

HI-SEAS as a Testbed for Living and Working on Other Worlds



Brian Shiro
International Moonbase Summit
4 October 2017

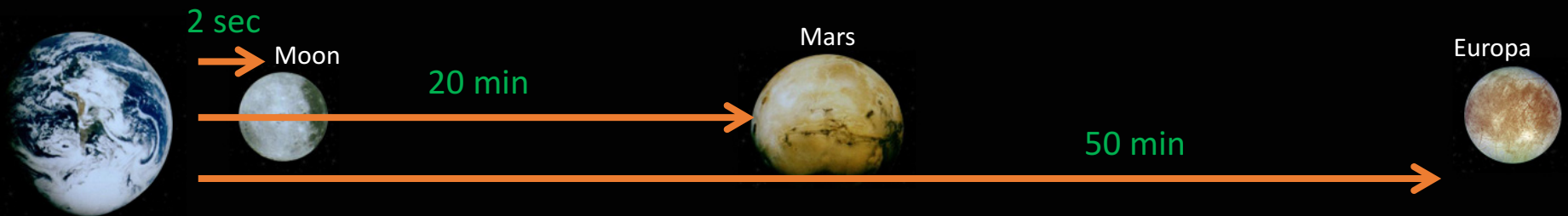


Humans → Moon → Mars

Challenges

- Getting there
- Radiation
- Low gravity
- Resources
- Distance from Earth
 - Long mission duration
 - Isolation
 - Psychological health
 - Time delay

Time Delay → Need Autonomous Crews





HI-SEAS

Hawai'i Space Exploration Analog and Simulation

Why HI-SEAS?



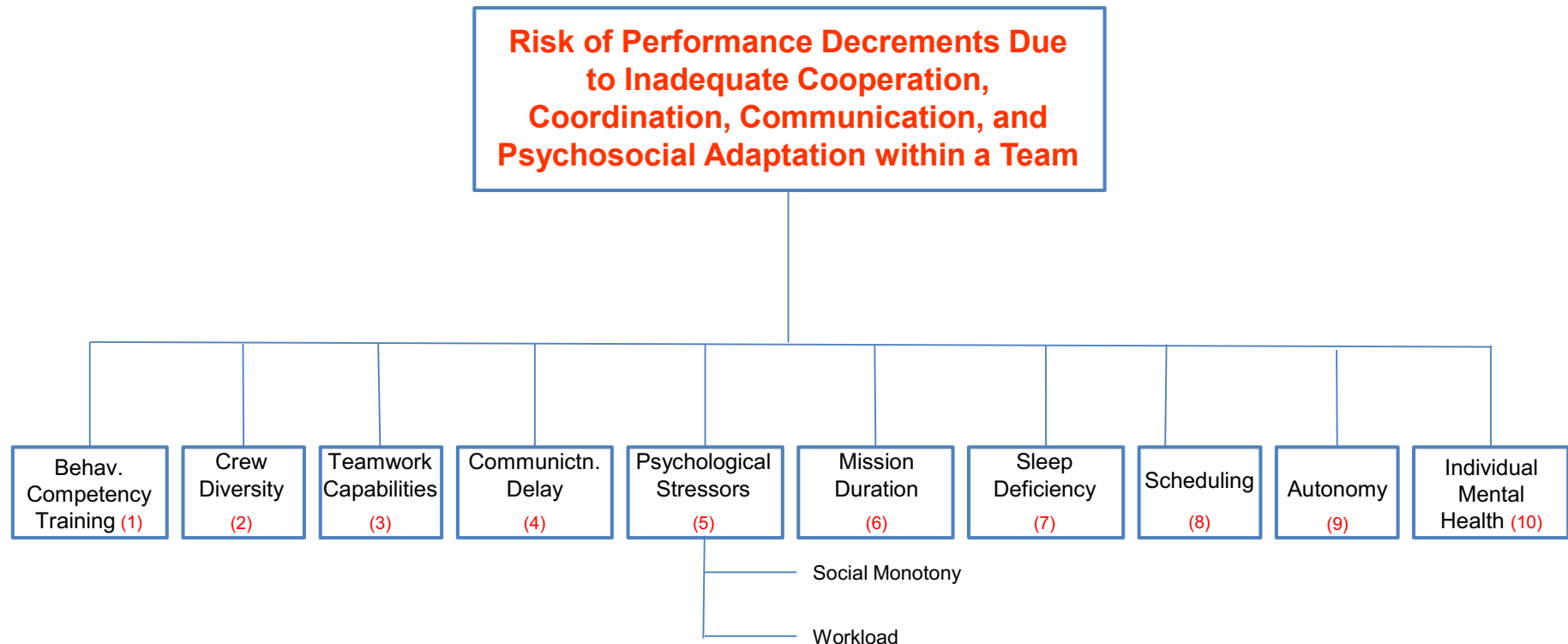
To mitigate risk on long-duration, high-latency missions via:

- High-fidelity mission profile and environment.
- Site that allows both crew isolation and easy access year-round.
- Astronaut-like crews.
- Tracking crew performance through collaborative field tasks.



Current Status

Master Logic Diagram



NASA SKG's

Or to put it more simply...



How NASA Will Keep Astronauts From Going Stir-Crazy on Long Space Missions

by MEGAN GANNON

Why Mauna Loa?

- Isolated yet accessible year-round
- High elevation (2500 m)
→ little vegetation
- Disused quarry site
- Basalt rock similar in composition to Mars rock
- Many geologic features:
→ scoria ramparts, vents, pits, skylights, lava tubes, lava channels, tumuli, shatter rings



A dirt road is blocked by a chain with two warning signs. The background shows a dirt road leading into a hilly, arid landscape under a cloudy sky.

