YouTube Storyboard:

People, Space & the 21st Century

Part 2, Location

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Description:

People need the positive, look-ahead vision of the future that space exploration provides. The social conditions that created Apollo to the Moon are now gone, but we can revive human space exploration using 21st century means and data.

We need to learn to do space, again. Our most logical classroom is the Moon. In this video, we will look at a wonderful location, a gift from the gods, the Scott A Massif. Here we can build a settlement and thereby learn how to move on to settle Mars.

Purpose: This video proposes a space exploration program for the 21st century.

Intended Audience: Young Adult

YouTube: https://www.youtube.com/watch?v=U7umN5w06q8

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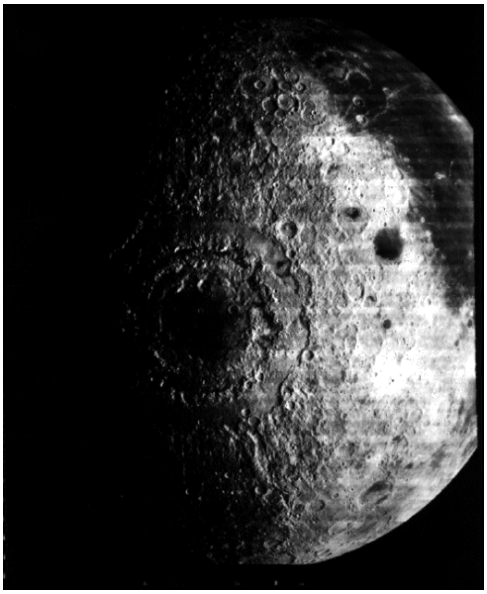
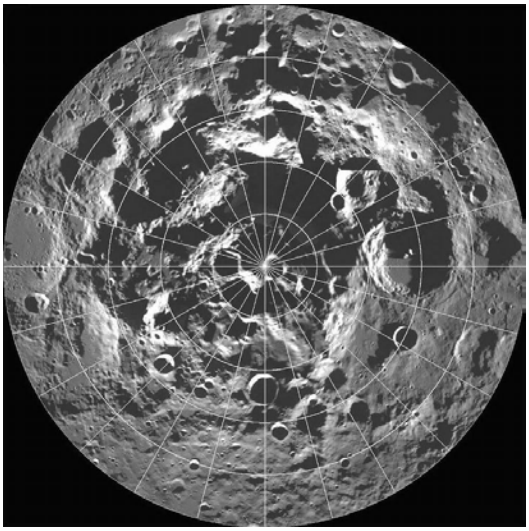
Storyboard:

Graphic	**Dialog** (Critical column for editing)
 Time: 10 s A Time: 31 s	Rocket sound 4 seconds **People, Space, and the 21st Century** **Part 2, Location:** This is the second part of a three-part series. Part 1 covers how we propose to manage this lunar expedition. It features a 21st-century approach to human space exploration called MOVE. In Part 2, we cover in detail our primary location for a lunar settlement, the Scott A Massif. More parts are coming. All the parts of this series can be found with the hashtag #BigMoonDig.





B Time: 75 s

Ancient History:

Our story starts a very long time ago, perhaps four billion years. The Moon had already formed; it had phase locked to face the Earth and cooled enough to form a solid crust.

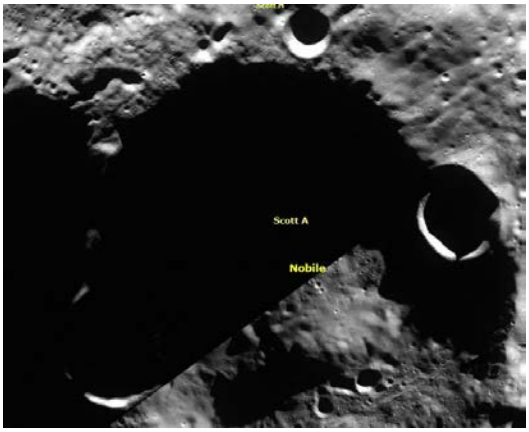
Then an enormous asteroid hit the Moon, striking in the southern hemisphere almost exactly opposite the Earth. It created a truly magnificent basin with many concentric rings. It must have looked much like today's Mare Orientale, but much, much bigger.

