THE RELATIONSHIP BETWEEN LAVA FANS AND TUBES ON OLYMPUS MONS IN THE THARIS REGION, MARS.

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Lava Tubes and Fans on the Flanks of Olympus Mons, Mars

Introduction

-New mapping based of THEMIS/HRSC

-Conducted during internship at Goddard Space Flight Center

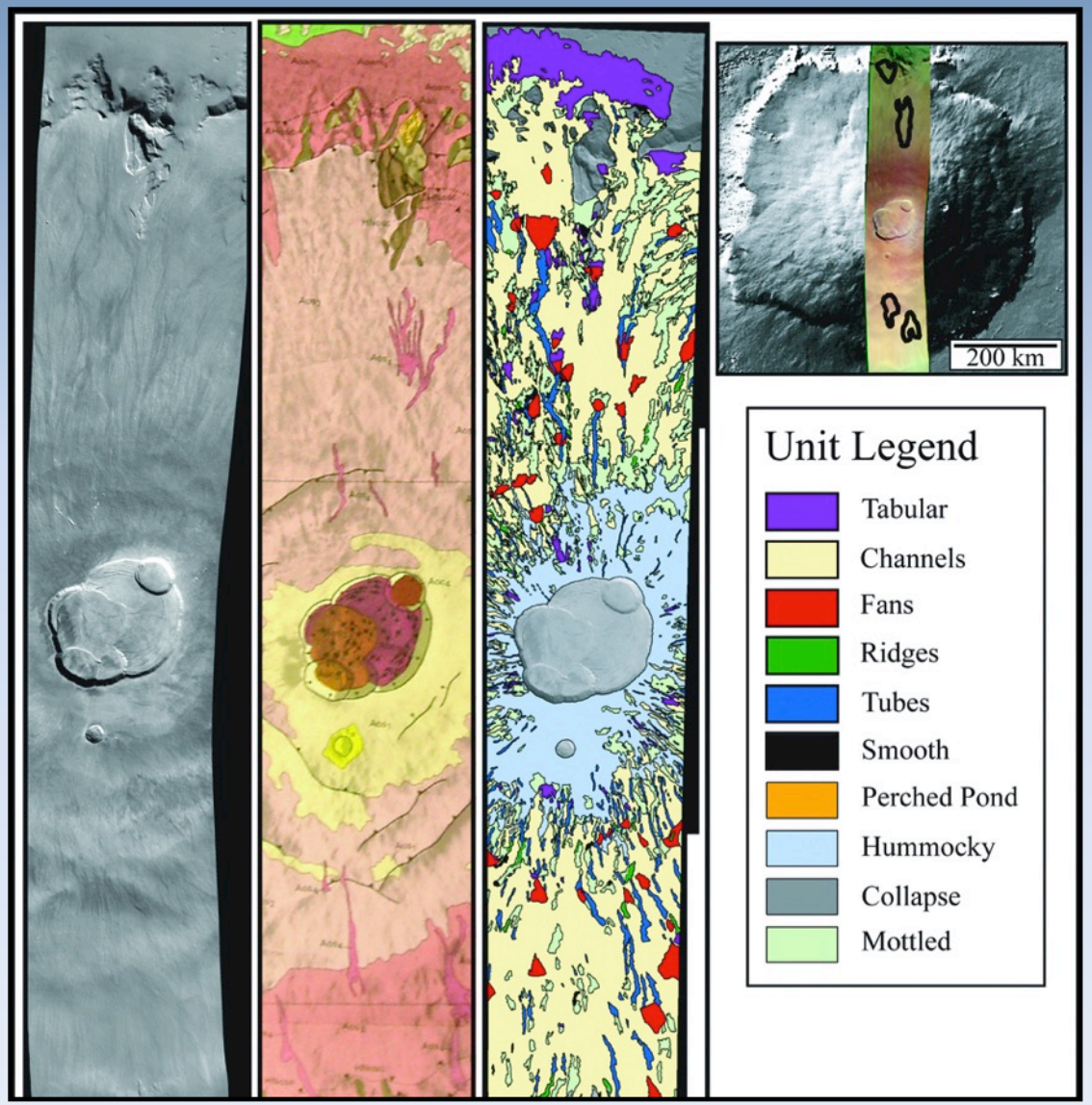
- "Catalog of Tharsis province small volcanic vents"

