



Cryovolcanism

in the Solar System

Houston, Texas
Lunar and Planetary Institute

June 5–7, 2018
#cryovolcanism2018

Objective:

Workshop centered around understanding the processes that may lead to volcanism and magmatism on the icy satellites, KBOs, and hydrous asteroids in our solar system.

- How and under what conditions does volcanism occur on these worlds?
- What are the mechanisms responsible for putative volcanic features imaged by spacecraft?

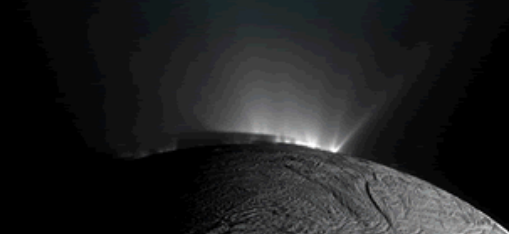
Meeting Themes

- Petrology & rheology of cryovolcanic materials
- Composition of icy magmas
- Subsurface plumbing of volcanic systems
- Cryovolcanic plumes
- Laboratory/Field analogs
- Surface morphology of cryovolcanic features
- Cryovolcanic processes/styles



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Science Organizing Committee

Lynnae Quick (National Air and Space Museum)

Emily Martin (National Air and Space Museum)

Louise Prockter (LPI)

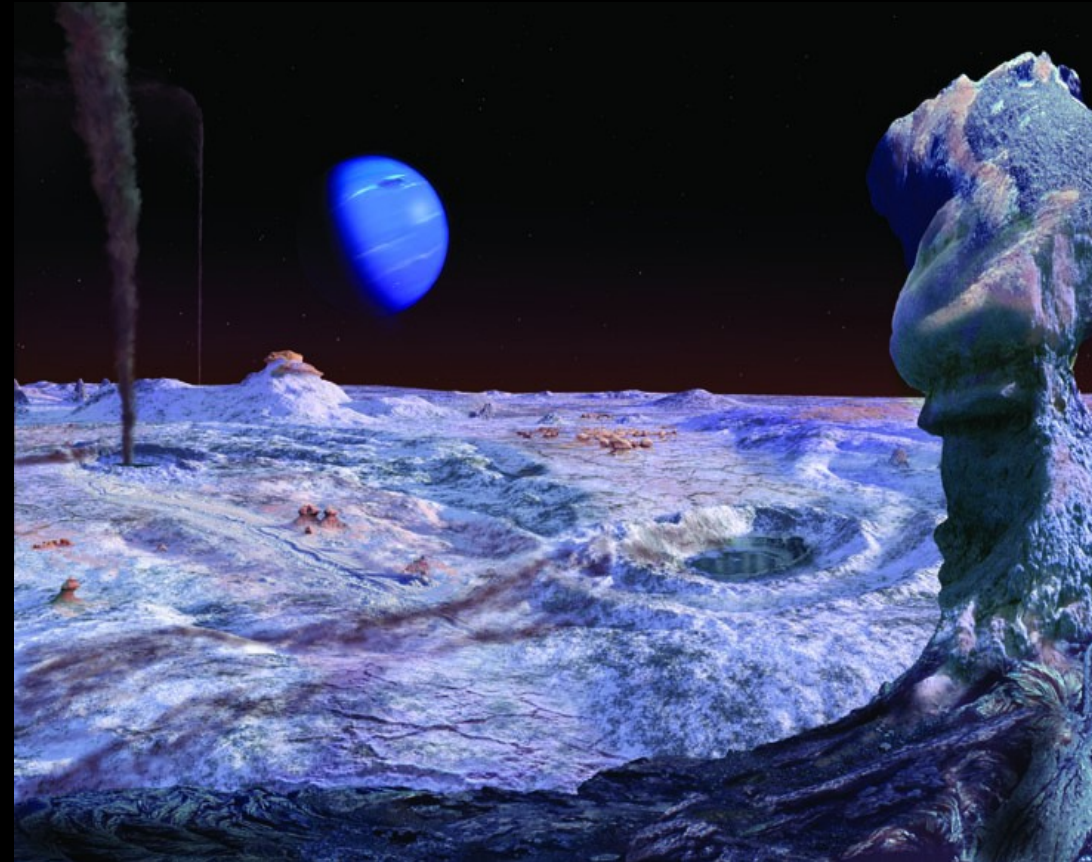
Sarah Fagents (University of Hawaii-Manoa)