Today, not much is left of its rings as most of the cratering of the Moon has happened since that time. In fact, there is not much left to see and the basin was not even discovered until the 1960s. There are, however, a few mountains left, like Mount Malapert, one of the most southerly features visible from Earth.

What is left is one enormous hole, the South Pole-Aitken Basin. In places, it is still more than 13 kilometers deep and 2500 kilometers wide. Why this basin did not fill with lava, we do not yet know.

The size and depth of this basin holds important value for human space exploration today. It is a key resource and an outright gift.

The Scott A Massif:



Latitude & Longitude

On the Moon:

	Long.	to Long.	Lat.	to Lat.
Scott A Massif:				
Scott Area	20	45	-84.7	-86.1
Scott Reference		34		-85.0
Mt. Malapert:				
Mt. Malapert Area	-5.0	4.0	-85.8	-86.1
Malapert Ref.	-4.0		-86.0	

C Time: 78 s

A massif is a geological term meaning a block of crust larger than one mountain but smaller than a continent. What a great word!

We are interested in just such a feature on the Moon. It is a ridge, a remnant of a ring of the South Pole-Aitken Basin. Such mountain ridges on the Moon are rarely named, but craters are. Mountain features then take their names from nearby major craters. In this case, the nearest crater is a secondary one of the larger Scott Crater to the north; it is called Scott A.

Our feature then is the Scott A Massif; it is about 120 kilometers from the lunar South Pole, on the near side, almost in line with the Earth. It is basically a hilly plateau running 35 kilometers east-west. The useful area could fit a very large Earth city like Los Angeles easily.

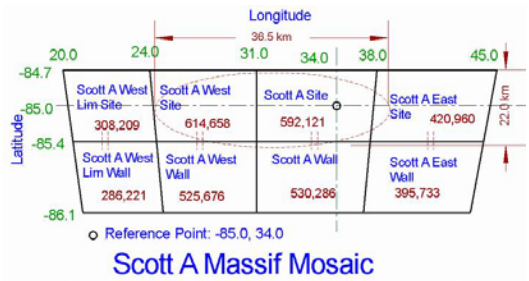
We must wait for the official astronomical governing body to provide an official name, but the Scott A Massif will do for now.

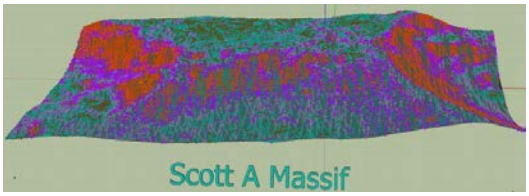
On the Moon, the Scott A Massif runs from 20 to 45 degrees longitude and -84.7 to -86.1 latitude. This is a little east of the Earth-Moon line and so far to the south of the equator that it is rarely visible from Earth at all.

Flyby:

The Lunar Reconnaissance Orbiter (LRO) was launched in June 2009. About 14 months later, the first-year of slightly worked altitude and slope data were made available to the general public.

We at the Big Moon Dig spent most of the next year reducing the LRO data on personal computers using common software like Excel and SketchUp. The result is 3D terrain maps that can be animated, machined with a CNC, or 3D printed.





Scott A Massif Flyby Graphic by Big Moon Dig

Landscape Color Code:

Color	Slope	Use
Light Green	0°	Build
Dark Green	5°	Build
Dark Green	15°	Travel
Light Blue	20°	Danger
Orange	25°	Disaster
Pink	30°	Disaster
Dark Red	35°	Disaster
Bright Red	40°	Disaster

D Time: 81 s

To do this, we had to break up the area into six pieces and then put them back together as a mosaic. Even so, each section still contained several hundred thousand altitude and slope data points.

The colors on the maps show the slopes read directly by the LRO. The greens are below 15% grade and are suitable for travel and construction. The light blues might be passable with a well-designed rover but could be dangerous. The purple, orange, and reds are simply death traps. They are steep slopes covered with fine, loose dust.

