To blast, or not to blast? – That is the Question

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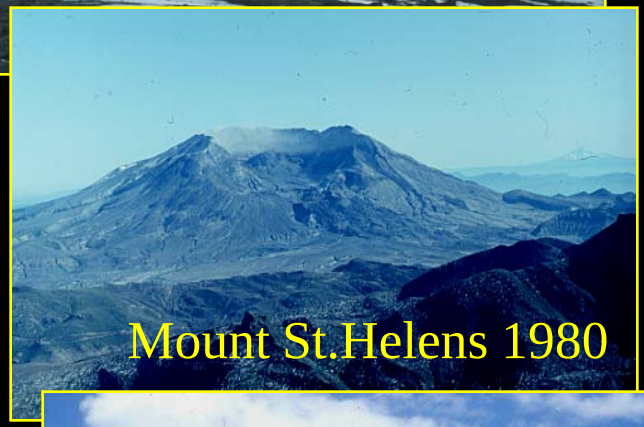
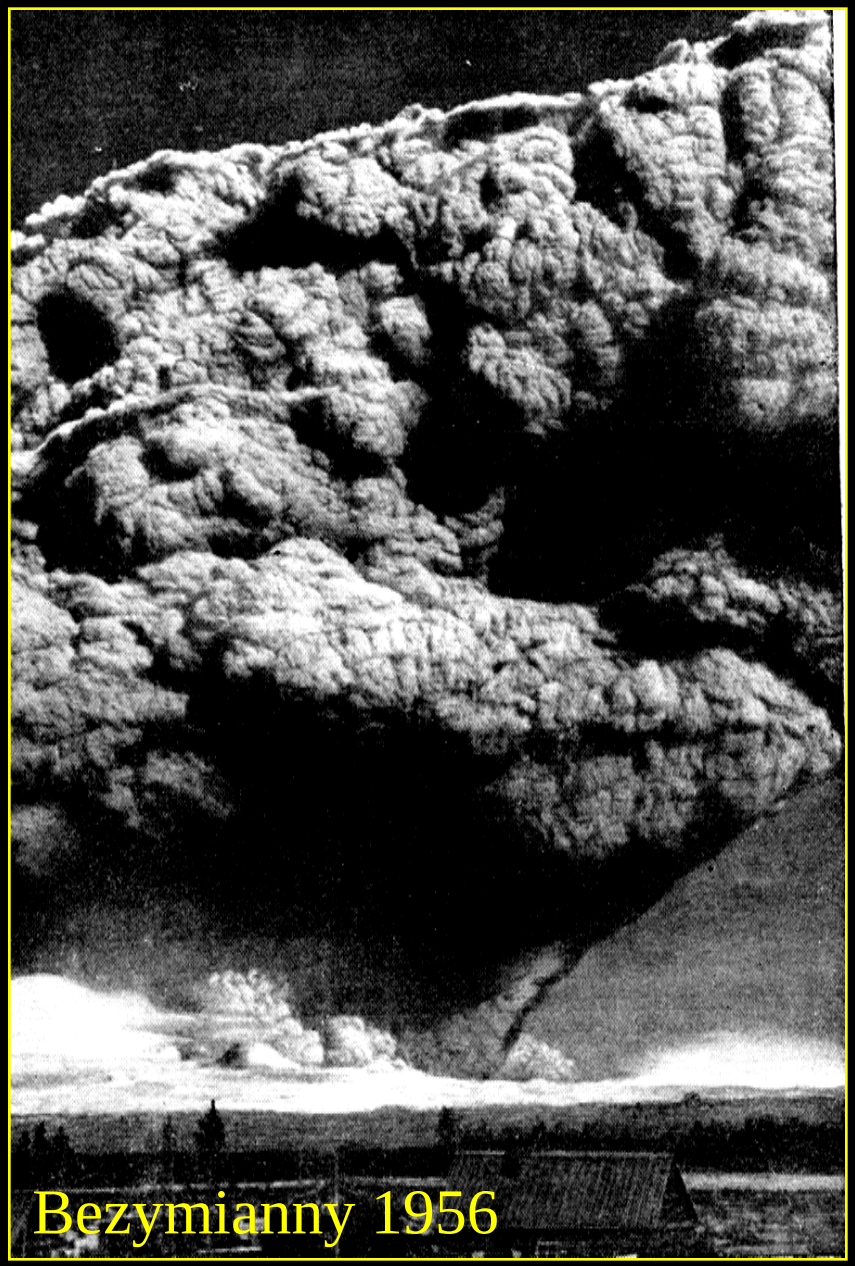