-Characterize and quantify spatial distribution of small volcanic vents

-Previous study by Bleacher et al. for Pavonis Mons

Objective: cataloging and spatial analysis of vents on Olympus Mons

Past mapping of Olympus Mons identified multiple features including lava fans

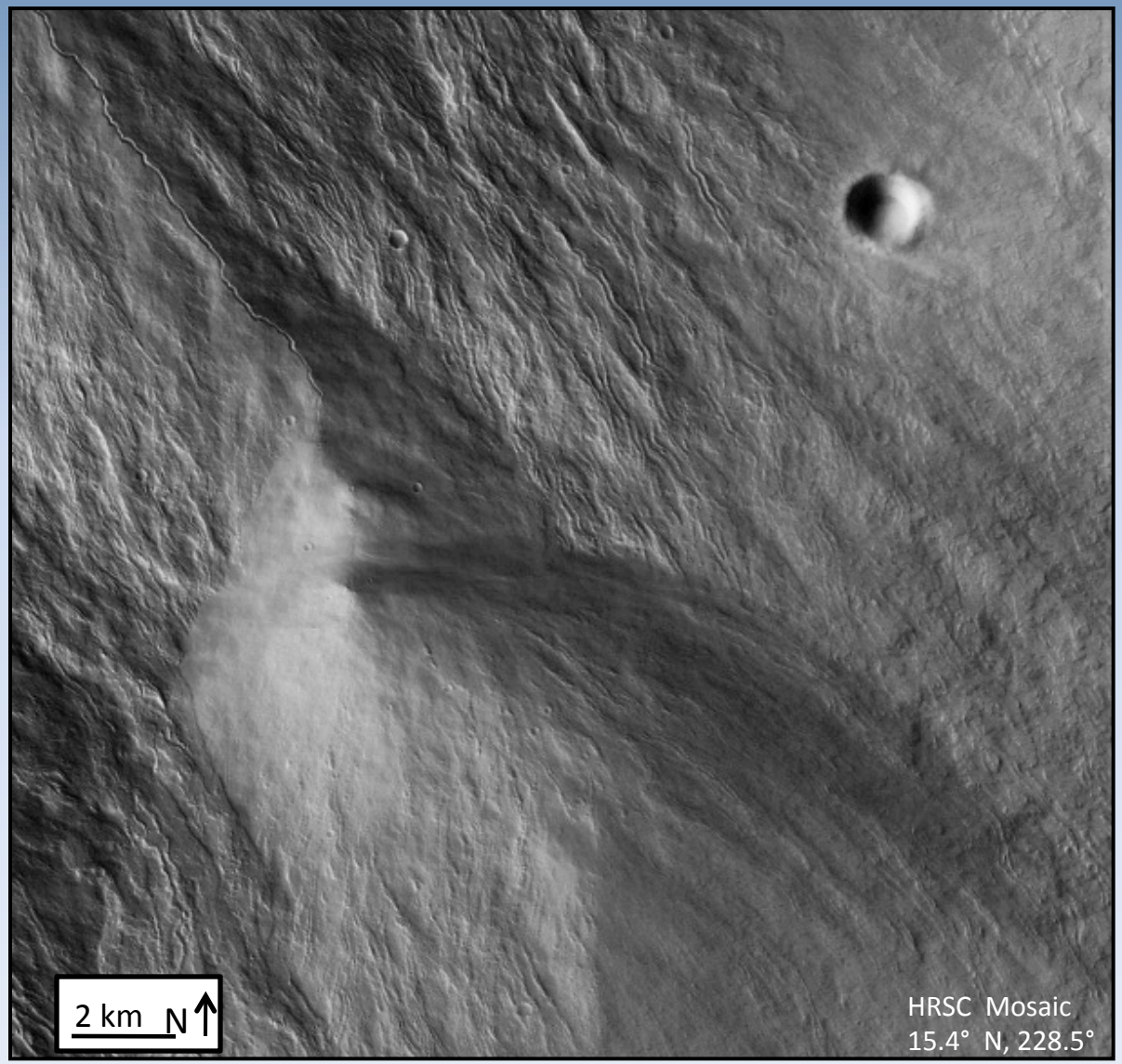


Lava Tubes and Fans on the Flanks of Olympus Mons, Mars