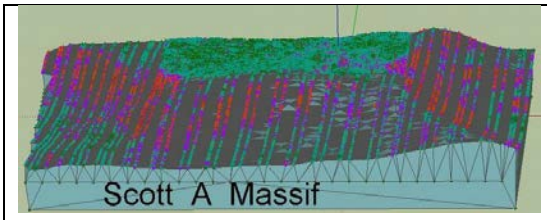
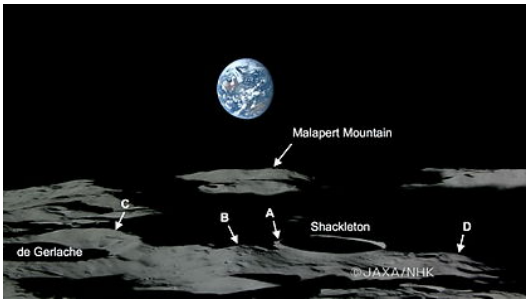
From these data, there appear to be at least four trails from the Scott A Massif down to the permanently shadowed craters to the south. The only way to prove this claim is to build and send a rover. What a great adventure!

Scott A Massif Flyby Movie.

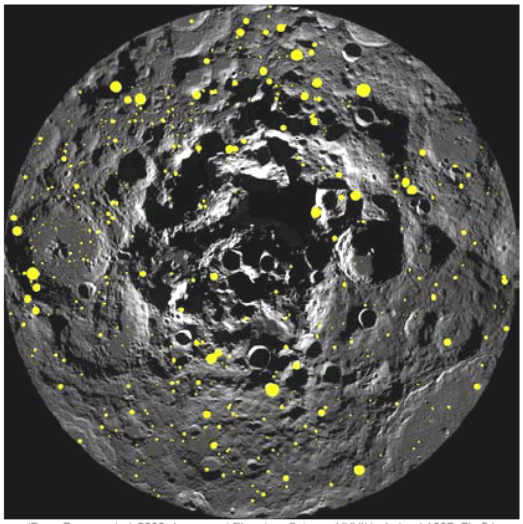
Let us do a flyby of the Scott A Massif model.

We start from the direction of the South Pole where the permanently shadowed craters are.

We fly up the eastern ramp. The lines of green points suggest one or possibly two passable trails here.

 E Time: 40 s / 44 s	We then cross the front of the ridge where our settlement construction will be. And then we turn to look behind as we leave. We retreat down the western ramp back toward the pole, again following the green dots. What's next? Now that much more refined data are available to the public, we can align these LIDAR altitude readings with the LRO photographs to give a strikingly real appearance. However, much work is still needed.
  F Time: 61 s	**Peak of Eternal Light:** The location and depth of the South Pole-Aitken Basin is probably the greatest good luck human space exploration has ever had. Everywhere else on the Moon, you have to deal with 14 Earth days of brutal sunlight and then 14 days of bitter cold night. In just a handful of places, like the Scott A Massif, all of which are just Earth side of the South Pole, at midnight the sun still shines across the deep basin and illuminates these Peaks of Eternal Light. Of course, there are irregularities both locally and across the basin along the far rim, but a well-planned solar power station would produce usable power more than 95% of the time, 24/7/365. You also always have a permanent view to the dark sky to support cooling. Furthermore, because of the near-polar location, all you have to do is mount your solar voltaic cells on a billboard with a central pivot and spin it around once in a month. This reduces power station design to simplicity.
	Permanently Shadowed Craters: There are places where the sun never shines, at least on the Moon.

Craters in the lunar south pole area containing permanent shadow



(From Bussey *et al.* 2003, *Lunar and Planetary Science XXXIV*, abstract 1897, Fig.5.)

G Time: 93 s

Near the two poles are craters that have not seen sunlight in billions of years. Furthermore, these areas directly face the deep black of space and are therefore some of the coldest places in the solar system.

Volatile materials, such as water from comets and Helium 3 from the sun, have been accumulating there slowly over eons. In our stories, these places are simply called "the cold and the dark."