Candy Hansen (PSI)

Catherine Neish (University of Western Ontario)

O. J. Tucker (NASA Goddard)

Steve Vance (JPL)



Agenda

Tuesday, June 5, 2018

- 9:00 a.m. What is Cryovolcanism?
- 10:50 a.m. What does Cryovolcanism Look Like? I
- 1:35 p.m. What does Cryovolcanism Look Like? II
- 4:30 p.m. Cryovolcanism Posters

Wednesday, June 6, 2018

- 9:00 a.m. How Does Material get from the Inside to the Outside? I
- 1:35 p.m. How Does Material get from the Inside to the Outside? II

Thursday, June 7, 2018

- 9:00 a.m. How Does Understanding Plume Dynamics Help Us Understand Cryovolcanism?

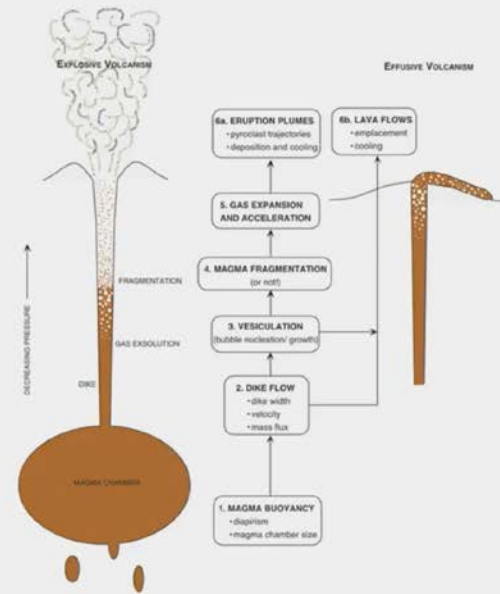
Attendees

- 40 people attended the workshop
- Attendees included scientists at all career stages, postdocs and graduate students
- International participation from France, Spain, and Japan
- Presentations centered on cryovolcanism on: Titan, Europa, Enceladus, Ceres, Pluto, Charon and Ganymede
- Attendees represented several NASA missions: Voyager, Galileo, Dawn, New Horizons, and Europa Clipper

Oral presentations were a mixture of invited and submitted talks

Silicate magmatism: Fundamental processes

- Melt generation
 - ~ 200 K melting interval allows a range of compositions and melt–crystal mixtures
- Deep ascent
 - Diapirs vs. dikes
- Formation of magma reservoirs
- Flow in conduit (dikes again)
 - Volatile exsolution/expansion
 - Magma fragmentation?
- Explosive eruption vs. surface flows



Rheological Properties of Ammonia–Water Liquids and Crystal–Liquid Slurries: Planetological Applications

