Mystery Solved for Mega-Avalanches in Tibet, and Perhaps on Mars
by Alan Fischer

An international scientific effort determined the cause of a highly unusual and deadly glacier avalanche in Tibet in 2016, a new Nature Geoscience paper says.

PSI Senior Scientist Jeff Kargel is a co-author on “Massive collapse of two glaciers in western Tibet in 2016 after surge-like instability.” Andreas Kääb, Department of Geosciences, University of Oslo, Oslo, Norway, is lead author on the paper, which was published Jan. 22, 2018.

In July 2016, a glacier in Tibet — inconspicuous among thousands of others — did something documented on Earth only once before: Almost the entire ice mass slipped off its bed, careening at high speed in a mighty avalanche, down slopes so gentle that ordinarily not even a small avalanche could occur, Jeff said. The mega-avalanche, one of the largest ever documented worldwide, killed nine herders and hundreds of their animals.

“What happened next was truly remarkable. A neighboring glacier did the same thing! It slipped off its bed, down a similar low slope, just two months after the first, creating another giant ice avalanche,” Jeff said. “Fortunately, no other people perished.”

A six-nation team of satellite remote sensing sleuths looking closely at the first glacier’s demise were dumbfounded by the second event. The team found that both glaciers exhibited similar precursory slippage over their beds in the months and years preceding collapse, a behavior that indicated the penetration of meltwater to the bottom of the glaciers. This was a significant clue, because the glaciers occur at permafrost elevations between 17,000 and 19,000 feet above sea level, where the ice had been thought to be frozen solid to the ground. The fact that melting and basal sliding had appeared to be underway might be related to climate warming or increased summer rains.

Two glaciers in the Aru Mountains, western Tibet (location shown in the upper right panel), slipped off their beds in 2016 creating giant ice avalanches. The upper left panel shows a thermal image draped onto a topographic model of the mountains. The panel at the bottom shows a commercial Planet image, highlighting the relatively low slopes of the two glacial valleys, which nevertheless dumped these enormous ice avalanches onto the barren plain. Credit: C. Scott Watson, University of Arizona.

Another key finding was made by Jeff and Gregory Leonard (University of Arizona) — first based on satellite images, then confirmed by samples collected by other team members — that the bed is made of fine-grained sedimentary rocks, such as siltstone, sandstone, and clay. This is a rare type of bed for glaciers, where ordinarily mountains made of such soft rocks would be ground to mud in short order.

The team thinks that the glaciers had been almost completely

Continued on page 2
Isaac Smith Joins PSI’s Colorado Office

Isaac Smith joined PSI in May 2016 as a Postdoctoral Research Scientist and was promoted to Research Scientist in 2017. He came to us from Southwest Research Institute (SwRI) in Boulder, CO.

Isaac studies climate and ice properties of Mars, especially following investigations of layers in the polar layered deposits (PLD) by the Shallow Radar (SHARAD) instrument on Mars Reconnaissance Orbiter (MRO). He also organizes conferences for the Mars polar science community.

Isaac earned his M.S. in Physics at the University of Missouri, St. Louis (2007), and his Ph.D. in Geological Sciences from the Jackson School of Geosciences at University of Texas, Austin (2013).

Isaac was raised in the woods of east Texas by a nature-loving mother. She fostered in him an interest in the night sky. For instance, in 1986 she woke him and his younger brother in the middle of night to look at Halley’s comet. Isaac says, “It hung over the neighbor’s cow pasture in an image I will never forget.” Later, his mother took him to see comets Hale-Bopp and Hyakutake during Astronomy Night events.

He recalls he was under 10 years old when he first answered the question, “What do you want to be when you grow up?” with “Scientist.” Also around this time, his grandfather gave him an encyclopedia of science, and the fascinating descriptions of science hooked him. He pursued his interest in science throughout high school and college, but it was only after starting his Ph.D. program that he realized studying Mars, and specifically ice and winds, could be a viable career.