These volatile stores are some of the most critical materials for the success of a lunar settlement. With them, we can make everything from breathable air to rocket fuel. We simply cannot stay on the Moon for the long term unless we learn to mine these materials.

Several permanently shadowed craters are near the Scott A Massif, but getting there means a long trek down a mountain trail at least 40 kilometers long.

We do not know exactly what we will find there because we have not yet retrieved any samples to test. We do not, however, expect to find a frozen lake. Rather, we expect to find the Moon's ever-present fine-ground rock, called regolith, with trace amounts of volatile materials adhering to the particles.

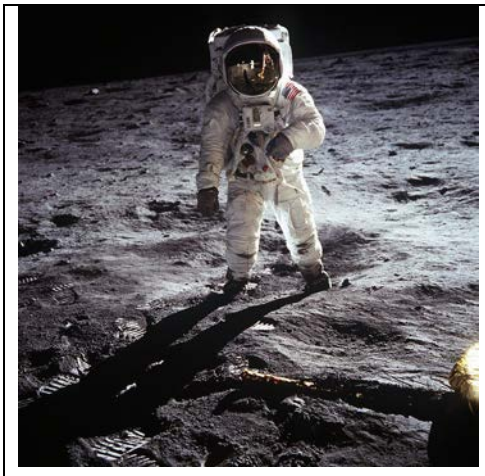
Cooking this material to 600°C will ensure that all the volatiles come off, but this would certainly mean hauling bulk material to sunnier areas, like the Scott A Massif, where solar power is available.

Looking around:

What would it be like to stand on the Scott A Massif and look around?

In some ways, it would be very like the Apollo sites. All surfaces are covered with a finely ground, gray powdered rock with many scattered rocks and small craters. The surface is nearly colorless and about the shade of an old asphalt parking lot.

None of the surfaces is flat and there are no sharp clefts. The southern boundary simply rolls off steeper and steeper by degrees until your rover wheels can no longer get traction. Too bad!



H Time: 80 s

The sunlight is harsh; the shadows are long and black. The sun is always low in the sky as it goes around monthly. It never gets more than a few hands above the northern horizon, even at noon, and it skirts the southern horizon near midnight.

Anything left in the sun gets very hot, up to 200°C, and anything in the shadows gets very cold. All equipment on the surface takes a real beating, but even one meter underground the temperature is stable at around 20°C.

The Earth hangs permanently in the northern sky, low to the horizon, tracing out a lazy figure 8 over the month.

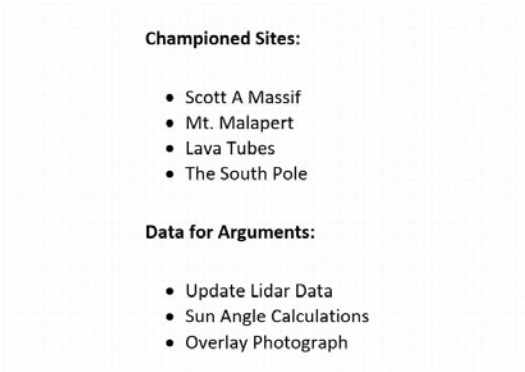
To the south lies a great darkness, and somewhere in that darkness are the permanently shadowed craters and the South Pole.

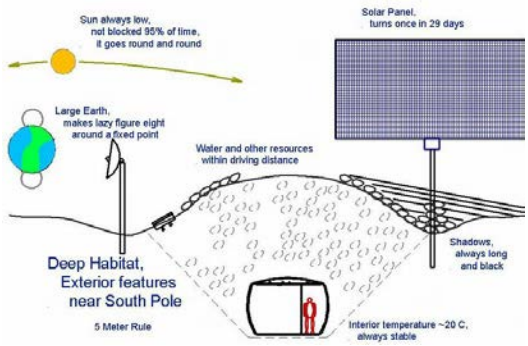
What Is Wrong?

