Working Group 4: Linking MI & Gas Datasets

AGU Fall Meeting | New Orleans, LA | November 14, 2025

Behnaz Hosseini

Shishaldin Volcano | PC: USGS_AVO, Cyrus Read

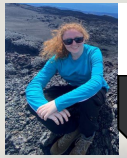
Meet the Team!

Saisha **Brody**

University of Texas at Austin

Claudia **Cannatelli**

University of Alaska Anchorage

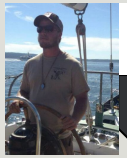


Annabelle **Carozza**

University of Oregon

Echo **Ding**

University of Florida



Nathan **Graham**

University of Alaska Fairbanks

Rick **Hervig**

Arizona State University

Michael **Hudak**

Williams College

Ellyn **Huggins**

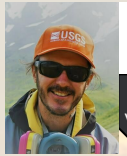
Cornell University

Pavel **Izbekov**

University of Alaska Fairbanks + AVO

Emily **Johnson**

USGS - Cascades Volcano Observatory



Peter **Kelly**

USGS - Cascades Volcano Observatory

Skye **Kushner**

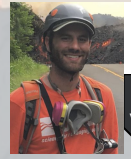
University of Alaska Anchorage

Jess **Larsen**

University of Alaska Fairbanks + AVO

Daniel **Lee**

LDEO - Columbia University



Allan **Lerner**

USGS - Cascades Volcano Observatory

Matthew **Loewen**

USGS - Alaska Volcano Observatory

Taryn **Lopez**

University of Alaska Fairbanks + AVO

Madison **Myers**

Montana State University

Terry **Plank**

LDEO - Columbia University

Felipe **Rojas Vilches**

University of New Mexico

Paul **Wallace**

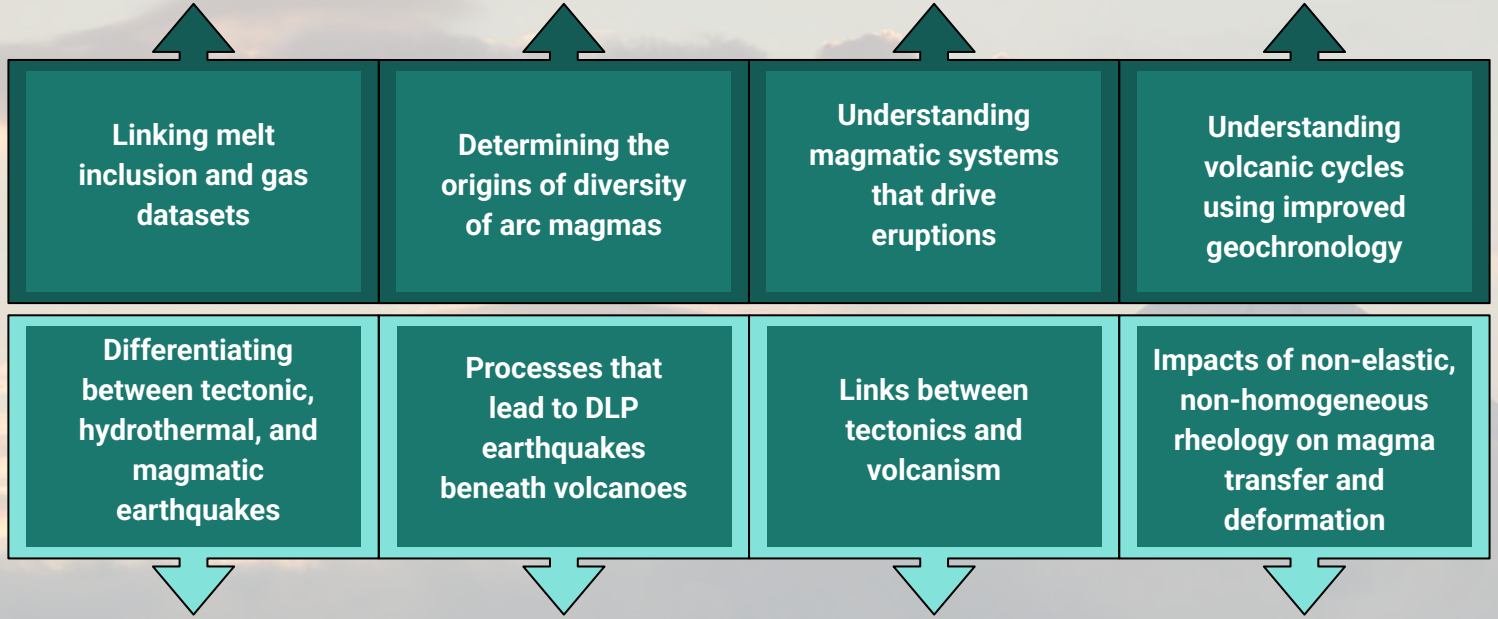
University of Oregon

Penny **Wieser**

University of California, Berkeley

AVO-Identified Science Priorities

Advancing our Understanding of Volcanic Cycles and Plumbing Systems



Analyzing Real-Time Datasets For Improved Interpretation of Active Systems

Broad Working Group Objectives

Improving our understanding of volatile fluxes and cycling

Identifying best practices for volatile restoration in melt inclusions

Improving degassing models for linking MIs to surface gas signatures

May Working Group Discussion Topics