Small-scale volcanic features on the flank of Olympus Mons

- Fans
- Lava Tubes
- Ridges

What can we learn about the development of Olympus Mons by studying lava fans?



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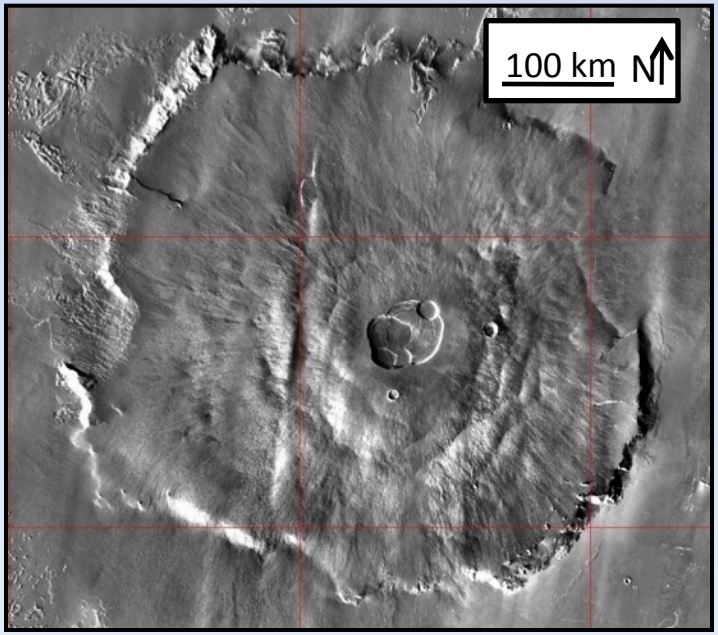
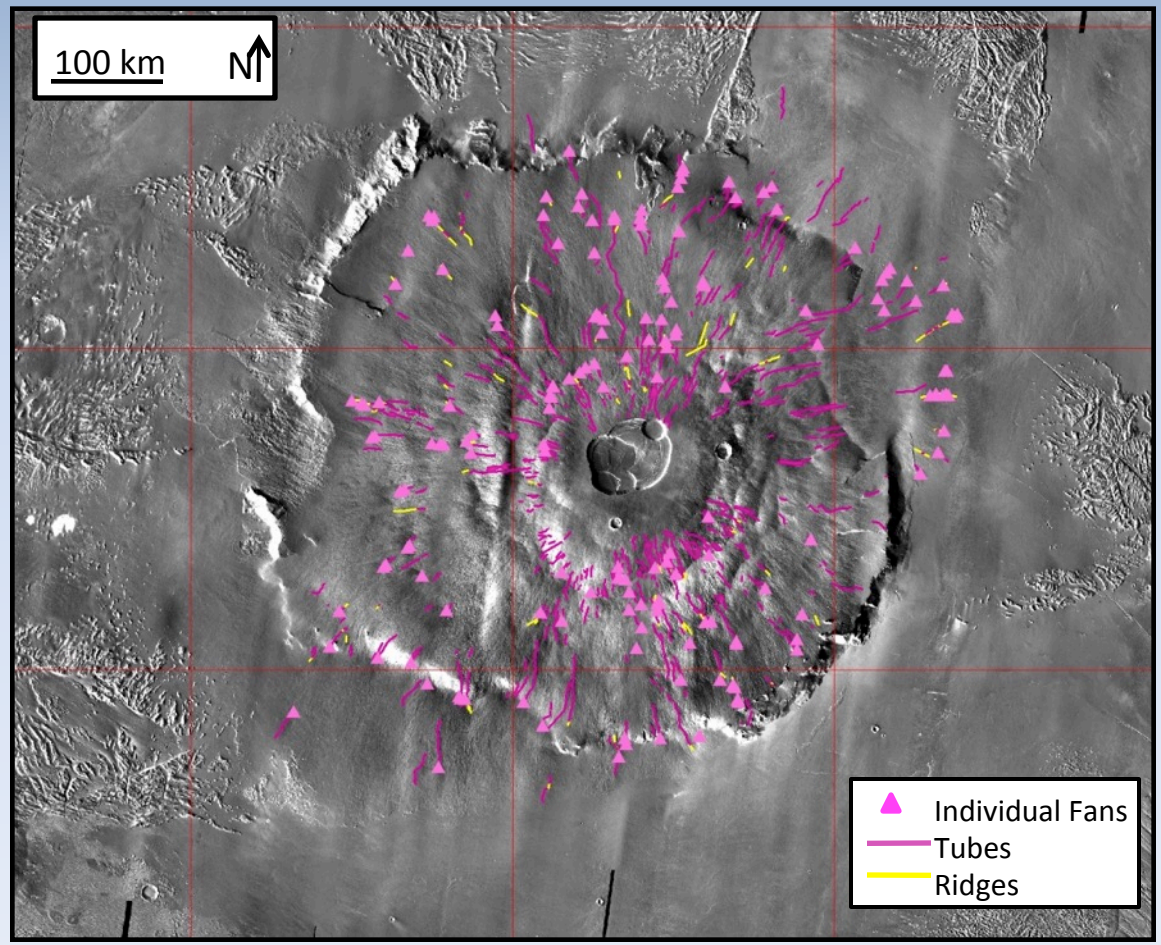
3 Prevailing Hypotheses

