Nevada's Volcanic Hazard

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What we will cover in this talk

- Introduction – Nevada Quaternary Volcanoes
- Volcanic Terms
- Volcanic Fields in Nevada
- Timeline of Nevada Eruptions
- Volcanic Hazards and Risks
- Out-of-State Volcanic Hazards
- Recommendations to Nevada

Nevada's Quaternary Volcanoes

- Over 165 Quaternary volcanoes in seven volcanic fields
- Multiple eruption types, but monogenetic basaltic eruptions dominate over the last 1 Myr
- Most Recent Eruption: 6-5 ka (Rodrigues & Ruprecht 2023; 2024); phreatomagmatic eruption near Fallon (Soda Lake volcano)
- The Lahontan Valley volcanic field has a moderately high risk of an eruption and Lunar Crater volcanic field has a low-to-moderate risk; four fields are active but have a low risk and two fields are inactive

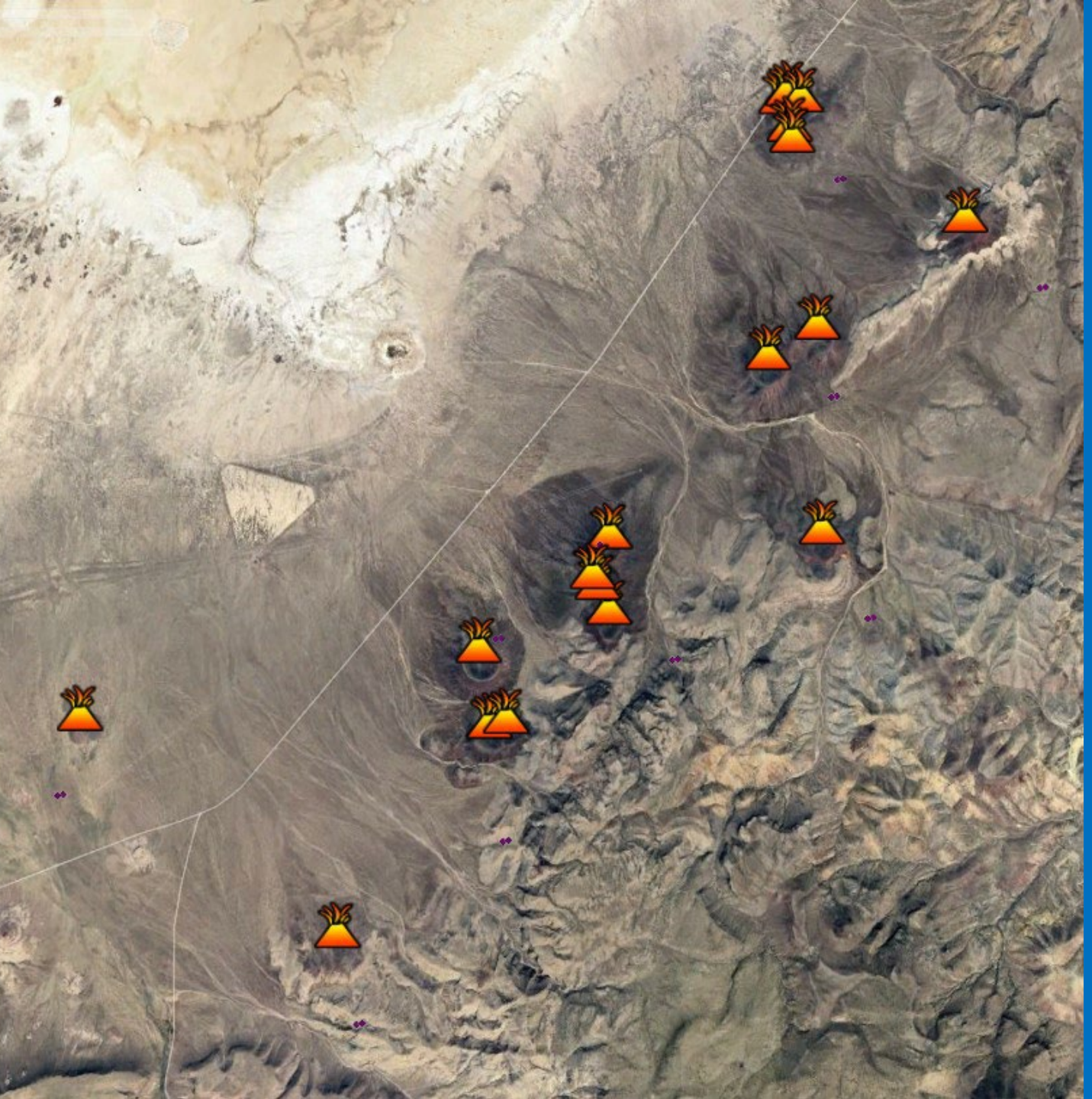
Volcanic Terms

- **Volcano**: **vent**, landform, process
- **Volcanic Rocks**: < 2 mm *ash*, 2-64 mm *lapilli*, > 64 mm *bombs, and blocks* (collectively called tephra, pyroclastic material, ejecta)
- **Cones**: cinder, spatter (agglomerate), scoria
- **Lava Flows**: Aa flows; pahoehoe flows
- **Eruption Types**: Hawaiian; Strombolian; Vesuvian; phreatomagmatic; Surtseyan
- **Phreatic/Hydrovolcanic Features**: maar; crater; tephra ring; tephra cone
- **Monogenetic volcano**: single-eruptive-episode volcano (contrast polygenetic) [forces activity call to be on the volcanic field]

Seven Quaternary Volcanic Fields in Nevada

Average Inter-Eruption Time (AIET)

AIET = Volcanic Activity Duration / # of Eruptions - 1



Buffalo Valley Volcanic Field

18 volcanoes, 8 groups

12.5 km, Cousens + (2013)