Data gaps in the volatile record (MI, gas) for volcanoes in the Alaska-Aleutian Arc

Which volcanoes have both MI and gas **data ready for integration**? Which volcanoes have good gas data but need MI data, and vice versa?

What can we do ***now*** as a community, sans additional funding? Where should we focus our efforts?

Research priorities that require **funding**

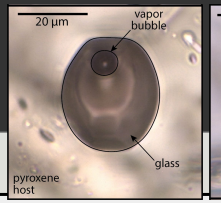
First Task: Data Compilation of MIs and Gas

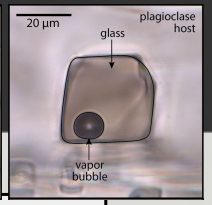
Table1

Volcano	Eruption (Year)	eruption?	Type of erupted product	Melt Inclusions? (Y/N)	Phases measured	Are there GOOD samples	Fluid Inclusions?	MIs with Reconstructed CO2?	Number of melt inclusions analyzed	Pressure Range (if Reconstructed CO2)	Volatiles measured	Author / Group
Shishaldin	1999		tephra, scoria	Yes	olivine	Yes	??	Yes	~50	20 km	H2O, CO2, S, Cl	Rasmussen/Plank
Seguam	1997			Yes	olivine	Yes -Terry		Y				
Pavlof	2016, 2014					Okay - not a lot of material						
Makushin	Driftwood Pumice			N	opx, cpx, plg	Yes (historic eruptions)						Jess
Korovin						Ask Michelle (gross?)						
Iliamna						Sort of (altered - 1 sample)						
Augustine	1,100 ybp (Tephra C)	ll stratigraphic section	tephra	Y (in progress)	Plag + OPX	Yes - K. Walowski/A. Koleszar		N	231		H2O, CO2, S, Cl, F	S. Brody, K. Walowksi, A. Koleszar
Augustine	1,100 ybp (Tephra C)	middle, and end		Y (in progress)	Olivine	Yes	yes, hydrous	Y (in progress)			CO2, S, CL	Annabelle Carozza (Wallace Lab)
Augustine	Pleistocene			Y (in progress)	Olivine	Yes	yes, hydrous	Y (in pregress)			CO2, S, CL	Annabelle Carozza (Wallace Lab)
Augustine	2006			Y (published)	cpx, plag, opx	Yes		N			H2O, CO2, S, Cl	J. Larsen
Augustine	1986											
Spurr	1992	sk - ask Jim Beget	lapalli									
Gareloi												
Semisopochnoi	2019-2023, Holocene											
Martin												
Mageik												
Trident												
Novarupta	1912		(Tephra + Do									
Great Sitkin												
Kanaga												