- **Lava Tubes**
  - Carr (1973) • Greeley (1973)
  - Carr et al. (1977) • Bleacher et al. (2007)
- **Terraces**
  - Morris and Tanaka (1994)
- **Rift zones**
  - Mouginis-Mark & Christensen (2005)



Method

- GIS mapping
- All tubes, ridges, fans mapped
- Correlated feature relationships
- Nearest neighbor statistical analysis



What is a lava fan?

Earth Analogue

osaic
228.5°
E

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Single Apex Fans

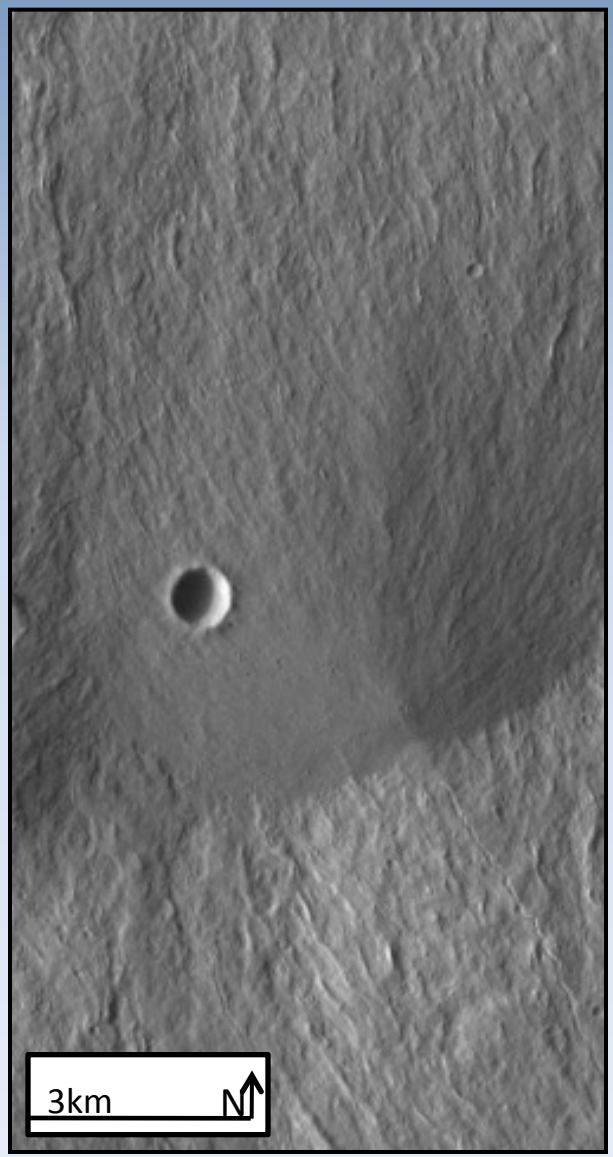
Fan Complexes

Nested Fans

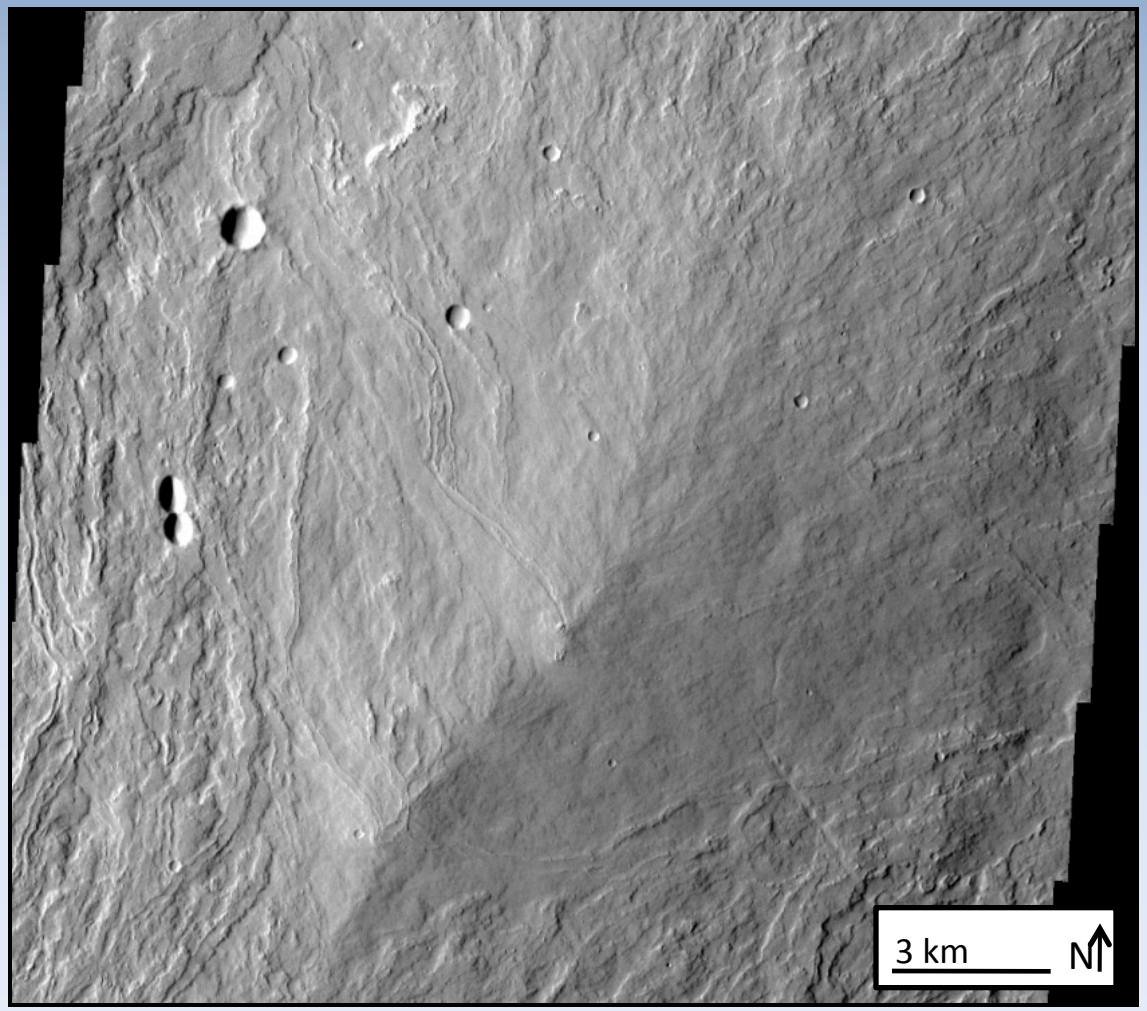
Adjacent Fans

Single Apex Fans

- Exhibit a delta-like shape
- Often composed of outpourings of lava that can be traced to a single apex
- Have a single apex that serves as topographic high-point
- Small collapse pits and boulder-like features are commonly located at the apex
- Fans are typically embayed by younger lava flows