Some of the best experiences in Isaac’s life so far occurred during the two years he lived abroad, in Stuttgart, Germany and Paris, France. From Sept. 2013 to May 2014, as the recipient of an International Fulbright Fellowship, he worked at Universite Pierre et Marie Curie in Paris, doing research with Aymeric Spiga and concentrating heavily on learning French. He took full advantage of his time in Europe to not only advance academically, but also to visit other countries nearby, and make innumerable friends.

Isaac also enjoys motorcycle travel and tries to take a long trip each year. This year he traveled to Oregon to see the Great American Eclipse, then carried on to visit three glorious national parks: Glacier, Yellowstone, and Grand Teton. Altogether 3,400 miles, a relatively short trip. One year he rode from St. Louis to Virginia, Maine, San Diego, Seattle, San Antonio, and back to St. Louis. He clocked 31,000 miles (50,000 km) in under 12 months. Isaac said, “It was a busy year, full of great memories.”

When he is not traveling Isaac enjoys mountain biking, hiking, and running. He also tries to keep up his foreign language skills by reading books in French and Spanish.

It’s wonderful to have Isaac on the PSI team!

Special Thanks

Isaac has put 64,000 miles on his 2007 Suzuki DL650 VStrom.

Mystery Solved for Mega-Avalanches in Tibet

(continued from front page)

frozen and unable to slip and grind until recently. After enough water collected at the glacier bed, the glaciers started grinding the rocks and making a slippery wet mud that caused the glaciers to suddenly slide out of control when summer meltwater intruded. It bodes poorly for Tibet, where similar rock types, similar glaciers, and similar climate warming will likely result in more unpredictable icy events.

“There might be a nugget of insight for Mars where similar-appearing giant avalanches have been a longstanding mystery,” Jeff said. “If the Martian avalanches were of ice and various soft rocks, and a similar transition from totally frozen to partly thawed conditions took place—wham! The Mother of all Ice Avalanches!”

Read the full article at https://www.nature.com/articles/s41561-017-0039-7.

Front page banner: Massive black hole shreds passing star.

An artist’s illustration of a tidal disruption event named ASASSN-14li, discovered in 2014, which shows a star dragged into a black hole and torn apart by intense tides. The debris is gathered into a disk around the black hole. Data from NASA’s Swift satellite show that the initial formation of the disk was shaped by interactions between incoming and outgoing streams of tidal debris. Credit: NASA/Goddard Space Flight Center

Isaac visited the Rodin Museum when he lived in Paris.

Isaac visited the Rodin Museum when he lived in Paris.
Meet Vicki Hansen, Structural Geologist

Vicki Hansen joined PSI in 2016 as a Research Scientist. Vicki is a structural geologist interested in the dynamic evolution of terrestrial planets. Her work focuses on Earth and Venus, but draws on insights from the Moon, Mars, Mercury, and the moons of Jupiter and Saturn.

Vicki’s hybrid approach to planetary research combines two seemingly different tracks—terrestrial field-based research and analysis of remote-sensing data from Venus. Many planetary geologists use Earth analogs to understand other planets. Vicki flips this around, using the geologic history read from Venus’ intricate surface features to discover the nature of tectonic processes once active on Venus and then attempts to apply these lessons to our understanding of early Earth.

Venus is similar to Earth in many first-order ways that govern geodynamic processes and evolution—size, density, composition, heat budget, age, and location in the Solar System. Venus and Earth were likely most similar during their early years but later followed different paths—like many siblings. Just as one can learn much about a person by their siblings, we can learn some of Earth’s secrets by way of Venus. Unlike Earth, Venus never developed plate tectonics; therefore, Venus’ lithospheric, crustal, and surface record is much more complete. Venus preserves pages of her baby book—pages that may have been similar to Earth’s which are now mostly destroyed.

Vicki works with NASA Magellan mission data, particularly the spectacular SAR (synthetic aperture radar) images. When combined with altimetry data the SAR imagery allows nearly complete 3D global views. Venus’ protective dense atmosphere and lack of an active hydrologic cycle result in a surface that preserves a near pristine record of each geodynamic process that affected or acted on Venus’ surface through time and space. Vicki’s research on Venus is firmly rooted in geologic and structural mapping of the surface—effectively it is remote field geology. She and her students have authored several 1:5M-scale maps, given the name VMaps by USGS.