Volcano?	Published Gas Data? (Y/N)	Data Interval?	Passive Degassing / Unrest / Eruption?	Method	Published CO2 Gas Data?	Published C/S Ratios?	Other species?	Author / Group	Citation (w/DOI if available) or Work in Progess?
Spurr	Y			satellite SO2 + airborne SO2 + MG				AVO/VEP	Werner et al., 2011 and older
Redoubt	Y		pre/syn/post	satellite SO2 + airborne SO2 + MG		yes		AVO/VEP	Werner et al., 2012, 2013, Kelly et al., 2013, Lopez
Iliamna	Y			satellite SO2 + airborne SO2 + MG + LGR		yes	yes	AVO/VEP	Kern & Kelly, Werner et al. 2011
Augustine	Y		syn/post	airborne SO2 & ground based (MG + fumarole sampling)		yes		AVO/VEP	McGee et al., 2010, 2013; Werner et al. 2011
Veniaminof	Unpublished		pre/post eruption	satellite SO2 + airborne SO2 + MG		Unpublished		AVO/VEP	TBD
Pavlof	Unpublished		pre/post eruption	satellite SO2 + airborne SO2 + MG		Unpublished		AVO/VEP	Lopez et al in prep
Shishaldin	Unpublished		pre/post + syn (satellite only)	satellite SO2 + airborne SO2 + MG		Unpublished		AVO/VEP	Lopez et al in prep
Makushin	Unpublished			satellite + airborne (SO2, MG, LGR? + ground based (MG + fumarole sampling)		Unpublished		AVO/VEP	TBD
Cleveland	Y			satllite + airborne + continuous DOAS		Y		AVO/VEP	Werner et al., 2018, 2020, Kushner et al., dissertat
Korovin	Unpublished			satellite SO2 + airborne (SO2, MG, LGR + groundbased (MG + fumarole sampling)		Unpublished	yes	AVO/VEP	Kelly, Lopez et al., in prep
Great Sitkin	Unpublished		pre/syn	satellite SO2 + airborne (SO2 + maybe CO2/S?)		Unpublished		AVO/VEP	TBD
Kanaga	Y			groundbased (MG + fumarole sampling) + airborne (SO2 & CO2)		yes	H2O, CO2, S, SO2, H2S, HCl, HF, He, H2, Ar, O2, N2, CH4, CO, He-Ar-N isotopes	Fischer & Lopez	Fisher et al. 2022
Gareloi	Y			satellite SO2 + airborne (SO2 +MG) + groundbased (MG + fumarole sampling)		yes	H2O, CO2, S, SO2, H2S, HCl, HF, He, H2, Ar, O2, N2, CH4, CO, He-Ar-N isotopes	Fischer & Lopez	Fisher et al. 2022
Semisopochnoi	Y		eruption	satellite SO2 + airborne SO2 (maybe C/S?)			yes?	Fischer & Lopez, AVO	Fisher et al. 2022; Lyons et al., 2025
Little Sitkin	Y			groundbased MG + fumarole sampling		yes	H2O, CO2, S, SO2, H2S, HCl, HF, He, H2, Ar, O2, N2, CH4, CO, He-Ar-N isotopes	Fischer & Lopez	Fisher et al. 2022
Kiska	Y			groundbased DOAS/MG + fumarole sampling		No?	H2O, CO2, S, SO2, H2S, HCl, HF, He, H2, Ar, O2, N2, CH4, CO, He-Ar-N isotopes	Fischer & Lopez	Fisher et al. 2022
Tanaga	Y							Fischer & Lopez	Fisher et al. 2023

Categories Emerging from Data Compilation:





