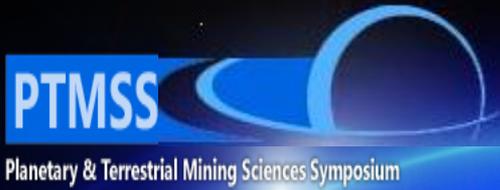


Planetary & Terrestrial Mining Sciences Symposium

2015

Montreal, Quebec, Canada, Earth



PRISM

PISCES Robotic International Space Mining competition

Leveraging University, State & Natural Resources for Student Success

John Hamilton

PISCES Operations and Education/Public Outreach Manager
Physics & Astronomy, University of Hawai`i – Hilo



History

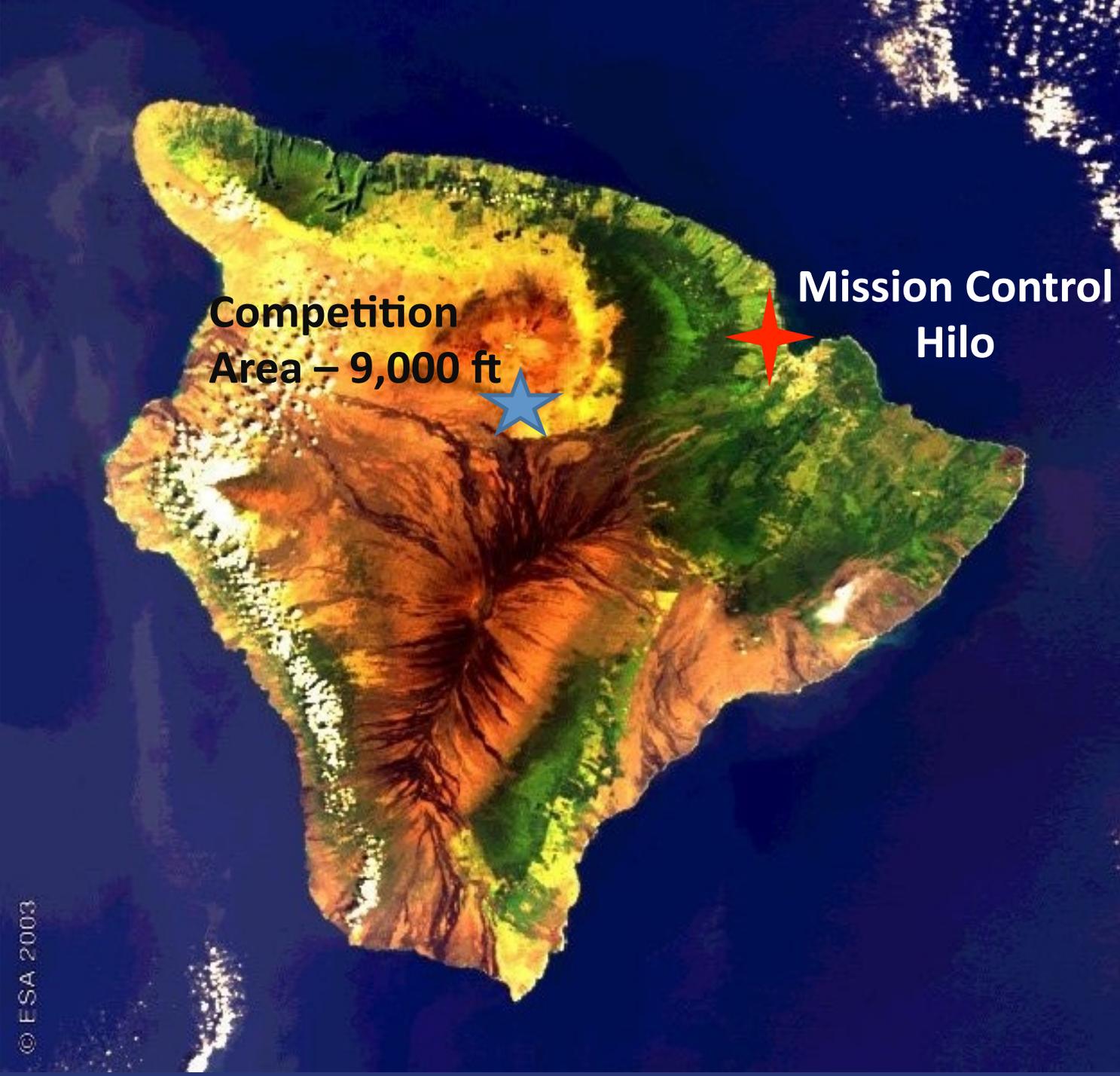
- Regolith Excavation Challenge 2008-2009



- NASA Lunabotics 2010-2013
- NASA RMC – 2014-15
USA only (2010,14,15)

- **College Team Wins NASA Lunar Robot Prize**
- Paul's Robotics, a team led by college student, Paul Ventimiglia of Worcester Polytechnic Institute won the \$500,000 first prize in the 2009 Regolith Excavation Challenge