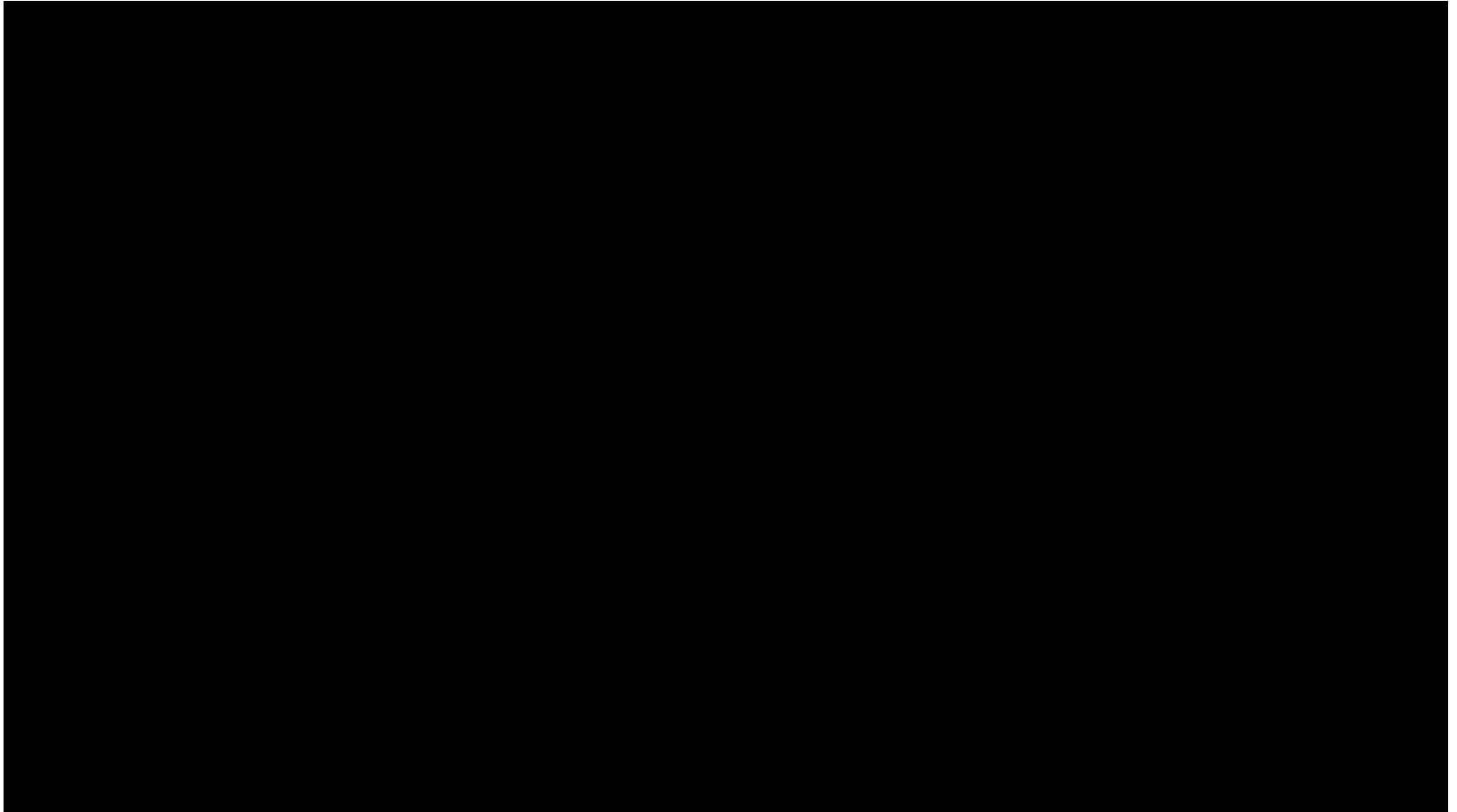
**RESTRICTED
AREA**

PLEASE KOKUA

ISOLATION STUDY IN PROGRESS. PLEASE DO NOT ENTER THIS AREA, OR INTERACT WITH THE CREW. FOR MORE INFORMATION ABOUT THIS PROJECT, SEE HI-SEAS.ORG. IF YOU REQUIRE ACCESS, PLEASE CONTACT THE DEPARTMENT OF LAND AND NATURAL RESOURCES AT (808) 587-0400.

MAHALO!

HI-SEAS overview video

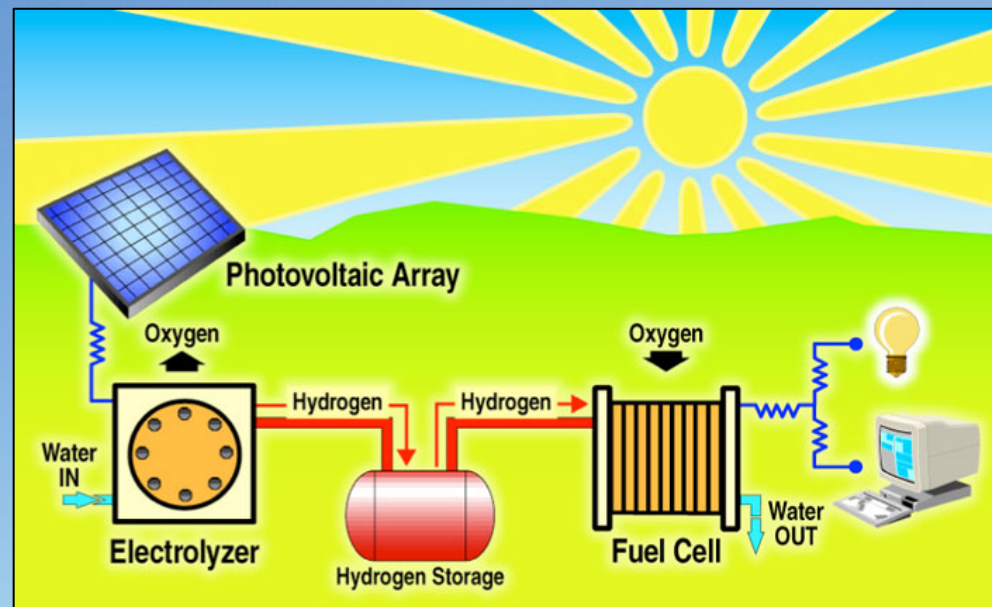






Credit: Blue Planet Research





Sensors → Smart Hab

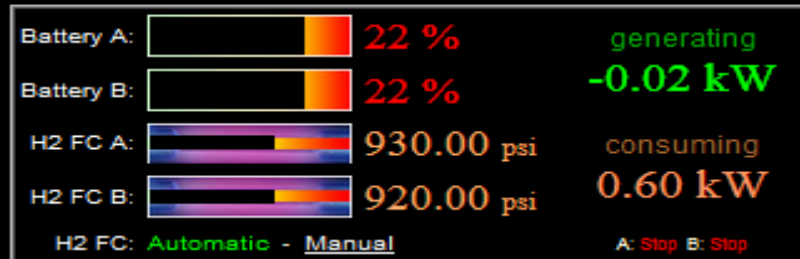
UILA / HI-SEAS Systems Monitor

(Aloha....)

View: [\[dashboard\]](#) [\[sensors\]](#) [\[cam\]](#)