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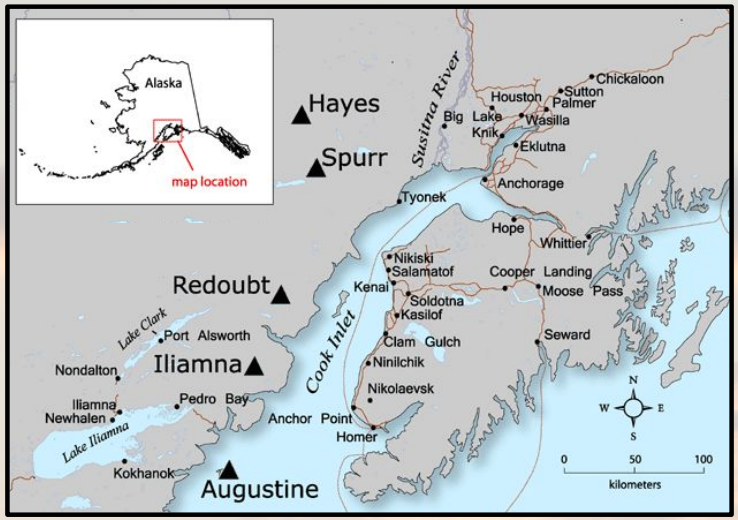
Group 2	✔	✖	✔	Augustine 2006 Pavlof 2016 (IP; Plank & Lee) Spurr 1992	Reconstruct CO_2 from MIs
Group 3	✖	✖	✔	Shishaldin 2023 Cook Inlets!	Analyze MIs
Group 4	✔	✔ or ✖	✖	???	Deploy multi-GAS during unrest
Group 5	✖	✖	✖	Douglass (some gas, no holocene eruptions)	Analyze MIs from any available material, and deploy multi-GAS during unrest?

Working Group Findings



FC: J. Schaefer / AVO ADGGS

→ Cook Inlet volcanoes don't have much published MI data but…

→ …all Cook Inlet volcanoes ranked as high to very high threat and…

very high threat

high threat

Rank	Volcano	State	Aviation threat score	Overall threat score	Latitude (in decimal degrees)	Longitude (in decimal degrees)
1	Kilauea	HI	48	263	19.425	-155.292
2	Mount St. Helens	WA	59	235	46.2	-122.18
3	Mount Rainier	WA	37	203	46.87	-121.758
→ 4	Redoubt Volcano	AK	48	201	60.485	-152.742
5	Mount Shasta	CA	39	178	41.42	-122.2
6	Mount Hood	OR	30	178	45.374	-121.694
7	Three Sisters	OR	30	165	44.133	-121.767
8	Akutan Island	AK	47	161	54.134	-165.986
9	Makushin Volcano	AK	47	161	53.891	-166.923
→ 10	Mount Spurr	AK	48	160	61.299	-152.251
11	Lassen volcanic center	CA	32	153	40.492	-121.508
→ 12	Augustine Volcano	AK	48	151	59.363	-153.43
13	Newberry Volcano	OR	30	146	43.722	-121.229
14	Mount Baker	WA	15	139	48.777	-121.813
15	Glacier Peak	WA	37	135	48.112	-121.113
16	Mauna Loa	HI	4	131	19.475	-155.608
17	Crater Lake	OR	37	129	42.93	-122.12
18	Long Valley Caldera	CA	29	129	37.7	-118.87
19	Mount Okmok	AK	47	117	53.43	-168.13
→ 20	Iliamna Volcano	AK	34	115	60.032	-153.09
21	Yellowstone caldera	WY	27	115	44.43	-110.67
22	Aniakchak Crater	AK	41	112	56.88	-158.17
23	Hualālai	HI	27	109	19.692	-155.87
24	Mono-Inyo Craters	CA	29	106	37.88	-119
25	Mount Martin	AK	23	106	58.172	-155.361
26	Mount Mageik	AK	23	106	58.195	-155.253
27	Trident Volcano	AK	29	106	58.236	-155.1
28	Mount Katmai	AK	35	106	58.28	-154.963
29	Mount Veniaminof	AK	47	102	56.17	-159.38
30	Atka volcanic complex	AK	35	102	52.381	-174.154
31	Korovin Volcano	AK	35	102	52.381	-174.166
32	Shishaldin Volcano	AK	41	93	54.756	-163.97
33	Clear Lake volcanic field	CA	15	92	38.97	-122.77
34	Mount Adams	WA	15	92	46.206	-121.49
→ 35	Hayes Volcano	AK	34	90	61.64	-152.411

Ewert et al. (2018)