2-1.1 Ma; 4 episodes

AIET 113,000 yrs

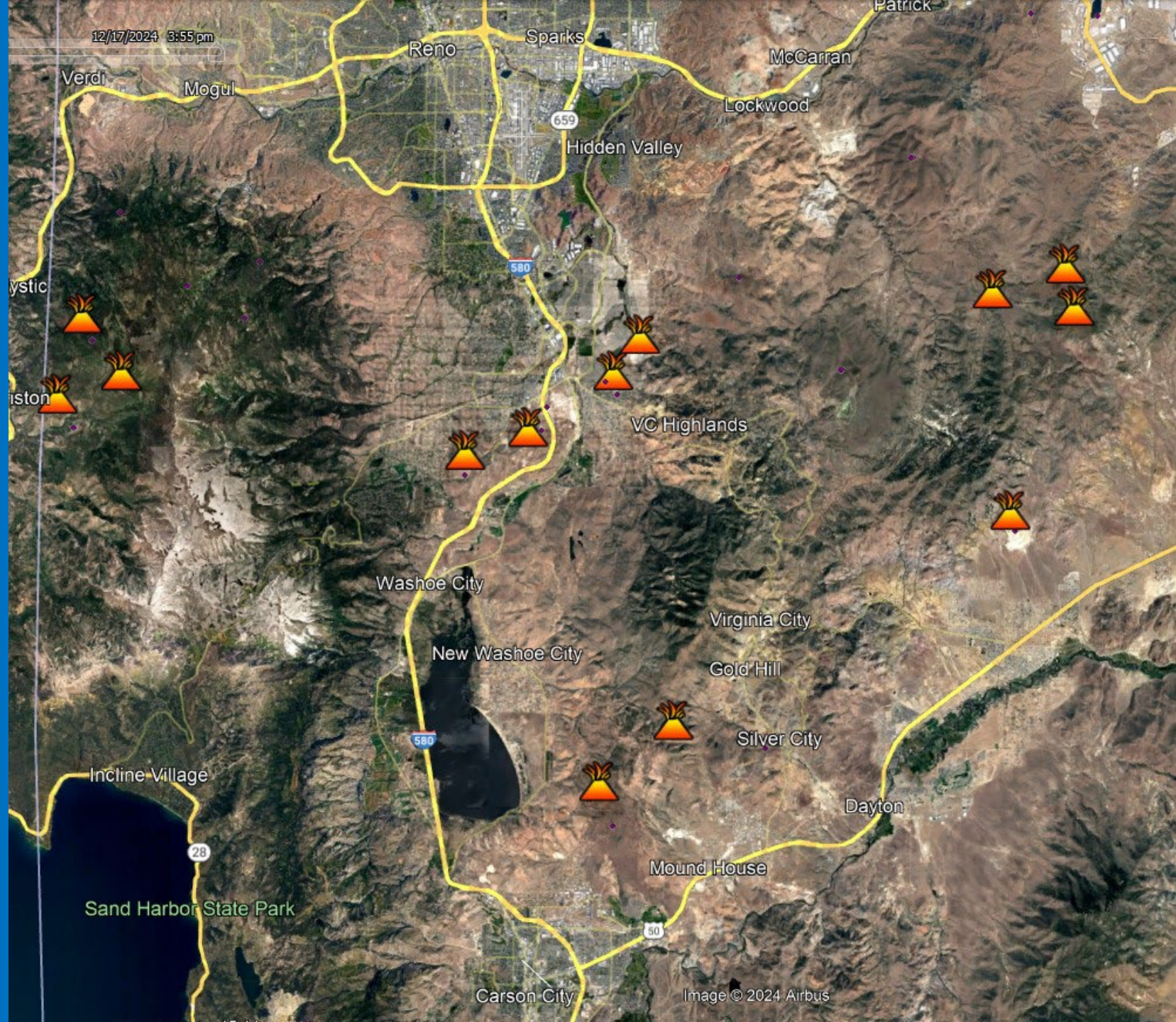
inactive

Buffalo Valley Volcanic Field

Western Nevada Volcanic Field

13 isolated volcs.
2.55-1.2 Ma
2 episodes
Cousens + (2012)
AIET 38,000 yrs

inactive



Aurora Volcanic Field

10-15 volcanoes
2.6 Ma-40,000 ybp
3 episodes
John + (2015)
AIET 320,000 yrs

active

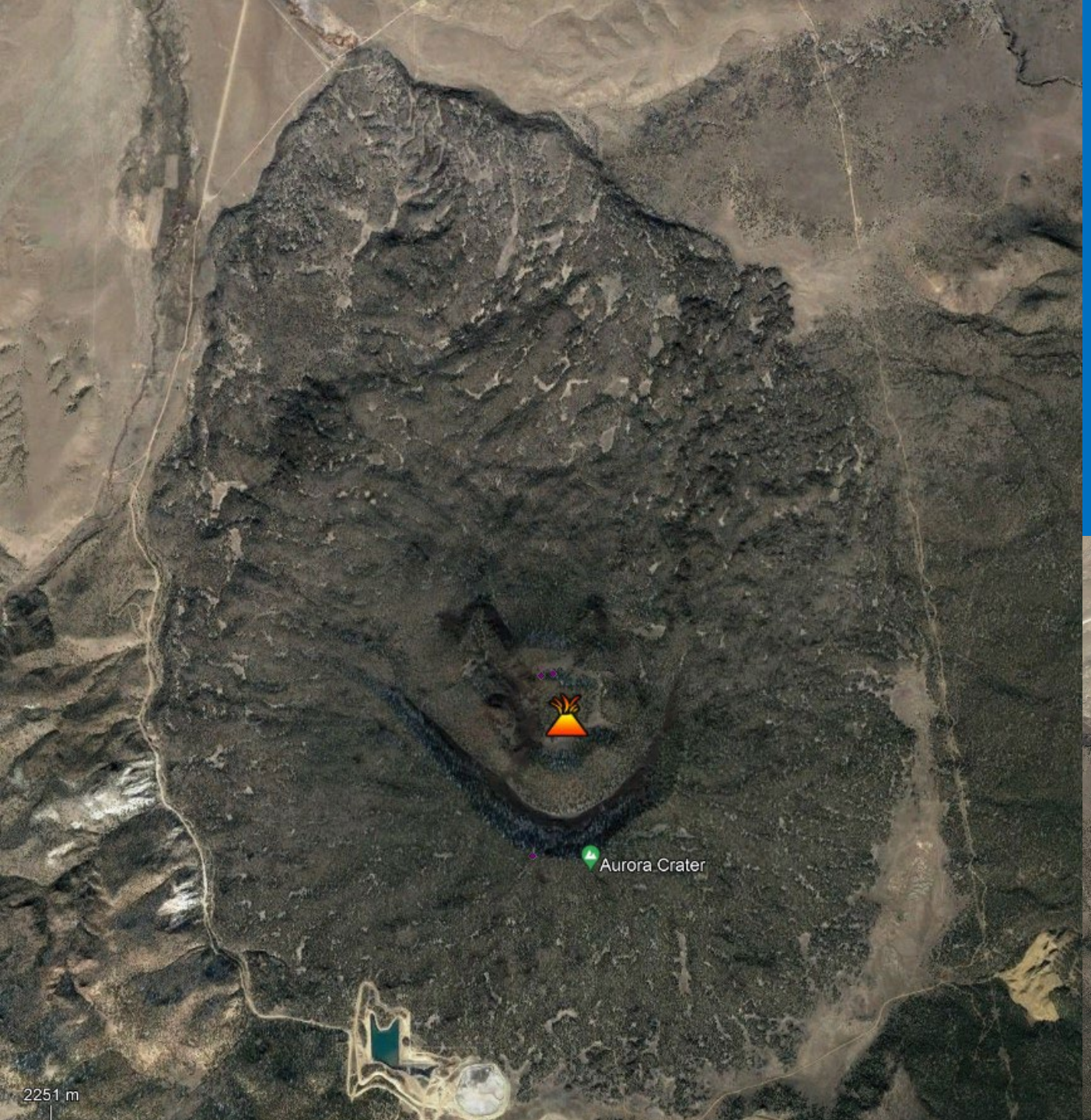
Aurora Crater Volcano

470-260 ka John + (2015)

200 m high, 4 km wide

110-40 ka John + (2015)

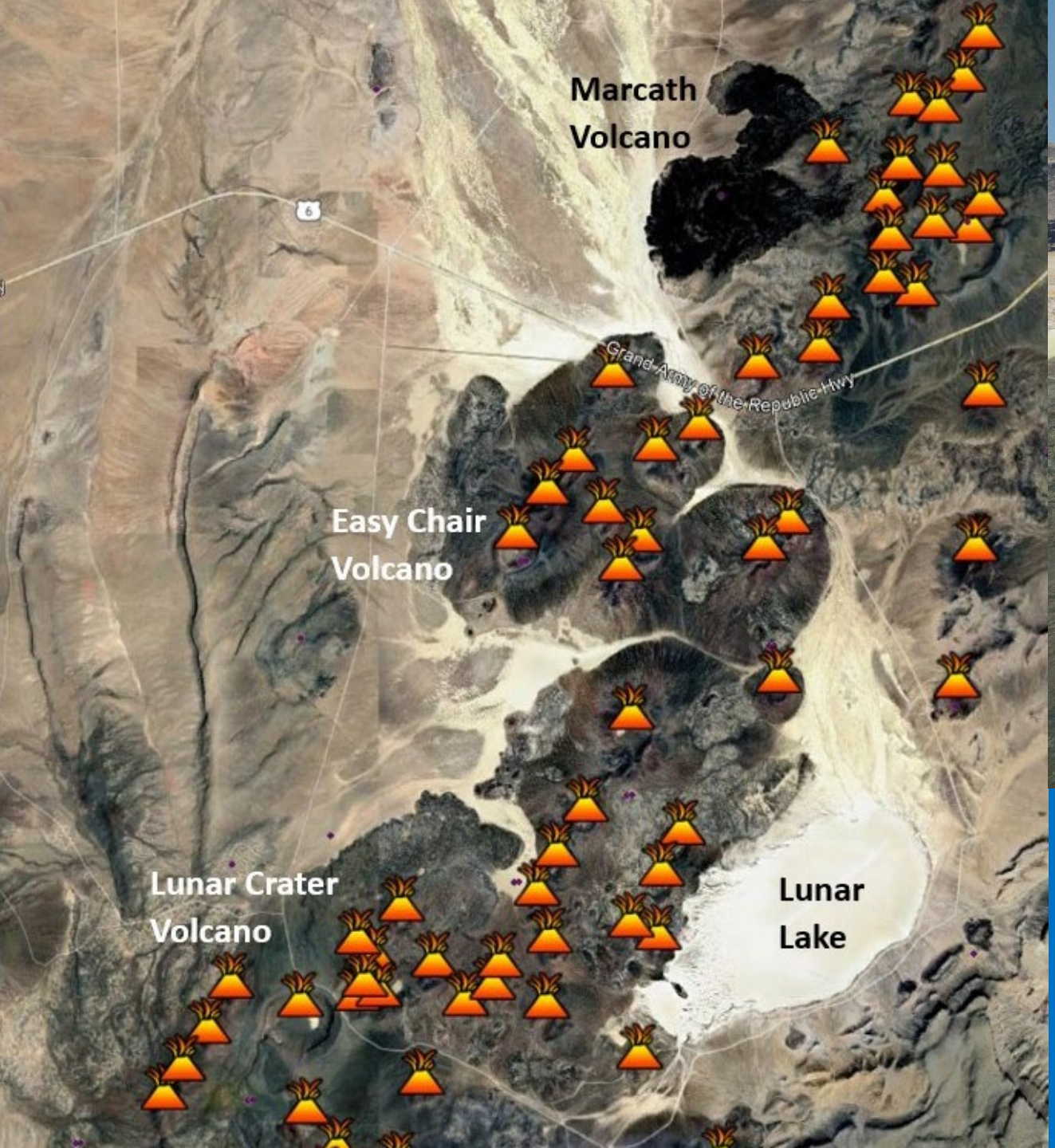
Mud Springs Volcano

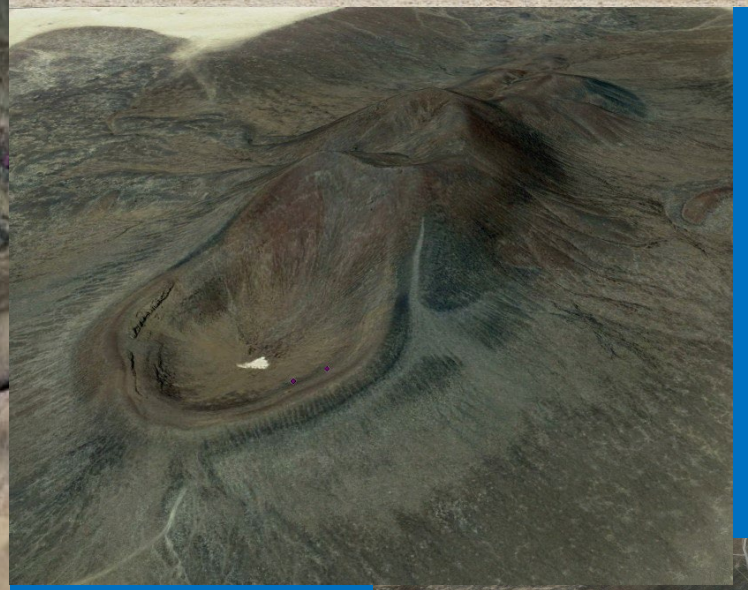


Lunar Crater Volcanic Field

103 volcs., 35 km
1.1 Ma-35,000 ybp
2 episodes
Valentine + (2017)
AIET 13,000 yrs