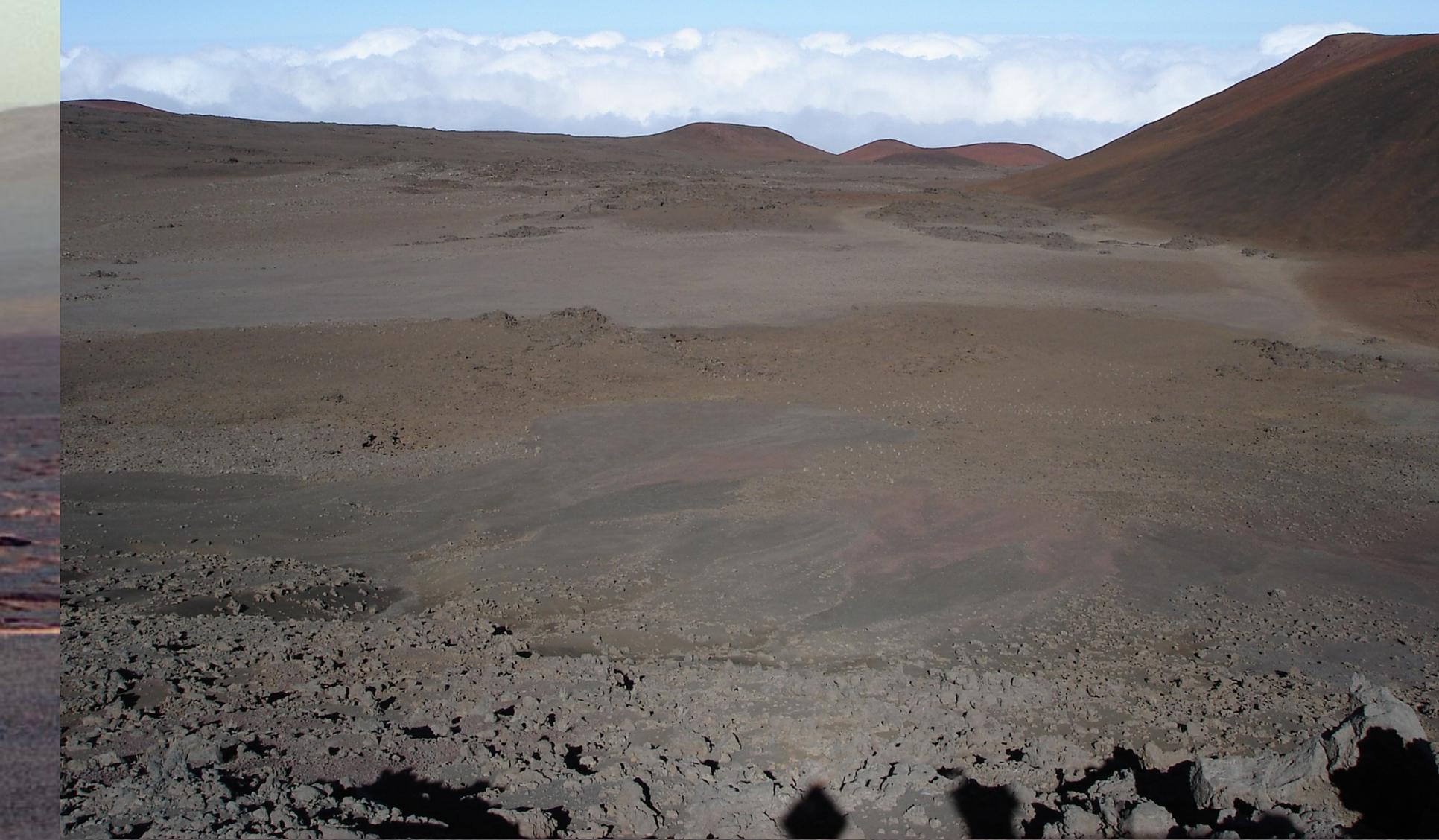
**Competition
Area – 9,000 ft**

**Mission Control
Hilo**

PRISM

- PISCES Robotic International Space Mining
 - Follow on to NASA Robotic Mining Competition
 - International and conducted in the field





Hawai`i island is a terrestrial analog
to Mars

Mars Soil Similar To Volcanic Sand On Hawaii's Mauna Kea, NASA Curiosity Rover Finds

10/30/12 05:15 PM ET EDT **AP**

FOLLOW: [Video](#), [Curiosity Soil](#), [Hawaii Soil](#), [Mars Hawaii](#), [Mars Rover](#), [Mars Rover Curiosity](#), [Mars Soil](#), [Mars Soil Hawaii](#), [Mars Volcano](#), [Volcanic Soil](#), [Science News](#)

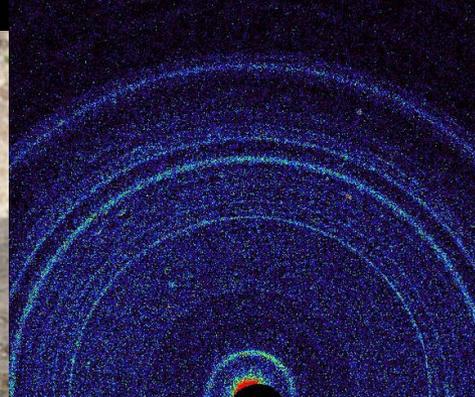
PASADENA, Calif. -- Scientists say the Martian soil at the rover Curiosity's landing site contains minerals similar to what's found on Hawaii's Mauna Kea volcano.

The finding released Tuesday is the latest step in trying to better understand whether the environment could have been hospitable to microbial life.

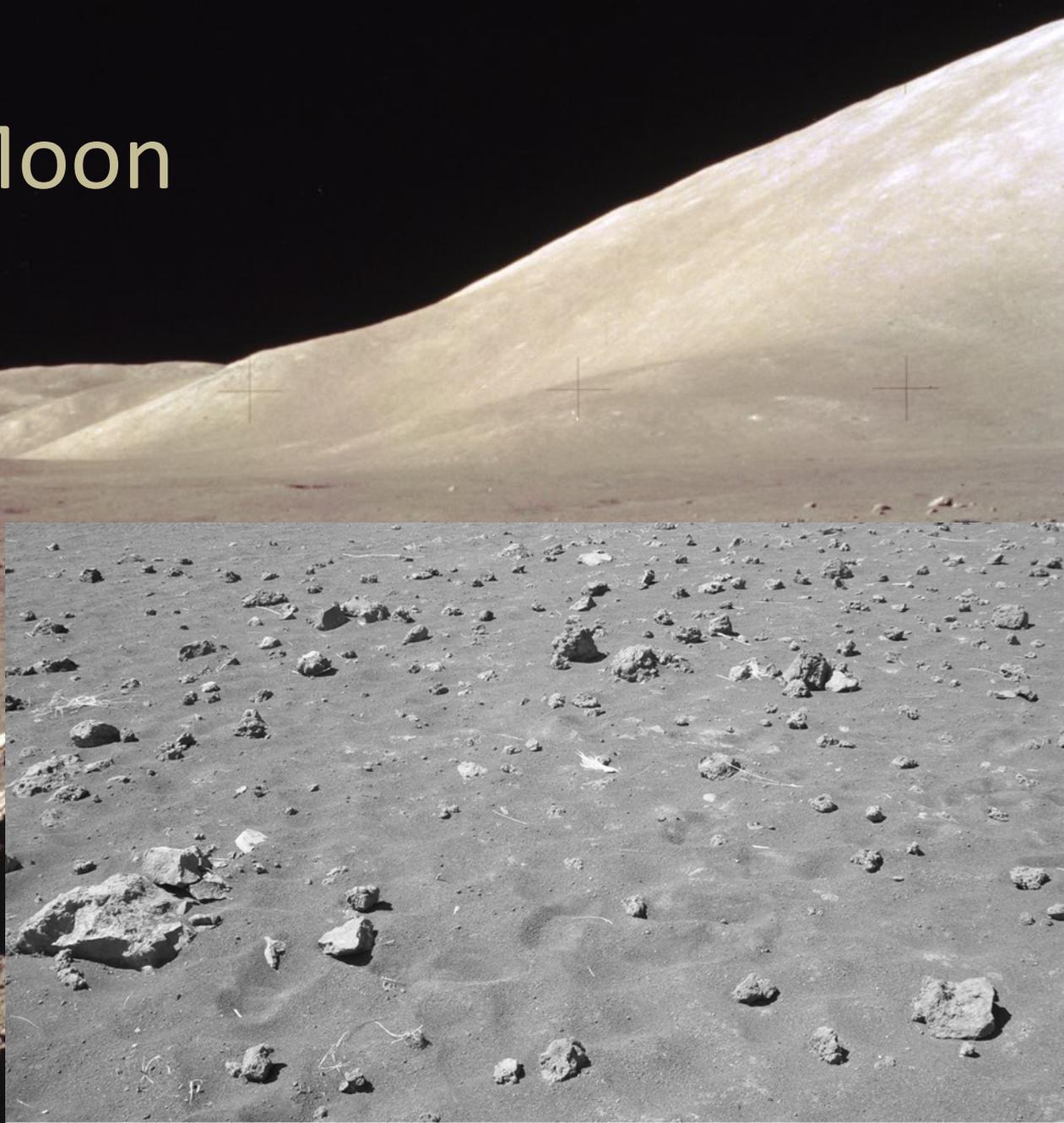
Curiosity recently ingested its first soil sample and used one of its instruments to tease out the minerals present. An analysis revealed it contained feldspar and olivine, minerals typically associated with volcanic eruptions. Mission scientists say the Martian soil is similar to volcanic soil on the flanks of Mauna Kea.



