Lunar Exploration Initiative

Briefing Topic:

Expanding BPLF Activity to the West

David A. Kring

Lunar Exploration Initiative

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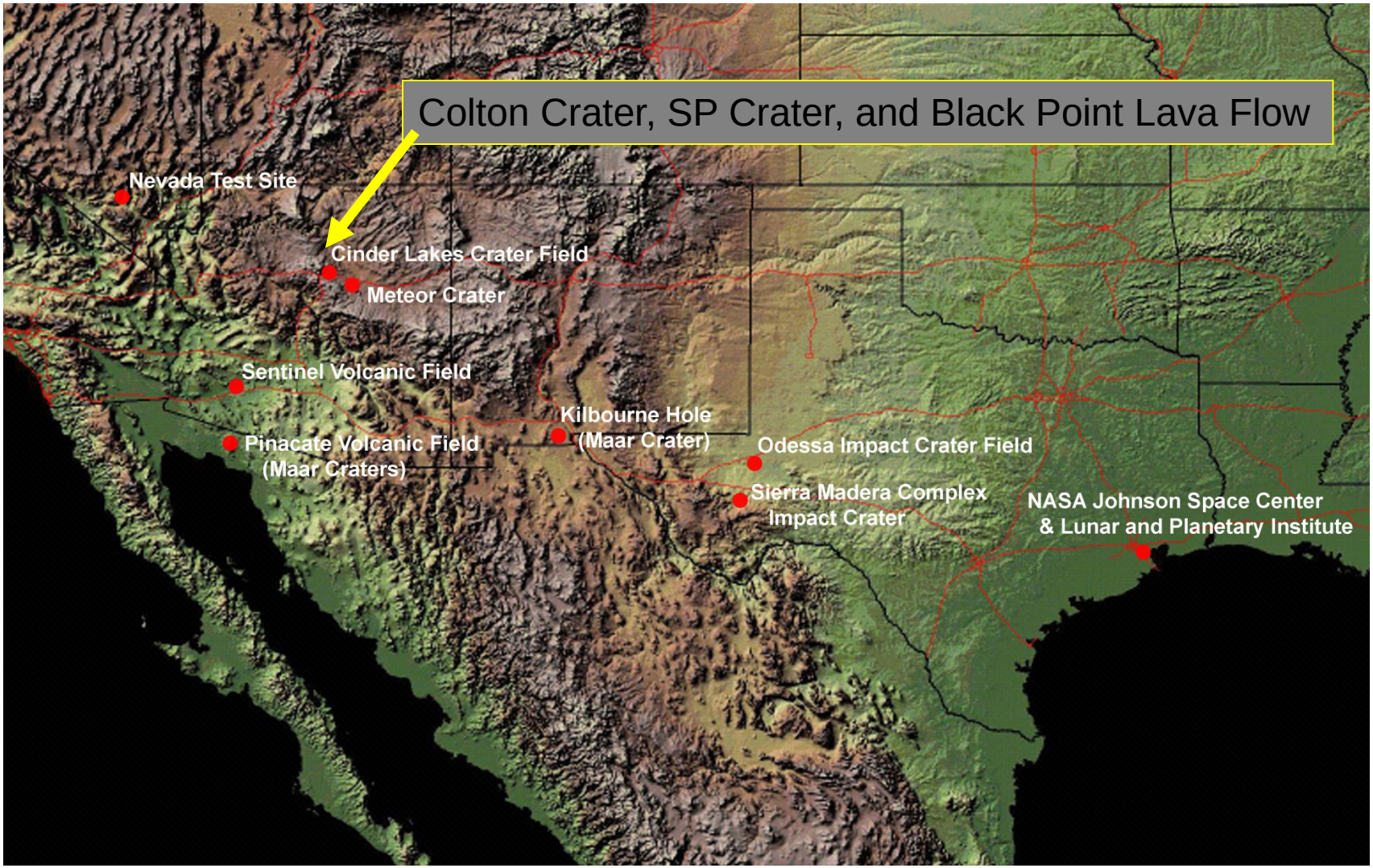
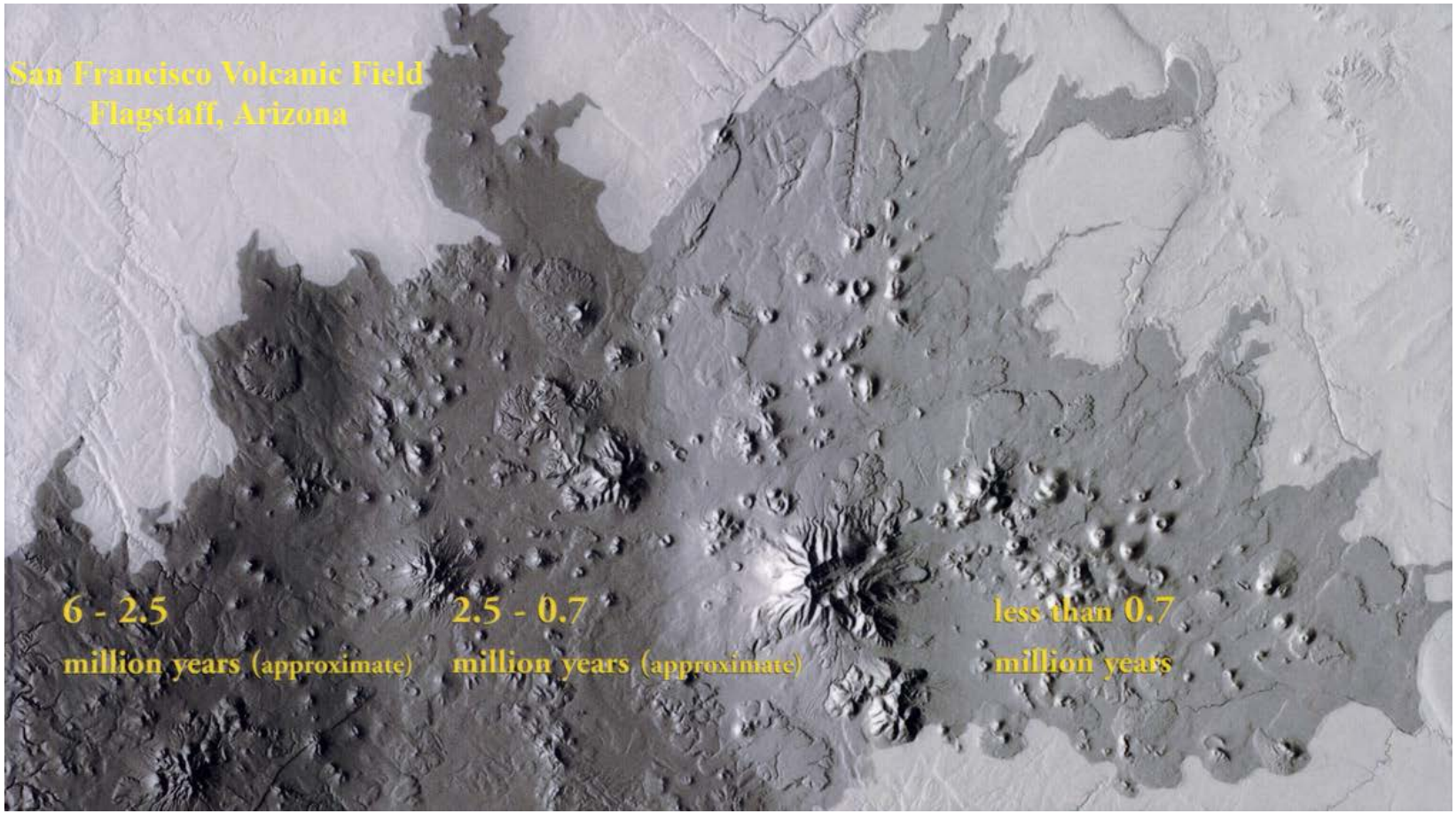
Lunar Analogue Training Sites



Regional Geologic Context

Outline of volcanic field that is visible in remote sensing images



Regional Geologic Context

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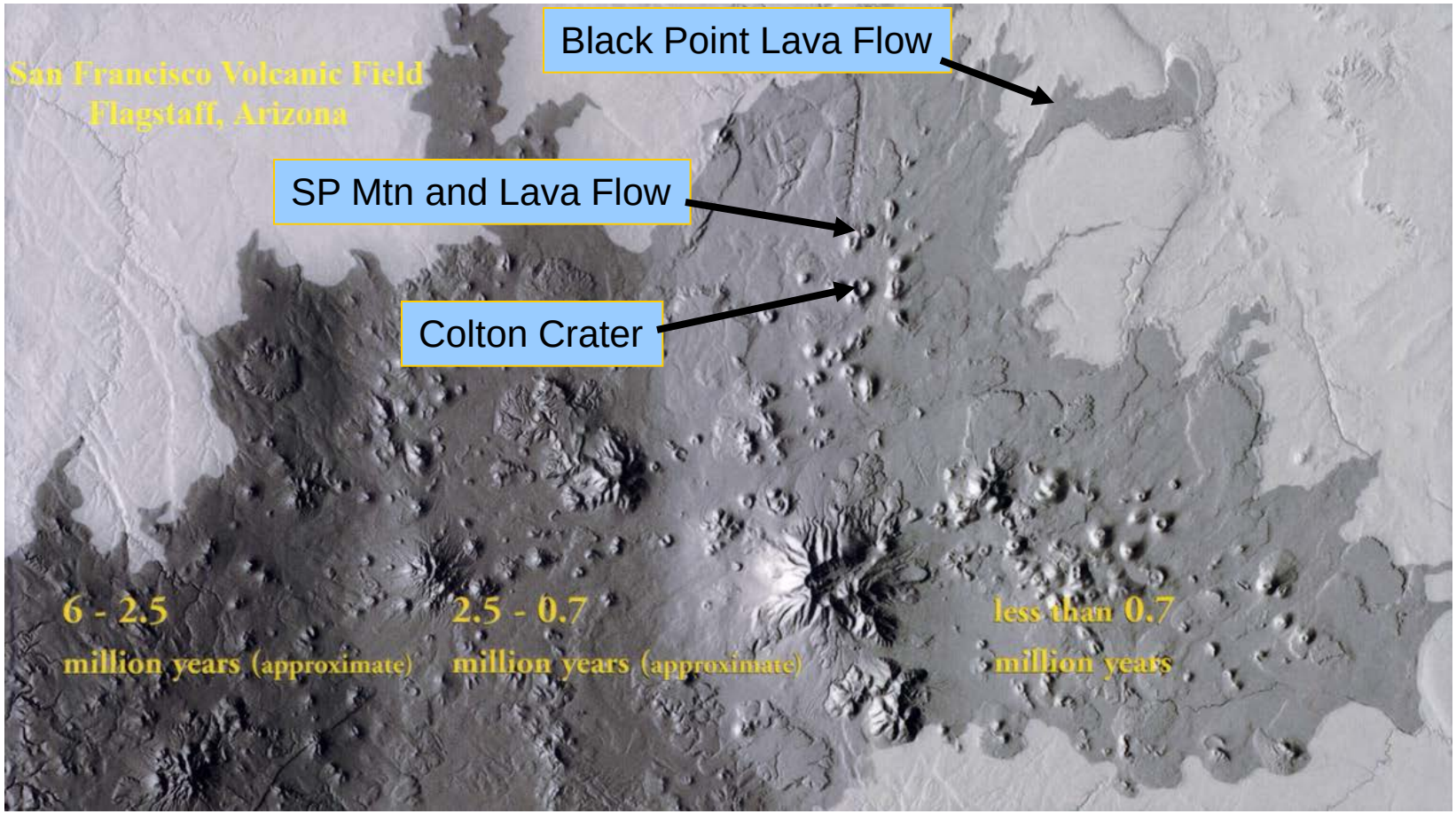
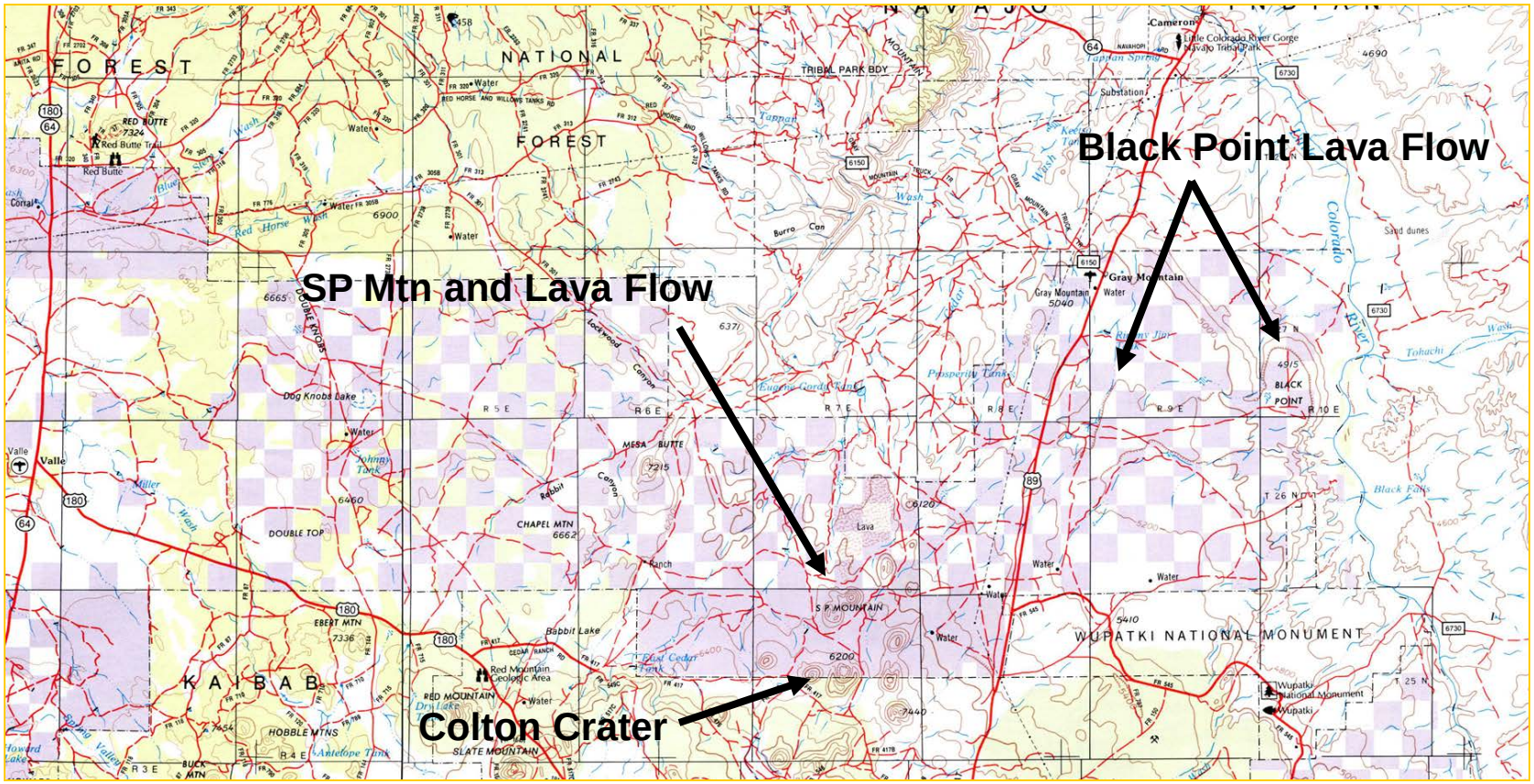
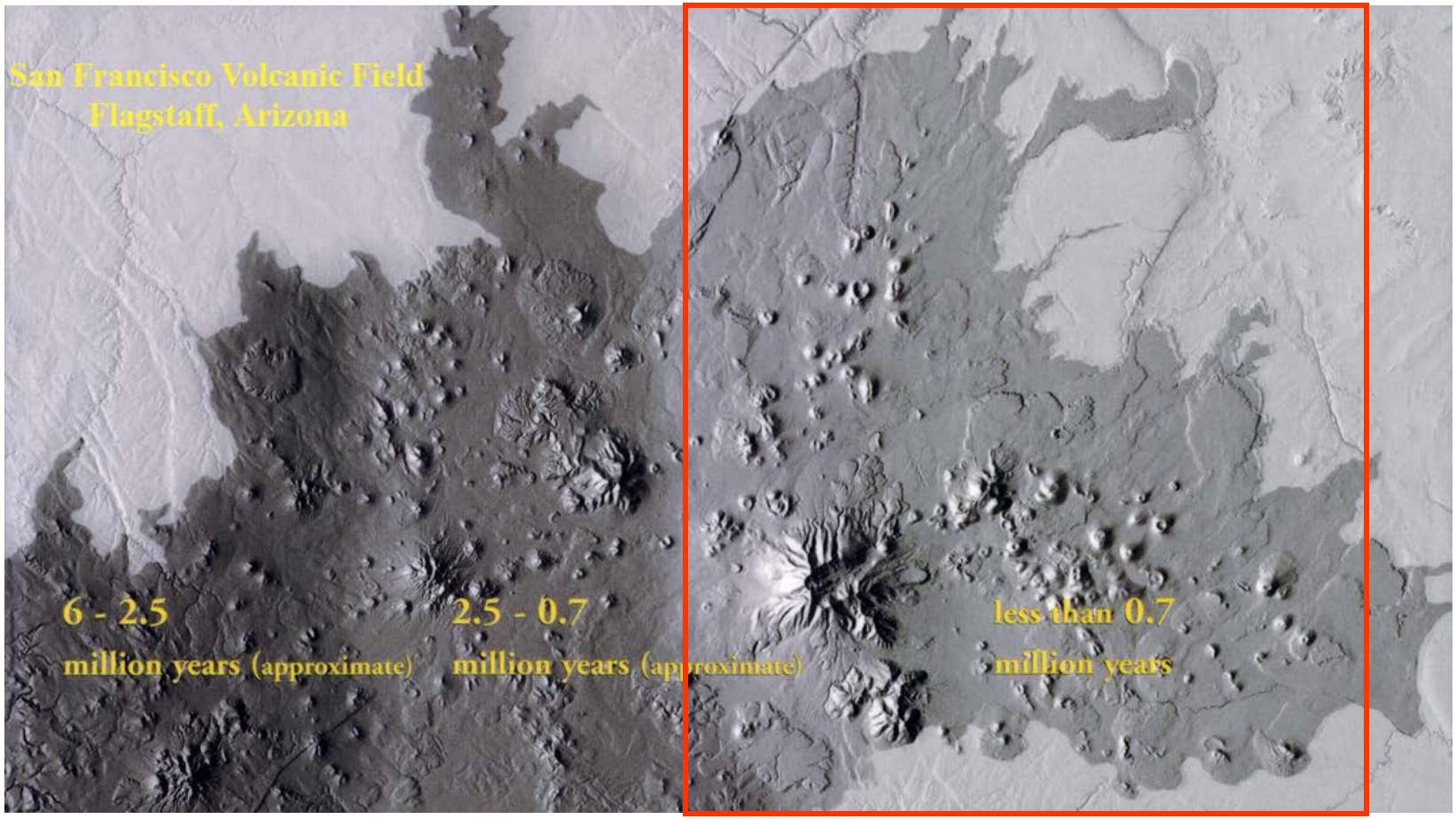