Working Group Findings

PC: S. Kushner / UAA

→ Cook Inlet volcanoes don't have much published MI data but…

→ …all Cook Inlet volcanoes ranked as high to very high threat and…

→ …these volcanoes are great targets because they have great gas data: annual flights, multi-GAS

very high threat

high threat

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Ewert et al. (2018)

Mount Spurr: 2025 Unrest

NBC NEWS

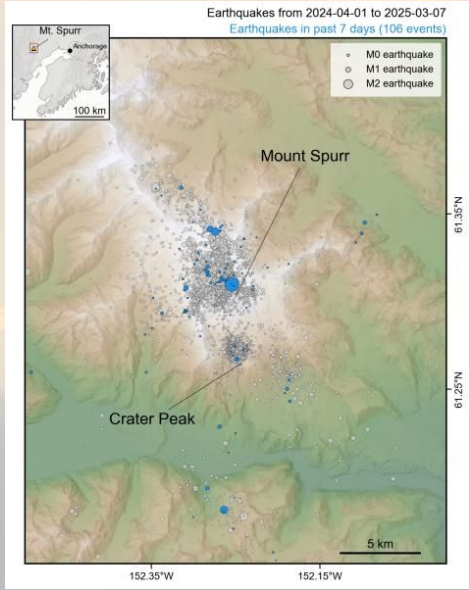
Eruption at Alaska's Mount Spurr is likely, and scientists say preparations should begin

SHARE & SAVE

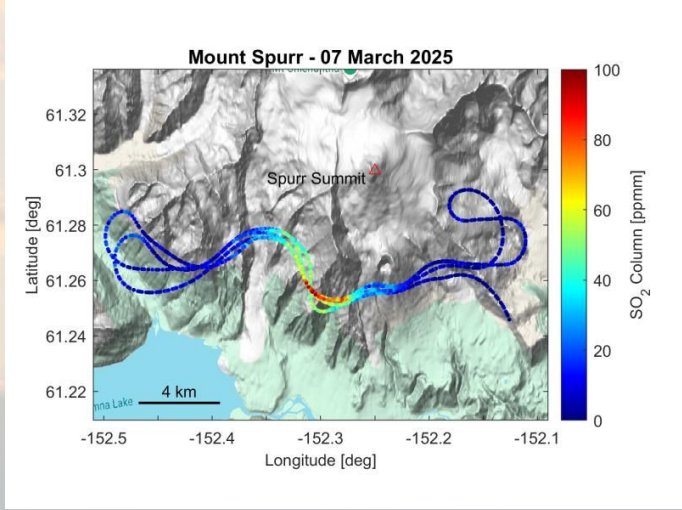
U.S. NEWS

Eruption at Alaska's Mount Spurr is likely, and scientists say preparations should begin

The Alaska Volcano Observatory said now is a good time for Alaskans to "familiarize themselves with the possible hazards of a Spurr eruption."



FC: USGS AVO



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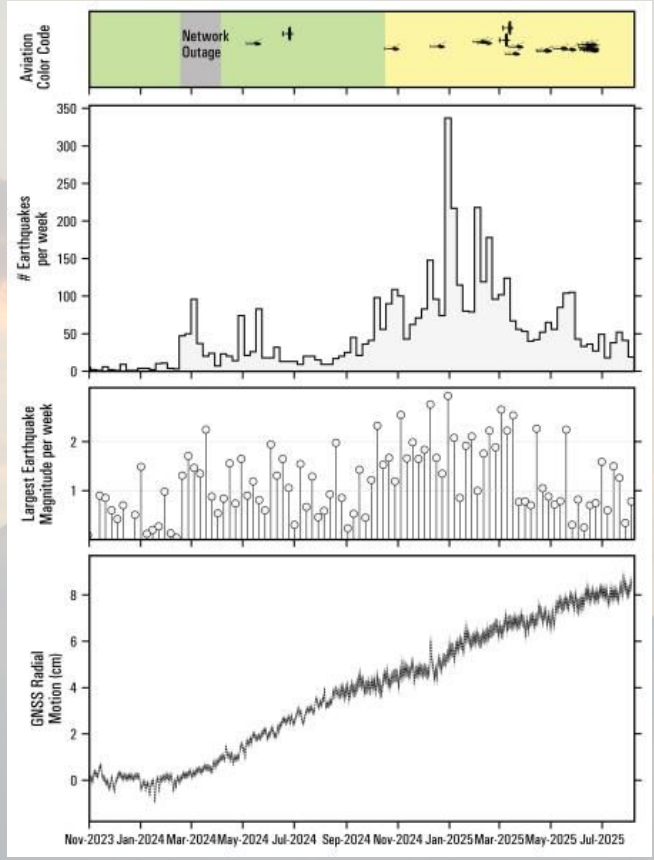