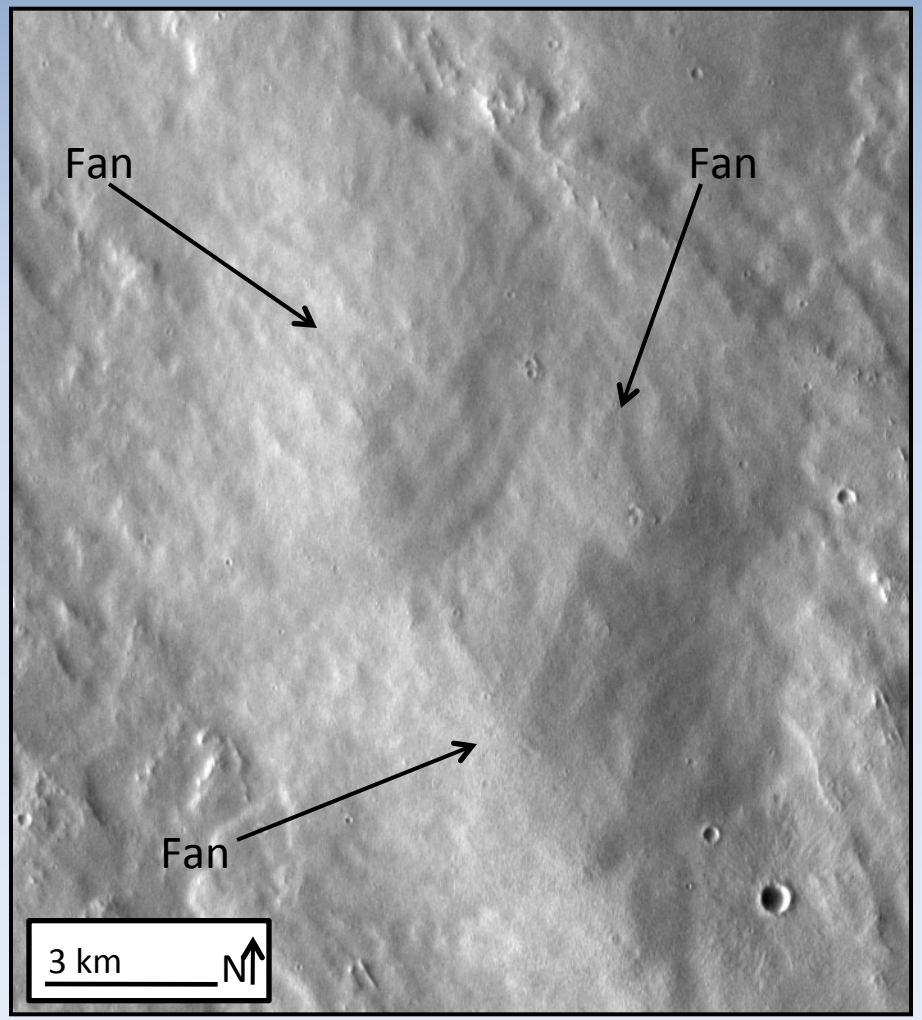
Fan Complexes



Nested Fan

- Characterized by outpourings of lava that can be traced to multiple apexes
- The apexes are in close enough proximity to create a single fan structure that can not be subdivided into multiple fans
- Boundaries of the oldest fan (proximal fan) embays the boundaries of the younger fans located down slope (distal fan)

Fan Complexes

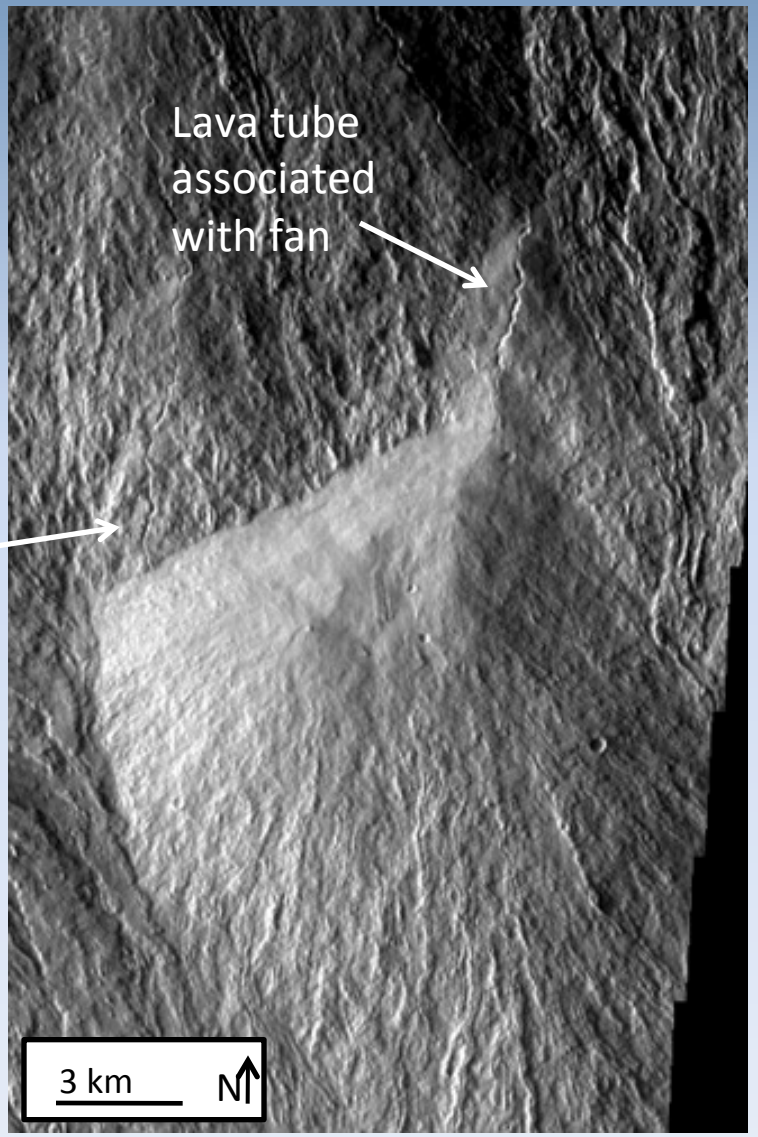


Adjacent

- Characterized by a cluster of single apex fans that can be dissociated from one another.
- Features generally overlap one another or
- Individual boundaries between features can be determined