Types of Land



Regional Geologic Context

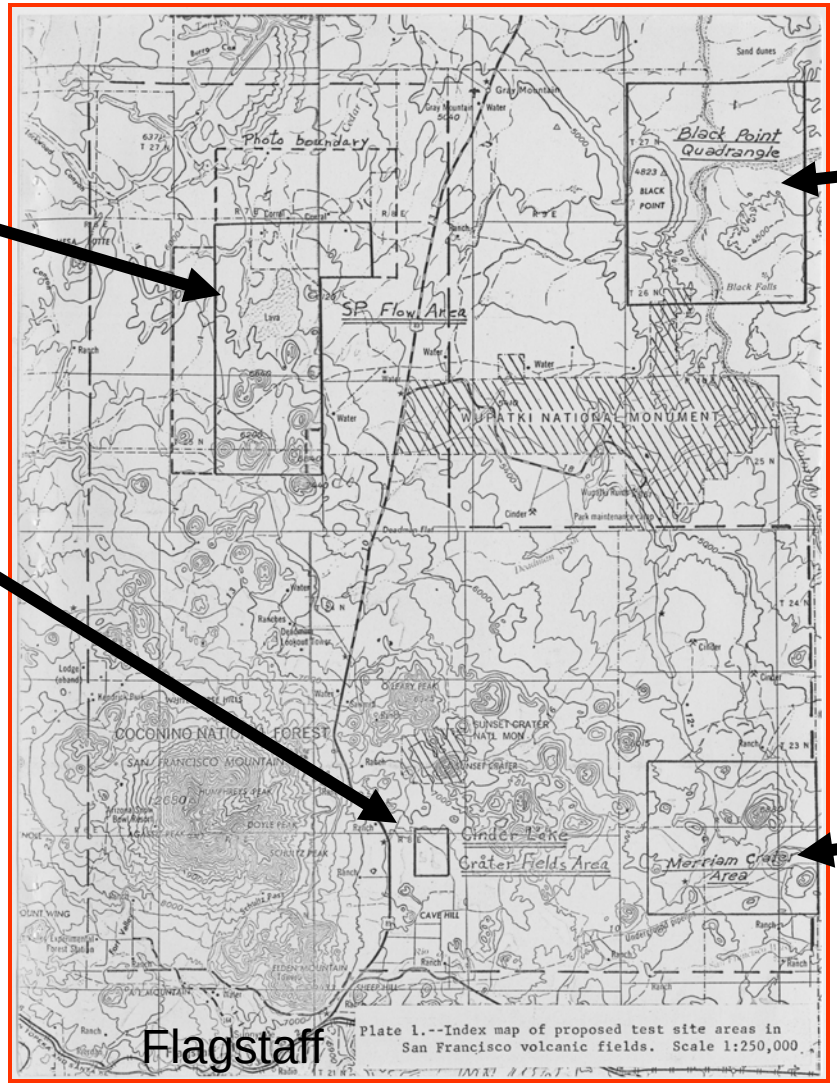
Portion of the area used during the Apollo era



Proposed Flagstaff-area Test Sites (1969)

SP Crater & Lava Flow (including Colton Crater, then known as Crater 160)

Cinder Lakes (& Crater Field)



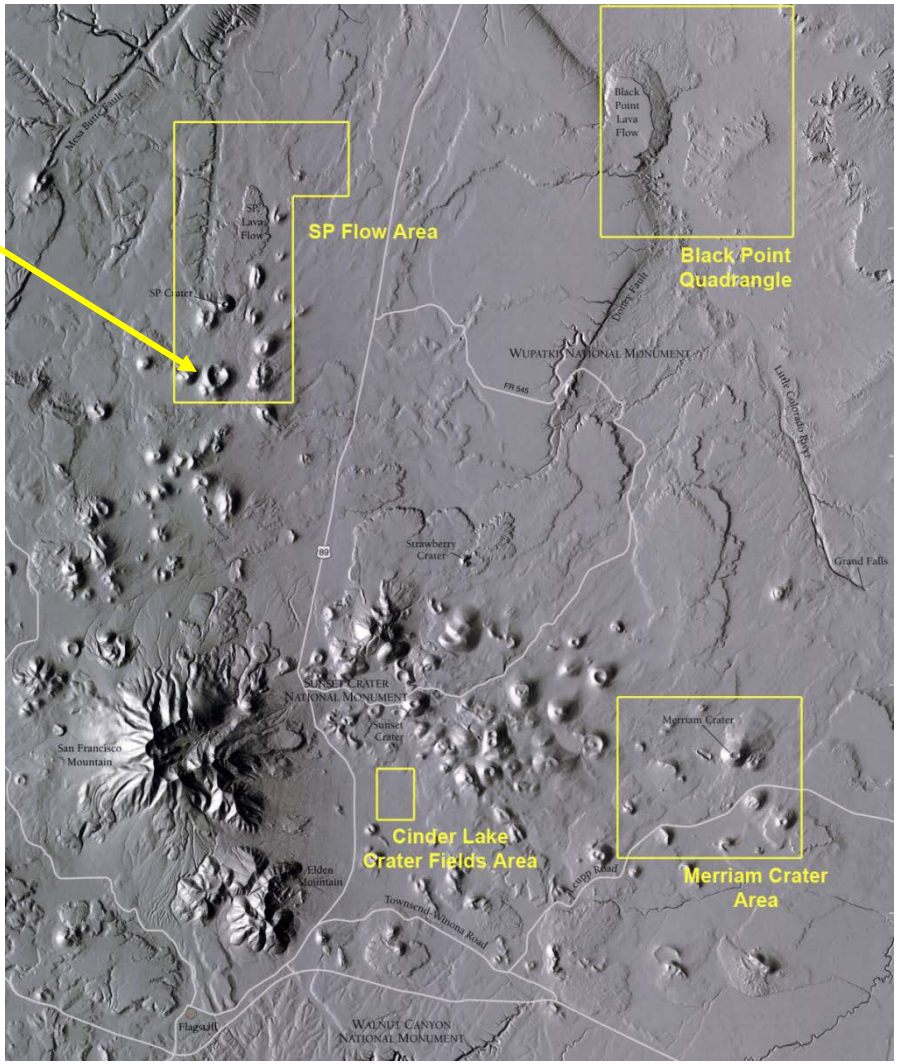
Black Point Lava Flow

Merriam Crater

This is the map in the original 1969 test site proposal.

Proposed Flagstaff-area Test Sites (1969)

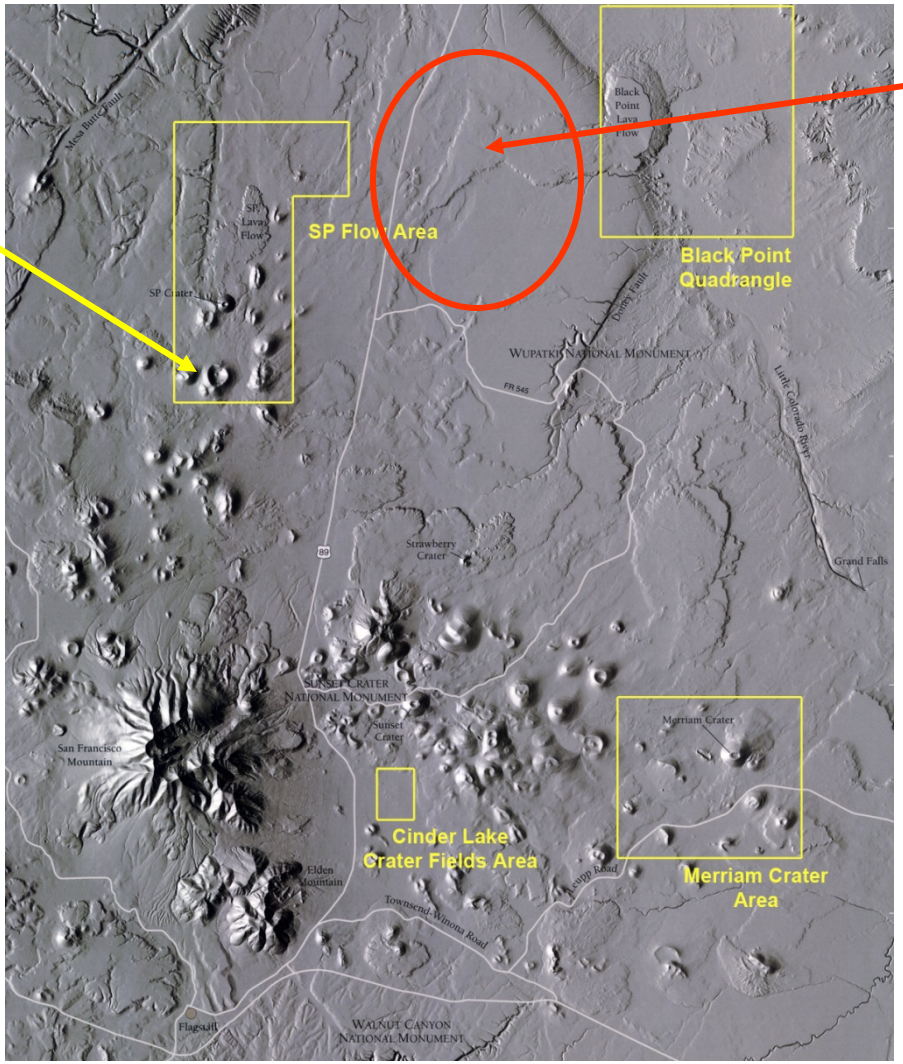
Colton Crater



Modern DEM of the northeastern portion of The San Francisco Volcanic Field.