- **Active volcanoes frequently collapse**
- **5 sector collapses of volcanoes in the 20th century**

Collapse of an active volcano commonly provokes strong explosive eruption

Mount St.Helens 1980



Bezymianny 1956

QUESTIONS

- What are the main scenarios of failure-related eruptions?
- What factors determine the scenario?
- What factors lead to directed blast?

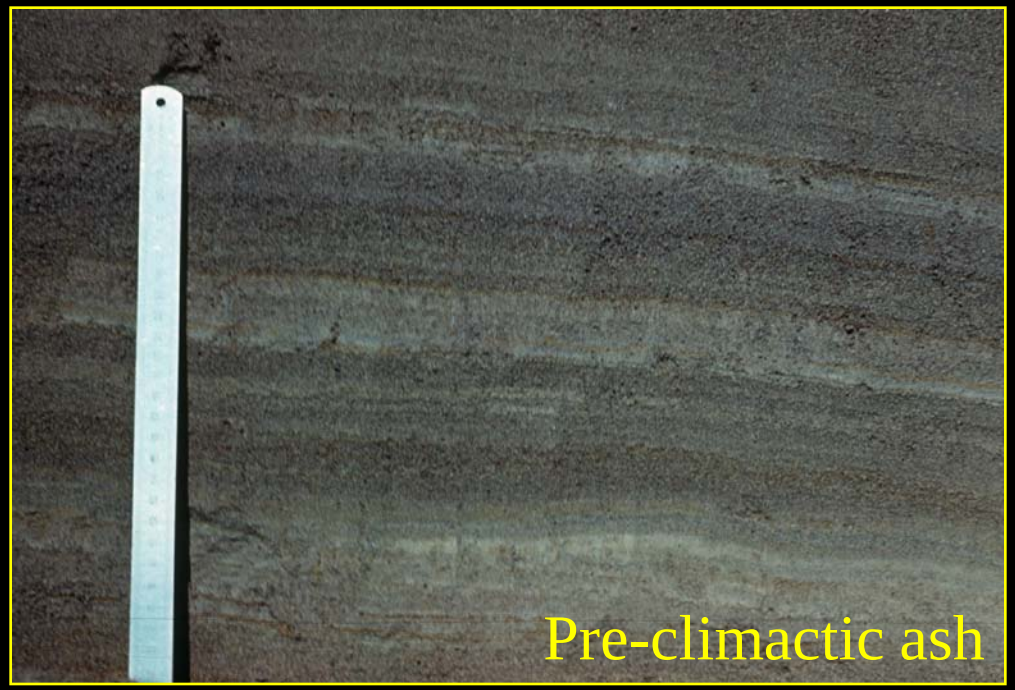
Sources of information

- Observational data
- Stratigraphy

Pre-failure activity

Intensive seismicity, and in some cases deformations and volcanic activity indicate intrusion of magma into the edifice