active

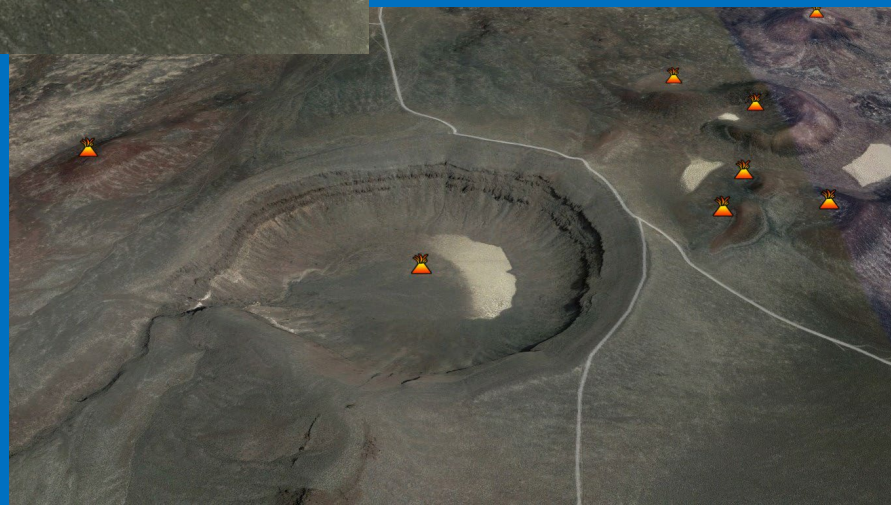


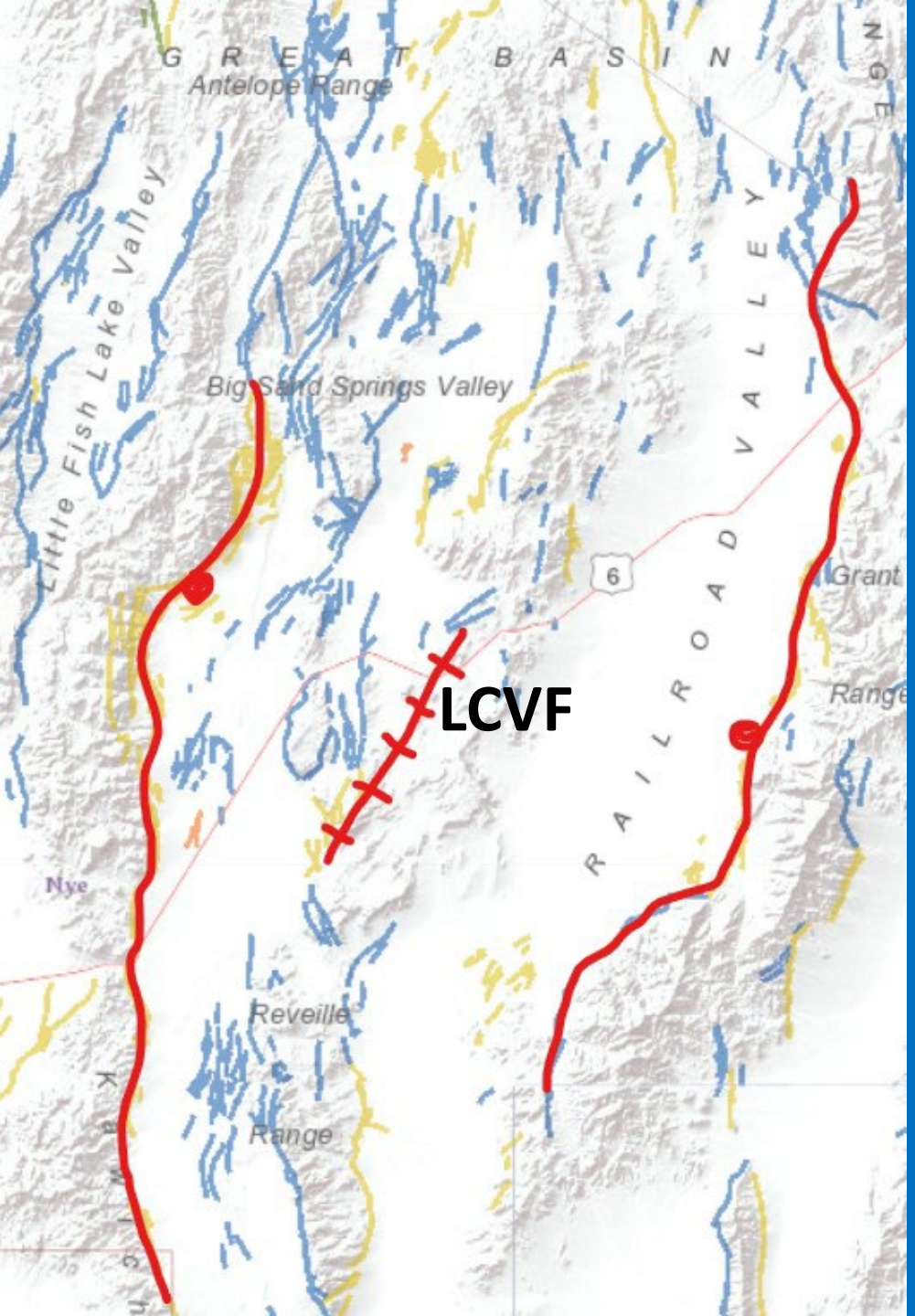


Marcath Volc.
35,000 ybp

Easy Chair Volc.
130,000 ybp

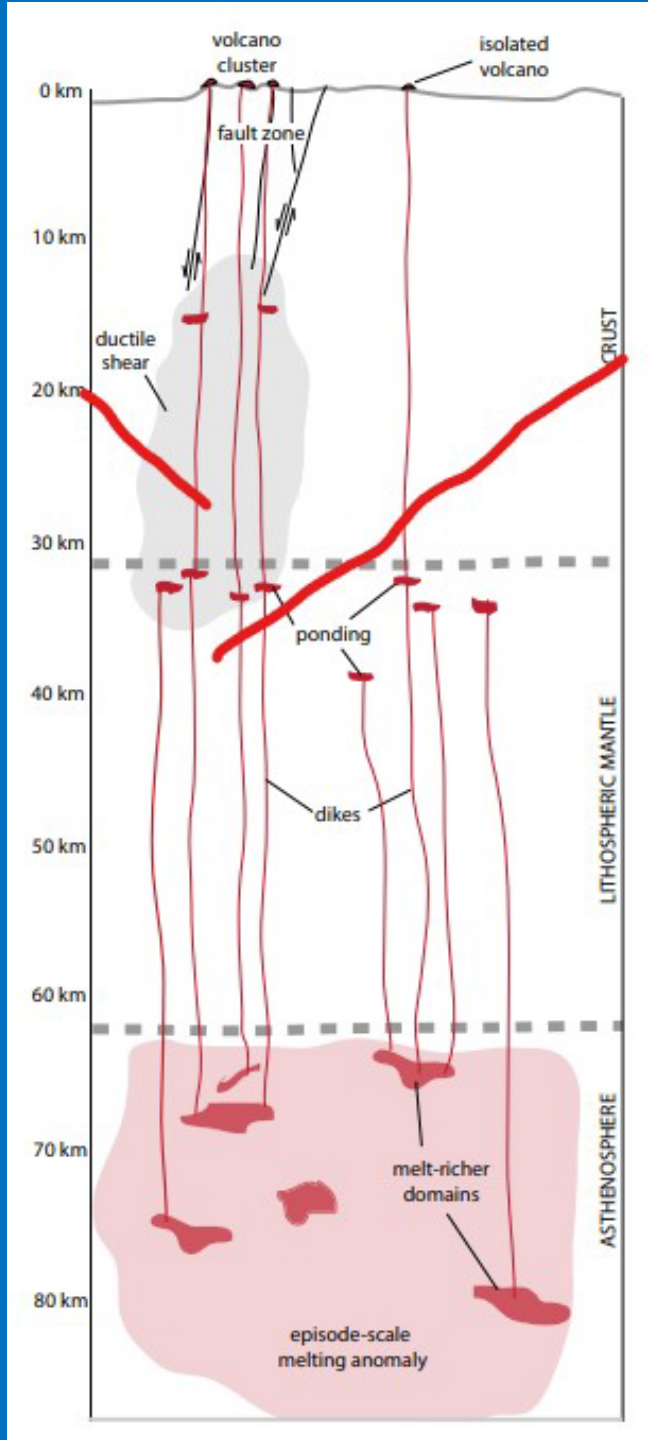
<190,000 ybp
Lunar Crater Volc.

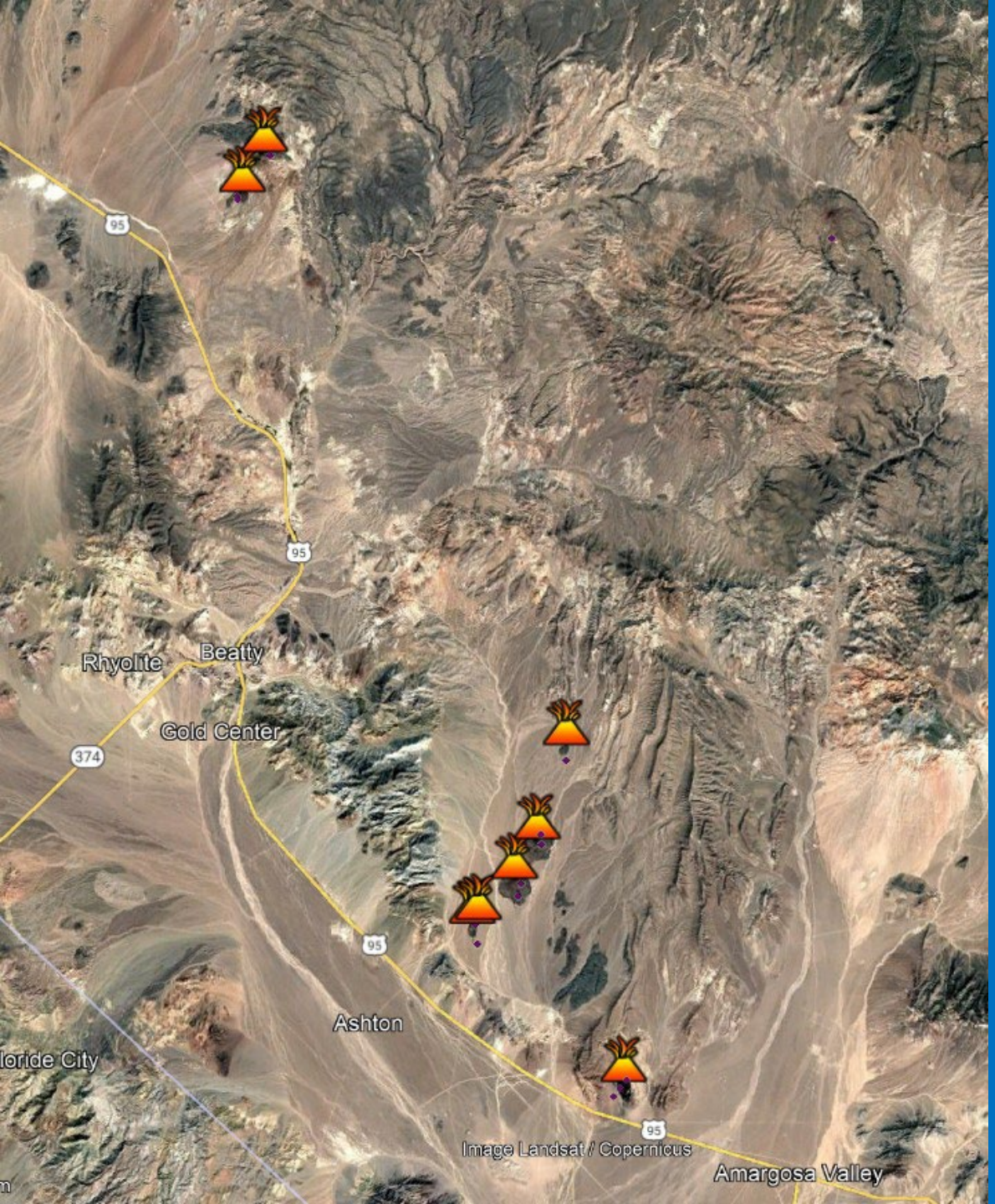




dePolo (2008)