Vicki’s most recent work focuses on 1:10M-scale mapping of the Niobe Planitia and Aphrodite 1:10M-scale maps called IMaps (much larger scaled USGS-named maps)—together covering about one fourth of Venus’ surface in space, and all of Venus’ recorded history in time. The geodynamic record likely spans the temporal equivalent of the Archean to the present on Earth.

Now that the maps are submitted, Vicki and her cartographic colleague, Ivan López (Universidad Rey Juan Carlos, Madrid), will be decoding and digesting the results in order to discover linkages in process between Venus and Earth in the near future.

Vicki recalls there was never a time when she wasn’t wondering how the world worked, and she looked to science to answer those questions. At Carleton College (’80) she was a chemistry major until she noticed geology majors appeared to be having more fun. She was immediately blown away with the big picture questions geology asked, compared to interesting, but seemingly much less exciting questions about bonds between atoms.

She earned a Master of Science degree from the University of Montana (’83) working in extensional terrain in Washington, and earned a Ph.D. from UCLA (’87) with work in collision terrains in Yukon.

Vicki was on the faculty at Southern Methodist University (SMU) for almost 15 years where she met Roger Phillips—a meeting that serendipitously extended her ‘field projects’ to Venus. She joined the faculty at the University of Minnesota, Duluth in 2002.

Vicki spends extra time and energy paddle boarding, hiking, biking (fat tire bike replaced skis), gardening, and playing with clay (where rheology – the study of the flow of matter – rules, as it does in her scientific endeavors). An example of her clay art is at right.

Vicki and her husband John Goode share a lovely retreat in Duluth’s north woods—a combination natural zoo and botanical garden—described by some as a cabin in the woods, yet in town. Their children Casey and Berit currently offer visiting opportunities in San Diego and Ithaca, respectively, where he works for Amazon and she is pursuing a Ph.D. in Applied Physics at Cornell.

Vicki welcomes the opportunity to interact with the rich community of planetary scientists at PSI, to mentor young scientists, and to learn more about the incredible range of processes recorded across the surfaces of bodies within our vast Solar System.

We are so glad Vicki joined PSI!
Jamie Molaro: My Art & Science

I joined PSI on November 8, 2017, as an Associate Research Scientist, and was promoted to Research Scientist on December 5, 2017. Prior to this, I was a NASA Postdoctoral Fellow at the Caltech/Jet Propulsion Laboratory.

Growing up in Northern California, nestled in the foothills of the Sierra Nevada Mountains, I spent a lot of time hiking, camping, building tree forts, and generally enjoying the outdoors with my family. And in a family with six kids (I am the youngest), there were always a lot of different interests and opinions. We would regularly end up sitting at the dinner table for hours in discussions that moved from local news, to art history, philosophy, and science. My mother liked to call these “Kitchen Documentaries,” and they helped to foster a love of learning within me.

In high school I became interested in science and math thanks to a particularly engaging and supportive physics teacher. I got a job at a local science museum, and found mentors and friends in the many people I worked with there. This led me to pursue an undergraduate degree in physics and astronomy at San Francisco State University. During my time there, I decided to attend graduate school to study particle physics. However, a chance opportunity came up for me to attend a NASA Spaceward Bound expedition. This program allowed students interested in teaching science to attend a field expedition to the Mojave Desert with geologists, biologists, and planetary scientists from NASA and other institutions. It was my first exposure to the study of planetary surfaces, and I fell in love. I spent the following year working with Dr. Chris McKay at NASA Ames, whom I had met on this expedition, and that set me on the path to graduate school working with Dr. Chris McKay at NASA Ames, whom I had met on this expedition, and that set me on the path to graduate school. During my time there, I decided to attend graduate school to study particle physics. However, a chance opportunity came up for me to attend a NASA Spaceward Bound expedition. This program allowed students interested in teaching science to attend a field expedition to the Mojave Desert with geologists, biologists, and planetary scientists from NASA and other institutions. It was my first exposure to the study of planetary surfaces, and I fell in love. I spent the following year working with Dr. Chris McKay at NASA Ames, whom I had met on this expedition, and that set me on the path to graduate school at the University of Arizona’s Lunar and Planetary Laboratory, where I received my Ph.D. in 2015.