Bezymianny 1955


Pre-climactic ash

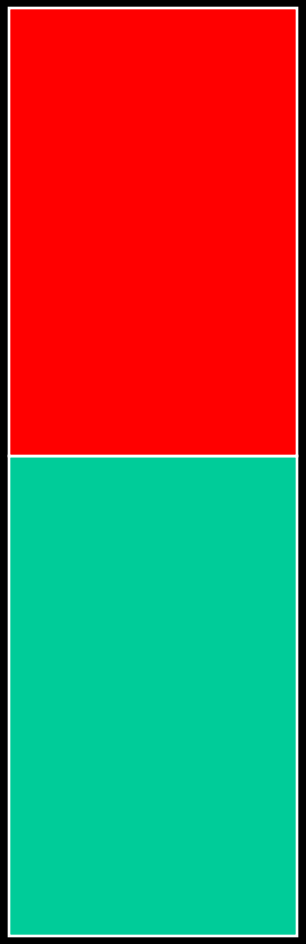

Common trigger of collapse:
intrusion of viscous magma

Climactic stage

1. Edifice failure
2. Strong explosive magmatic eruption

First type of stratigraphy

deposits of failure-related eruptions



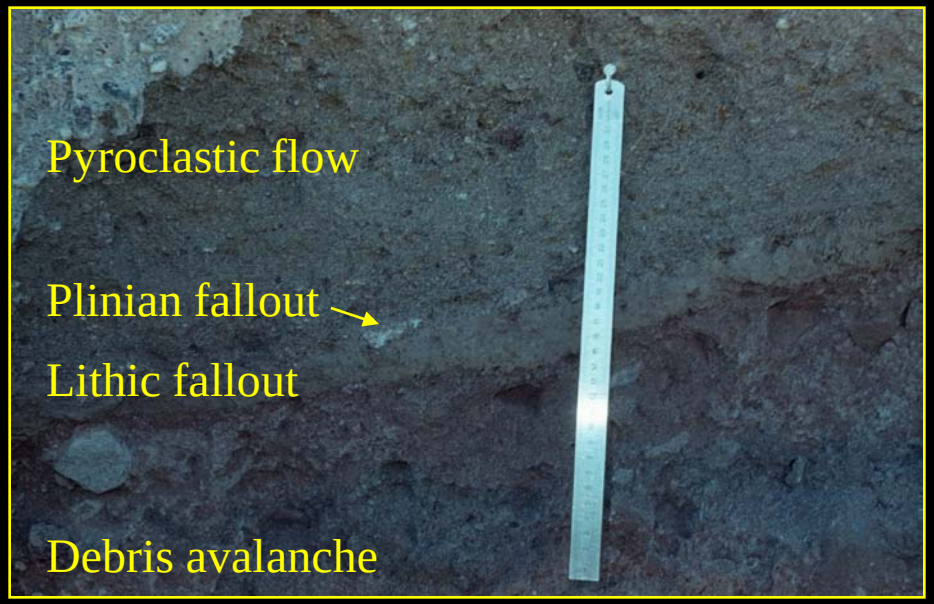