Fan/tube Relationships

- Directly associated
- Probably associated
- Not associated



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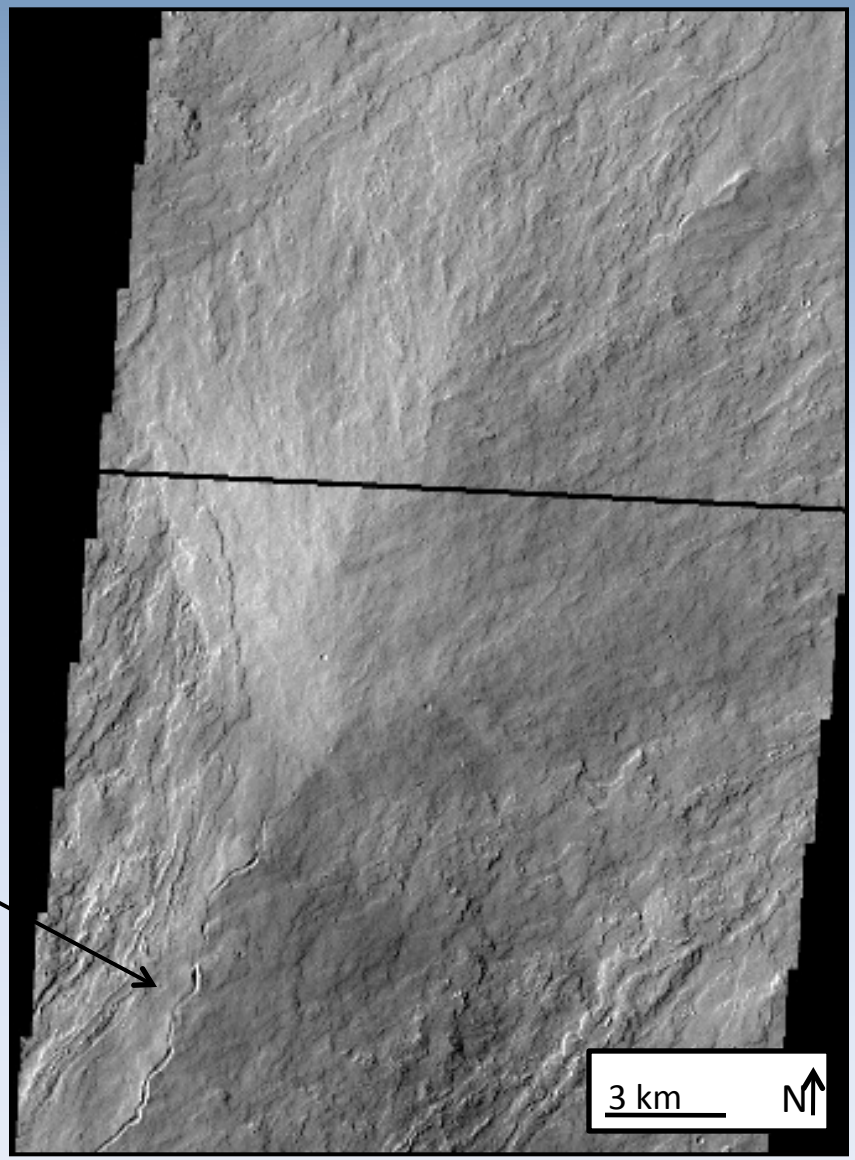
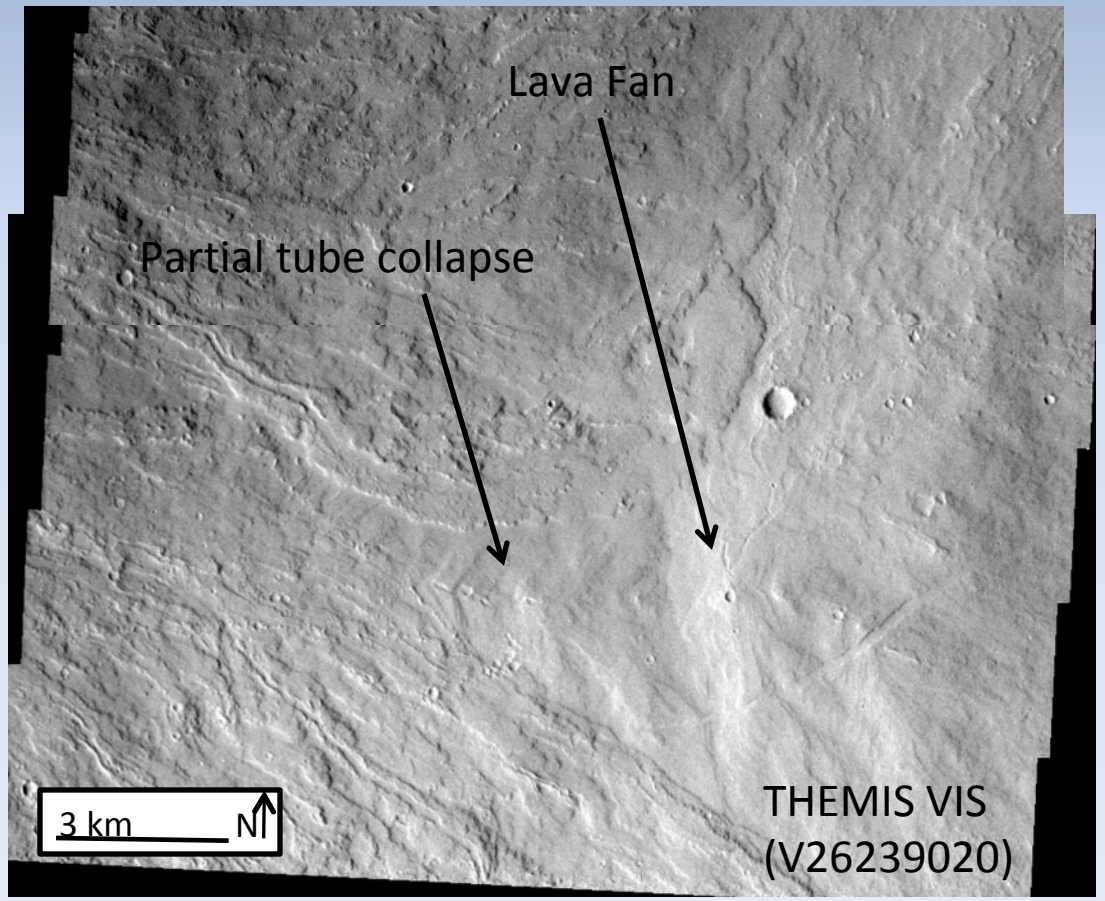
Fan/tube Relationships

- Directly Associated
  - Lava tubes trends into fan's apex
  - Continual or partial collapse of tube