FC: J. Lubbers / USGS AVO

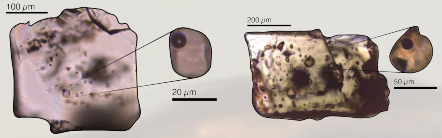
AVO Community Experiment Solicitation

Mount Spurr melt inclusion community experiment

Mount Spurr, Alaska, is a very high threat volcano located 80 km from Anchorage, Alaska's largest city and a global air cargo hub. The volcano showed signs of new magma intruding early in 2024 and its alert level was elevated starting in October 2024. In February 2025, gas emissions markedly increased and AVO became increasingly concerned that activity was leading to an eruption. Since then, activity has somewhat decreased but remains elevated.

There are critical petrologic knowledge gaps on the Spurr magmatic system which AVO would like to fill in order to better interpret current unrest and gas emission data. We seek volunteer help from the volcanology/petrology community to help fill these gaps. Specifically, we seek a complete characterization of the volatile budget from melt inclusions (e.g., H2O, CO2, S, Cl). We are asking for volunteer labs to help prepare a modest number of melt inclusions from the last eruption of Mount Spurr (1992) to expedite this typically time-consuming task through collaborative group effort. If you want to help:

Community Response Timeline: Mount Spurr Case Study



Jun. 2025

Plg- & Pyx-hosted MIs prepped by participating labs (MSU, UF, CVO)

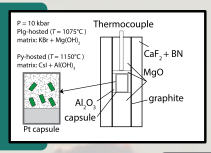
Sample splits distributed by AVO

Aug. 2025

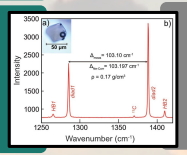
Initial estimates of MI glass volatiles & major elements by FTIR and EPMA at USGS-CVO

Aug-Oct. 2025

Subset of MIs homogenized at UF

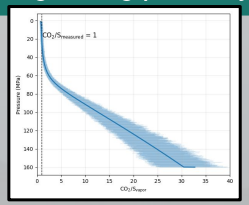


Subset of MI VBs measured by Raman at UCB



Nov. 2025

Preliminary Sulfur_X modeling to estimate entrapment pressure & degassing pathways



Jan. 2026

Measure homogenized MI glass by SIMS at ASU

Feb. 2026

Measure homogenized MI glass by EPMA at UAF-GI

Mar. 2026

Refine Sulfur_X modeling

Some Preliminary Findings

→ **Collected an MI dataset (including CO_2)** for Mount Spurr, **a very high threat Cook Inlet volcano,** via a community effort using readily available resources.