Valentine + (2017)





Southwest Nevada Volcanic Field

8 volcanoes
1.1 Ma-77,000 ybp
3 episodes
Valentine & Perry (2007)
AIET 170,000 yrs

active

Clayton-Columbus Volcanic Field

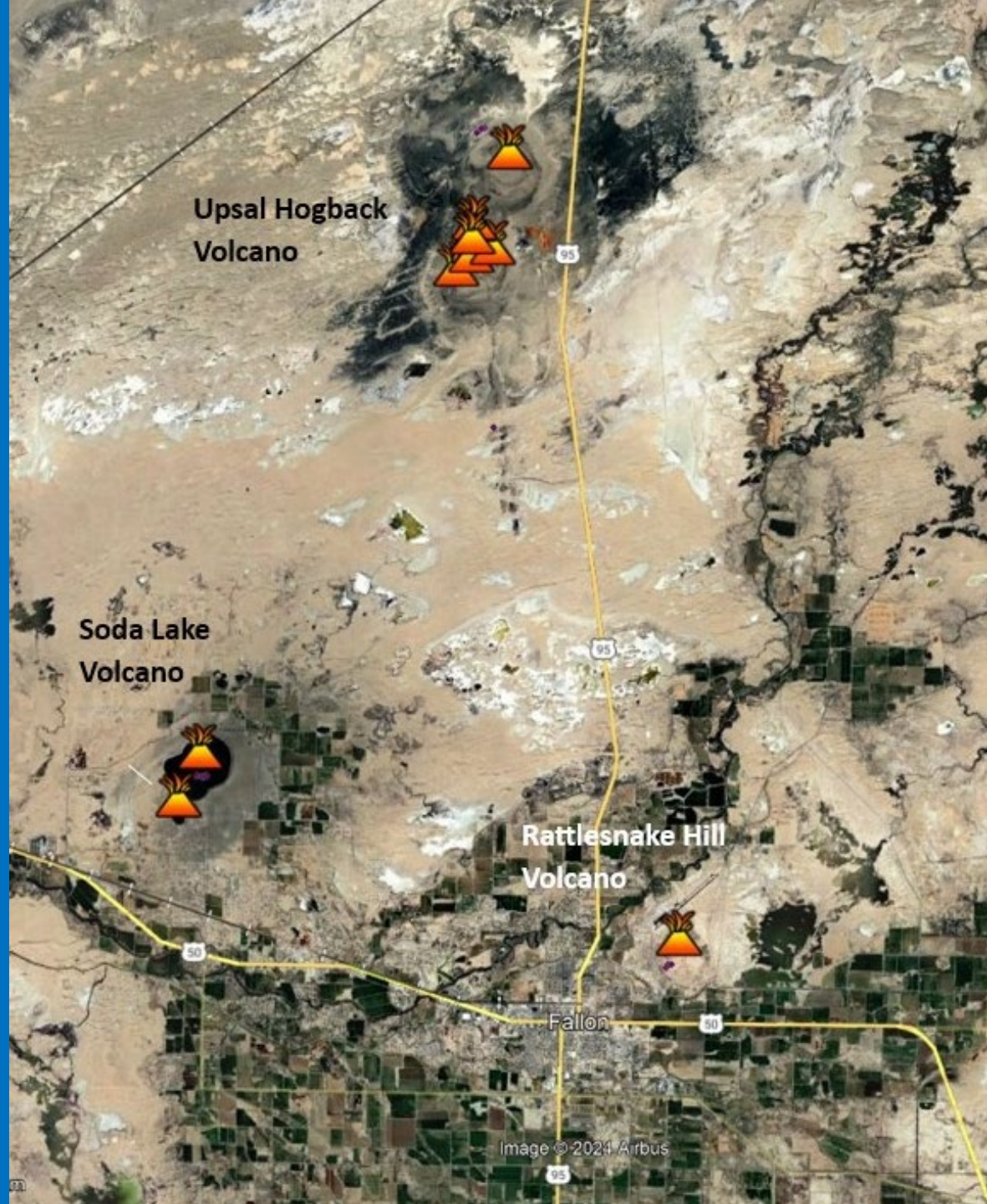
4 isolated vents
1-2 Ma-390,000 ybp
Wood & Kleine (2007)
AIET 537,000 yrs