CheMin at PISCES 2008 Test



...and the Moon









Humu'Ula Trail

Mauna Kea Humu'Ula Trail

Mauna Kea Access Rd

Mauna Kea Visitor Information Station



Map

Traffic



A

C



19 3:58PM



18 9:15PM



18 9:15PM

PISCES Planetary Analog Site



PPATS



NASA KSC Competition

- NASA's Sixth Annual NASA Robotic Mining Competition is for university-level students to design and build a mining robot that can traverse the simulated Martian chaotic terrain, excavate Martian regolith and deposit the regolith into a Collector Bin within 10 minutes.



NASA
National Aeronautics and Space Administration

Robotic Mining Competition
Kennedy Space Center Visitor Complex

May 19 - 23, 2014
Kennedy Space Center Visitor Complex

**Design it.
Build it.
Dig it.**

Artwork by Pat Rawlings/Eagle Applied Sciences

For more information visit:
www.nasa.gov/nasarmc

www.nasa.gov

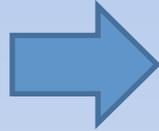
© 2013-09-28 KSC

The poster features a detailed illustration of a six-wheeled rover with a large front-mounted bucket, positioned on a reddish-brown, rocky terrain. In the background, there are several large, white, cylindrical structures supported by tripods, resembling a simulated Martian mining or research station. The overall scene is set against a dark, reddish sky, creating a realistic Martian atmosphere.

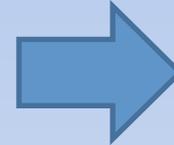
NASA RMC Operation



Rover Checkout
(LunaPits)



Practice Pits



Suit-up



Mission
Control



LAN connection

~50 yards



Regolith Arena
(Lunarena)

Practice Sand Box

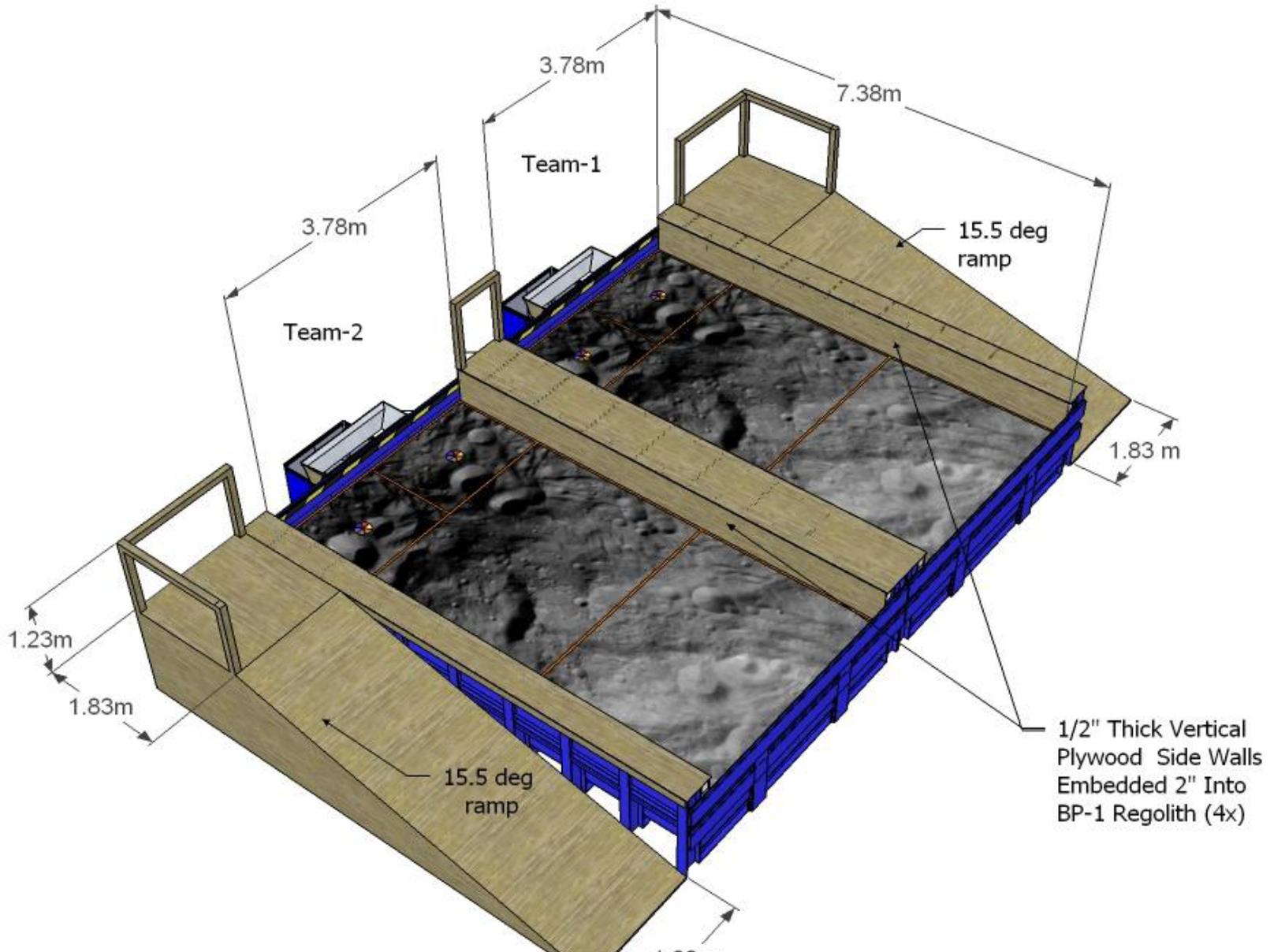


Areas (2)