2015-01-13 @ 6:33:40

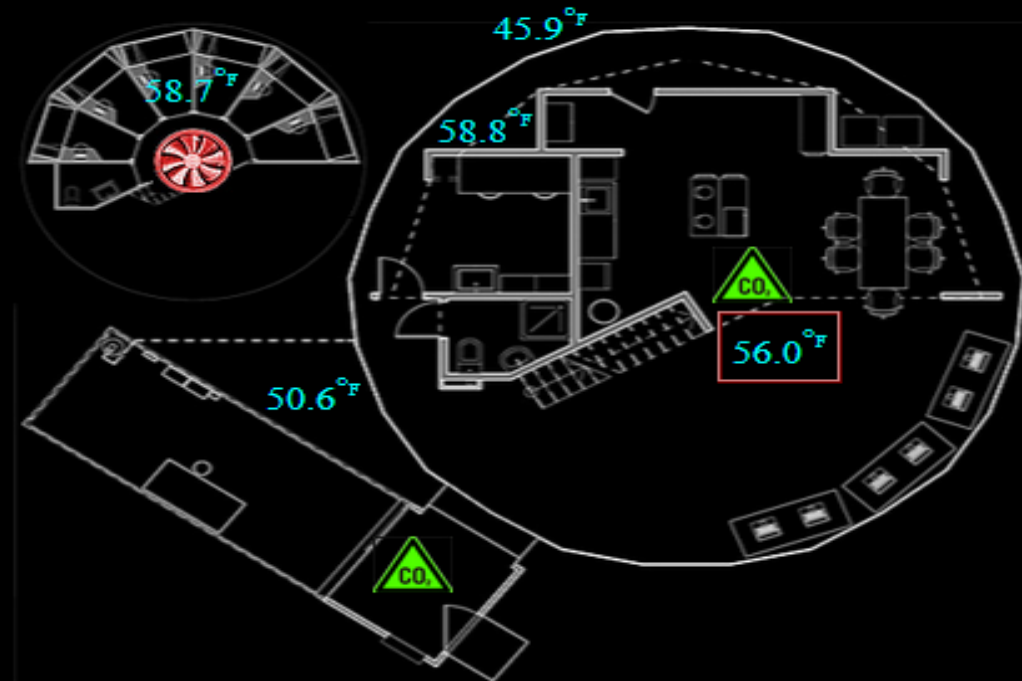
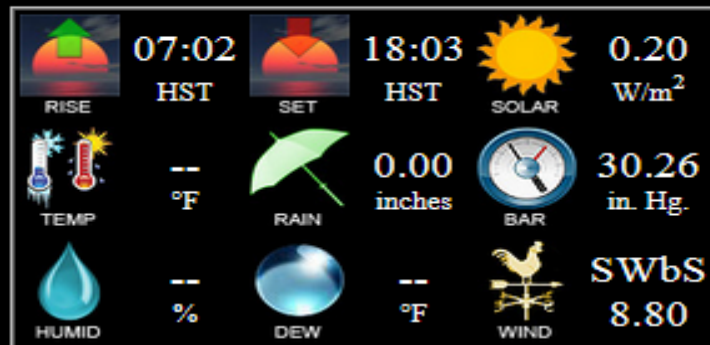
POWER



WATER



WEATHER



Tap/Click any numeric values or CO₂ sensors for graphs.

Mars Habitat / Mauna Loa
Hawai'i Space Exploration Analog & Simulation



Credit: HI-SEAS

Crew Selection

- Using NASA standards
- Look for skillsets and psychological compatibility
- Prefer demographic balance
- There is no “perfect astronaut.”