potentially active

Lahontan Valley Volcanic Field

3 volcanoes
2.5 Ma-~5,500 ybp
2 episodes

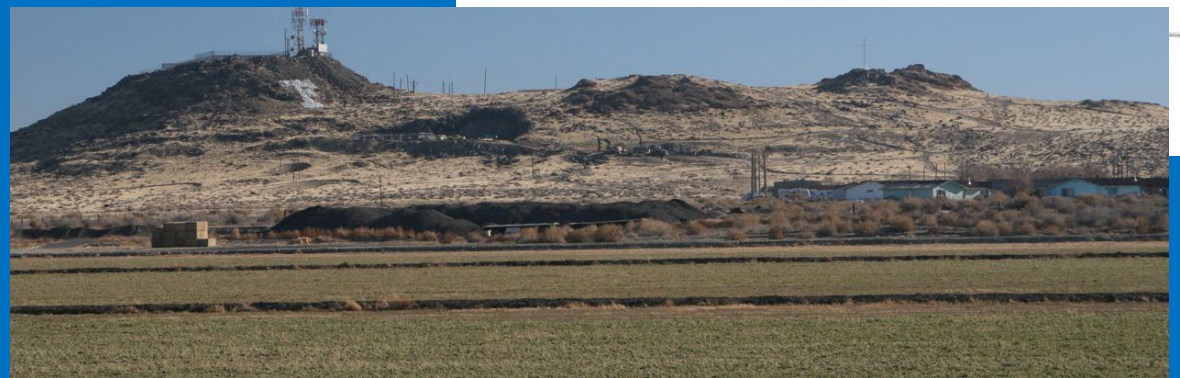
active

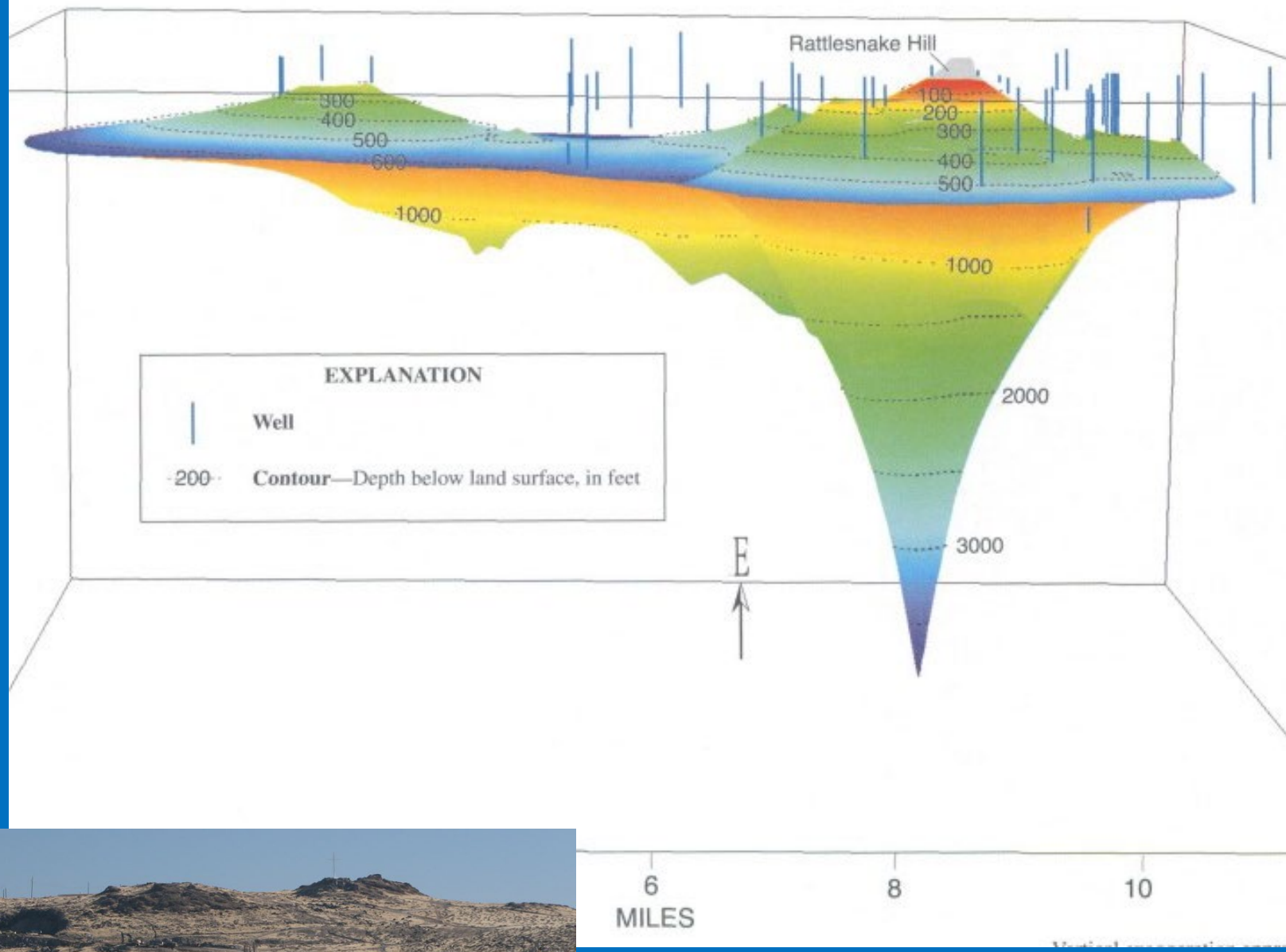


Rattlesnake Hill Volcano

2.5 Ma-~900,000 ybp
Maurer & Welch (2001)
buried 180 m sed.
polygenetic volcano?
≥2 centers?

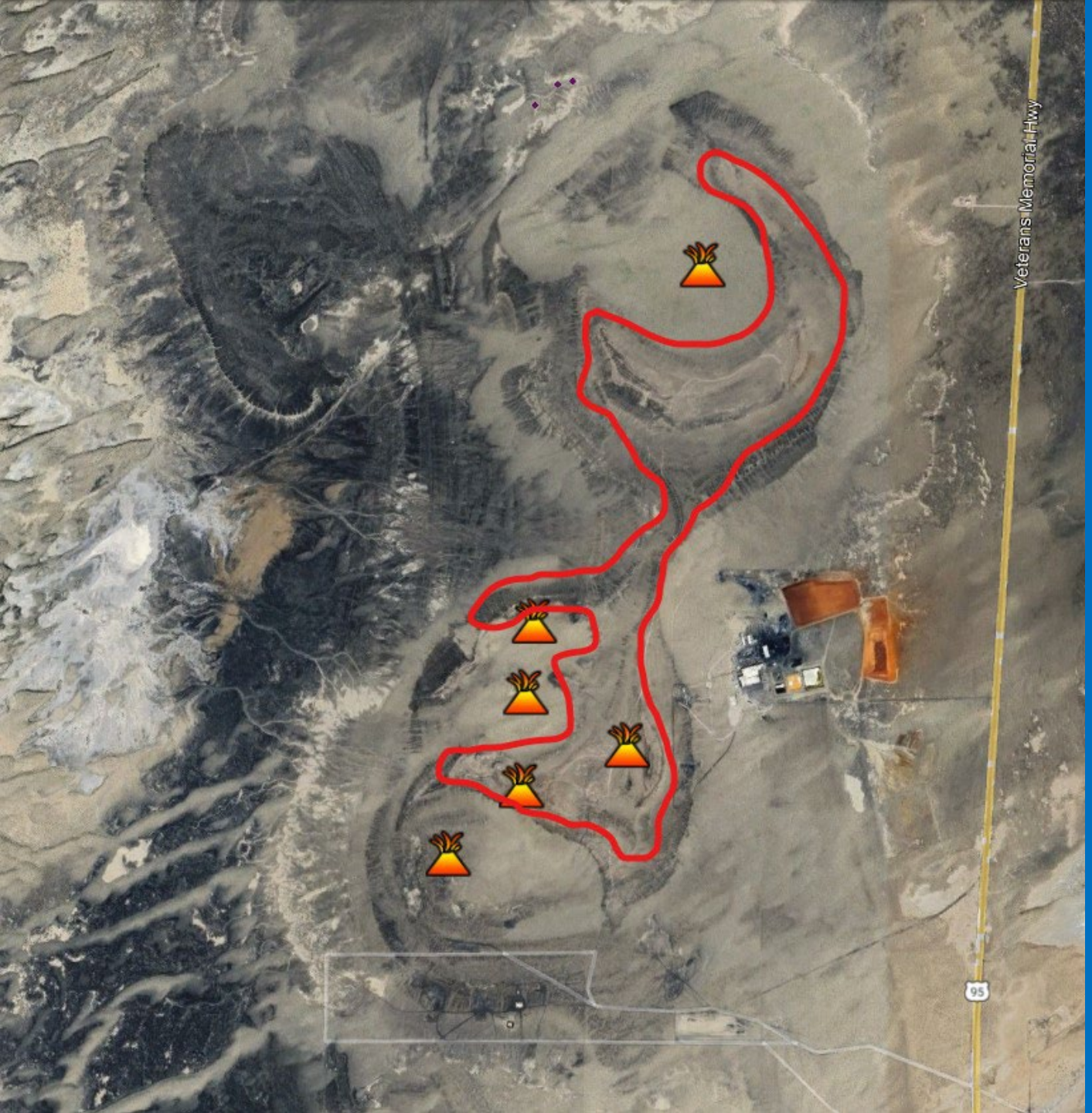
extinct





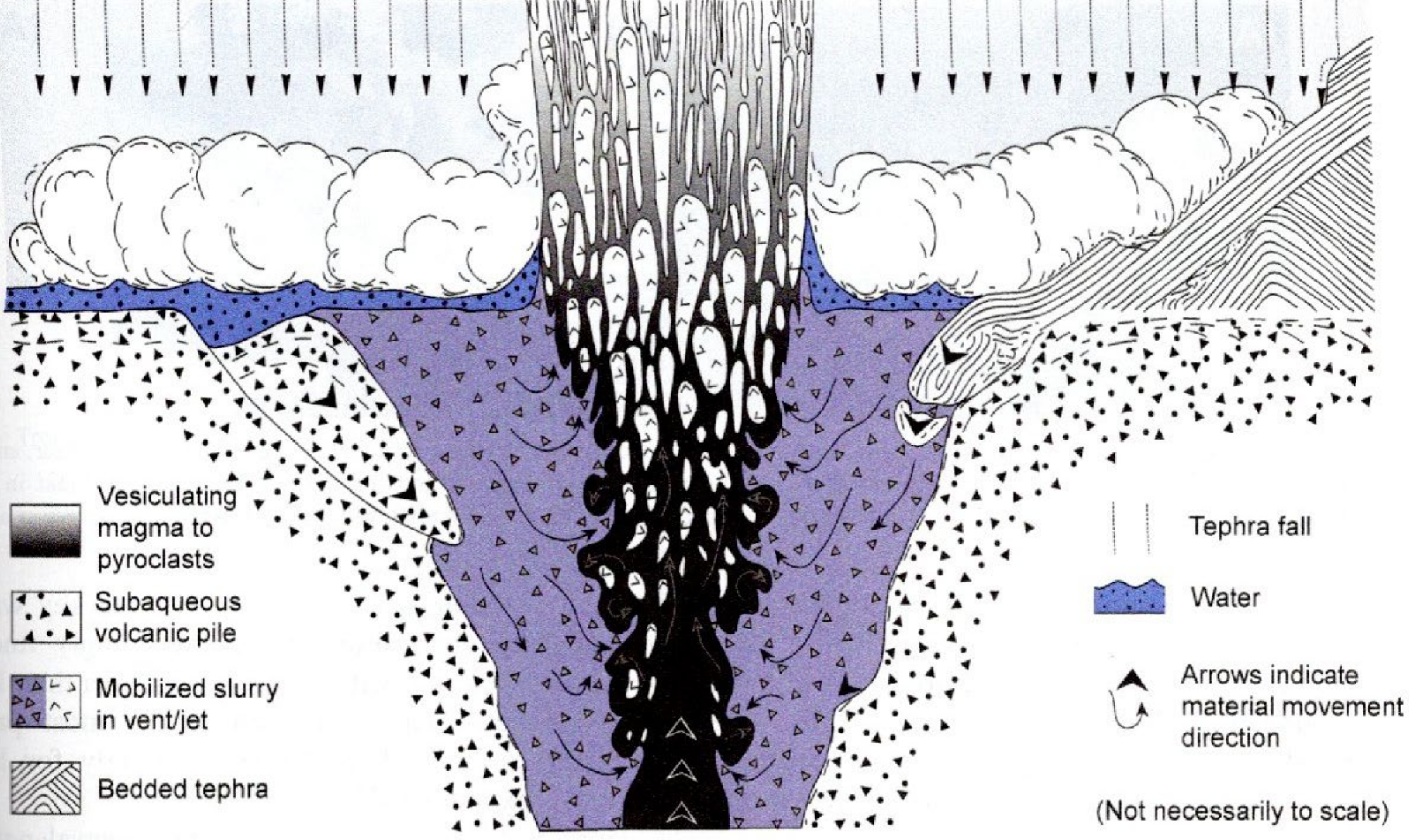
Upsal Hogback Volcano

20 – 14 kyr; 6 craters; 4 km long
Erupted thru Lake Lahontan
Surtseyan eruptions
Broad hydrovolcanic craters
Two earlier eruptions?