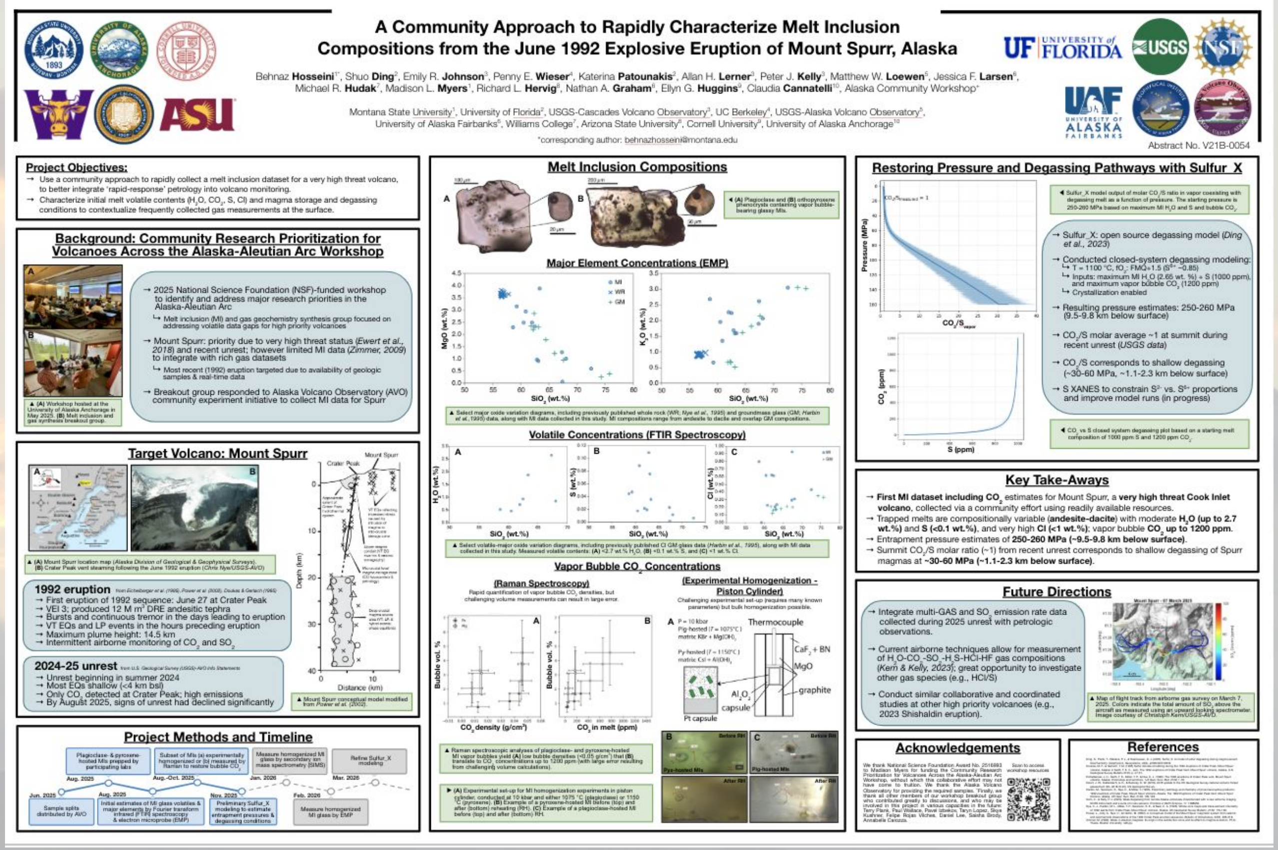
→ Trapped melts are compositionally variable (**andesite-dacite**) with moderate **H_2O (up to ~2.7 wt.%)** and **S (up to ~0.1 wt.%)**, high **Cl (up to ~1 wt.%)**; vapor **bubble CO_2 up to 1200 ppm.**

→ Entrapment pressure estimates of **250-260 MPa (~9.5-9.8 km below surface).**

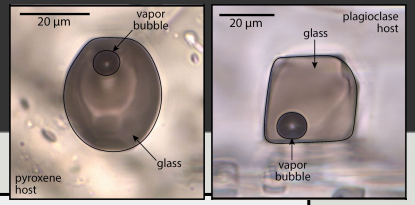
→ Summit CO_2/S molar ratio (~1) from recent unrest corresponds to shallow degassing of Spurr magmas at **~30-60 MPa (~1.1-2.3 km below surface).**

Visit our poster on Tuesday, Dec. 16 from 8:30 am -12 pm*!

* Attending Norman L. Bowen Award Lecture from 8:30-10 am so actually come by between 10-12 pm! 🙂



Categories Emerging from Data Compilation:



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What's Next?

How can we make the MI data collection process more efficient in a community response scenario?

How do we prioritize systems to focus on as a community?

Join our Slack workspace!

→ New workshop attendees: we would love to hear your ideas and perspectives!