Modeled on NASA Lunabotics Competition 2010-2013

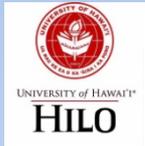




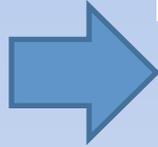
Mission Control



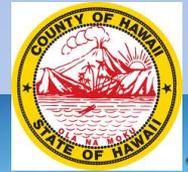
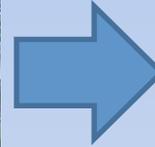
PRISM Operation



Rover Checkout
(U. Hawaii – Hilo)



Practice Area
(Imiloa)



“Launch”
Transport to
Mauna Kea Test Site



Mission Control



Gemini Obs., Hilo Base Facility

LAN connection



~26 miles



Regolith Arena
Analog Test Site
(9,000 ft)

Mauna Kea from Hilo Bay



Monday – Public Exhibition

Hilo Bayfront Park



10am – 2pm Public viewing
Team Check-In
Robot Inspection – Volume &
Weight

Press Kickoff
Rep. Clift Tsuji,
Mayor's Office &
County R&D reps.

Promotes Edu-Tourism concept



Public Exposition Hilo Bay black sand beach park





Camp PRISM

4 Tents:

(1) PISCES C & C, Rover

(3) Teams

Each Team had a 10'x10' pit area

(2 teams per 10'x20' tent)

AC Power (Laptops and battery charging)

Tables and chairs

2 Luas (Kona Lua) (paid by County)

Erected on Saturday during TS Wali
(8 people, 4 from Alaska team)







Infrastructure

- RMC regulation bin dimensions
- Dumped into plastic bins
- Weighed bins on scale after competition heat
- Scale borrowed from Gemini Observatory





Day 0 - Practice

- All teams move into their tents
- Assignments random (first come, first serve)
- Open field practice
- Comms checkout
- Kealakehe High School visit











Day 1 Competition

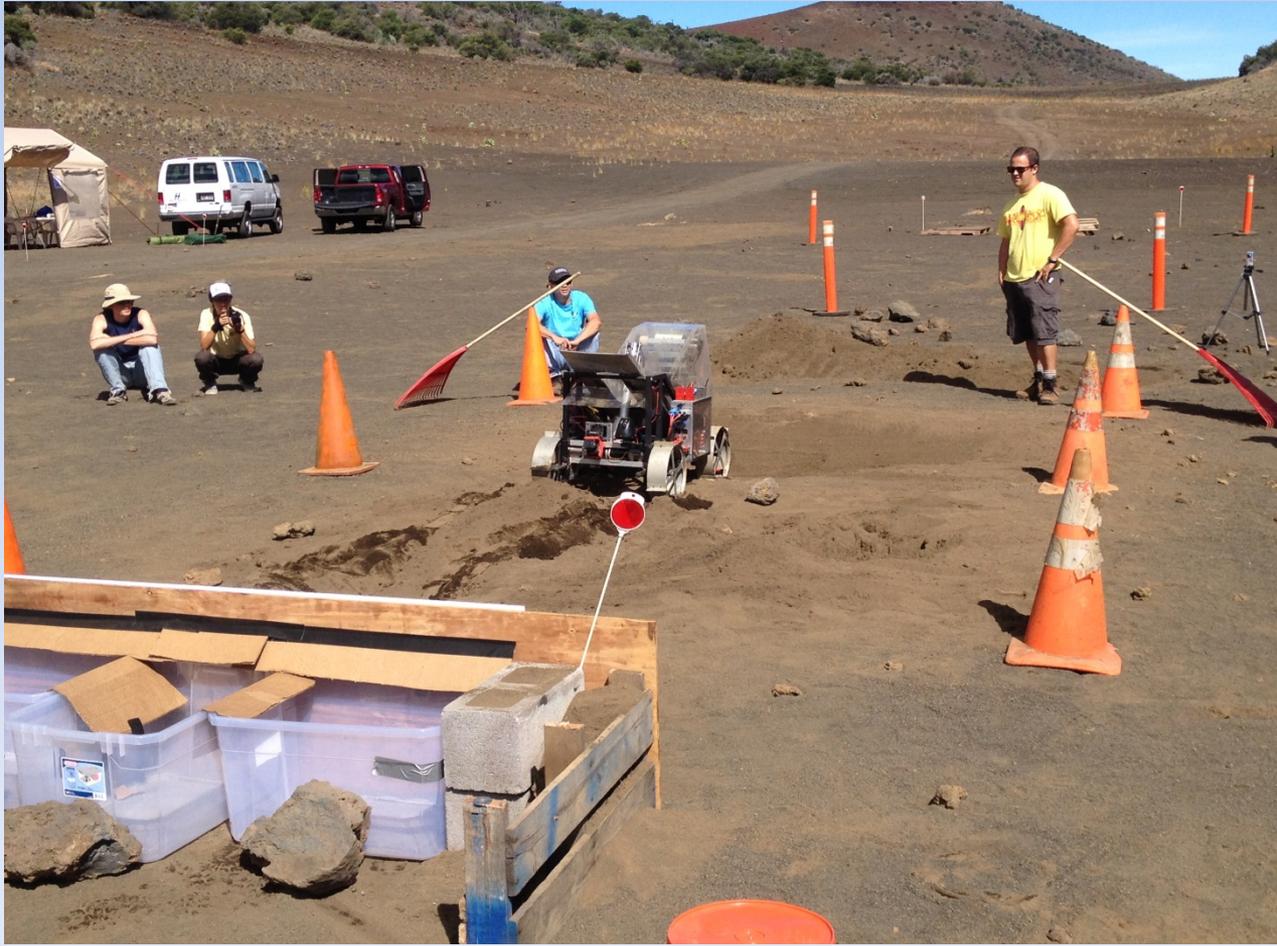


- Replicate the RMC Area, times of heats
- Gives a direct comparison between BP-1 and our tephra (PRIMO-1).
- PRISM tephra also native condition with embedded rocks. (not sanitized)
- Varying moisture content between days and during day (as material is gardened, it dried out and became less packed)



