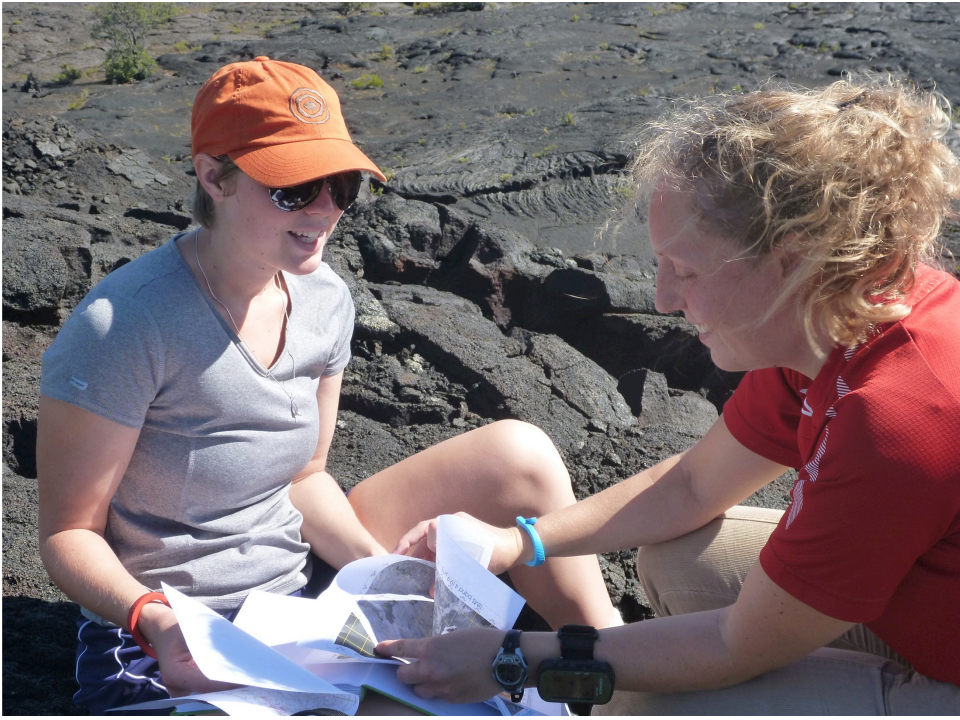
Credit: HI-SEAS

Crew Training



NOLS training with 2013 NASA Astronaut Candidate Class

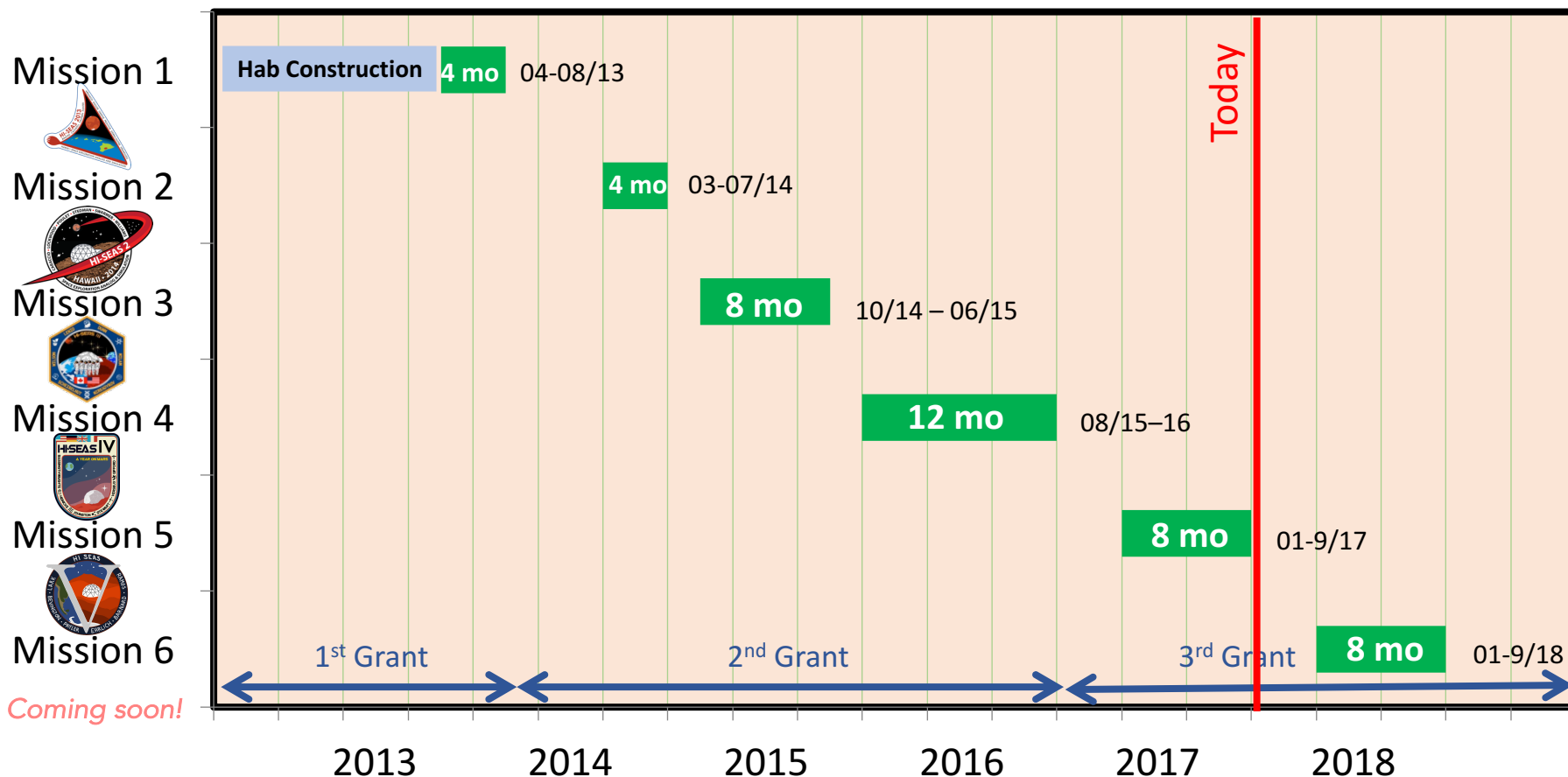
Credit: HI-SEAS



Credit: HI-SEAS

HI-SEAS Missions

crews of 6 living and working in isolation with semi-autonomy



Mission 1



Food,
Exercise, Clothes,
Sleep, and more

Credit: HI-SEAS

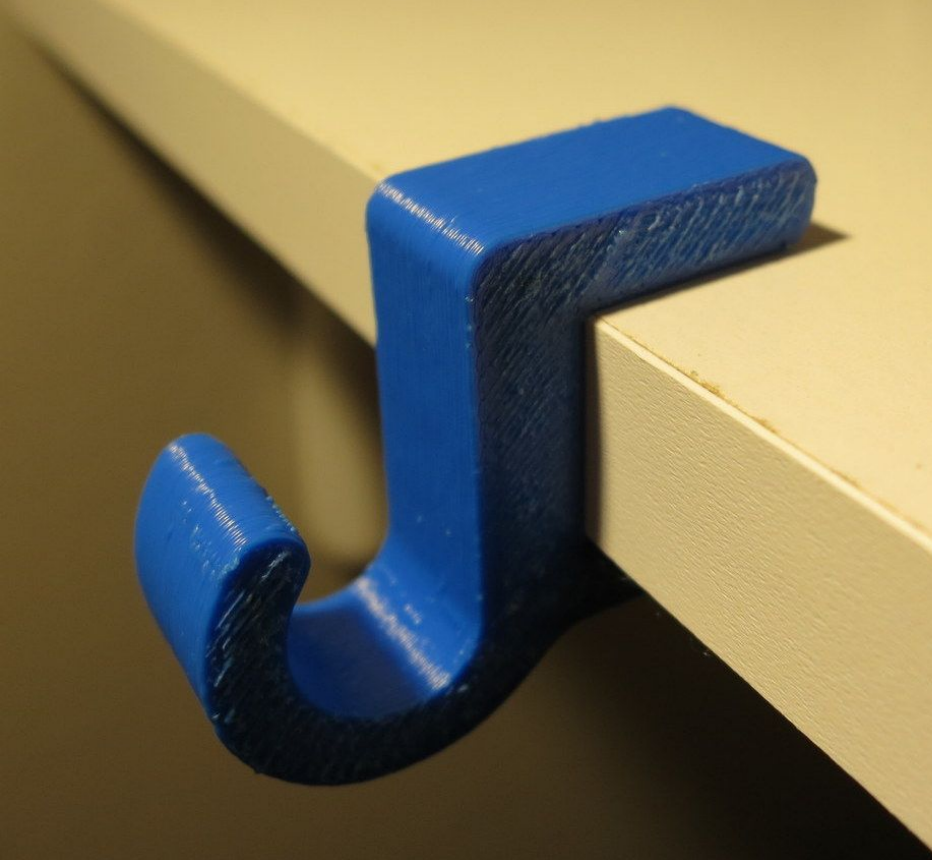


Credit: HI-SEAS

Missions 2, 3, 4

Crew Cohesion &
Performance
+ more