Proposed Flagstaff-area Test Sites (1969)

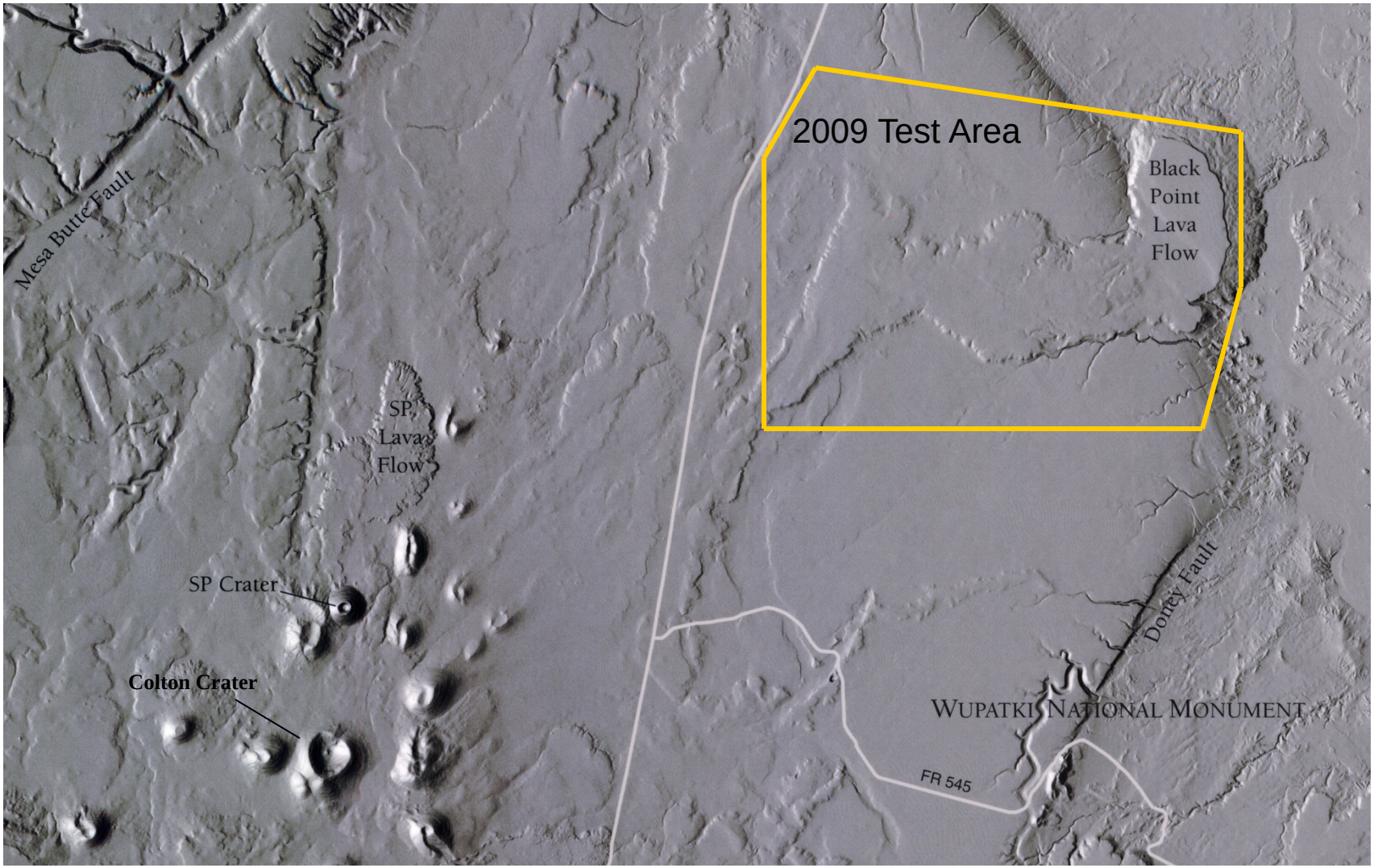
Colton Crater



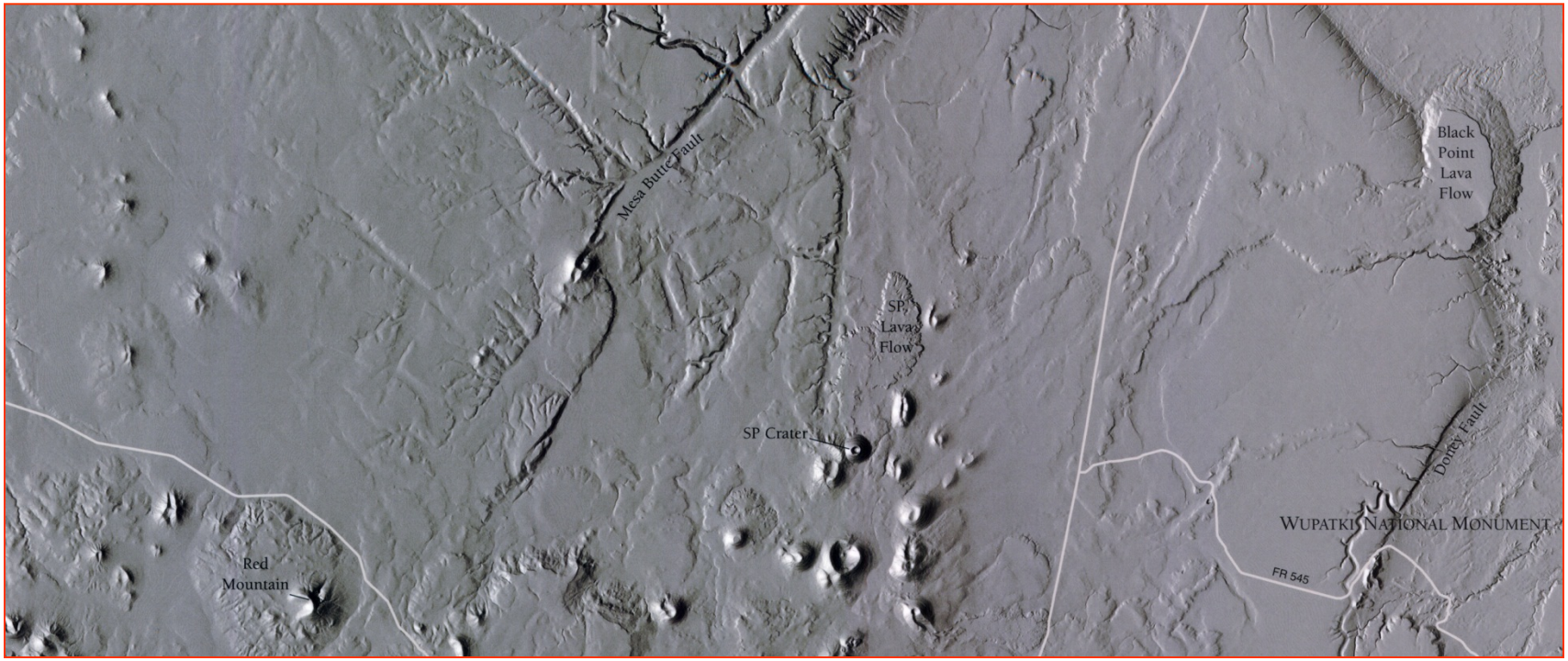
Black Point Lava Flow area used to test four lunar surface mission scenarios, October 2008.

Modern DEM of the northeastern portion of The San Francisco Volcanic Field.