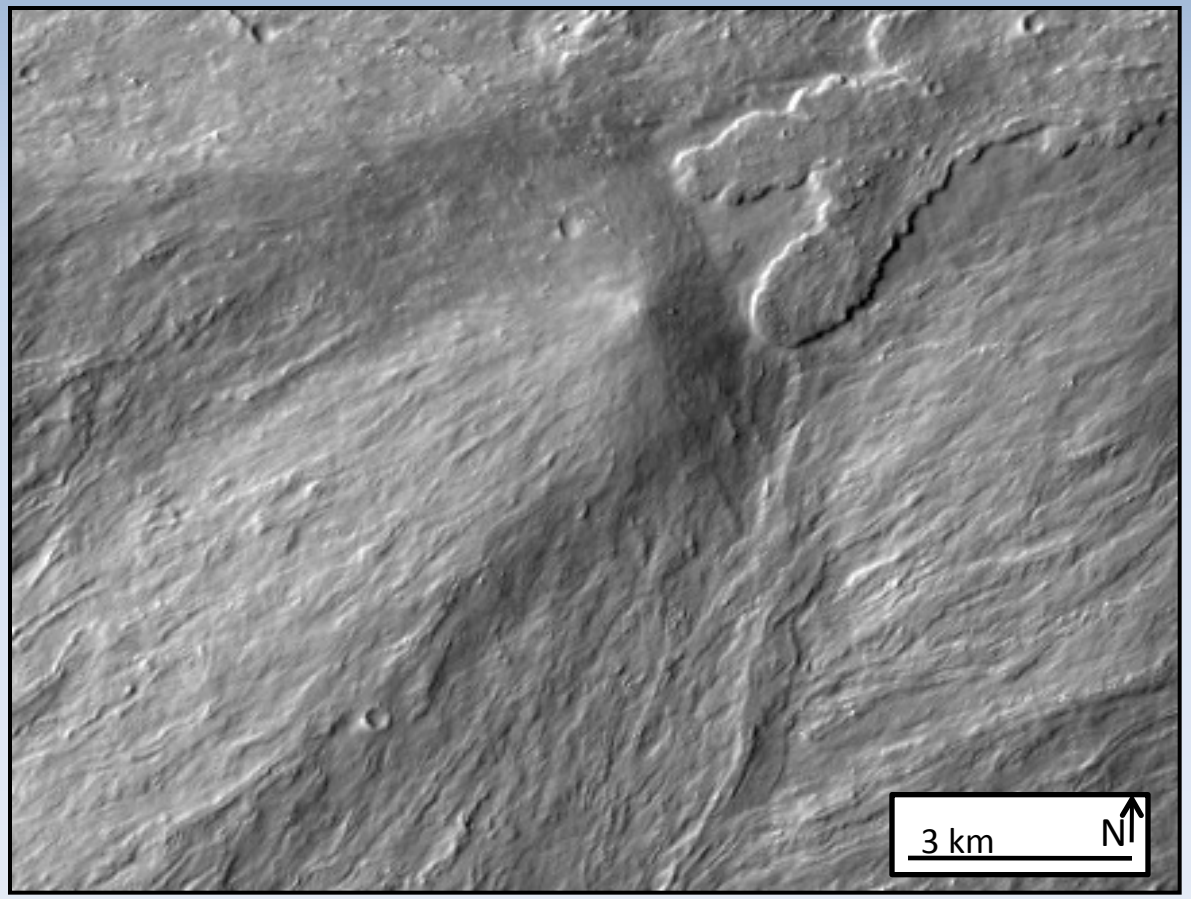
Fan/tube Relationships

- Likely Associated
  - Fans or fan complexes located in close proximity down slope of a collapsed or partially collapsed lava tube
  - Tube may be buried or not collapsed



Fan/tube Relationships

- Not Associated
  - No tube is present
  - Or tubes do not trend into the apex of the fan



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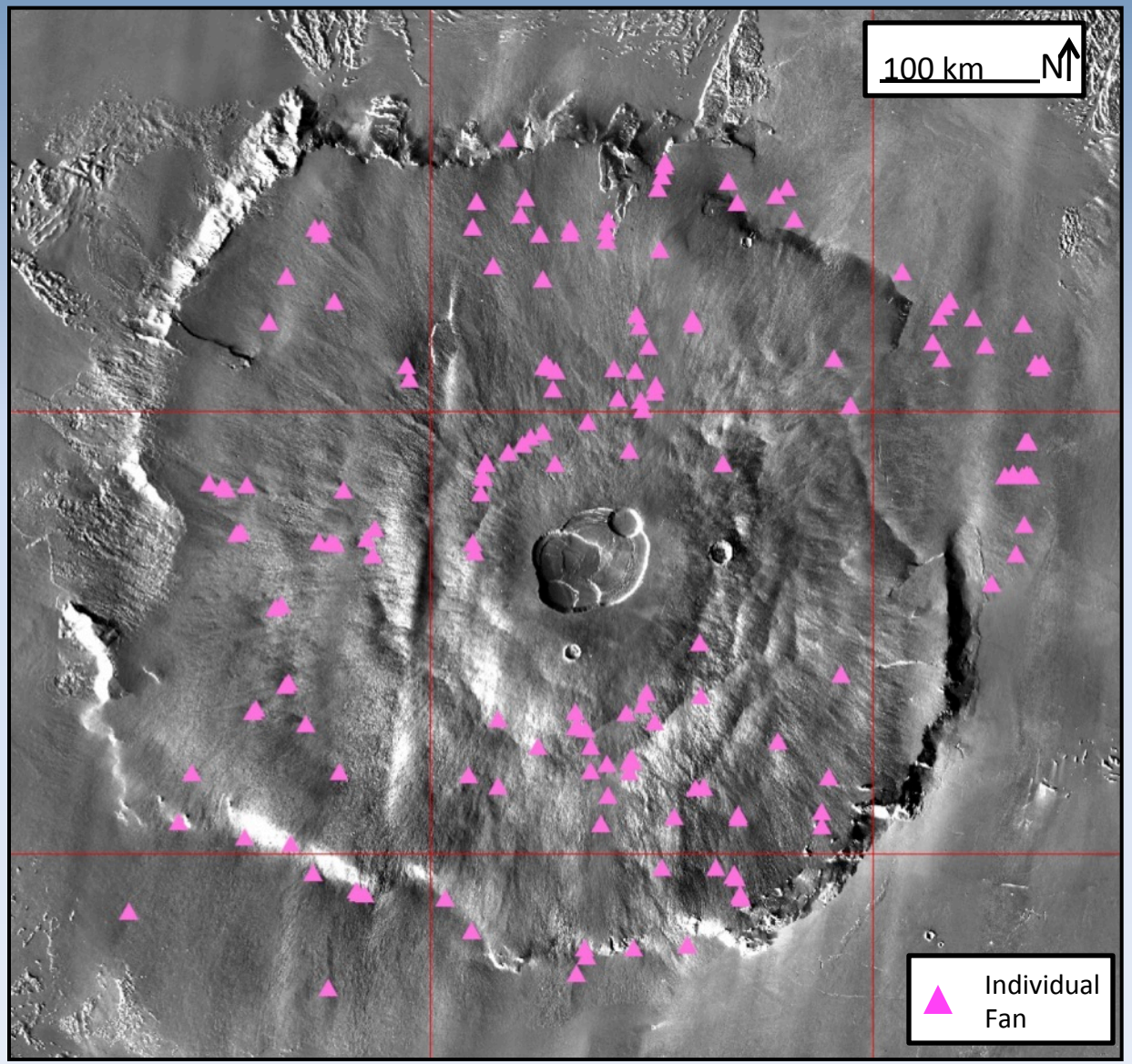
Results