Pyroclastic flow and fallout deposits

Debris avalanche deposit

Examples: Harimkotan 2000 C14 and 1933

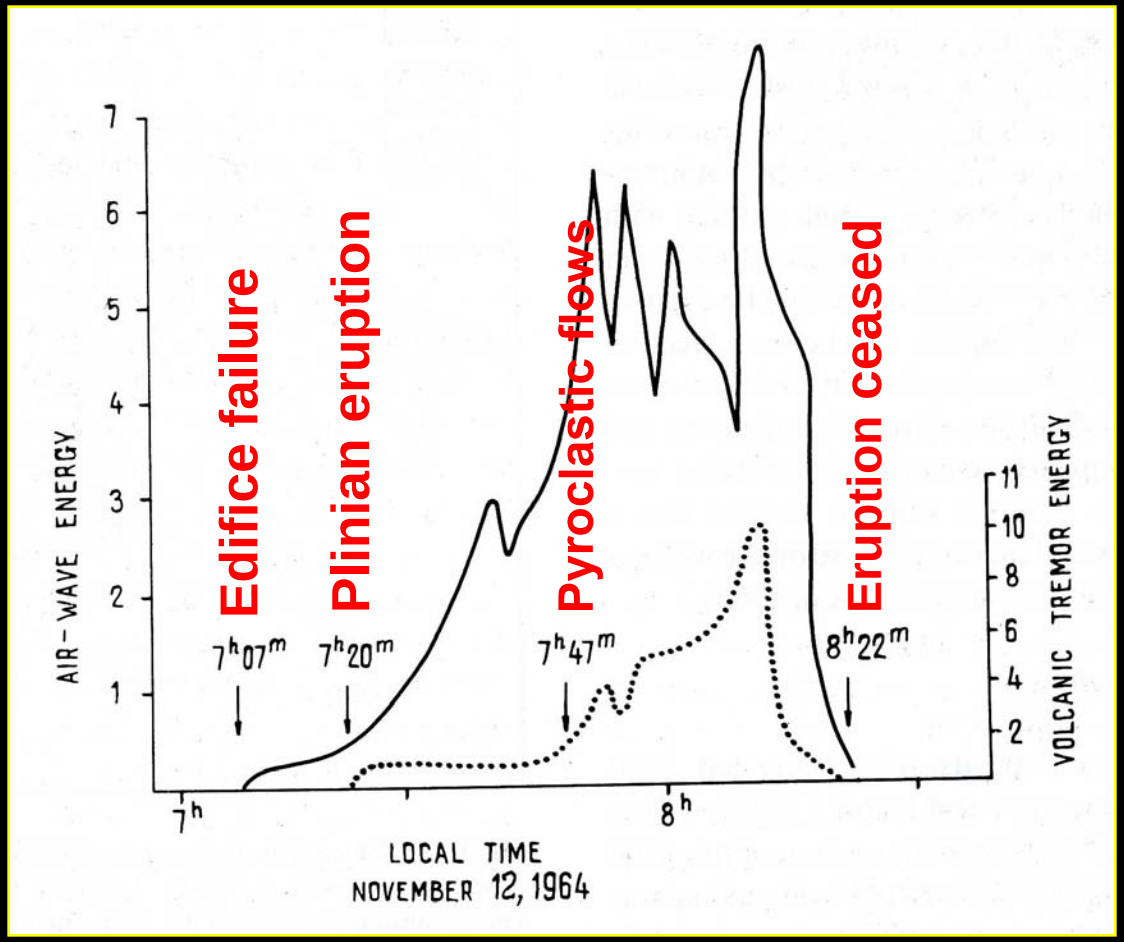
Shiveluch 1964

1. Failure
2. Phreatic explosion
3. Plinian eruption
4. Deposition of PFs



Shiveluch 1964

Time gap between failure and onset of magmatic eruption was large (13 min).