Desert RATS 2009



Extending the Test Area to the West

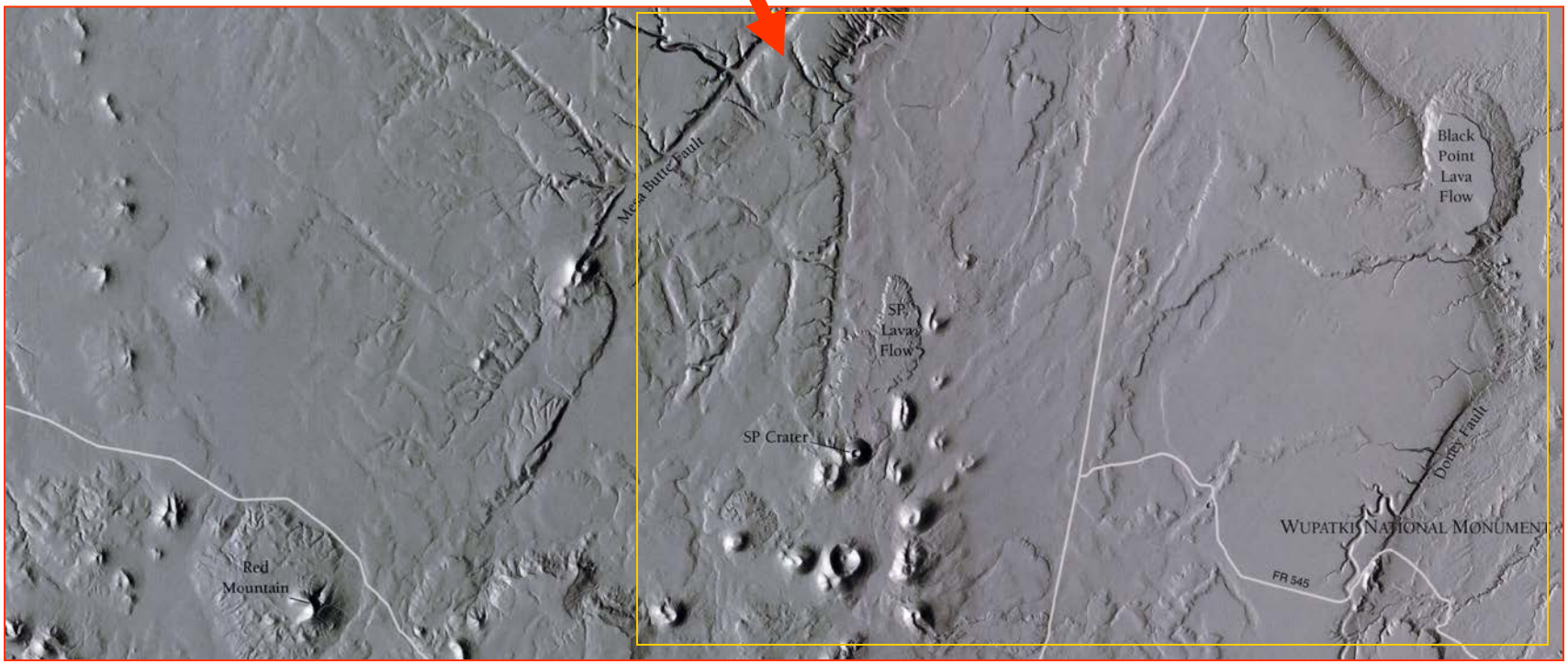


~ 50 km

Extending the Test Area to the West

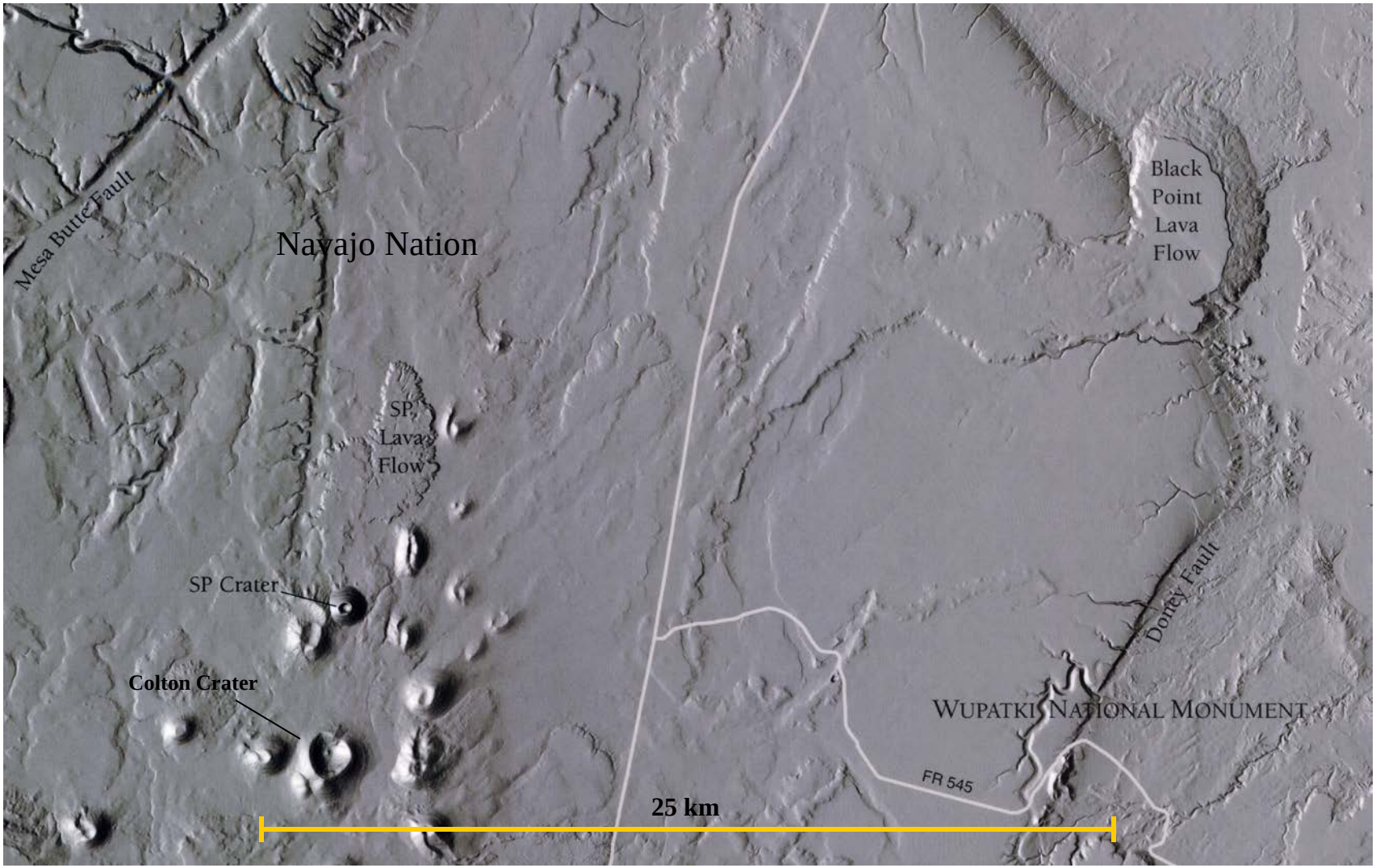
~ 50 km

Potential Option for 2010

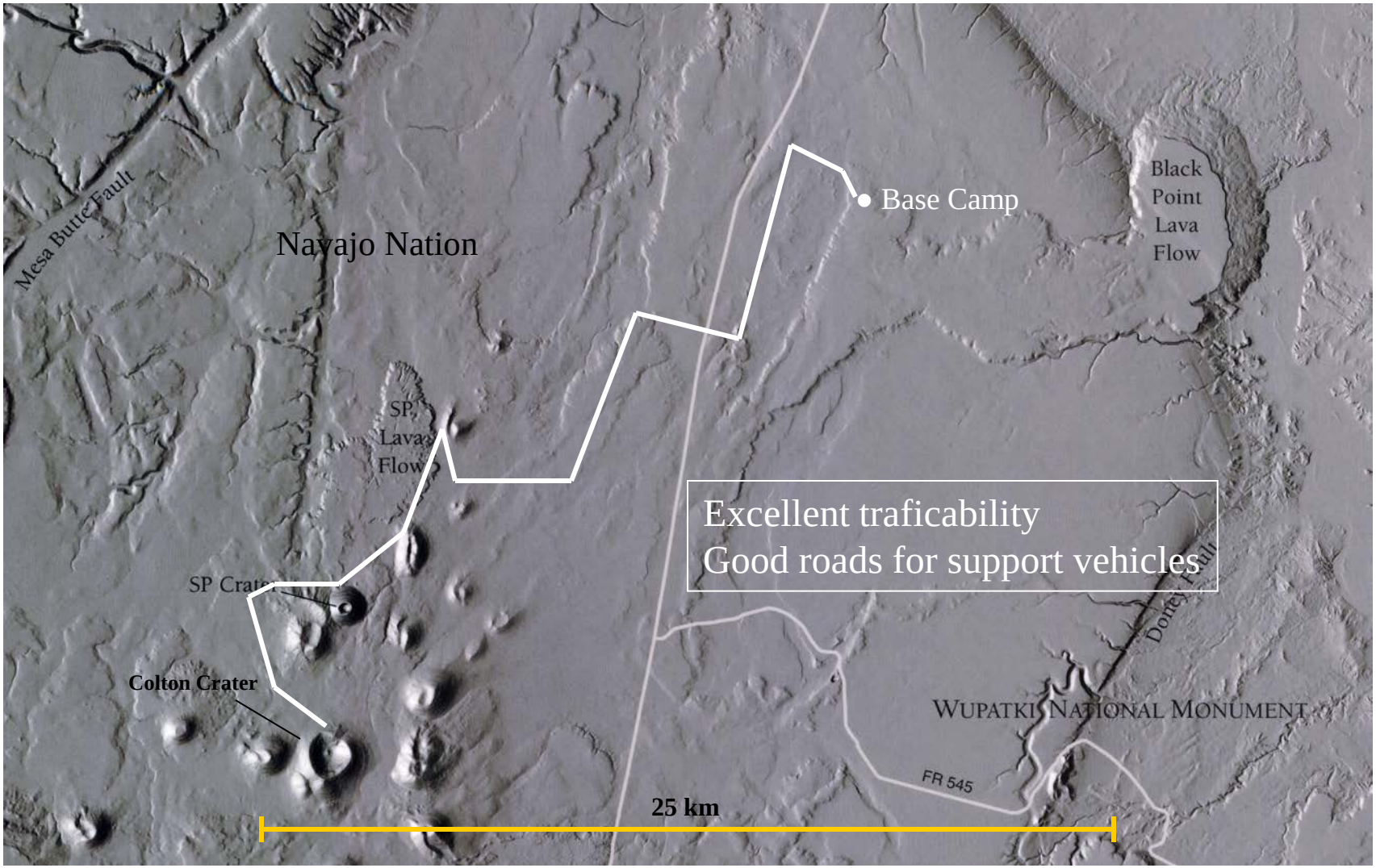


~ 50 km

Potential Option for 2010



An Example of Possible LER-1 Traverse



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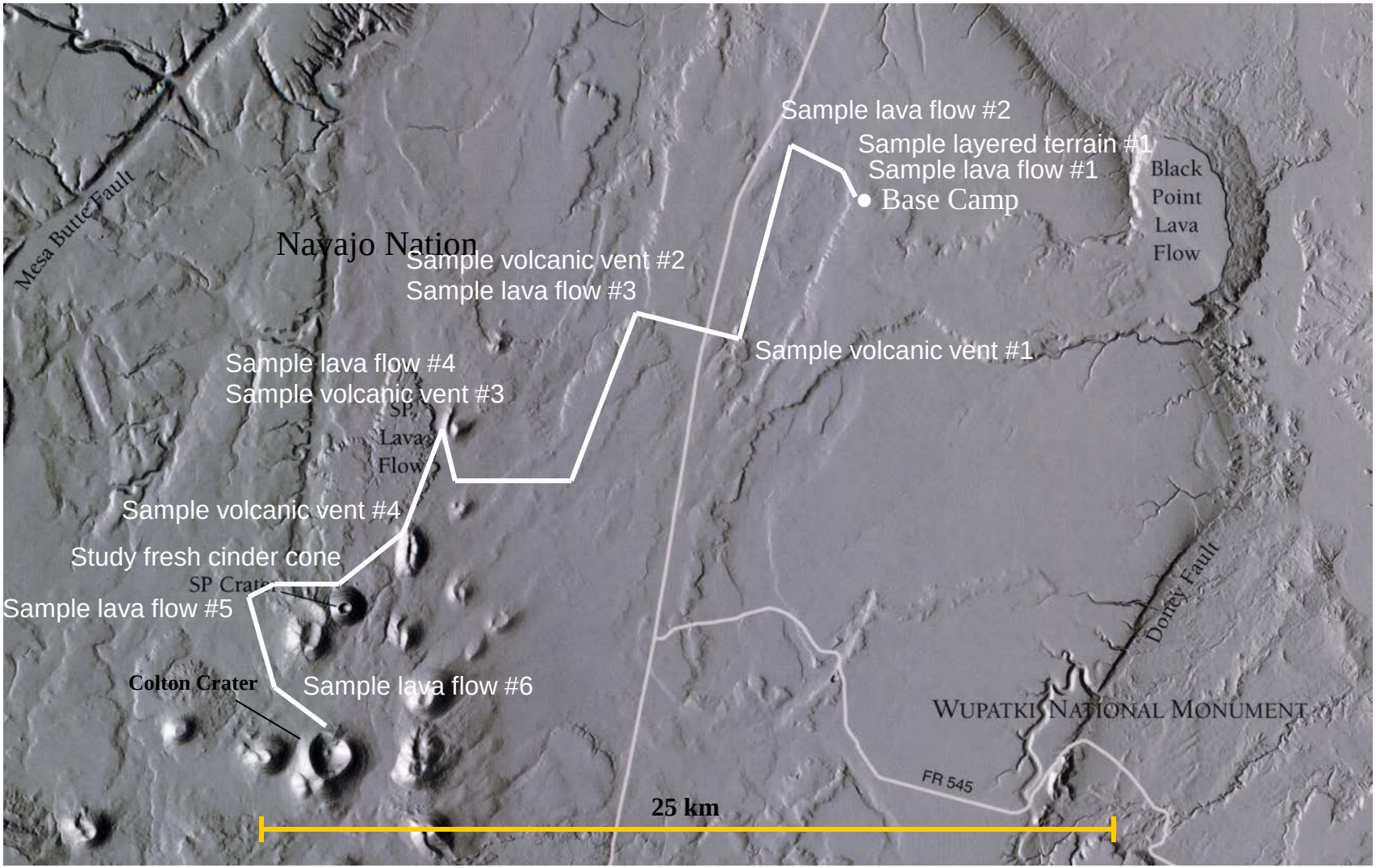
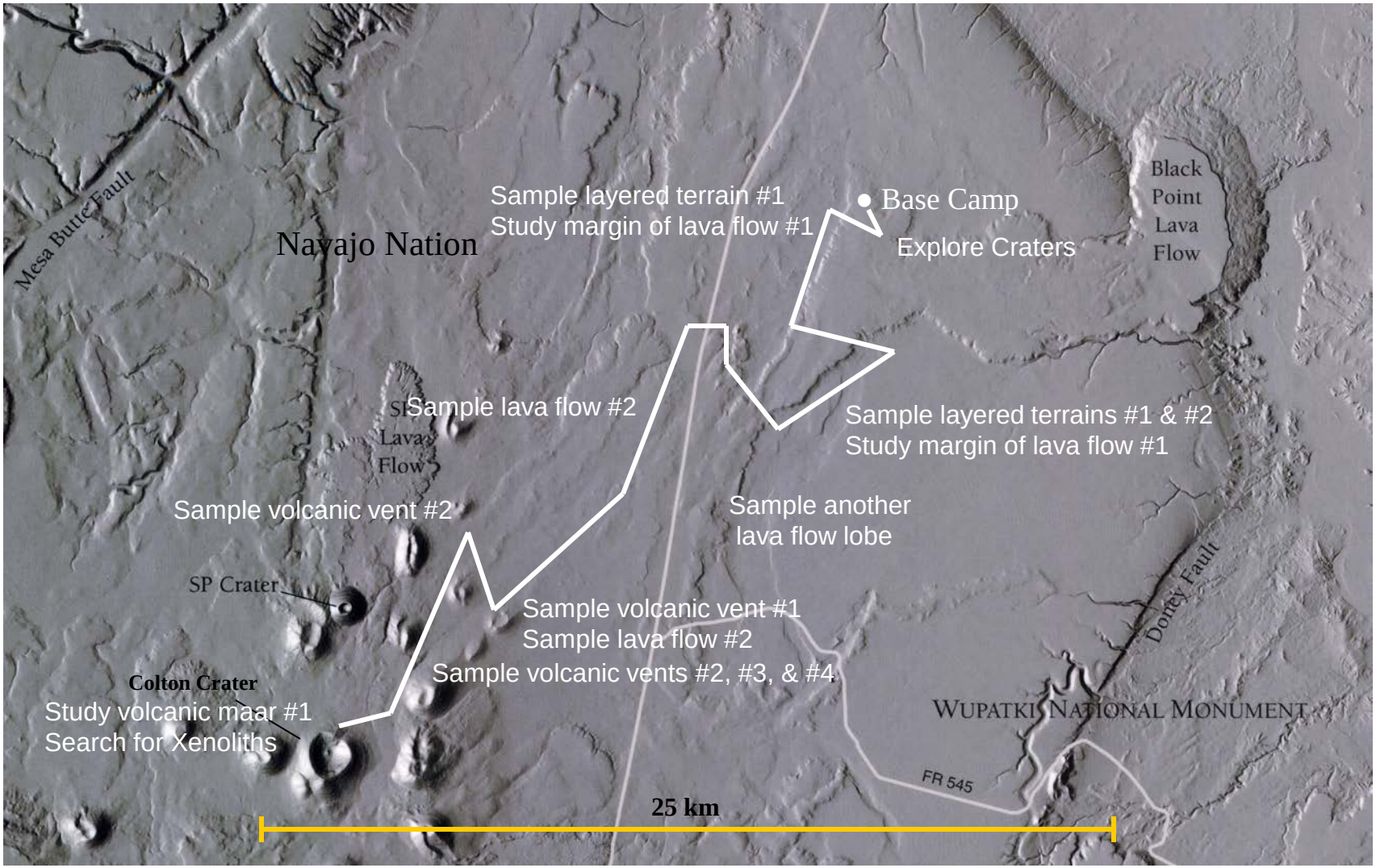
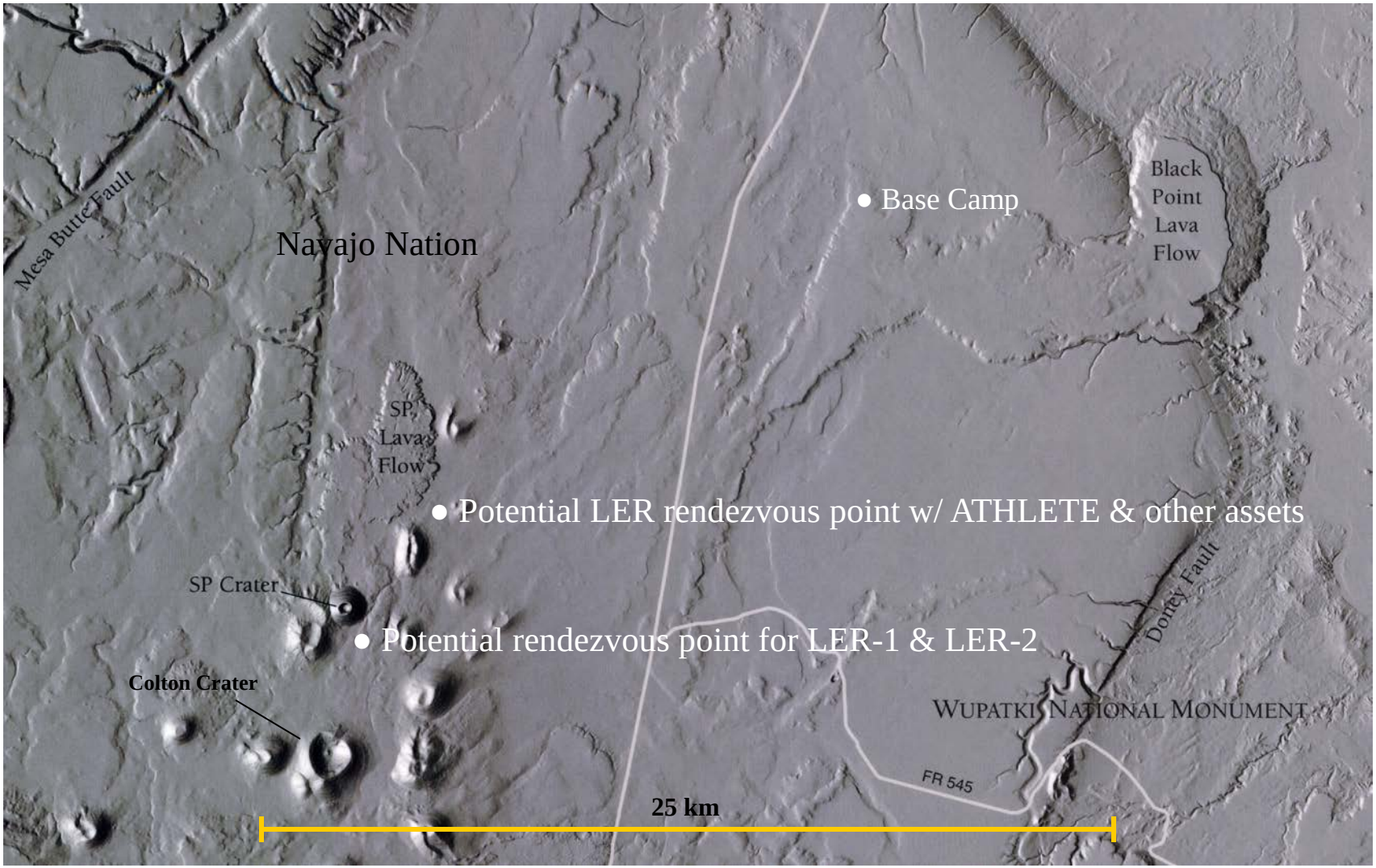