J. S. KARGEL, S. K. CROFT, J. I. LUNINE, AND J. S. LEWIS

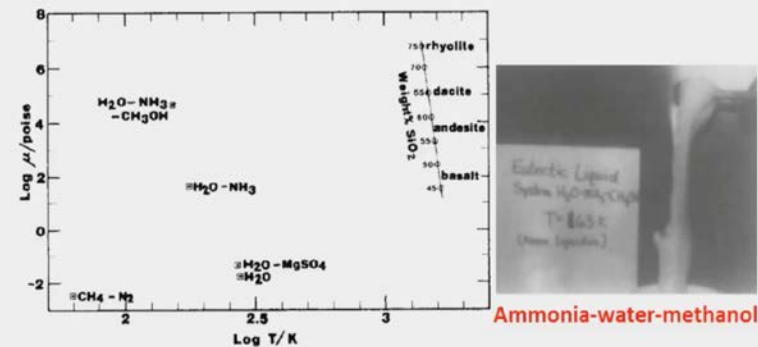
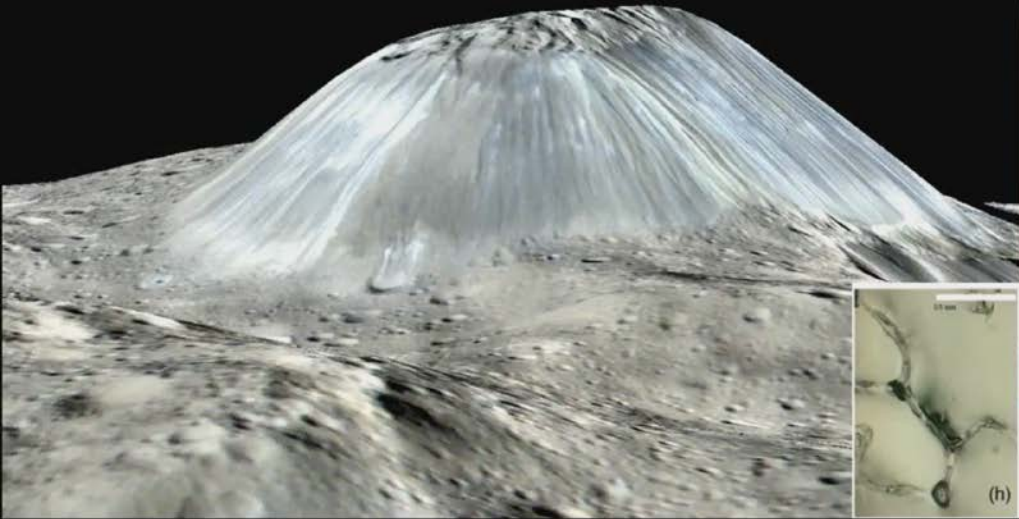


FIG. 9. Viscosities of cryogenic and silicate liquid mixtures. All data are for crystal-free mixtures. Silicates are at their respective liquidus; cryogenic liquids are at their respective eutectic and peritectic points.

A 4-km Tall Mountain!!



- The emplacement of 4-km high Ahuna Mons requires a partially molten source (Ruesch et al., 2016), indicating a few % brine in at depth
- Bright streaks are rich in Na-carbonate (Zambon et al., 2017)



Meeting Feedback

Participant Feedback

- Participants rated the scientific content as excellent (91%) or very good (9%)
- Discussion and dialog amongst attendees was rated as extremely valuable
- Periodic meetings proposed
- Creation of a cryovolcanism listserv (QuickL@si.edu; MartinES@si.edu)

Meeting presentations available online:

<https://www.hou.usra.edu/meetings/cryovolcanism2018/presentations/>

Meeting Feedback

Participant Feedback

“It was really valuable to have such an intense focus on cryovolcanism with a group of people having diverse approaches to understanding the processes.”

“I found it valuable to see all the different ways that different people have been addressing the issue of how cryovolcanism might work. Synthesizing these various approaches is how we are going to finally solve the problem”

“I learned a ton, especially about the history of the topic from some of the (essentially) founders of the subfield.”

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Outstanding Questions

Avenues for further research/consideration

- Incorporation of laboratory work on low-temperature cryogenic solutions
- What is the role of impacts in facilitating cryovolcanism (e.g., Ceres)?
- Tidal effects during cryomagma transport
- Fieldwork/Analog studies
- Cryovolcanism as a significant exchange process/astrobiology
- Freezing and fractional crystallization in an impure icy crust

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