Credit: HI-SEAS



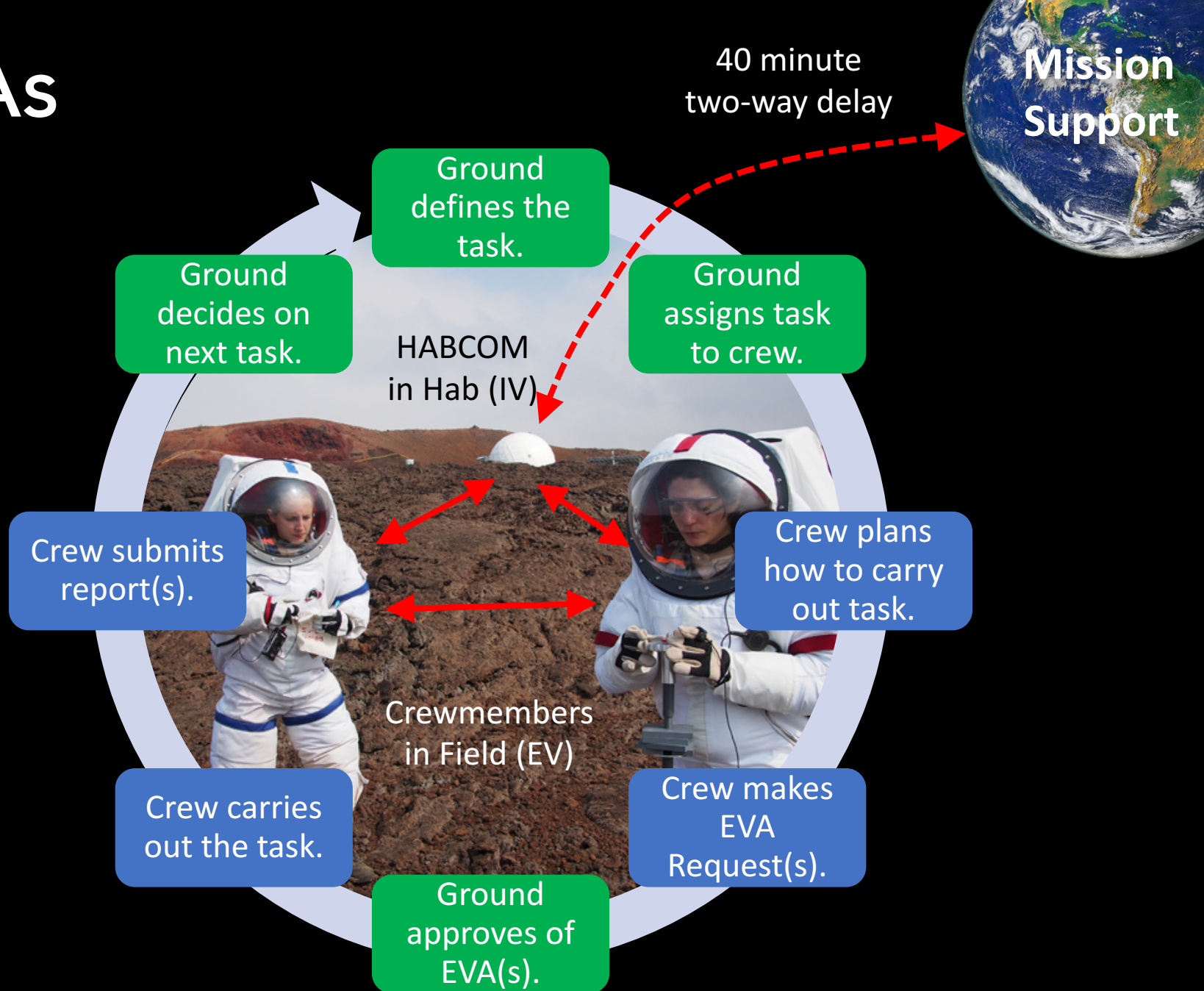
Missions 5, 6

Crew selection,
Varied autonomy
+ more

Geological Exploration



EVA_s







Credit: HI-SEAS



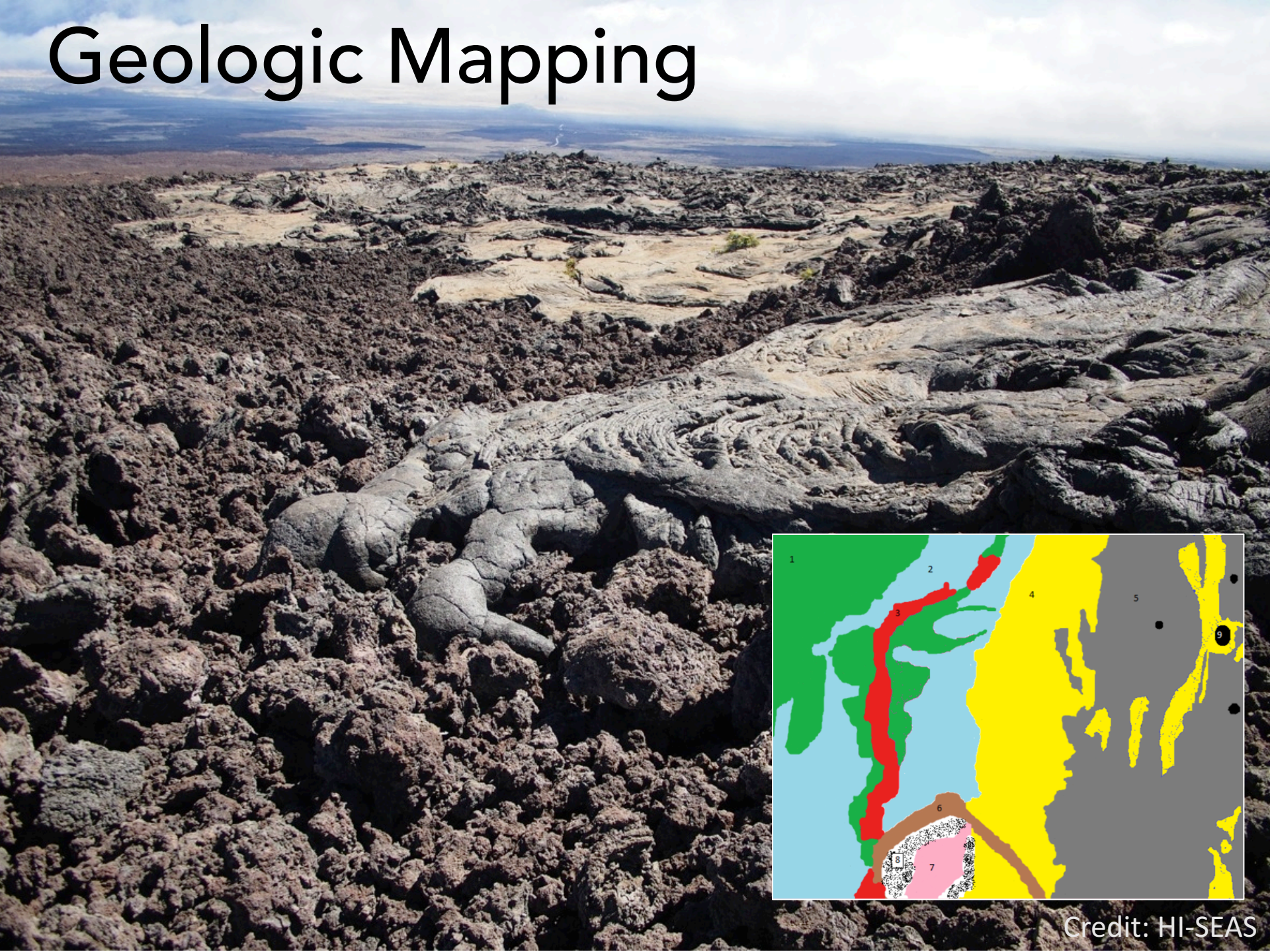
Credit: HI-SEAS

Traverse Planning

- EVA 11
- EVA 14
- EVA 16
- EVA 17
- EVA 18
- EVA 29
- EVA 31
- EVA 34
- EVA 40
- EVA 44
- EVA 49
- EVA 51



Geologic Mapping



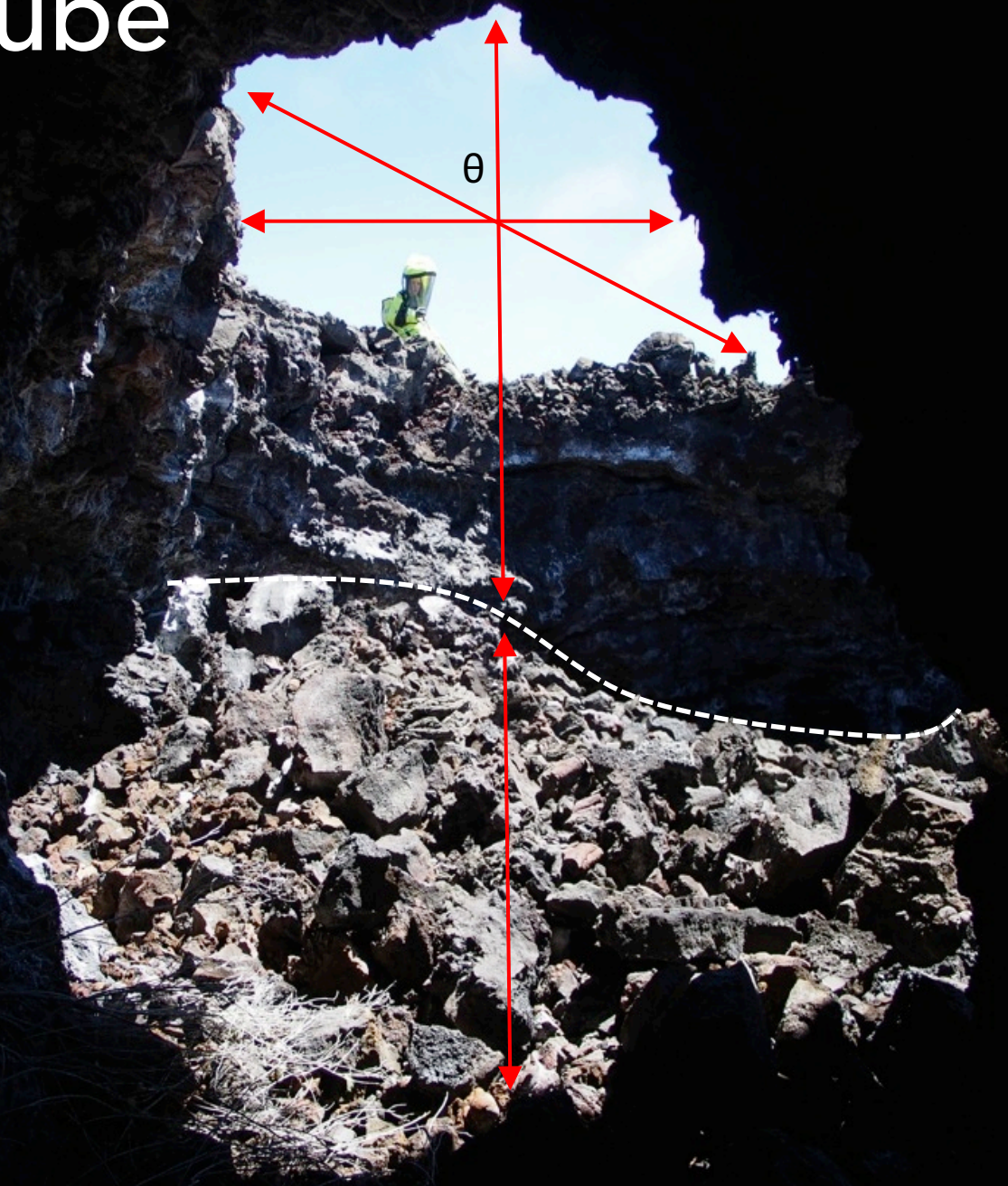
Credit: HI-SEAS

Skylights at HI-SEAS