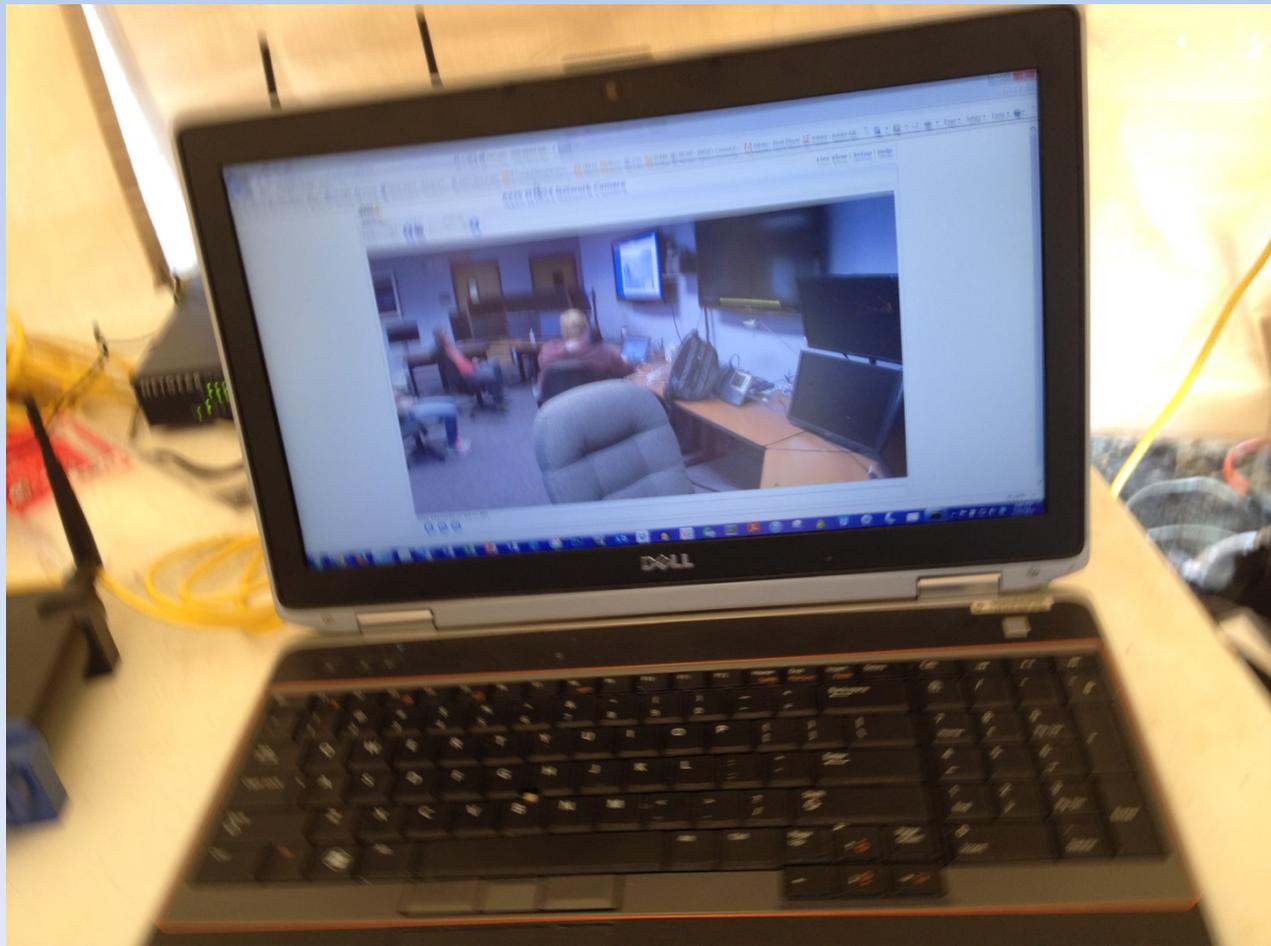
Mission Control

- Gemini Observatory
Hilo Base Facility
Remote Control Room
- Communications Stable
 - WLAN Valley -> WiFi
Relay -> Hale Pohaku ->
Gemini (Hilo)
- Day 2 – afternoon
 - Local control from tents
with one team spotter



View of Mission Control – “Earth”