The Scott A location is not so great that it does not have a few problems:

First, it simply takes more Delta Vee, and therefore more rocket fuel, to get to near-polar locations on the Moon. With any rocket you buy, you can simply send fewer kilograms.

Second, the orbit transfer there is not on a free-return-trajectory. Remember *Apollo 13*; the crew got home because their trip out was nearly the same as their trip back. This only holds for equatorial locations.

 I Time: 74 s	Third, it is a long way down to the permanently shadowed craters. The drop is 6 to 8 kilometers in a travel distance of 40 to 60 kilometers. Little solar power is available for this trip and the trip is a major challenge for rover design. However, remember that at the Apollo sites, which were all near the equator, the Moon days are 14 Earth days long and boiling hot by noon, the nights are the same length and without solar power but with cryogenic cold, and there are no volatile resources at all. In fact, the Apollo astronauts arrived in the early morning and would have cooked to death if their departure had been delayed as little as three days.
 Text on plain background  J Time: 45 s	**The Contest:** Clearly, we should not jump on the very first site we found. We need to find and analyze multiple sites. In fact, other sites, Mount Malapert, lava tubes, and the South Pole itself, have been proposed and warrant further study. Perhaps the Big Moon Dig should organize a big-dig contest? Some players will champion Scott A. Some players will champion other sites. All sites will get a closer look. To make a winning argument, the player will need to reduce the final lunar LRO data, make detailed studies of sun angles, and overlay photographs documenting the time of month. The decision of the judges is final. Good luck to all of you!
	Video Series: I have taken enough of your time for now. This is the second of three parts: Part 1, MOVE, tells how we propose to carry out this expedition, 21st-century style.



K Time: 29 s

In Part 3, Habitat, we look at key questions in the design of lunar habitats and answer the question: Why all the digging?

Look for the next part soon, and be sure to watch for bonus videos too.

Watch for Hashtag: #BigMoonDig

In Conclusion:

We now have one great lunar settlement site located, the Scott A Massif.

It is a peak of eternal light with access to permanently shadowed craters.

Let us search for others with a big-dig contest.

A lot of great student projects could be developed here too.

Watch for more parts of this series in 2017 and please join us.

In Conclusion: • We now have one great lunar settlement site located, the Scott A Massif. • It is a peak of eternal light and near permanently shadowed craters. • Let us search for other sites with a grand contest. • Lots of great opportunities for students. Watch us for more parts of this series in 2017 and please join us. We can make this happen. Welcome to the 21st Century Text on plain background L Time: 30 s	We can make this happen. Welcome to the 21st century, Digger03 The Big Moon Dig
Attributes 1: • Attribution-NonCommercial-ShareAlike (CC BY-NC-SA) • Voice: Paul NaturalReader13 • Titian 3 sounds by NASA • Mare Orientale by NASA • Lunar South Pole by NASA • Scott A region by NASA Time: 4 s	Rocket sound fading in
Attributes 2: • LRO by NASA • Peaks of Eternal Light by Kaguya mission, Japan • Water near lunar South Pole by NASA • Apollo astronaut by NASA • Earth Raise by NASA • Full Moon by NASA • All other graphics by author Time: 4 s	Rocket sound
References: • The Big Moon Dig, http://bigmoondig.com/BigMoonDig.html • Digger03, BMD@BigMoonDig.com • People, Space & the 21st Century, Part 1, MOVE	Rocket sound fading out

https://www.youtube.com/watch?v=glCJagp5Tmc #BigMoonDig Time: 4 s **Total:** ~ 12:32mm:ss	

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YouTube text description: (First sentence is critical for editing)

Let's go back to space Now!

In this video, we look at a wonderful lunar location, a gift from the gods, the Scott A Massif. Here we can build a settlement using 21st-century resources and thereby learn how to move on to settle Mars. Watch for more parts of this series.

Please join us.

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Enjoy,

- The Big Moon Dig, http://bigmoondig.com/BigMoonDig.html
- Digger03, BMD@BigMoonDig.com
- People, Space & the 21st Century, Part 1, MOVE https://www.youtube.com/watch?v=glCJagp5Tmc

#Space #BigMoonDig