An Example of Possible LER-2 Traverse



Potential Rendezvous Points



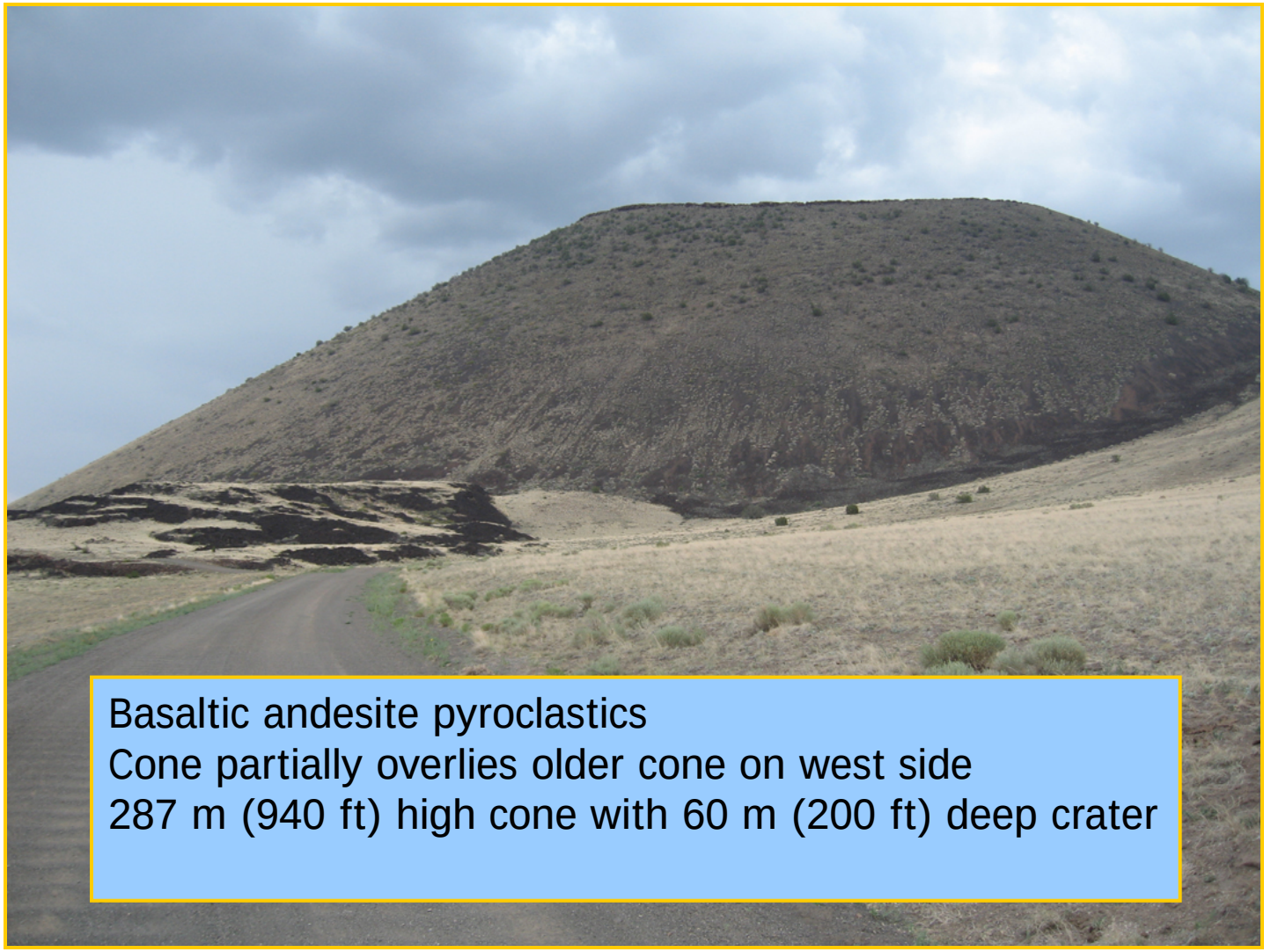
Key Targets Provided in Test Area

- The spectacular SP Cinder Cone and Lava Flow
  - → More details will follow in the next set of slides
- The equally spectacular Colton Crater, an explosive volcanic crater that mimics an impact crater and impact ejecta blanket
  - → More details will follow in the next set of slides
- At least 10 lava flows with different ages
- Over a dozen volcanic vents
- Slopes with boulder trains that mimic boulder trains on lunar massifs
- Two types of layered terrains
- Two types of channeled terrains
- Structural elements like faults and folds

Operational Elements Provided by Test Area

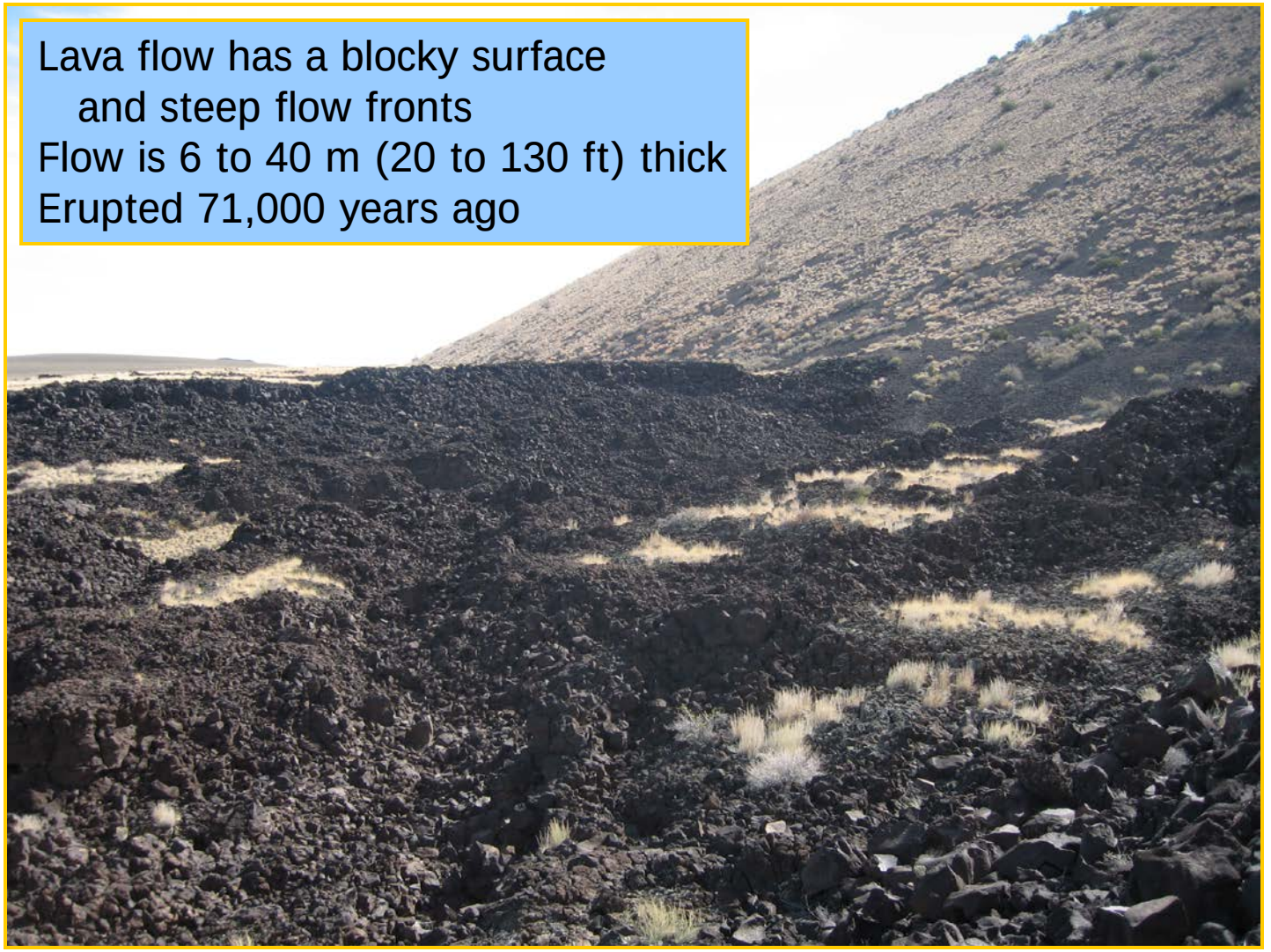
- Longer traverse distances for LER
- Large enough acreage to support multiple LER traverses
- Opportunity to test rendezvous scenarios with other assets (e.g., ATHLETE)
- The expanded area is open range (few fences and gates to navigate)
- Most of the area is managed by Babbitt Ranches
- Good surfaces for LER trafficability
- Good gravel roads for support vehicles

SP Mountain (or SP Crater)

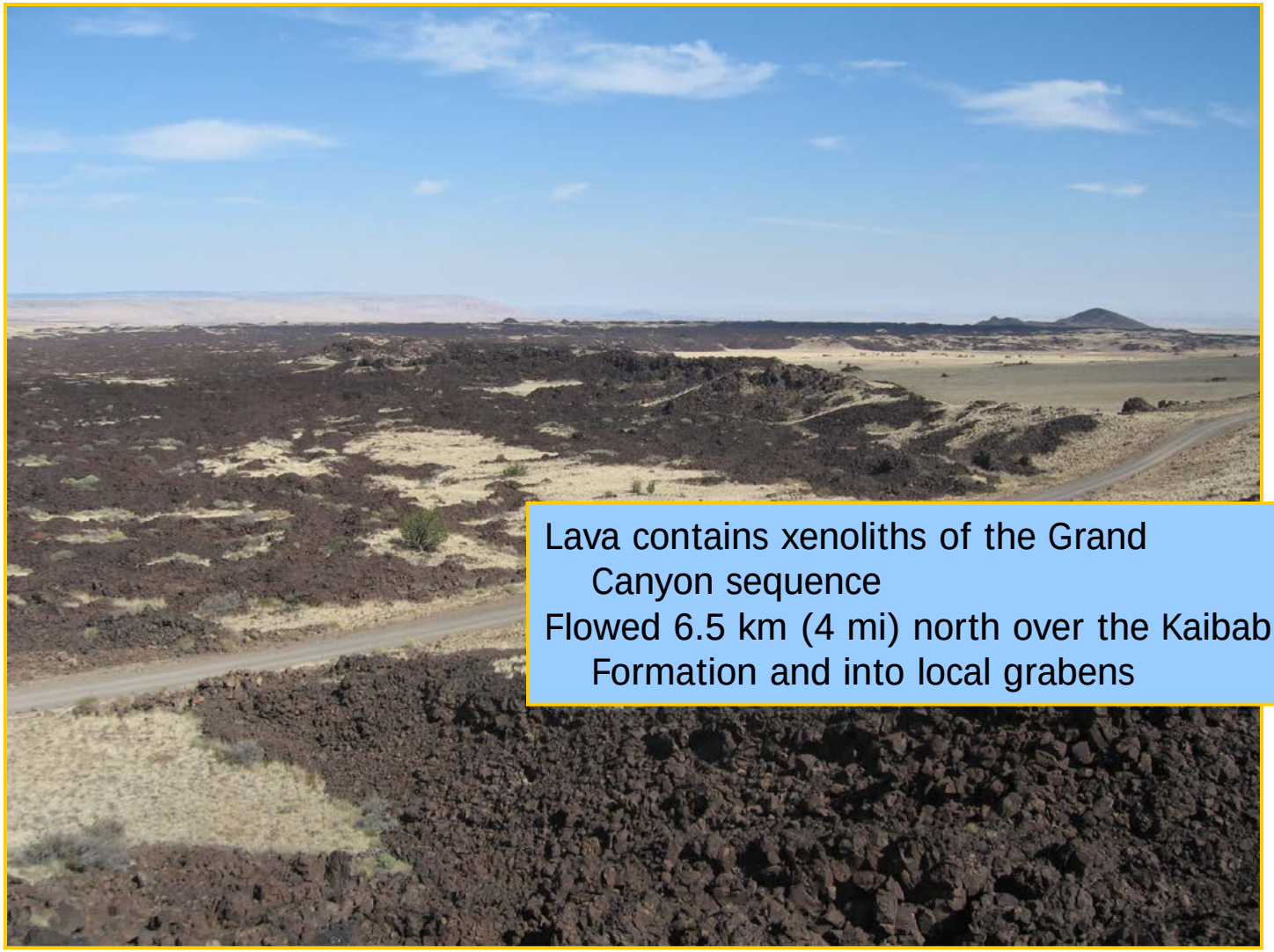


SP Mountain and Lava Flow

Lava flow has a blocky surface
and steep flow fronts
Flow is 6 to 40 m (20 to 130 ft) thick
Erupted 71,000 years ago



SP Lava Flow



Lava contains xenoliths of the Grand Canyon sequence

Flowed 6.5 km (4 mi) north over the Kaibab Formation and into local grabens

Crater 160 (now Colton Crater)