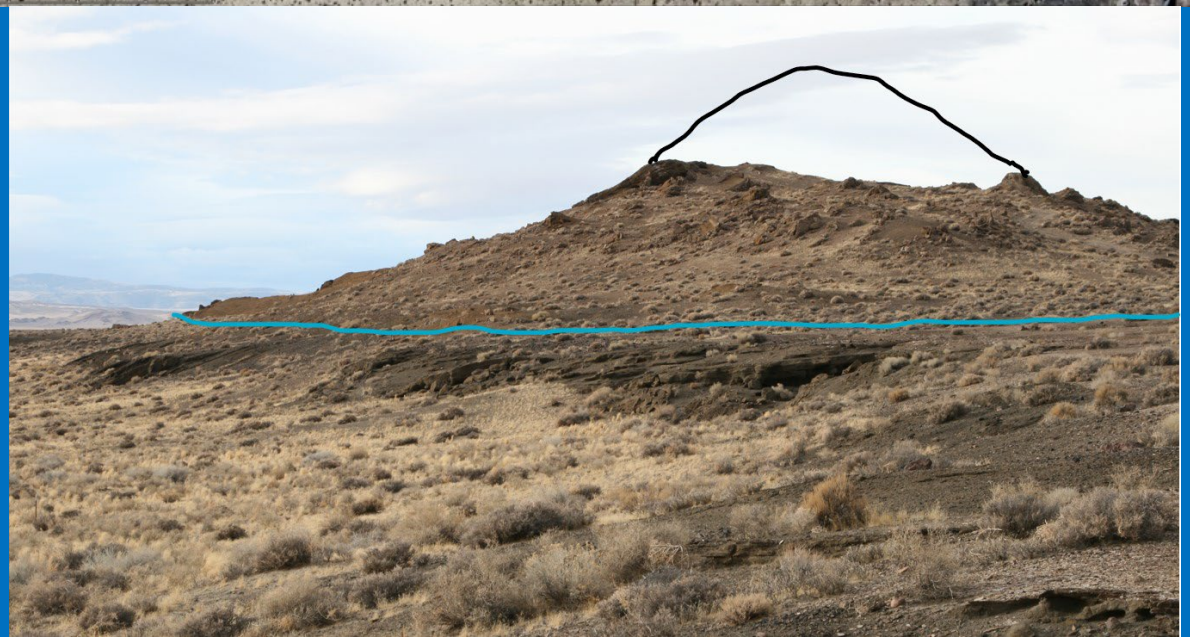


Upsal Island

Palagonite; Anderson (2014)
20 m high
45 m water depth
lots of basaltic ejecta
Post-eruption – submerged by lake


Vesiculating magma to pyroclasts
Subaqueous volcanic pile
Mobilized slurry in vent/jet
Bedded tephra
Tephra fall
Water
Arrows indicate material movement direction
(Not necessarily to scale)

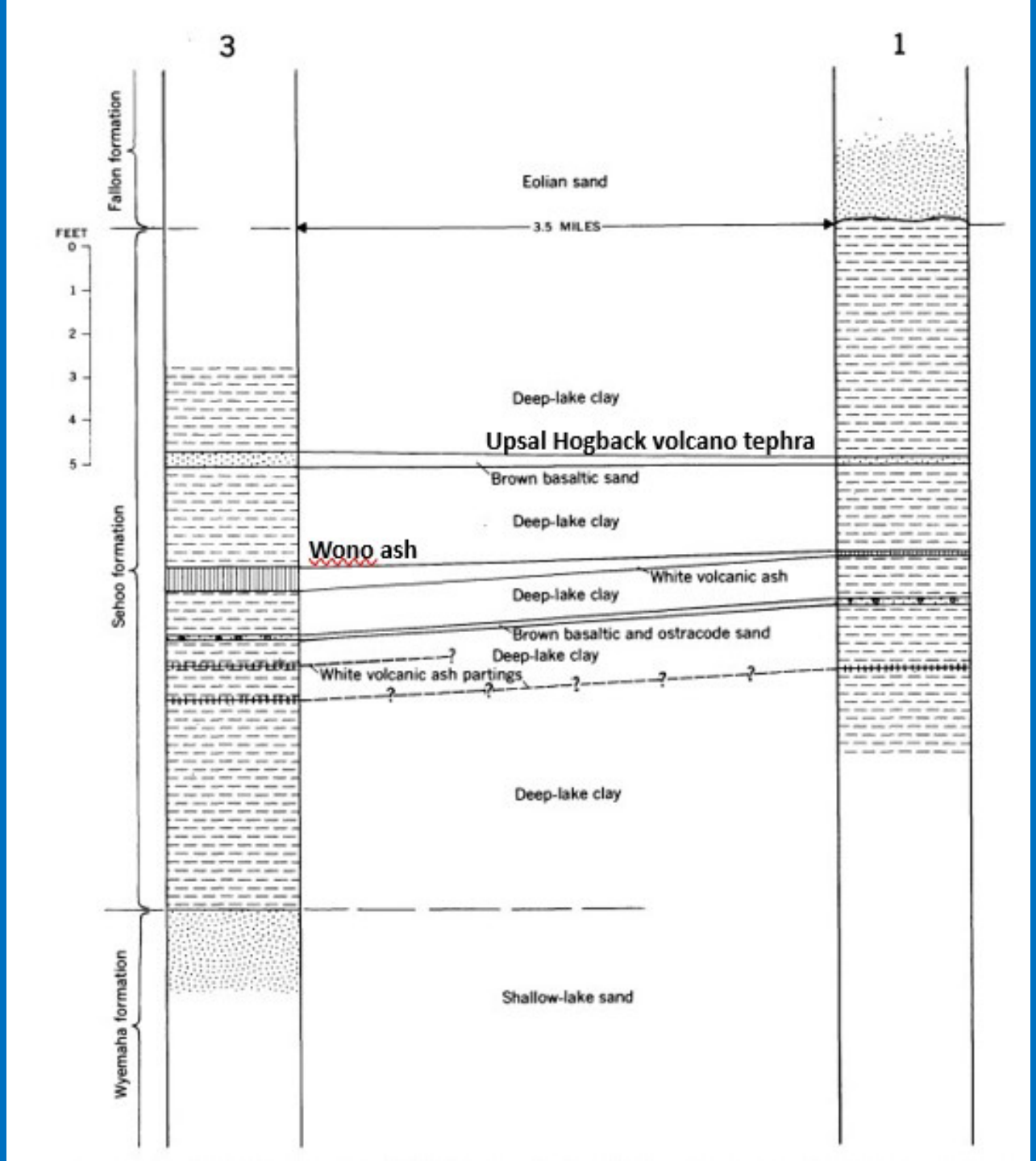

Google Ear



Upsal Hogback Volcano Tephra

Dr. Rodrigues Collecting samples and measuring radiation for optical-luminescence dating

older eruption



Morrison (1964)
Strat. S. side
Carson sink

Davis (1997) IDs upper basaltic sand as recent Upsal Hogback volcano eruption

Soda Lake Volcano

Phreatomagmatic Eruptions

Rodrigues and Ruprecht (2023) 5 – 6 ka

Rodrigues and dePolo

Penultimate eruption 13.6 – 11.6 Ka


Mid-Holocene
tuff ring
Paleo-tuff ring
w/shorelines

water well hole logs

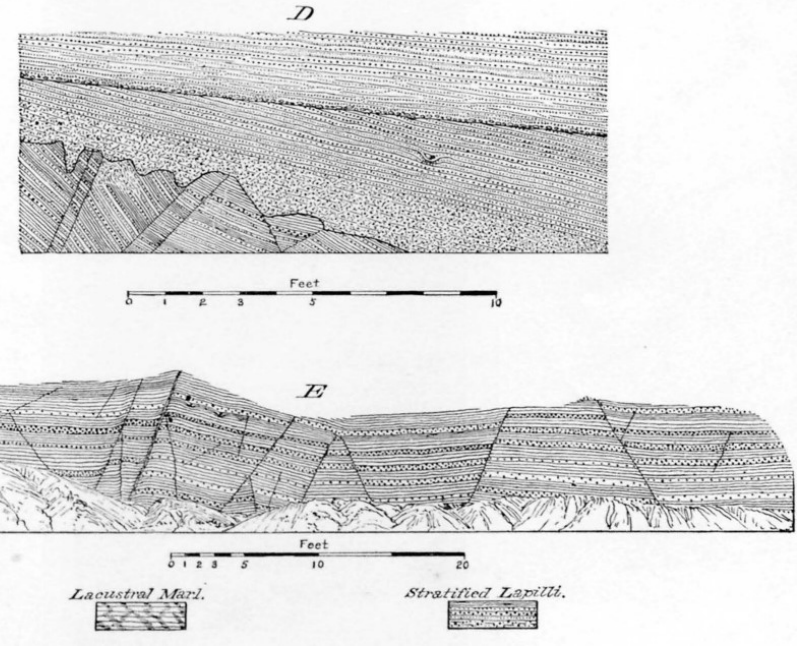
9h (L)

Near SW cor. sec. 5, on line between secs. 5, 6, T. 19 N., R. 28 E.; 4,060± 20 ft altitude. About 600 ft N. of Soda Lake. Water test well no. 56 in Clark and Lee (1916) report.

Geologic unit	Description	Thickness (feet)	(m)	Depth (feet)	(m)
Indian Lakes fm., volcanic sand complex of Soda Lake.	Sand and volcanic ash.	6	1.8	6	1.8
Do.	Soft clay.	19	5.8	25	7.6
Do.	Coarse cinders.	0.5	0.2	25.5	7.8
Do.	Soft clay.	37.5	11.4	63	19.2
Do.?	Hard clay and cinders	39	11.9	102	31.1

