the the great in tangible

105

00:04:28,170 --> 00:04:25,669

contribution from these Rovers is that

106

00:04:31,060 --> 00:04:28,180

Mars is no longer this you know strange

107

00:04:34,629 --> 00:04:31,070

unknown world I mean yes it's still

108

00:04:44,890 --> 00:04:34,639

mysterious but much of Mars is now known