Gemini Hilo Base Facility



Gemini South – Cerro Pachon



Gemini North – Mauna Kea



Gemini HBF



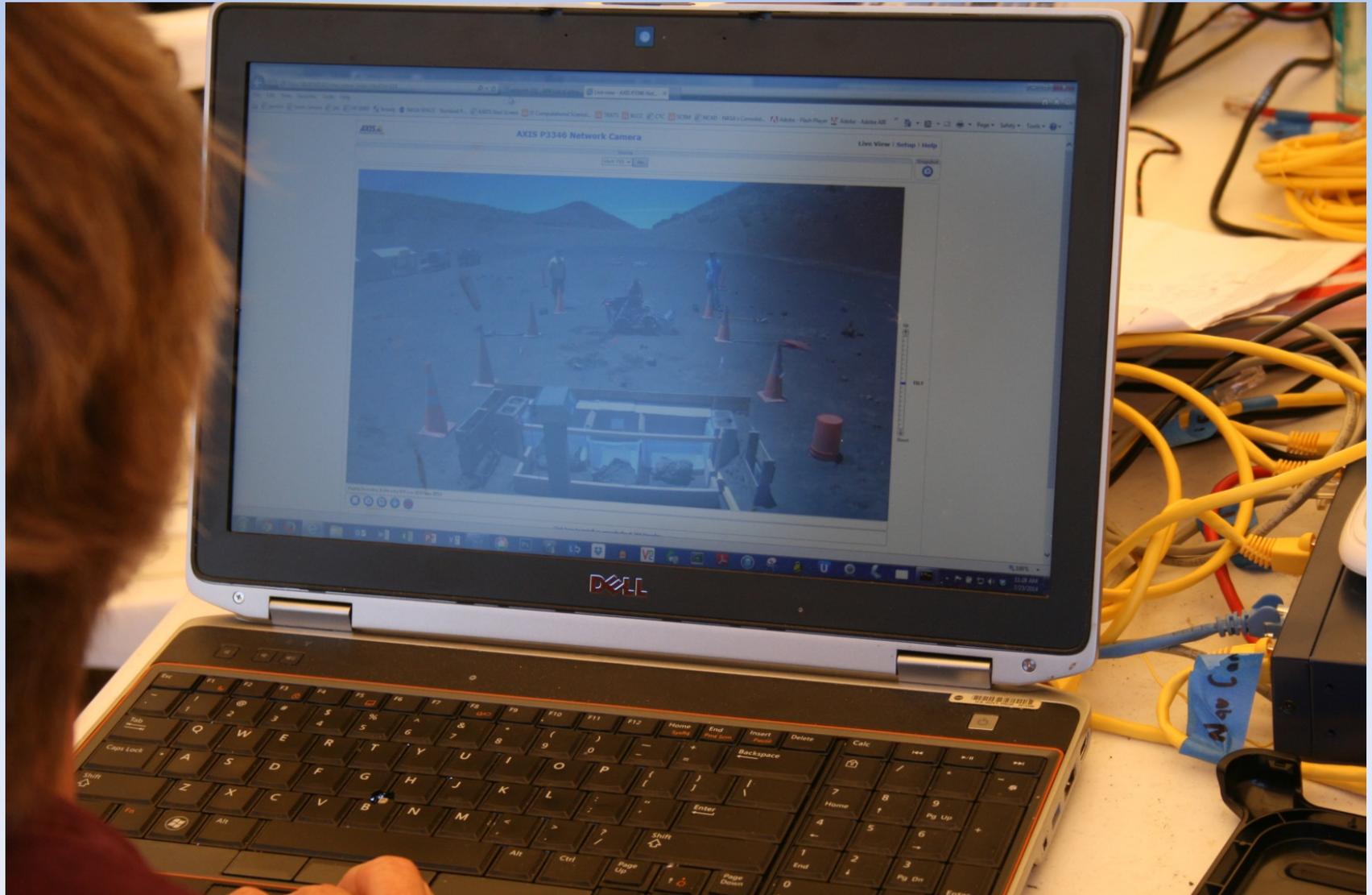
Mission Control in Hilo



View of MC from PPATS



View of PPATS from MC



Official NASA Comms Support









Pacific Astronomy & Engineering Summit (PAES)

- PISCES participation in this International High School STEM program
- `Imiloa connection
- Wed –
 - Viewing of Robots at Hale Pohaku
 - Star Gazing with PISCES telescopes (UAC staff)
- Thurs –
 - Viewing of Remote Control from Gemini Mission Control



Day 2 Competition



- Expanded area dimensions
- Larger obstacles (hills, rocks and craters)
- Longer bypass detour around obstacles (time penalty)
- 20 min competition heats
- ALL rovers successfully completed heat