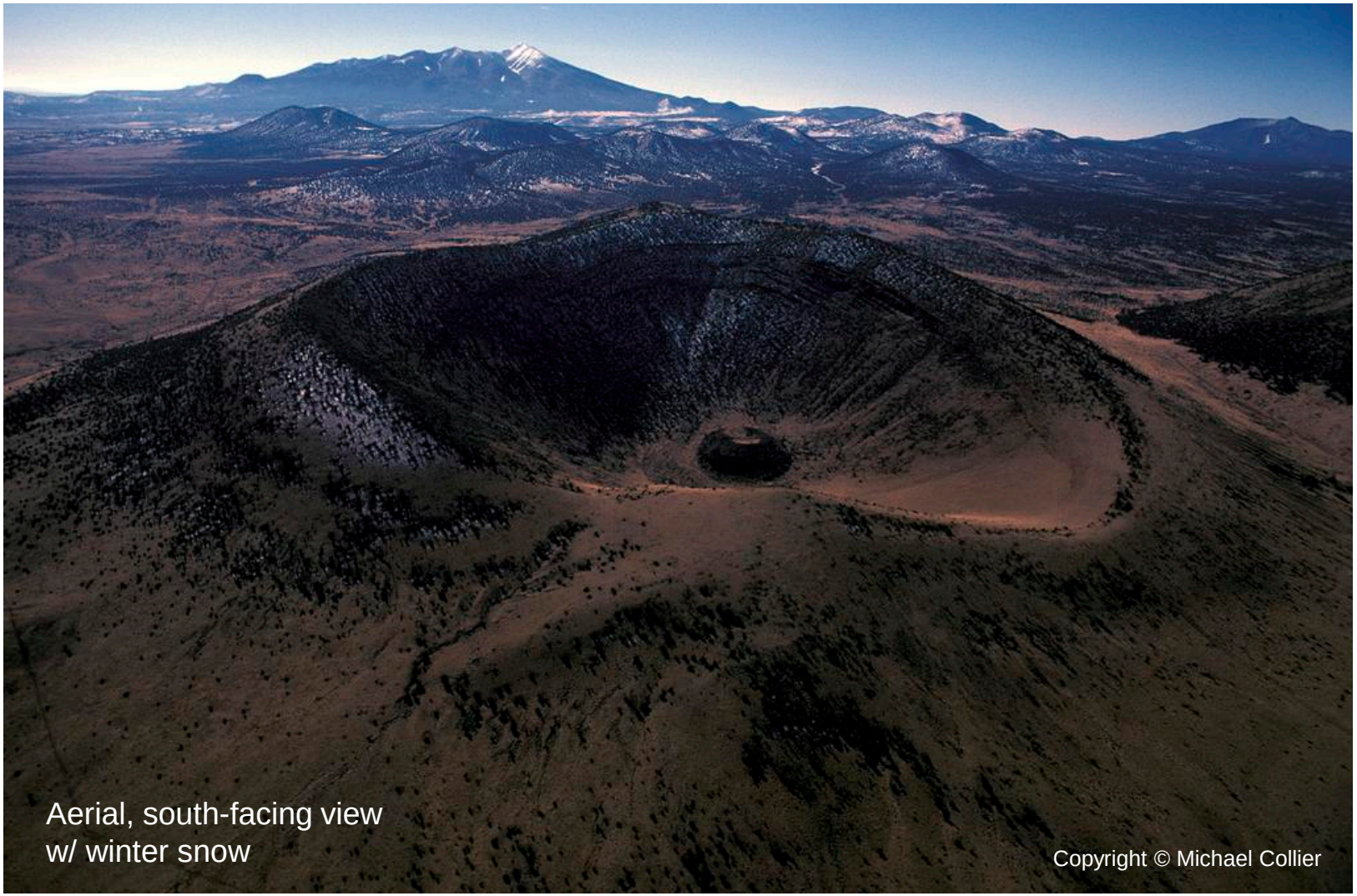
View from the northwest to southeast.
Mid-October.

Colton Crater

- A tuff ring or cone, related to explosive maar craters
- Rim diameter is 1.2 km
- The highest portion of the crater rim is ~450 m above surrounding landscape
- The crater floor is 80 m below the surrounding landscape
- The crater walls contain mantle and crustal xenoliths

Colton Crater

Colton Crater



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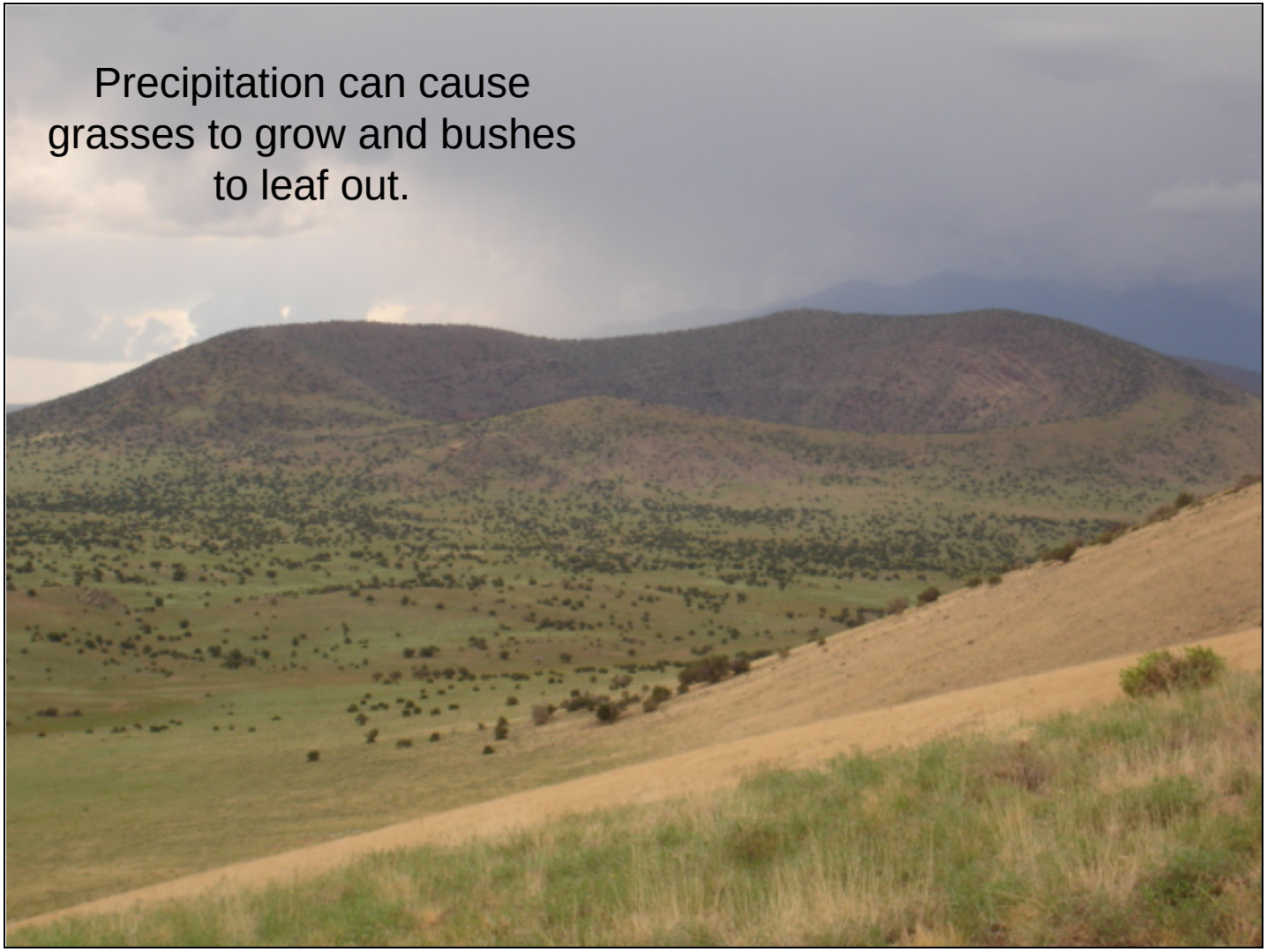

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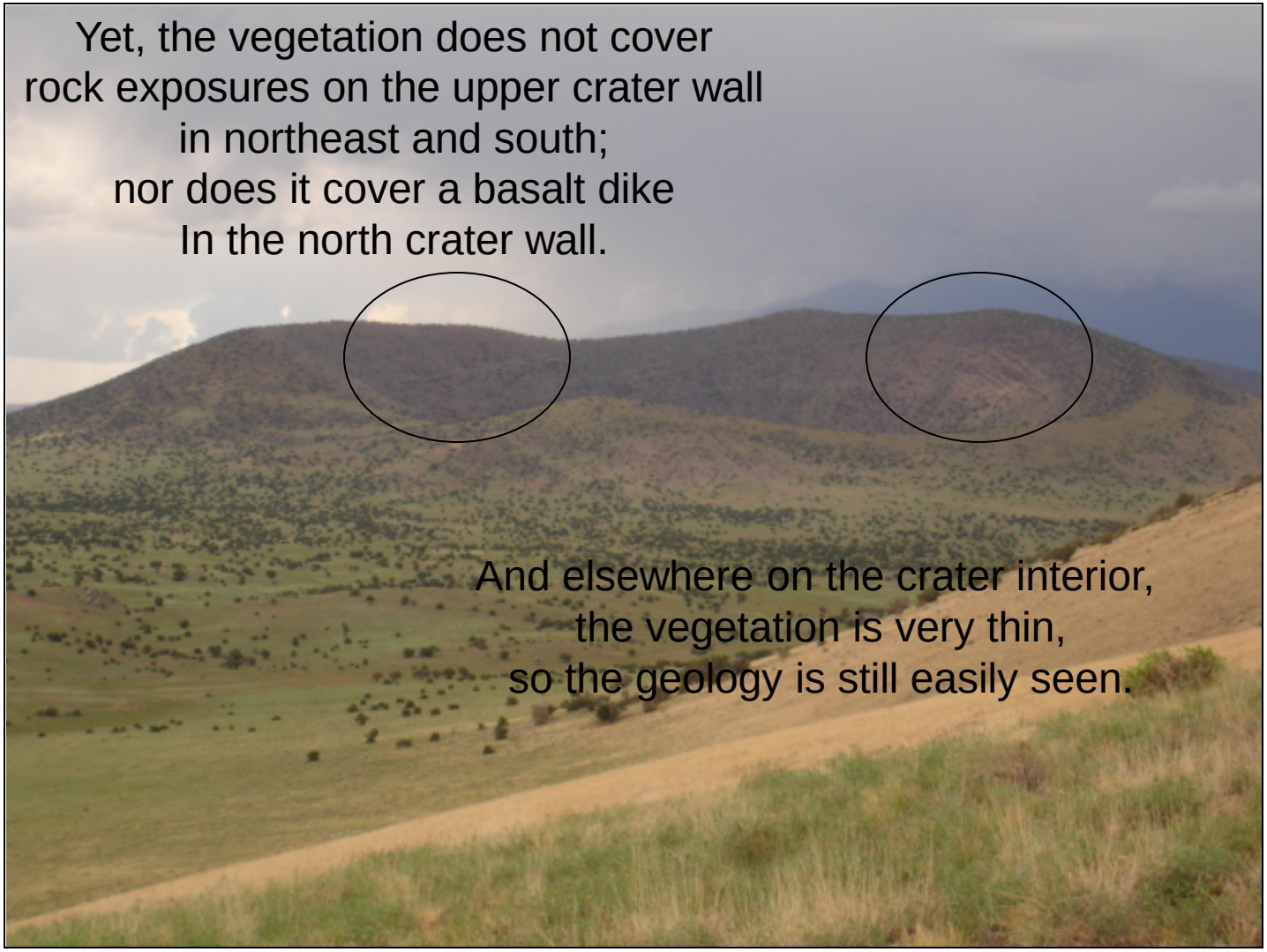

Colton Crater

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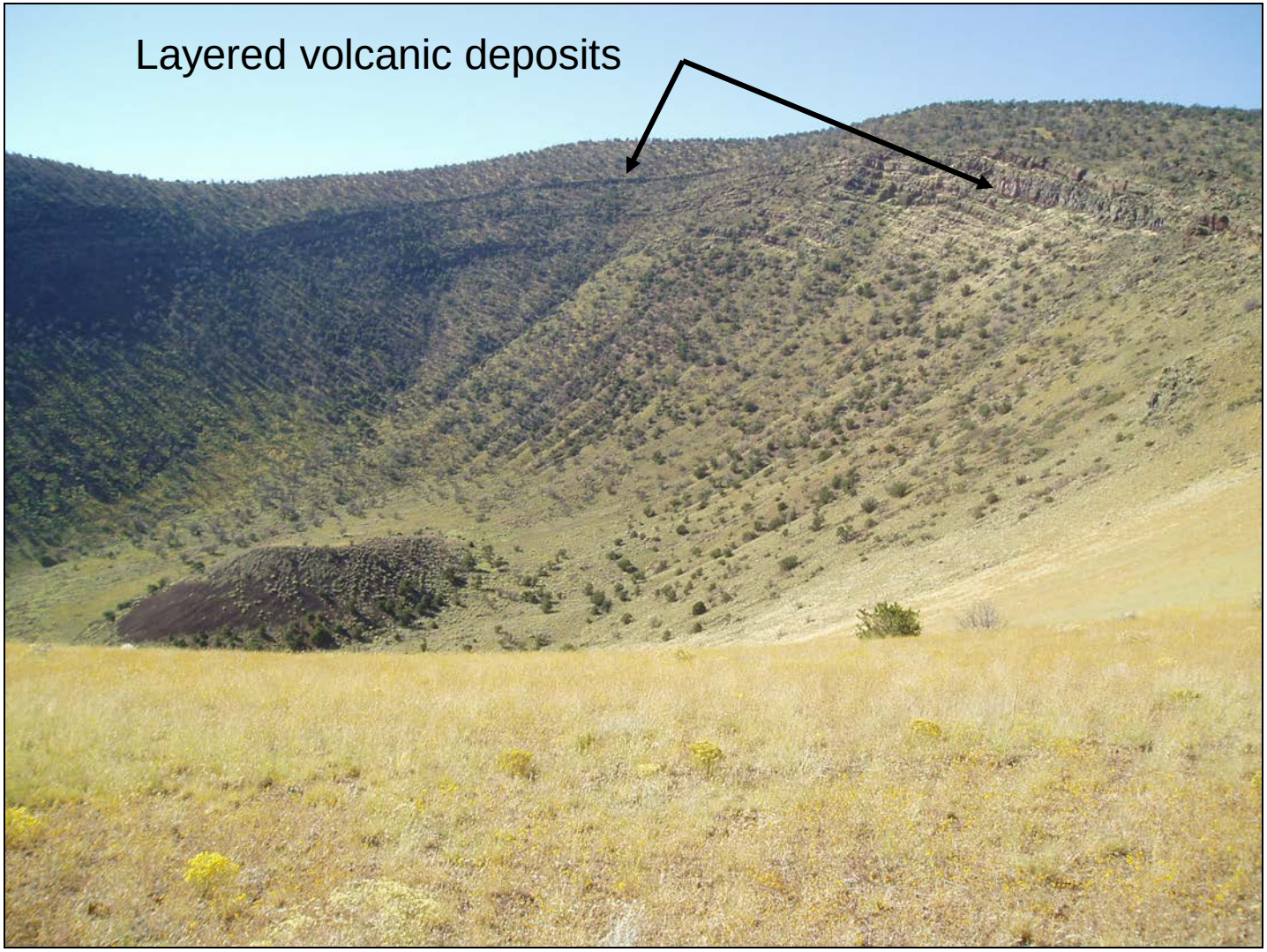