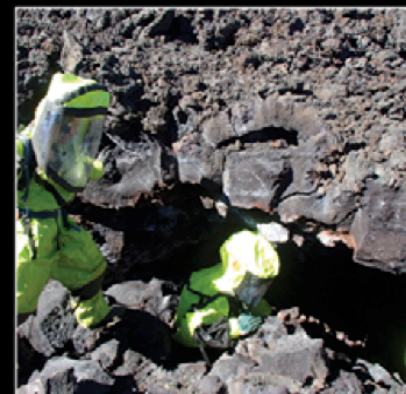
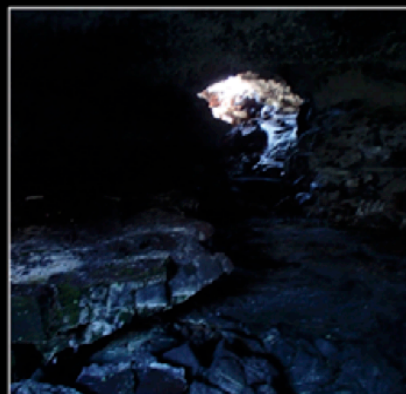
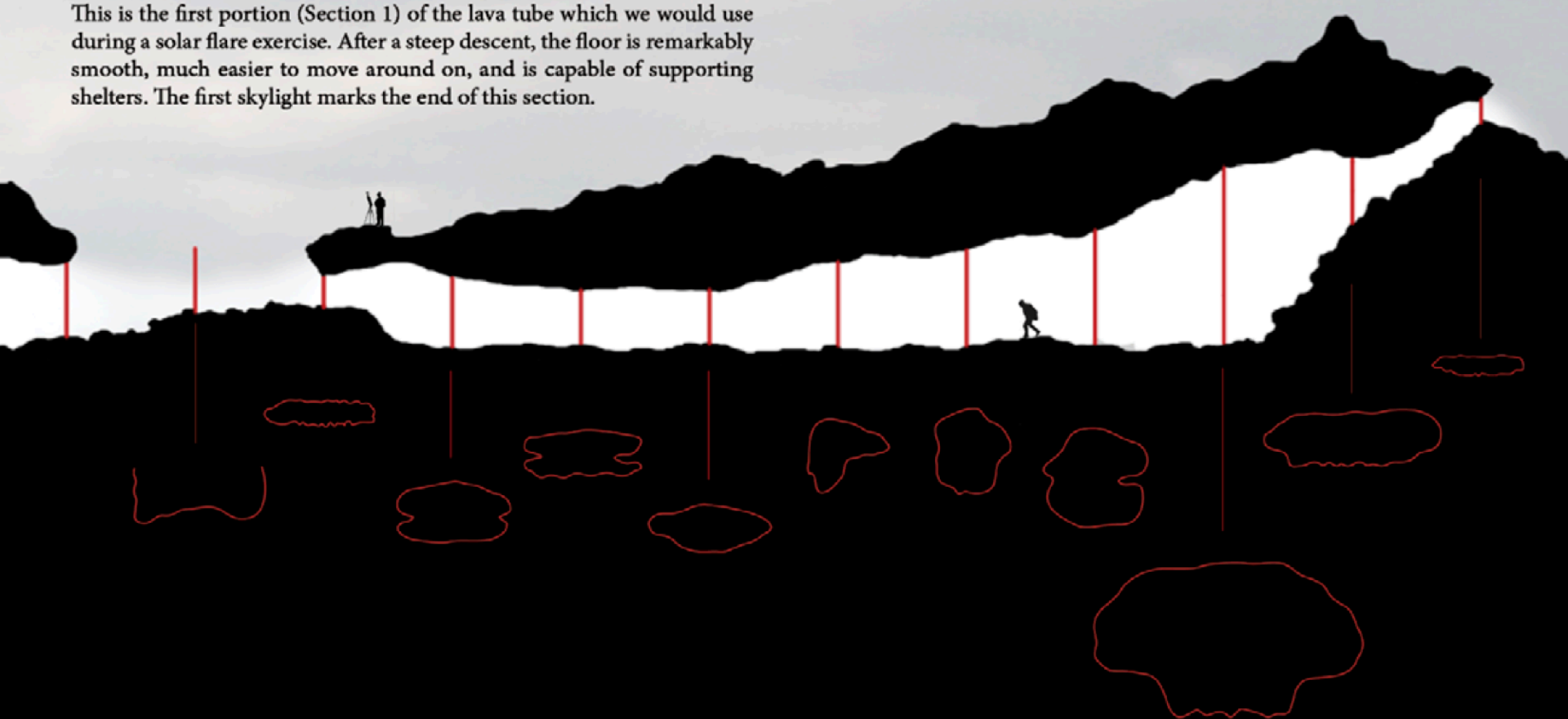


HI-SEAS Habitat

Lava Tube Caves



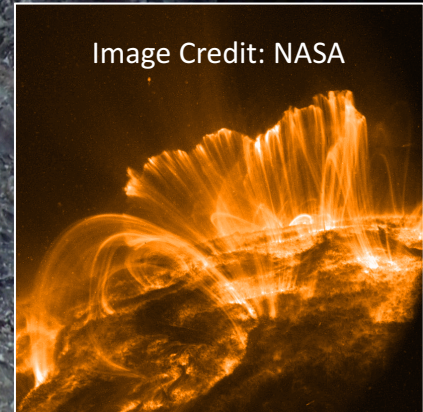
This is the first portion (Section 1) of the lava tube which we would use during a solar flare exercise. After a steep descent, the floor is remarkably smooth, much easier to move around on, and is capable of supporting shelters. The first skylight marks the end of this section.