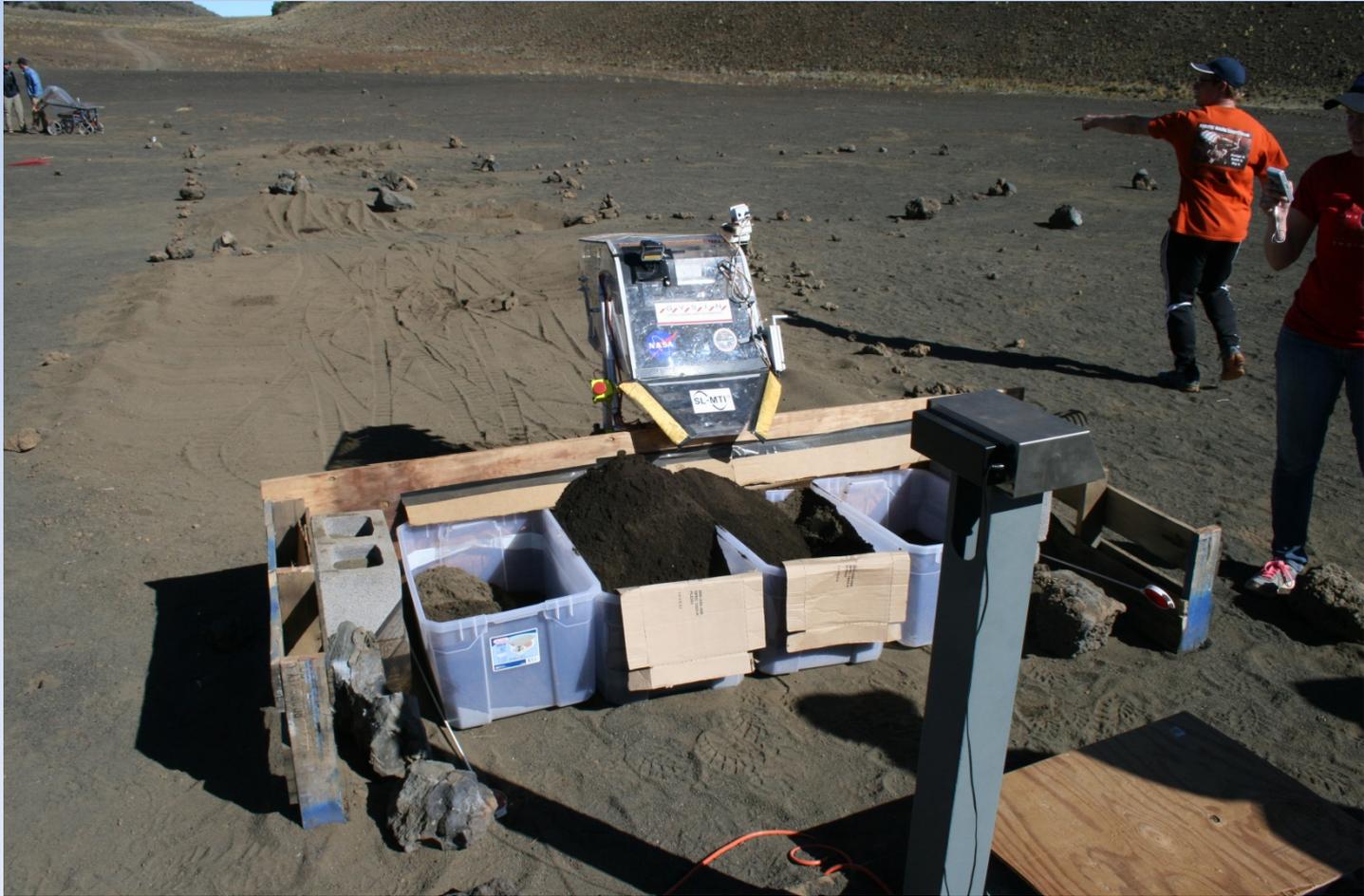






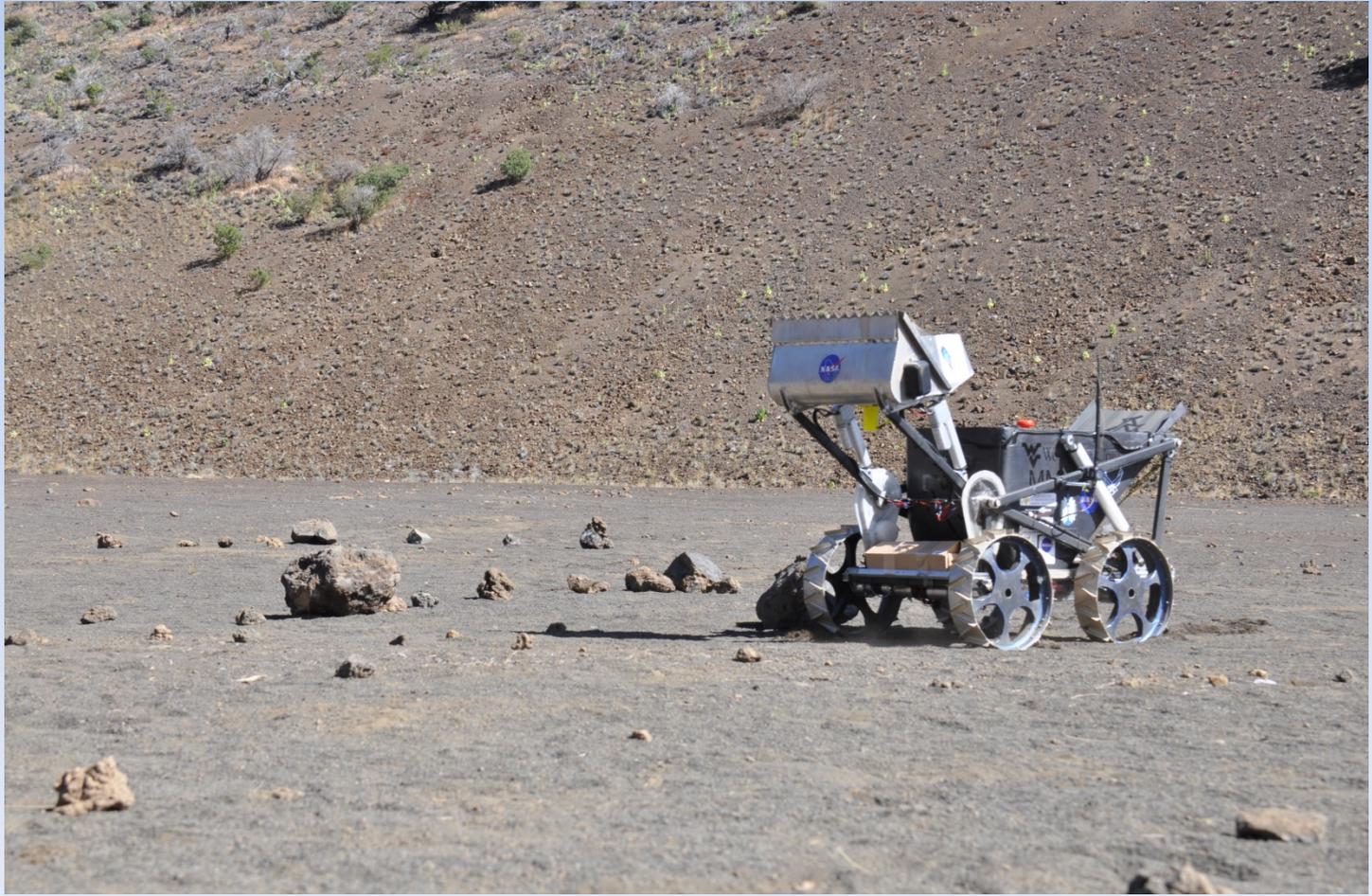


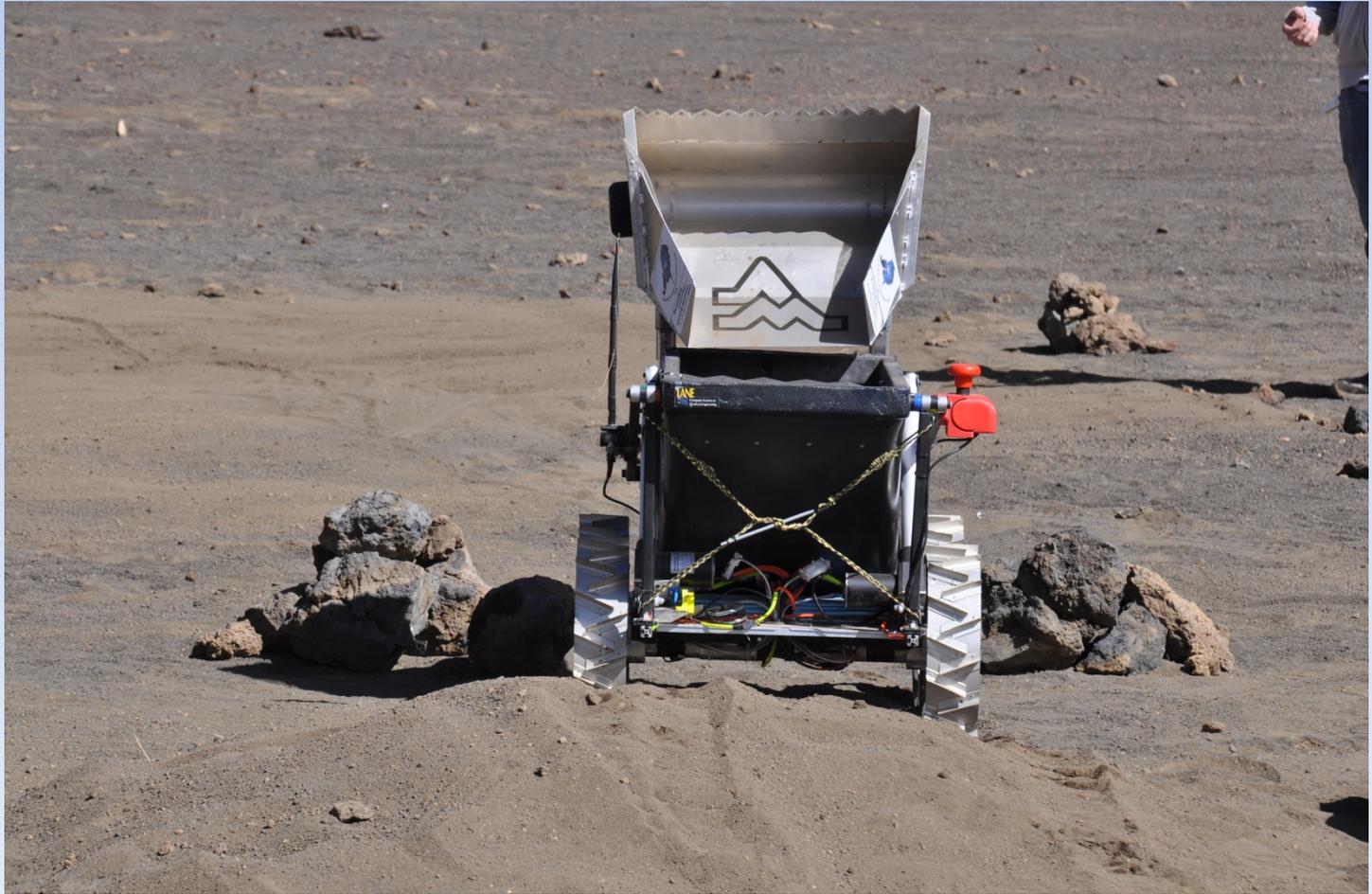
























4.65
FAIRBANKS
SCALES



Awards Day

- UHH Science & Technology Bldg, Large Lecture Hall
- BBQ dinner and awards ceremony
- Video of PRISM
- Social Networking



University of Hawai`i at Hilo





Results

Mining Award:

1. West Virginia University – 517 kg total
 2. Iowa State University – 499 kg total
 3. University of New Hampshire – 218 kg total
- Best Design and Innovation Award:
 1. Iowa State University
 2. University of Alabama
 3. Kapiolani Community College
 - Best Operation: (and overcoming obstacles/problems)
 1. West Virginia University
 2. University of Alabama
 3. University of New Hampshire
 - The Frank Schowengerdt Award for Excellence:
 - University of Alaska – Fairbanks

Comments from teams

- Pit area was better than RMC
- Food was better and cheaper
- Communications was better
- One team (WVir) would choose PRISM over RMC (!)
- RMC becoming stale, not challenging enough

Kapiolani Community College



Iowa



Alaska



Alabama



ALL



Outcomes (cont)

- Great Press coverage
(Mahalo to Mari-Ela)
 - Front Page of Hawaii Trib 2x (!)
 - HI business News
 - Big Island Video News
- Tech Works Video
- Internet, Social Media, Facebook, Video
- Lots of video (2 sit awareness cams, UHH live stream)
Must archive this asap
- Community Support
 - Mayor's Proclamation
 - County Council Resolution
- Simultaneous PISCES Rover Field test
 - Mahalo to Rodrigo & crew
- Now have robust, documented & repeatable comms link to HP (and to PISCES HQ & world)
- Good training on field logistics
- Security provided
- Characterization of Rover

Posted July 24, 2014 - 1:02am | Updated July 24, 2014 - 6:17am

In high gear: Teams gather on Mauna Kea for robotics competition



HOLLYN JOHNSON/Tribune-Herald