I study the surfaces of rocky and icy bodies in the Solar System that don’t have atmospheres. More specifically, I study the way in which materials on these surfaces break down and change shape due to heating and cooling from the Sun. For rocky surfaces, this may cause boulders to fracture and break apart into dust. For icy surfaces, this may cause ice grains or “snow” on their surfaces to become dense and hard over time. In general, I’m interested in the way that these types of processes evolve planetary landscapes, and what they can teach us about the history and future of those surfaces and the Solar System.

I’m working on several projects, but most recently I became a team member on NASA’s OSIRIS-REx mission, which will return a sample from the asteroid Bennu. As an affiliate at JPL, I’m also part of a research group tasked with characterizing the surface properties of Europa and Enceladus to support engineering efforts at JPL to develop spacecraft landing and sampling systems.

In my free time, I play a lot of board, video, and tabletop RPG (role playing) games, and spend time outdoors with my dog. I also love to make sci-art. I started an art show in graduate school called The Art of Planetary Science, which features works inspired by science and the Solar System, as well as works created using scientific data. In my work, I use topography data and images from spacecraft to craft landscapes out of paper. The Art of Planetary Science is now an annual event, and I also organize art shows at scientific conferences and local events when the occasion arises.

PSI is pleased to welcome yet another talented artist/scientist!

2018 Pierazzo International Student Travel Award Winners Announced by Alan Fischer

In December 2017 the winners of the 2018 Pierazzo International Student Travel Award, established by the Planetary Science Institute, were selected.

The travel award was established by PSI in memory of Senior Scientist Betty Pierazzo to support and encourage graduate students to build international collaborations and relationships in planetary science.

Gregory J. Gilbert (right) of the University of Chicago will receive the award for a U.S.-based graduate student traveling to a planetary meeting outside of the U.S. His research title is "A Universal Framework for Classifying Exoplanet Systems" and he will be attending the Exoplanets II conference in July at Cambridge, the United Kingdom.

Lauren McKeown (left) of Trinity College Dublin will receive the award for a non-U.S.-based graduate student traveling to a planetary meeting within the U.S. Her research title is "A Quantitative Comparison Between Theory and Experiment for CO2 Sublimation on a Granular Surface under Terrestrial and Martian Conditions" and she will be attending the 49th Lunar and Planetary Science Conference in The Woodlands, Texas, March 19-23, 2018.

A PSI representative will present each awardee with a certificate and check for $2,000 at their respective conferences.
**Director’s Note: Earth is a Planet, too!**

It never ceases to amaze me how our expanding knowledge of Earth and our expanding knowledge of other worlds inform each other. We find evidence of mega-avalanches, glaciation, and tsunamis on Earth and Mars. The physics of collapsing high-altitude lakes in the Himalayas may inform whether similar phenomena could occur on Titan (where the lakes are liquid methane). Earth is a touchstone for a lot of phenomena, geophysical, atmospheric and magnetospheric, that we see at other worlds, and as we gain insight into how they are manifest in those more distant locations we gain insight into how things work at our homeworld. Planetary science is a worthy investment in ourselves!

PSI scientists are currently involved with almost all NASA Solar System exploration missions and they are expanding their activity to new missions planned by the agency. Tom Prettyman is a member of the Gamma Ray and Neutron Spectrometer team of the Psyche mission, which will be launched to a metallic asteroid of the same name in the next decade.

Eric Palmer and Bob Gaskell are co-investigators of a New Frontiers mission for the Comet Astrobiology Exploration Sample Return mission (CAESAR) to return a sample from the nucleus of the comet 67P/Churyumov-Gerasimenko, recently visited by the ESA Rosetta spacecraft.