Colton Crater

15 m tuff

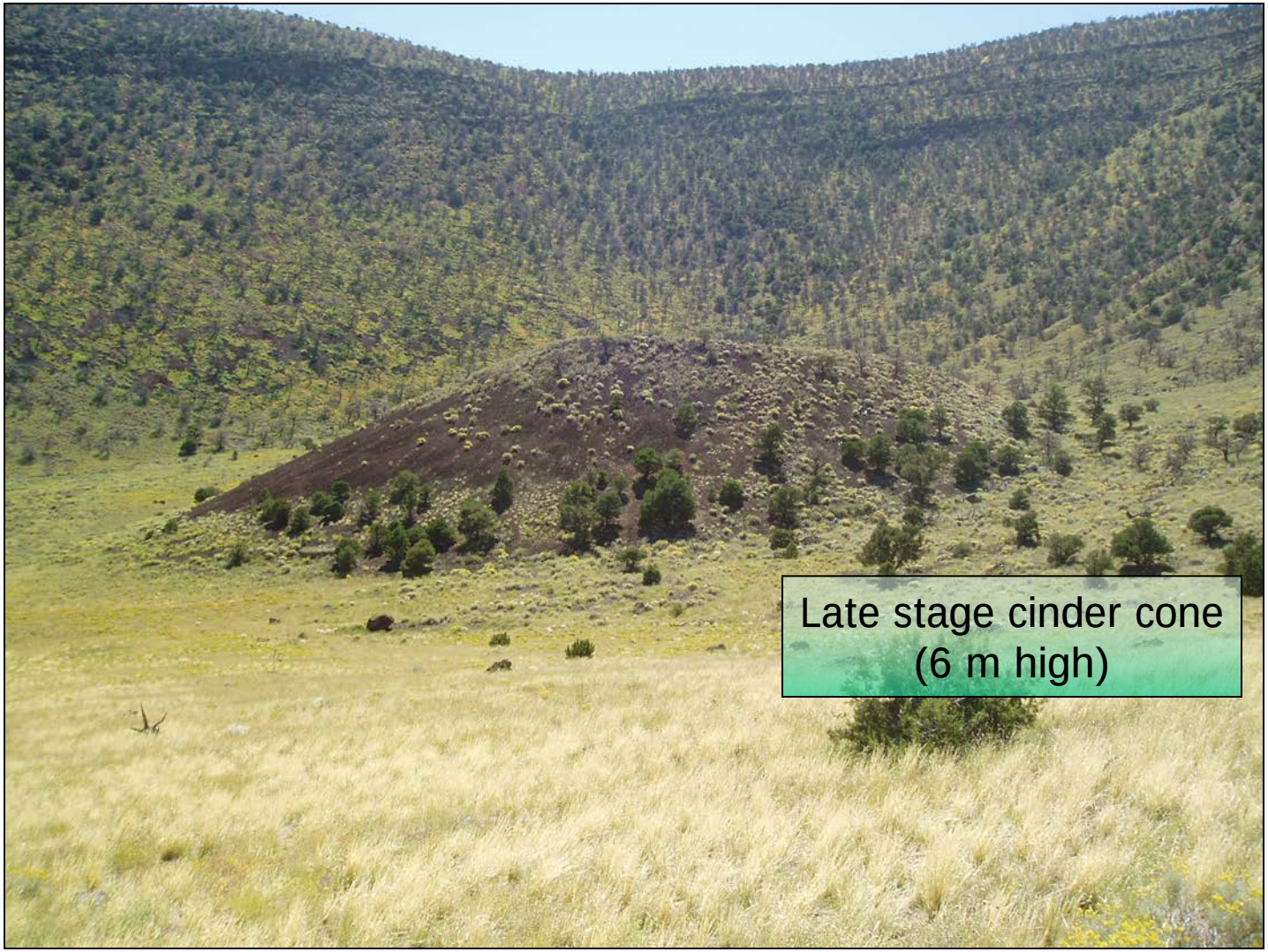
25 m cinders

7.5 m basalt flow

27.5 m cinders

75 m of total section measured by Cummings (1972)

Colton Crater



Xenoliths within Colton Crater

Xenoliths within Colton Crater

Xenoliths

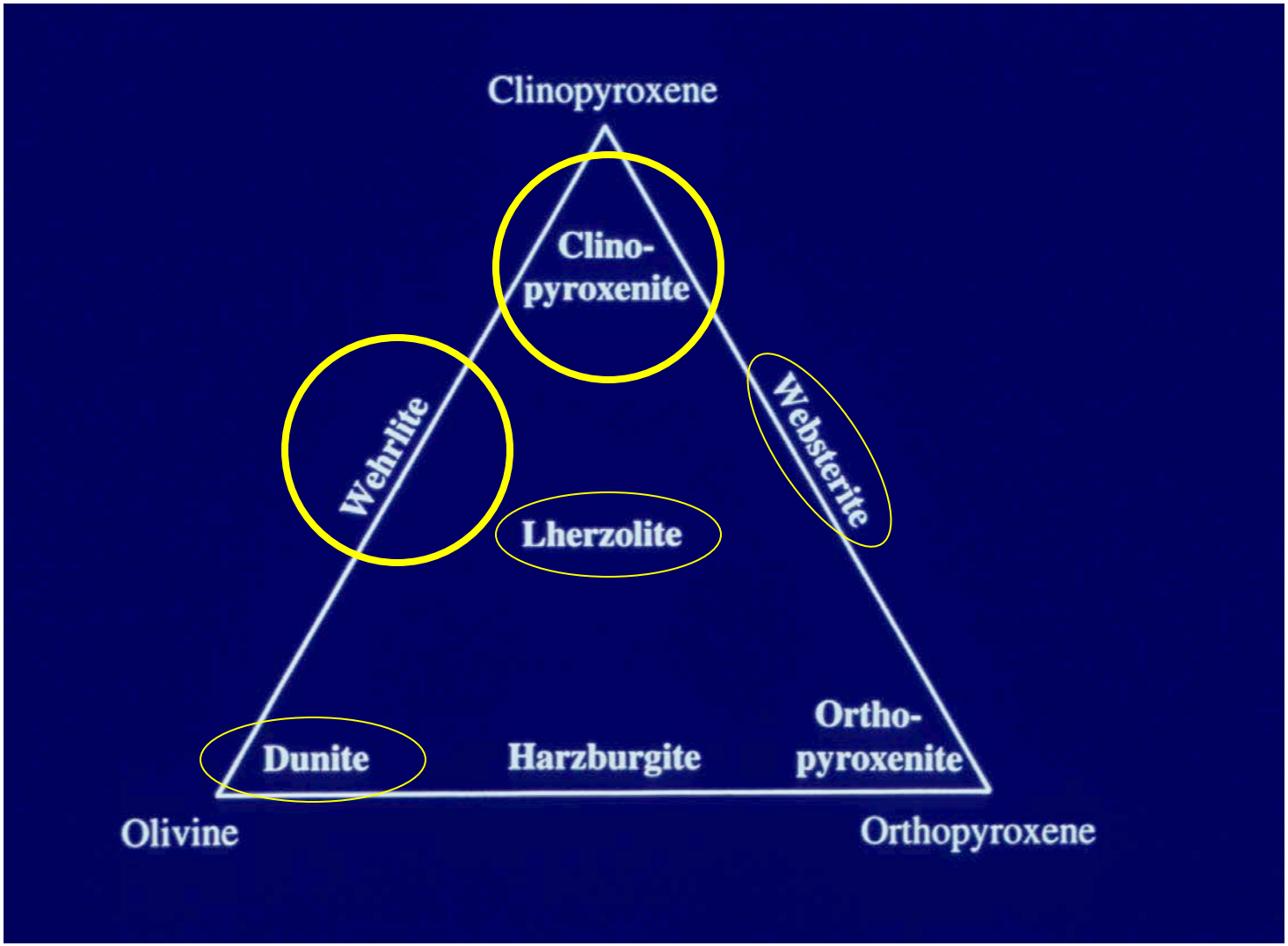
Most abundant varieties

- Clinopyroxenite
- Wehrlite

Also present

- Dunite
- Lherzolite
- Websterite
- Gabbro
- Norite
- Anorthosite
- Granite
- Granulite
- Paleozoic sedimentary rocks

Ultramafic (Mantle) Lithologies



Basaltic Pyroclastic Bombs

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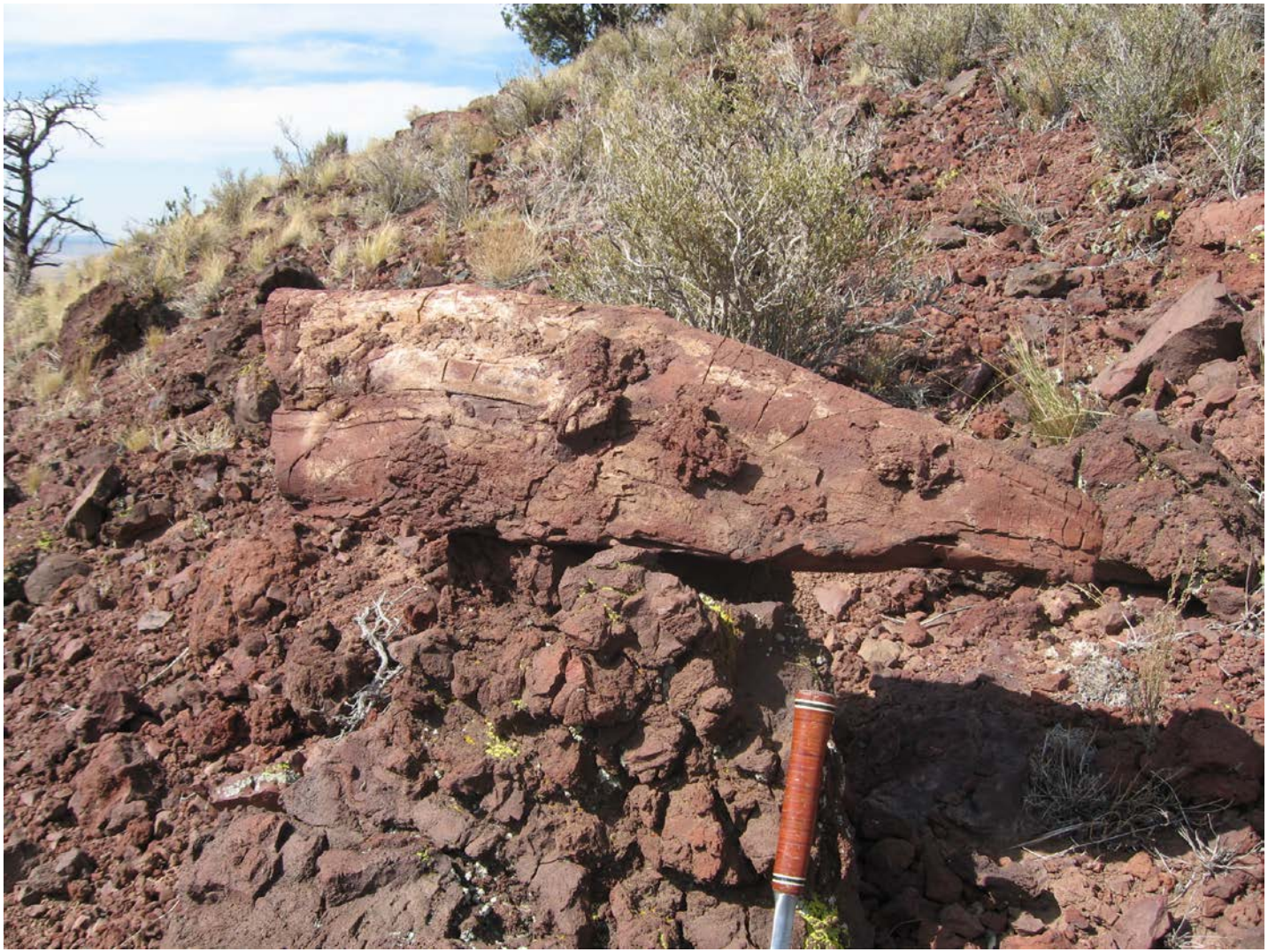
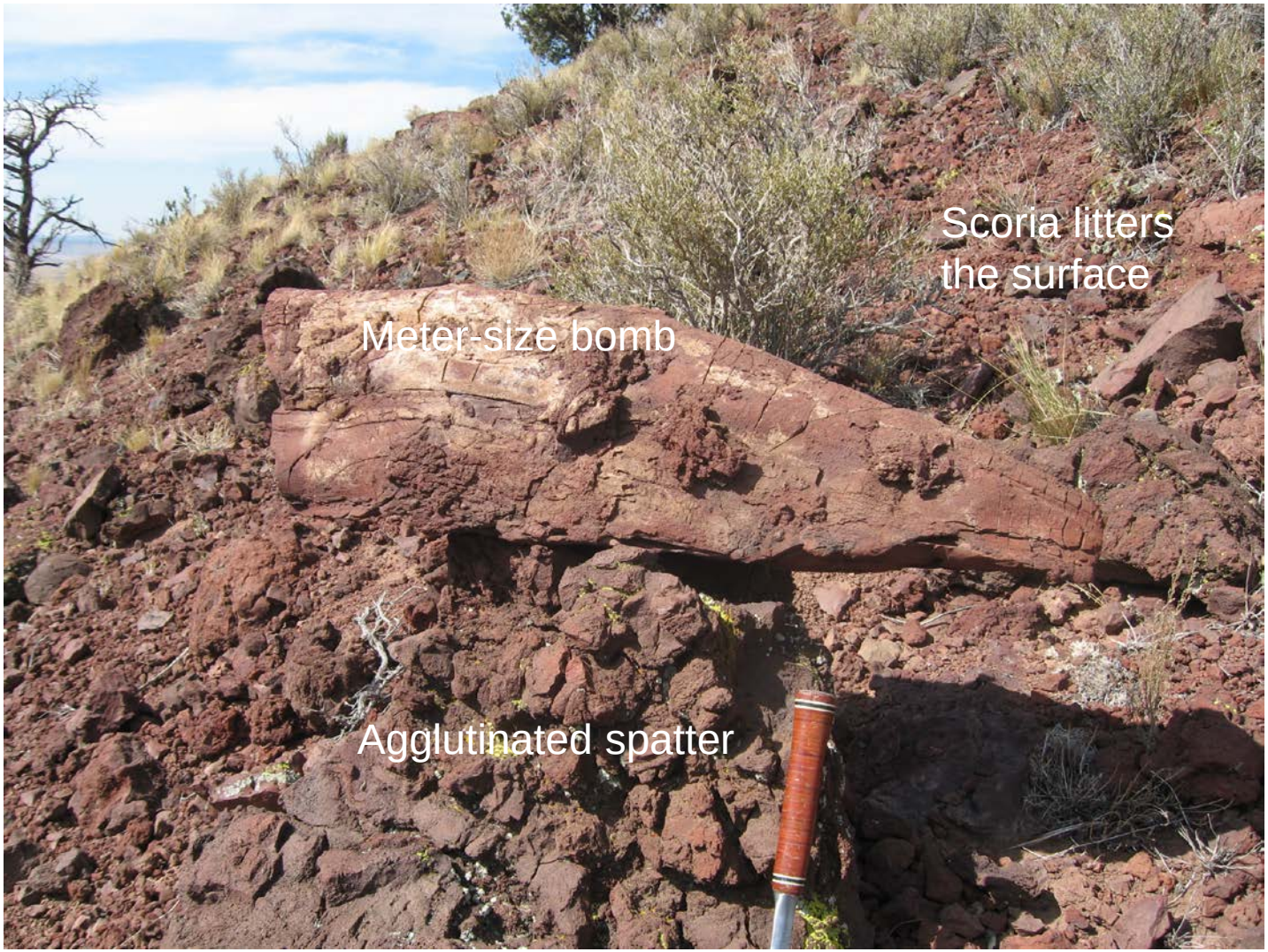
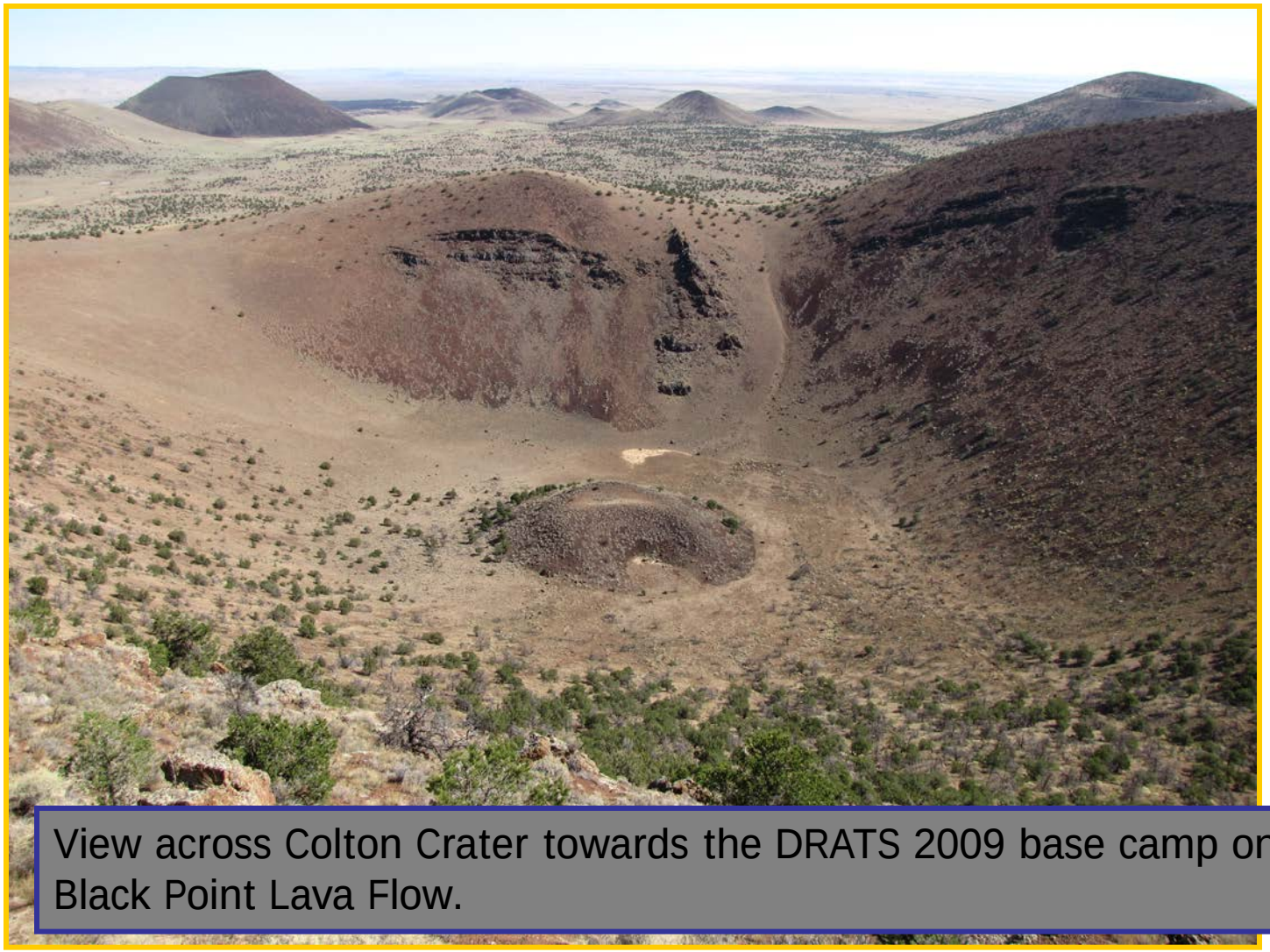