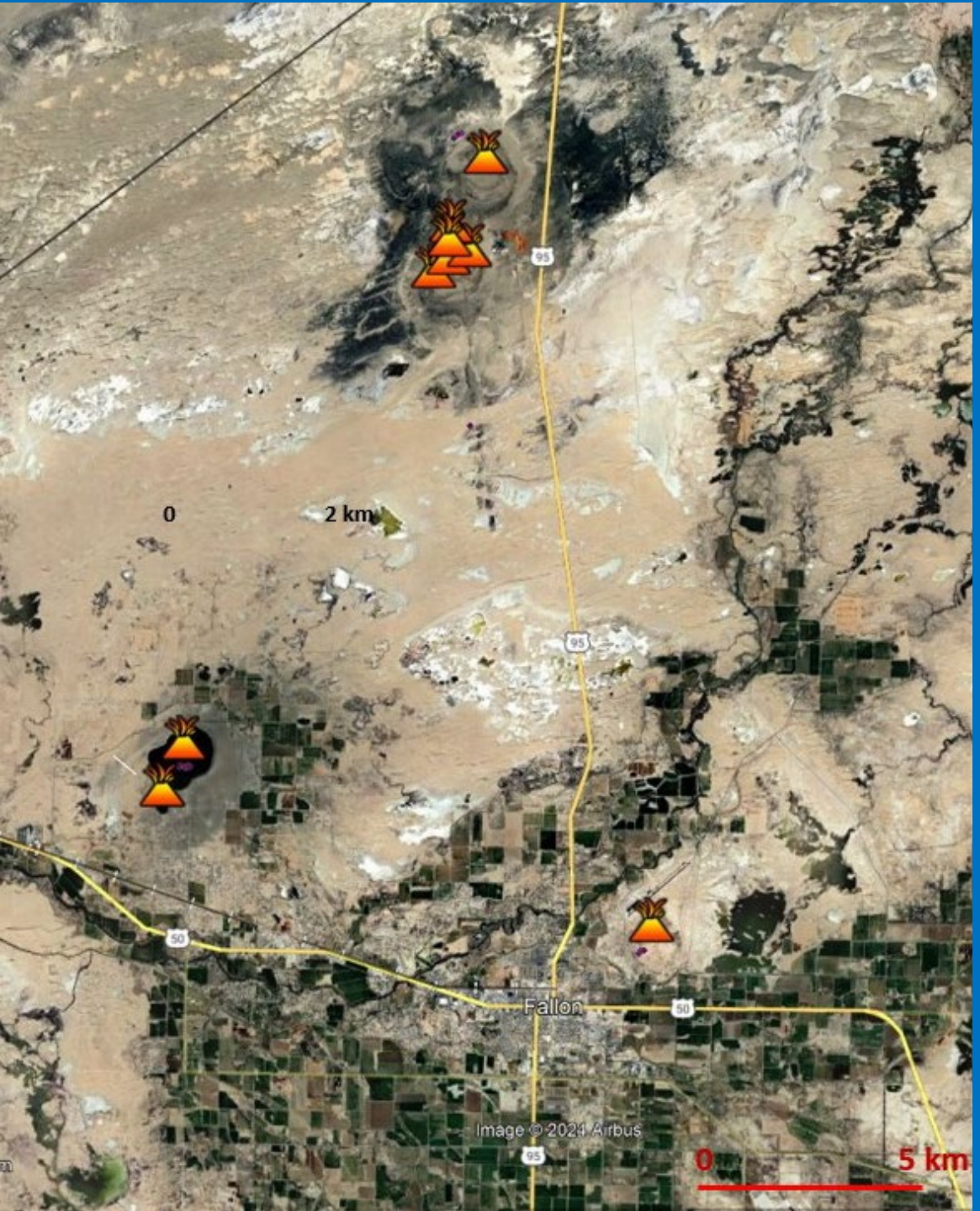
Morrison (1959)

Russell (1885) sides of Soda Lake



Young Basaltic Eruptions in the Lahontan Valley Volcanic Field/Nevada

Volcano	Age of Eruption	Time between Eruptions/midpoint
Upsal Hogback(?)	45,000 – 35,000 ybp (?)	
Upsal Hogback(?)	30,000 – 27,000 ybp	5 – 18 ky; 11.5 ky (?)
Upsal Hogback	20,000 – 15,500 ybp	7 – 16 ky; 11.5 ky
Soda Lake	13,600 – 11,600 ybp	1.5 – 8.4 ky; 5 ky
Soda Lake	6,000 – 5,000 ybp	5.6 – 8.6 ky; 7.1 ky



Lahontan Valley V.F. Consequences

Fallon pop. 9,659
Paiute-Shoshone Indian Colony
two airports
two highways, RR line
military facilities

High Consequences with eruption

Table 9-1. The Fifteen Most-Recent Dated Eruptions in Nevada

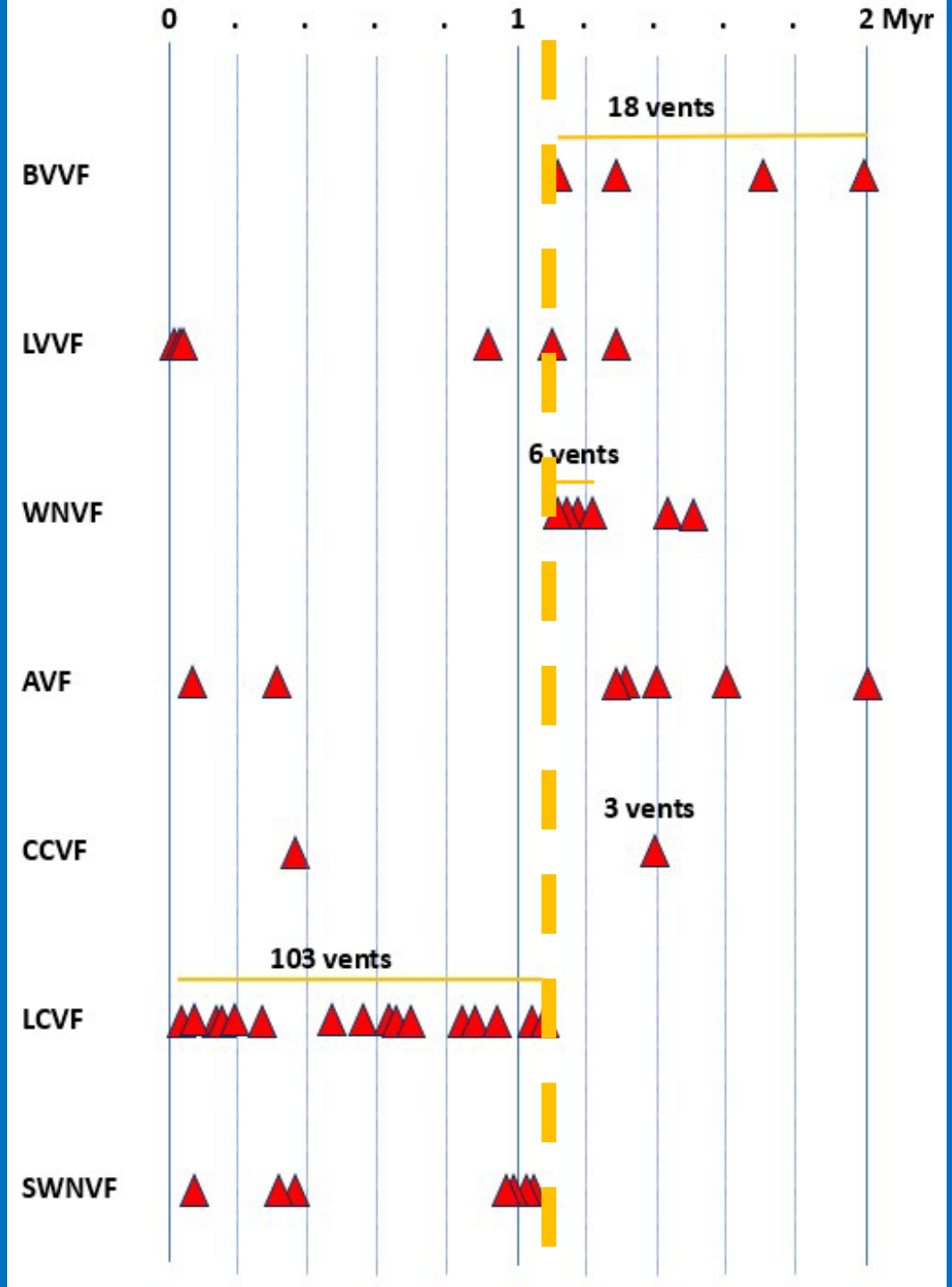
Years B.P.[1]	Location/Volcano	Volcanic Field	Reference
6-5 kyr	**Soda Lake**	Lahontan Valley volcanic field	Rodrigues, 2023
13.6-11.6 kyr	**Soda Lake**	Lahontan Valley volcanic field	Rodrigues, 2025
20-14 kyr	**Upsal Hogback**	Lahontan Valley volcanic field	Anderson, 2014
35 kyr	**Marcath**	Lunar Crater volcanic field	Valentine +, 2017
100-40 kyr	**Mud Spring**	Aurora volcanic field	John +, 2015
80-72 kyr	**Giggle Springs**	Lunar Crater volcanic field	Valentine +, 2017
77 kyr	**Lathrop Wells**	Southwest Nevada volcanic field	Valentine and Perry, 2006
130 kyr	**Easy Chair**	Lunar Crater volcanic field	Valentine +, 2017
140 kyr	**Lava near Lunar Crater**	Lunar Crater volcanic field	Valentine +, 2017
190 kyr	**Lunar Crater**	Lunar Crater volcanic field	Valentine +, 2017
270 kyr	**Lunar Lake lava**	Lunar Crater volcanic field	Valentine +, 2017
470-260 kyr	**Aurora Crater**	Aurora volcanic field	John +, 2015
323 kyr	**Little Black Cone**	Southwest Nevada volcanic field	Valentine and Perry, 2006
373 kyr	**Hidden Cone**	Southwest Nevada volcanic field	Valentine and Perry, 2006
390 kyr	**Clayton Valley**	Clayton-Columbus volcanic field	Wood and Klienle, 1990

[1] "Years before present"

2 Ma Nevada Volcanic Field Activity

55 Quaternary dates
~1/3 Quaternary volcanoes

Change in volcanic activity in Nevada at 1.1 Ma



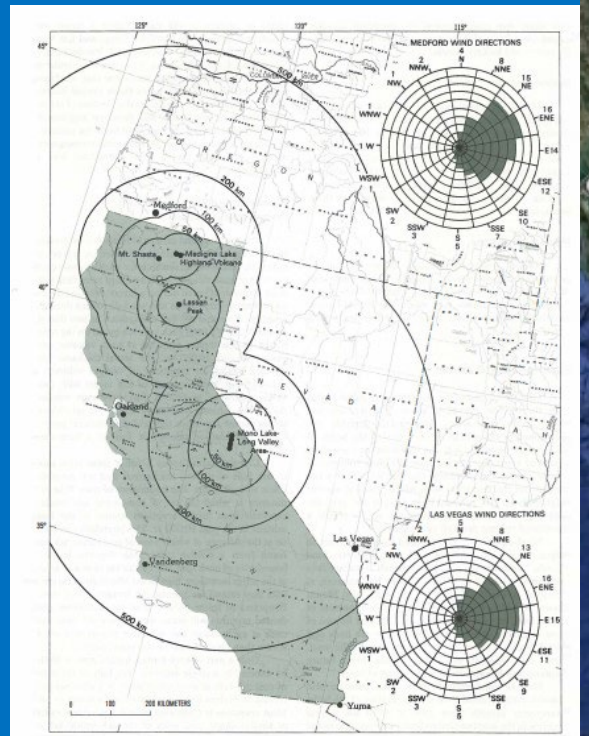
Nevada's Active and Potentially Active Volcanic Fields – in order of decreasing risk