The West Virginia University robot competes during the PISCES Robotic International Space Mining (PRISM) competition Wednesday afternoon on Mauna Kea. The event included six college teams each with sophisticated robots that faced the challenge of collecting and depositing regolith ("Martian" dirt) into a bin as part of a simulated Mars or moon environment. "This is the best place in the world to test anything going to the moon or Mars," explained John Hamilton of PISCES. The West Virginia team includes students Tim Godisart, Alexander T. Hyped, Matt Grubb, John Lucas and Professor Pawsiri Klinkhachorn.

Posted July 17, 2014 - 1:01am | Updated July 17, 2014 - 5:39am

Robot invasion: Big Island to host college competition



Jul 16, 2014, 5:35pm HST | **UPDATED:** Jul 17, 2014, 7:26am HST

International space mining competition to put robots on Hawaii's Mauna Kea volcano



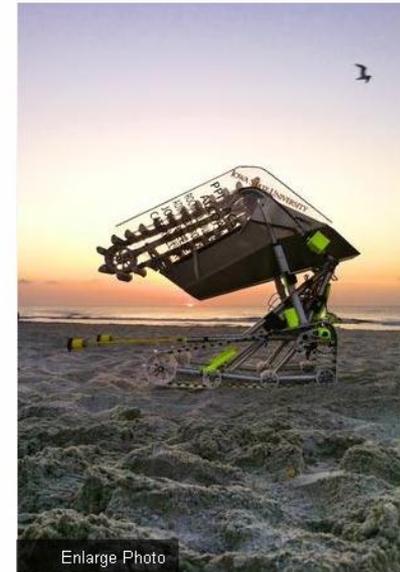
Matt Tuohy
Reporter-
Pacific Business News
Email

The University of Hawaii at Hilo is hosting a robotics competition next week that will put mining robots from seven universities on the slopes of the Mauna Kea volcano on the Big Island for testing and trials.

The competition, which is open to the public, begins on Monday and will be hosted by the Pacific International Space Center for Exploration System, or PISCES, and is called PRISM, or PISCES Robotic International Space Mining.

"It's basically collecting up the loose material on the surface, much like you sitting at the beach collecting up sand," said John Hamilton, the competitions project lead and instructor at UH Hilo, on how the robots will work.

"Mission control" for the competition will be set up in Gemini Observatory Remote Control Room in Hilo, where teams can control their robots and guests can watch all the action.



Enlarge Photo

Courtesy Iowa State University of Science and Technology

Iowa State University tests its robot on a beach in Florida in this file photo. The school is one of seven universities participating in the PISCES Robotic International Space Mining, or PRISM, competition that starts Monday on Hawaii's Big Island.



PRISM 2014.mp4

PAU





BREAKING NEWS

- Barry Obama endorses PRISM concept.
- Pledges non-financial support.
- Financial up to Hillary.

- Hamilton changes PRISM to the ISIS robotic contest.
- North Korea pledges team.

Pau Hana



Lunar Tiki Bar