Emergency Simulation



Image Credit: NASA



Credit: HI-SEAS

Ground Truth

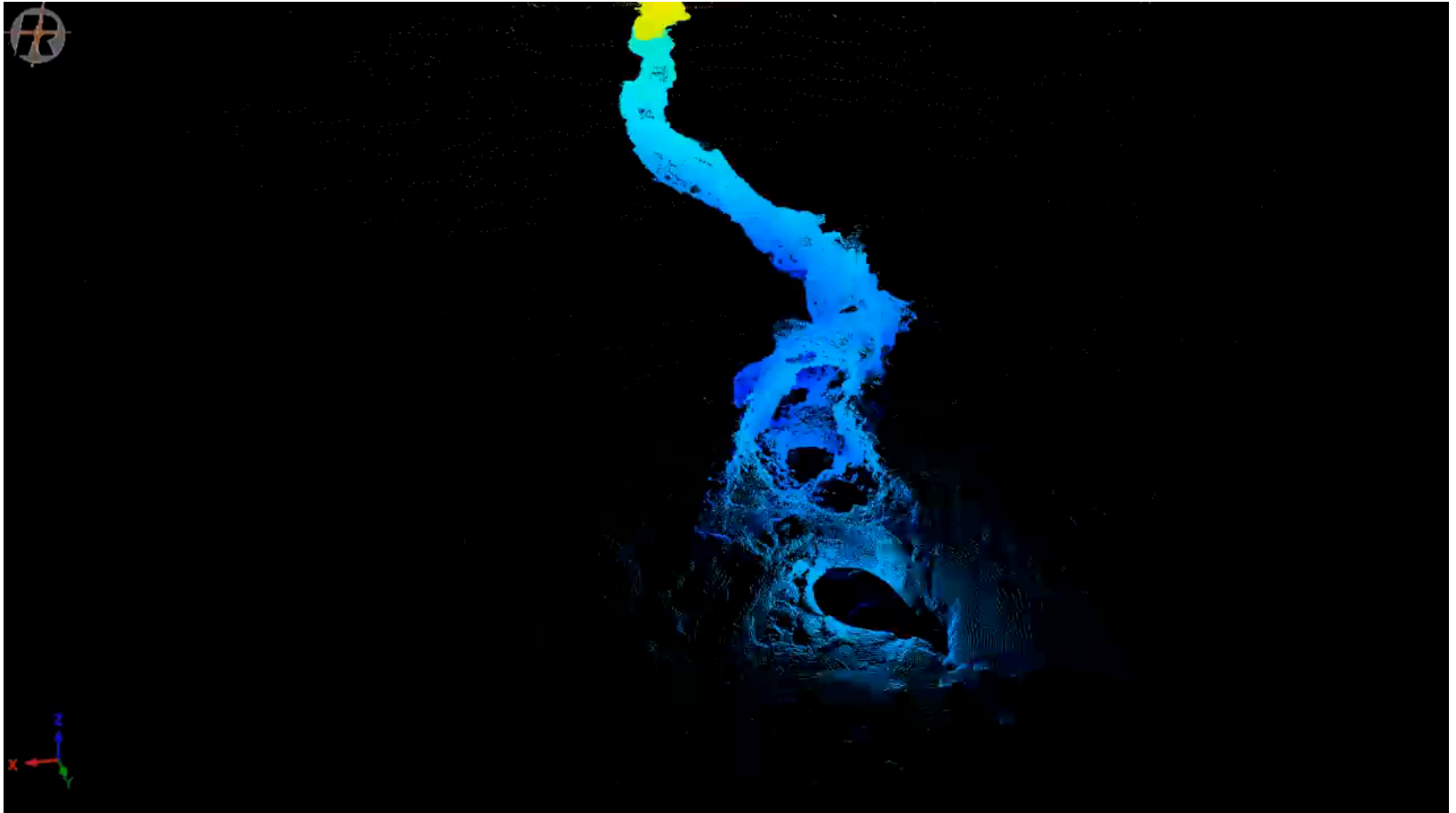


Credit: HI-SEAS

LiDAR



LiDAR Flythrough Video



Overall Lessons

- Crew-ground disconnect
- Third quarter syndrome
- Incompatible leadership/followership styles
- Depression and other mood disorders
- *Diagnosing/detecting* problems under high latency conditions



President Obama ✓
@POTUS



Following

Congrats to NASA and the scientists taking us a step closer to Mars. Now enjoy Hawaii and get a shave ice!



Mars simulation ends after a year on Hawaiian mountain

Six scientists who lived for a year inside a dome in Hawaii emerged from the experiment.

usatoday.com

RETWEETS

2,090

LIKES

7,188



6:28 AM - 29 Aug 2016



2.1K



7.2K



President Obama ✓
@POTUS

Dad, husband, and 44th President of the United States. Tweets may be archived: wh.gov/privacy.

© 2016 Twitter About Cookies

Credit: @POTUS

Mahalo!

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<http://hi-seas.org>



Extra Slides

About Brian

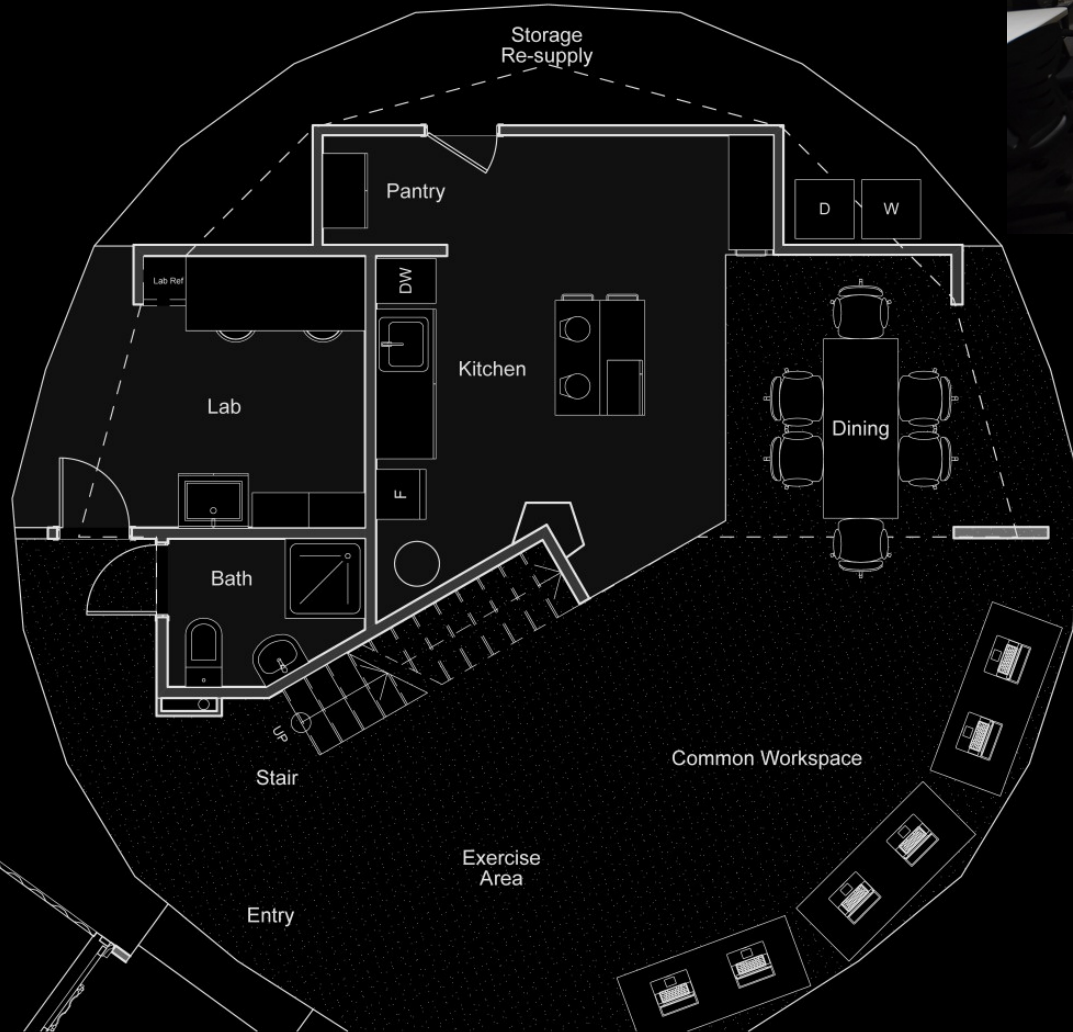
- Geophysicist with USGS
- Researcher with UH
- HI-SEAS Geology Lead
- Specializing in:
 - subsurface exploration,
planetary analog operations,
and seismic hazards
(earthquake, volcano, tsunami)