- **Lahontan Valley Volcanic Field** – active; highest risk in state; **moderately high risk**
- **Lunar Crater Volcanic Field** – active; mostly transportation impacts; **low-to-moderate** consequences and **risk**
- **Southwest Volcanic Field** – active; transportation impacts; Yucca Mtn.?; low to high? consequences; **low risk**
- **Aurora Volcanic Field** – active; aviation impacts; **low risk**
- **Clayton Valley** – potentially active; transportation; lithium mine; **low risk**

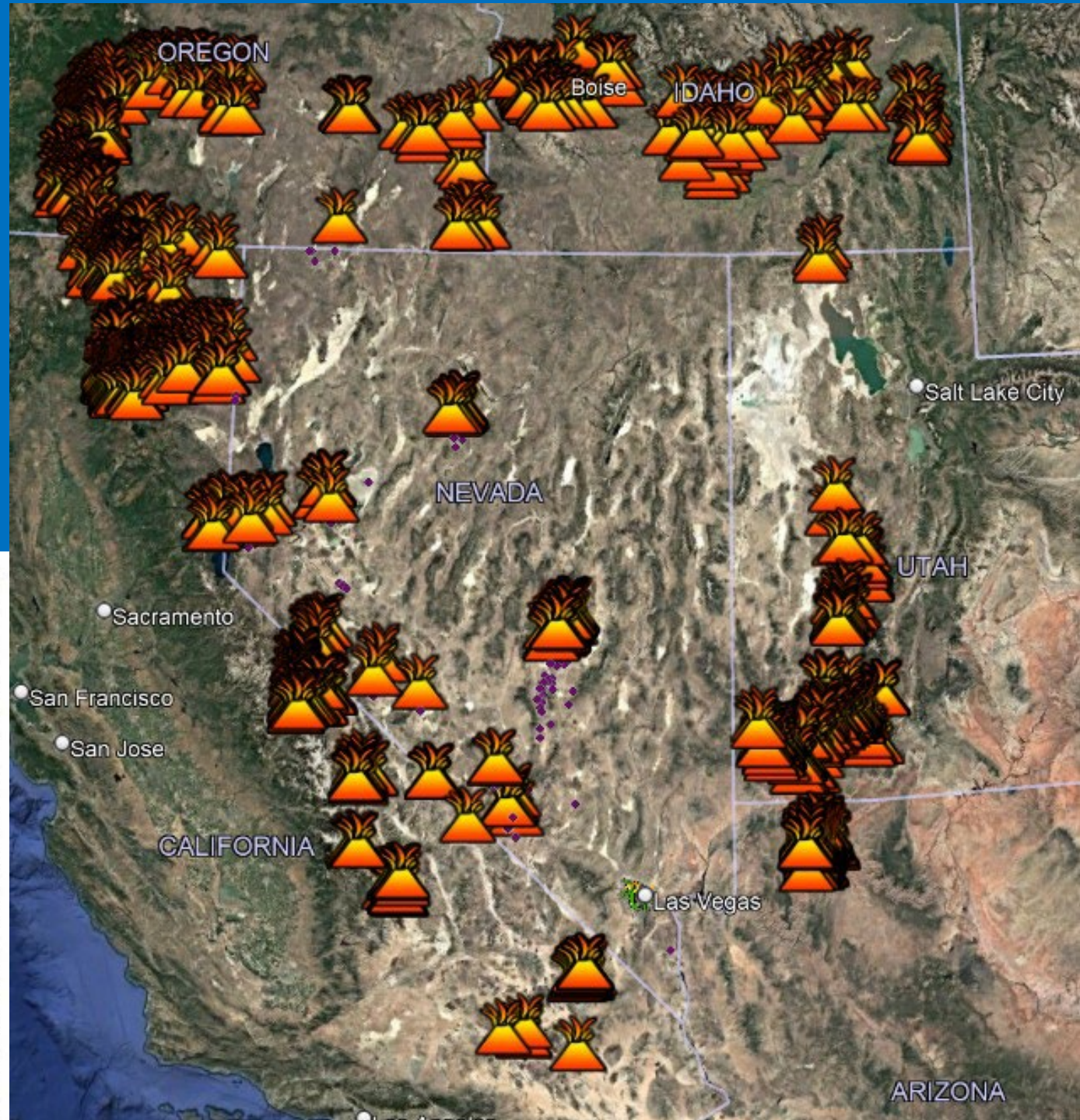
Out-of-State Volcanic Hazards

Modified from NBMG INGENEOUS Geothermal Project Quaternary volcano compilation

1776 volcanoes



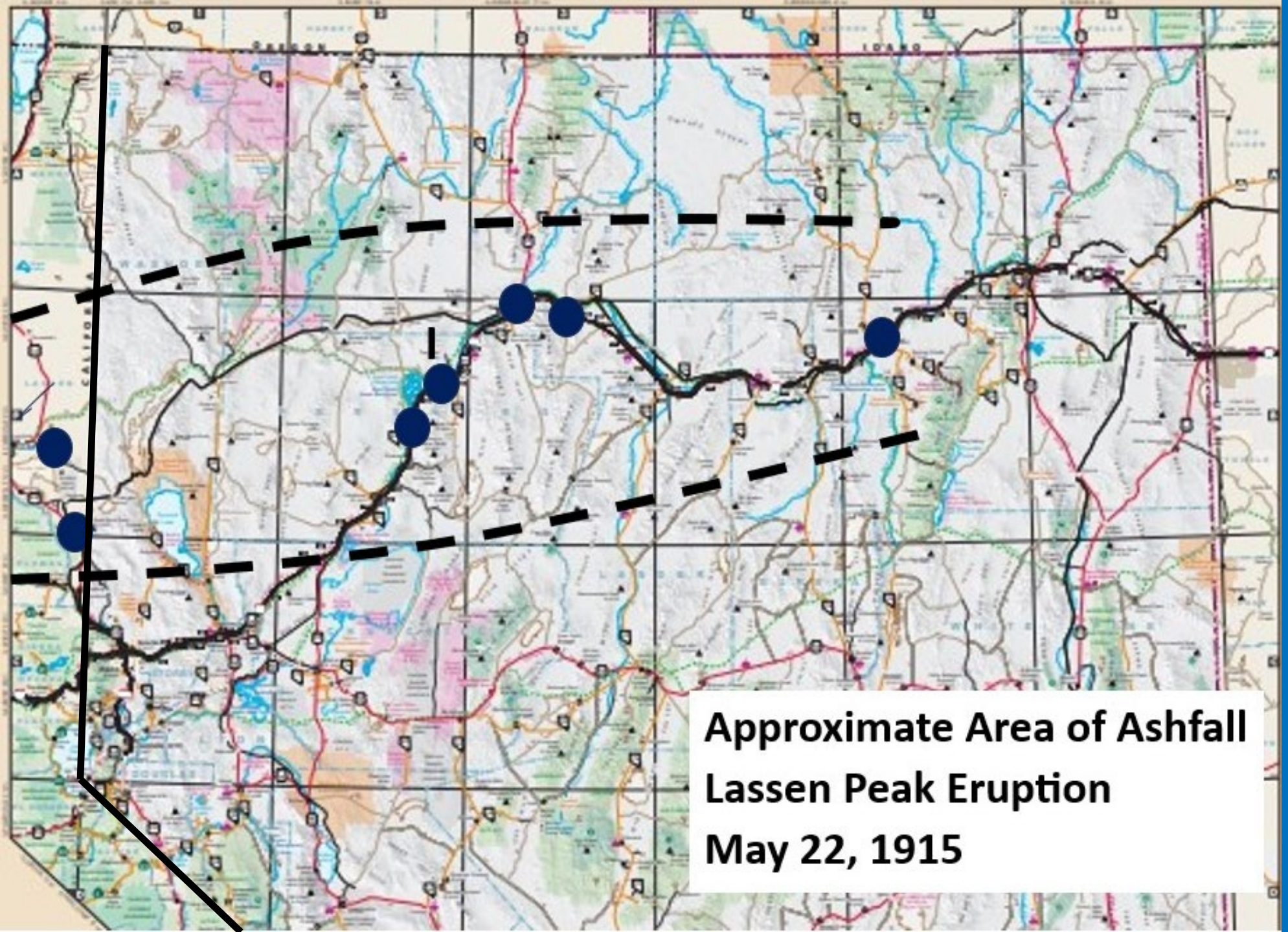
Miller (1989)



Lassen Peak, CA
May 22, 1915
Vesuvian eruption

views to east from Sacramento Valley

late afternoon eruption



"I" = Imlay RR Station

5-cm ash accumulation - fine like talcum powder

unconstrained boundaries

Recommendations to Nevada Concerning Volcanic Hazards

- 5 of 7 Quaternary volcanic fields can be considered active or potentially active.

- **Lahontan Valley volcanic field (LVVF)** has a moderately high risk of an eruption; the **Lunar Crater volcanic field (LCVF)** has a low-to-moderate risk; other volcanic fields are low risk.

- Most likely Nevada eruption: basaltic phreatomagmatic eruption and/or a basaltic fissure-cinder cone-lava flow Hawaiian or Strombolian eruptions - within LVVF or LCVF with adjacent areas affected. Eastern California eruption impacting Nevada is the most likely volcanic effect.

- Hold table-top exercises for eruptions in LVVF and LCVF in the affected counties with local, state, and subject-matter experts; work up potential consequences, emergency responses, and emergency mitigation. Possibly conduct an out-of-state eruption table-top exercise as well (piggyback on California exercise?). Document the results of the exercises with a report that can be used when a future eruption occurs.

1000 Thanks

Nevada Bureau of Mines and Geology
Nevada Division of Emergency Management
Federal Emergency Management Agency

NBMG INGENEOUS Geothermal Project (Great Basin volcanic center data)

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Quaternary Volcanism and Associated Hazards in Nevada



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2025