Aileen Yingst and Catherine Neish are co-investigators of the Dragonfly mission to study the surface and atmosphere of Titan using a dual quad-copter! One of these missions may be selected for flight in the next decade.

It is also wonderful to extend our human experience of the universe at PSI by welcoming Pamela Melroy to our Board of Trustees. To repeat myself from the article about her in this newsletter: As a former commander and pilot of the space shuttle, she represents the realization of the aspirations of many of us at the Institute. Part of PSI’s mission is to support human exploration (after all we are the native guides), so her experiences and insights are of great value to us. She is already helping to identify new funding opportunities for us to explore and she is deeply practical, which I very much appreciate.

We have a great team at the Institute!

*Mark V. Sykes*  
*March 2018*

---

**PSI Staff News**

**Henry Throop Receives Carl Sagan Medal**

PSI Senior Scientist Henry Throop received the 2017 Carl Sagan Medal for excellence in public communication at the 49th annual meeting of the American Astronomical Society’s Division for Planetary Sciences (AAS DPS) in Provo, Utah. Above, Throop is presented the Sagan Medal by outgoing DPS chair Lucy McFadden. He was notified of the award in June and received it in October. See the full article in the Summer 2017 PSI Newsletter.

Bravo, Henry!  
*Photo credit: Rick Fienberg/AAS*

---

**An Asteroid for Elaine Owens**

It’s official! Elaine Owens has been honored with an asteroid named after her. And despite the past tense in the minor planet citation (below), she is still at PSI in her current position as Contracts and Benefits Specialist.

(6944) Elaineowens = 1979 MR3  
Elaine Owens (b. 1947) was administrative coordinator at the Planetary Science Institute for over 25 years. Her ability to deal with a challenging group of scientists in the ever-increasing demands of a complex world while maintaining a pleasant and efficient persona made her essential to the organization.

So true! Congratulations, Elaine!

---

**PSI Attends 2017 DPS in Utah**

In October more than 40 PSI scientists attended the 49th annual meeting of the American Astronomical Society’s Division for Planetary Sciences (AAS DPS) held in Provo, Utah.

At left, PSI attendees, alumni and friends gathered at the Marriott Provo for a dinner during the conference.

*Photo credit: Henry Throop*
A New Trustee, Former Shuttle Commander
Colonel Pam Melroy by Alan Fischer and Chris Holmberg

In 2017, Pamela Melroy (Colonel, USAF, Retired), a former test pilot, astronaut, and Space Shuttle commander joined the PSI Board of Trustees.

Pam has a bachelor’s degree from Wellesley College in Physics and Astronomy and a master’s degree from the Massachusetts Institute of Technology in Planetary Science. After serving in the United States Air Force and at NASA, she worked at Lockheed Martin on the Orion program, and was acting Deputy Associate Administrator for Commercial Space Transportation at the Federal Aviation Administration. She most recently served as Deputy Director, Tactical Technology Office at the Defense Advanced Research Projects Agency (DARPA).

Pam is one of only two women to command the Space Shuttle and flew three missions in space to help assemble the International Space Station. Her husband, Douglas Hollett, is a geologist who most recently was the Acting Assistant Secretary of Energy for Fossil Energy.

“Pamela Melroy embodies the lifelong ambitions shared by many of us in space exploration,” said Mark Sykes, CEO and Director of PSI. “Her deep experience in human spaceflight, the aerospace industry, and related government programs will be of great value as we continue to expand the impact and application of our work.”

“I truly look forward to working with the PSI board,” said Pam. “It’s wonderful to be involved again with my first scientific passion —planetary science —and to support planetary scientists in their quest for knowledge of our universe.”

We look forward to working alongside Pam in the coming years!

Current PSI Board member Pam Melroy floats through the International Space Station in this NASA image from her time as a Space Shuttle Commander. She will be the Keynote speaker at our Annual Fundraising Dinner on May 2nd.