Apollo 15 astronauts training on Hawaii
Credit: AP

Downstairs



PACIFIC DOMES™

Credit: HI-SEAS

Upstairs



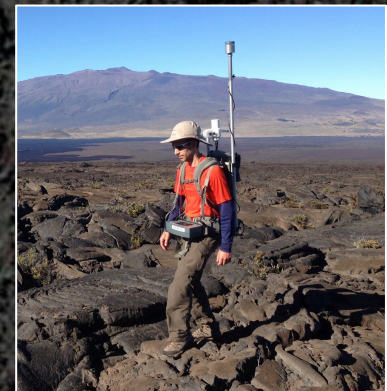
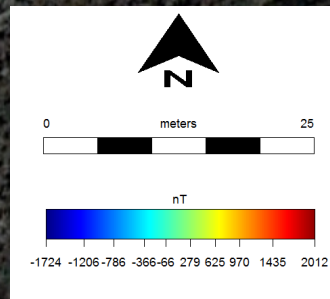
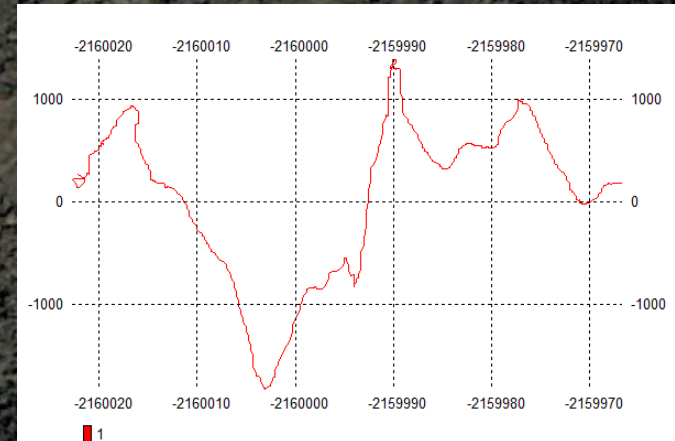
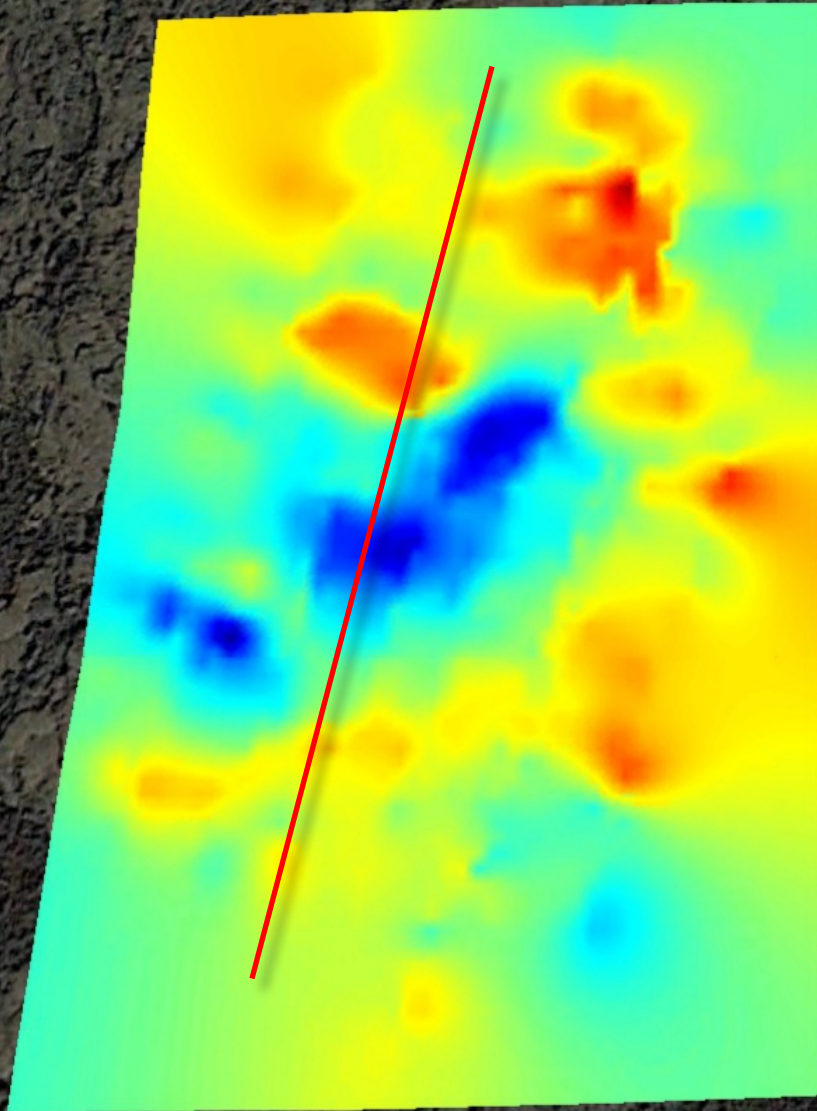
PACIFIC **DOMES**™

Credit: HI-SEAS

Ground Penetrating Radar



Magnetometer



Associated Astrobiological Work to Characterize Habitability

Goals: To study secondary minerals to gain insights into fluids (pH, temperature) and microbial populations in terrestrial caves.

- Field X-ray Fluorescence (XRF) chemical analyses (K. Young, D. Needham)
- X-ray Diffraction (XRD) and Evolved Gas Analysis Mass Spectrometry (EGA-MS) mineralogical analyses (A. McAdam, S. Andrejkovicova, C. Knudson)
- DNA sequencing to understand the microbial populations (S.S. Johnson)