3 hypotheses

- Tubes
- Terraces
- Rift zones

- 171 individual points of eruption
- 135 total fan events
- Nearest Neighbor statistics of individual fans (171) supports non-random distribution



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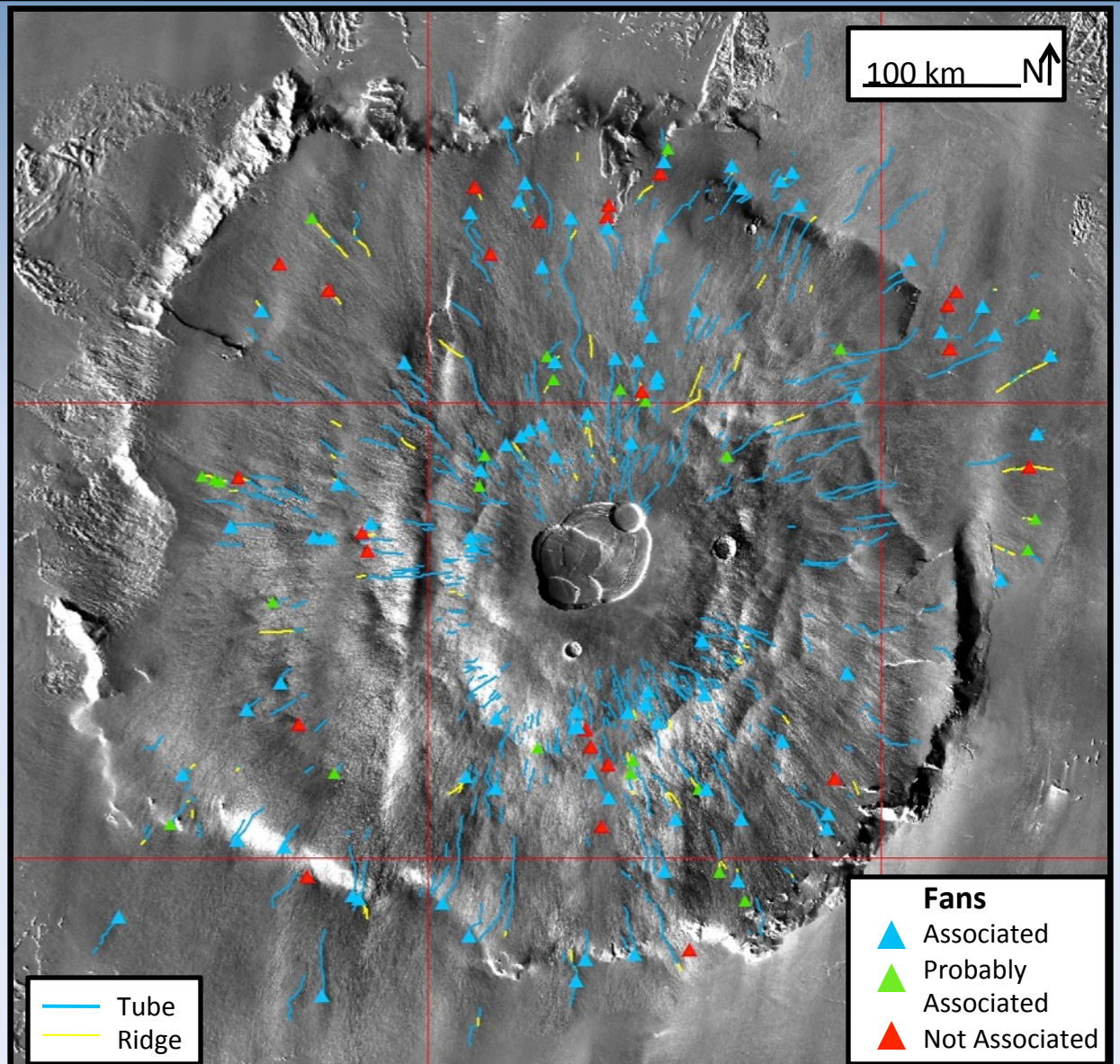
Results of Study

- 82% of fans associated with tubes
  - 86 fans associated with tubes
  - 25 fans probably associated
  - 24 fans not associated



Conclusion

- It is possible that there is more than one formation mechanism responsible for the total population of lava fans
- Strong relationship between lava tubes and fans
- Most of the fan features can be explained as surface features on the flank of Olympus Mons that are associated with lava tubes
- Burial of lava tubes could explain why 18% of surveyed fans are not associated with lava tubes
- Rift zones or another mechanism that has not yet been considered could also explain possible formation mechanism for fans that are not associated with lava tubes

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