Basaltic Pyroclastic Bombs

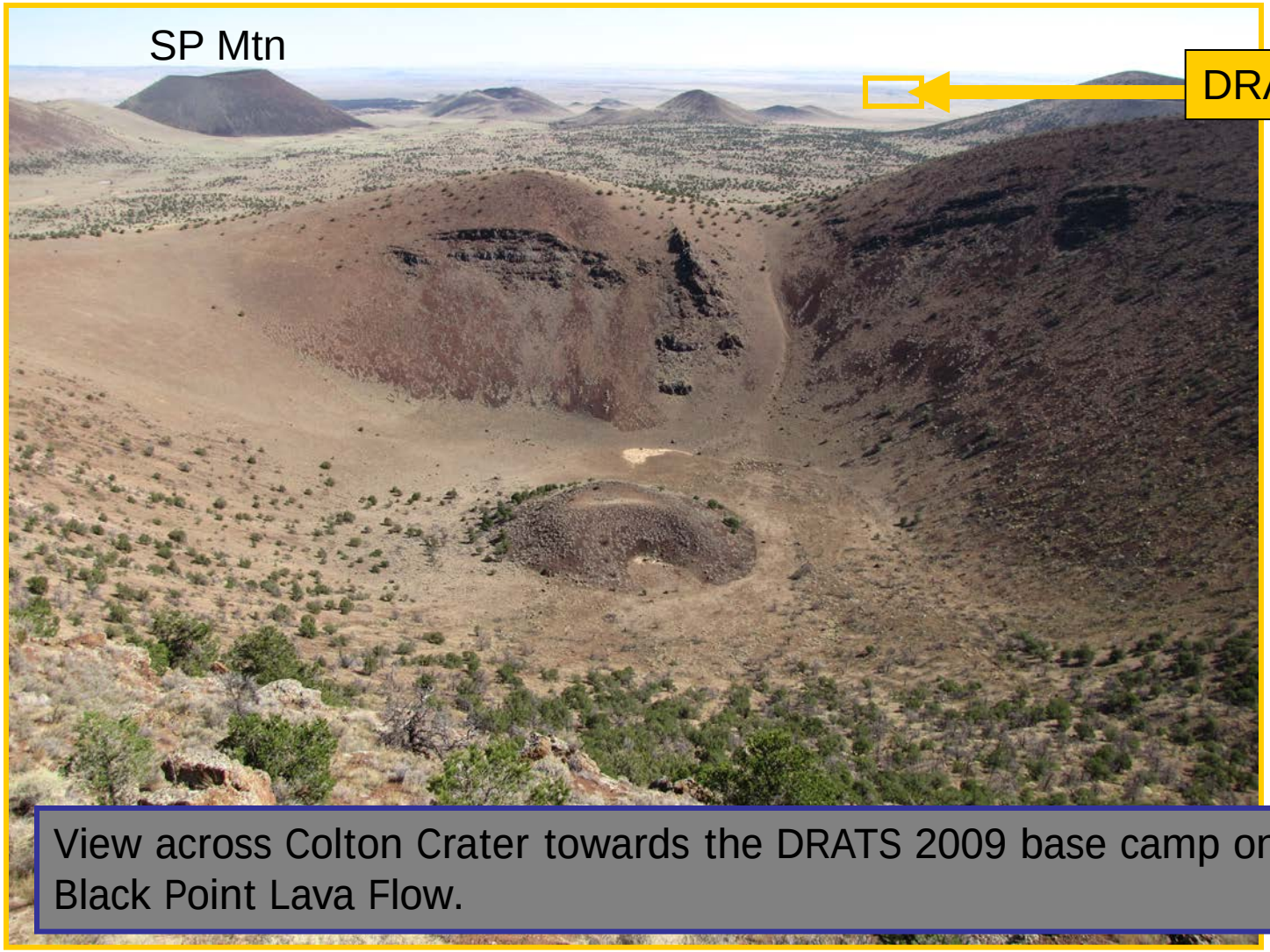


Looking Ahead to DRATS 2010



View across Colton Crater towards the DRATS 2009 base camp on the Black Point Lava Flow.

Looking Ahead to DRATS 2010



View across Colton Crater towards the DRATS 2009 base camp on the Black Point Lava Flow.

Looking Ahead to DRATS 2010

Zoom view across Colton Crater towards the DRATS 2009 base camp on the Black Point Lava Flow.

References

Billingsley, G.H., S.S. Priest, and T.J. Felger (2007) Geologic Map of the Cameron 30' x 60' Quadrangle, Coconino County, Northern Arizona. USGS Scientific Investigations Map 2977.

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Ulrich, G.E., G.H. Billingsley, R. Hereford, E.W. Wolfe, L.D. Nealey, and R.L. Sutton (1984) Map Showing the Geology, Structure, and Uranium Deposits of the Flagstaff 1° x 2° Quadrangle, Arizona. Map I-1446. U.S. Geological Survey.

USGS (1969) Appraisal of the San Francisco Volcanic Field as a Potential Field Test Area for Roving Vehicle and Traverse Research Studies.

Colton Crater

Additional Images

Xenoliths within Colton Crater

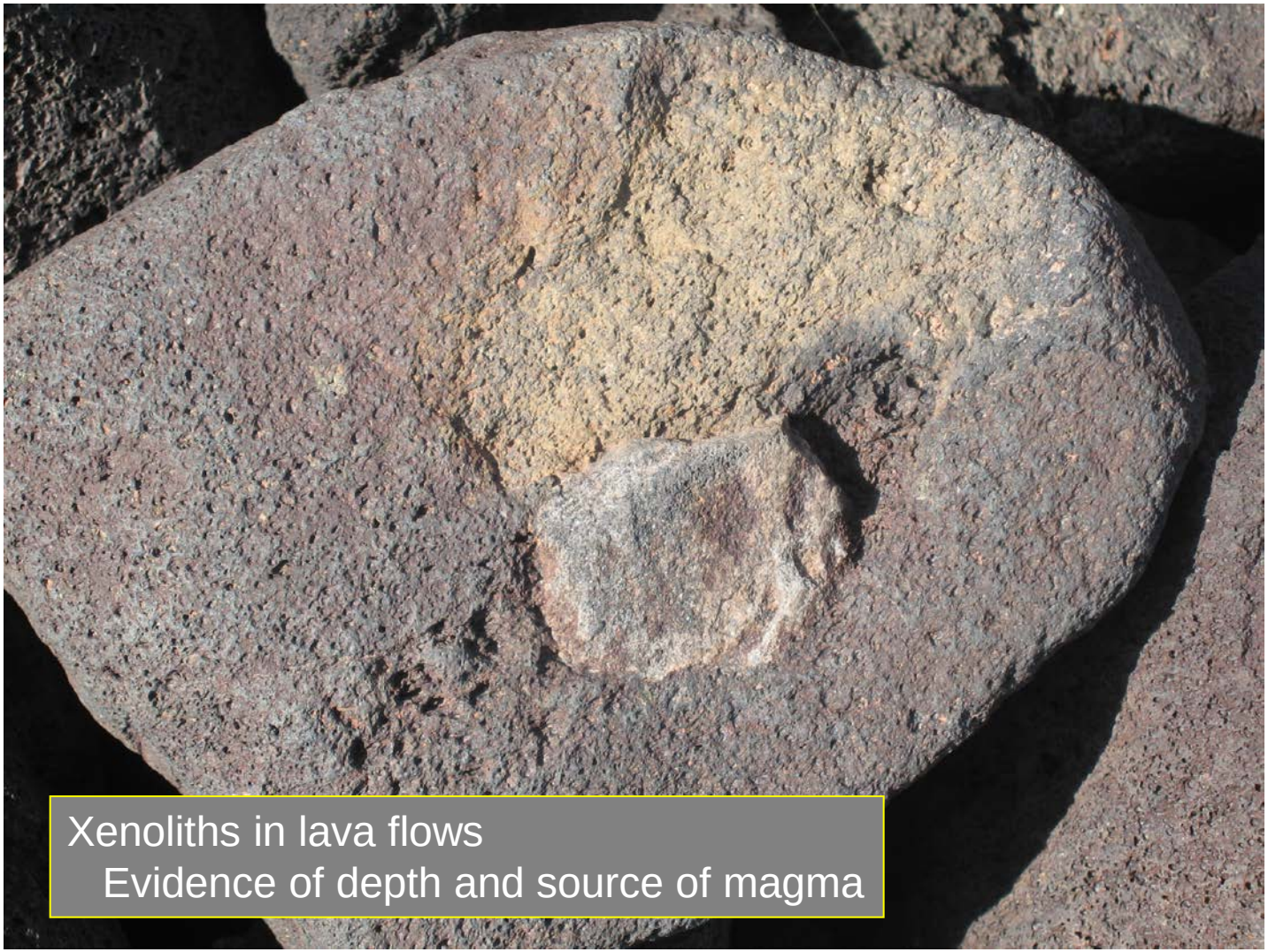
Regional Geologic Context

Final eruptive phase

A 6 m high cinder cone grew on the crater floor.

Regional Geologic Context

Regional Geologic Context



Regional Geologic Context

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