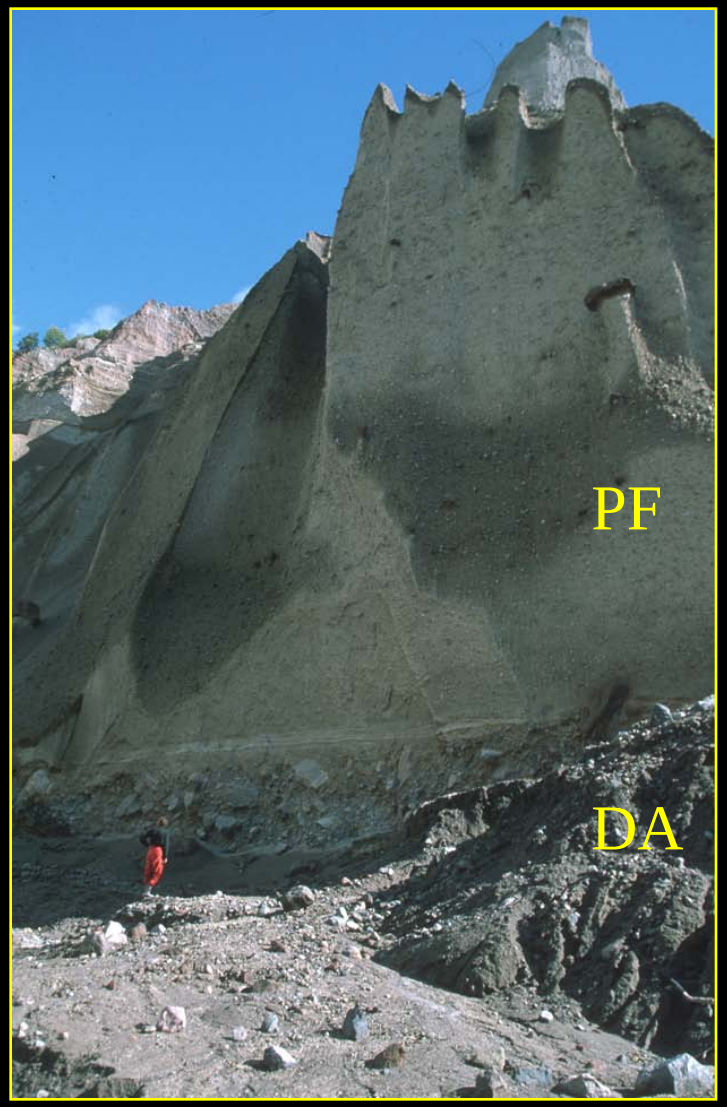


Air-wave and volcanic tremor energy during November 12, 1964 eruption of Shiveluch (with modifications after Tokarev 1967)

Shiveluch

500 BP

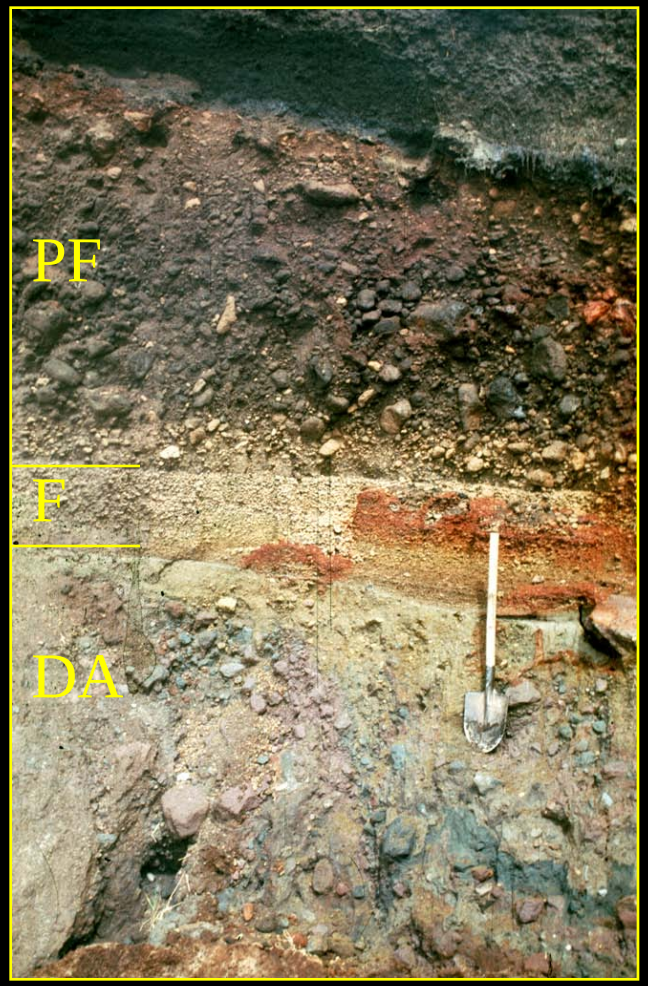
1600 BP



Harimkotan

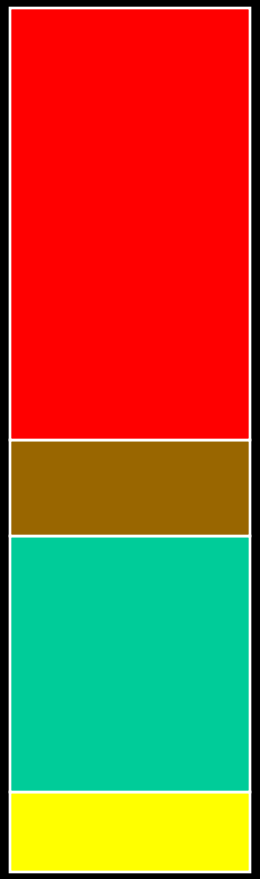
1933

2000 BP



Second type of stratigraphy

deposits of failure-related eruptions



Pyroclastic flow and fallout deposits

Directed blast deposit

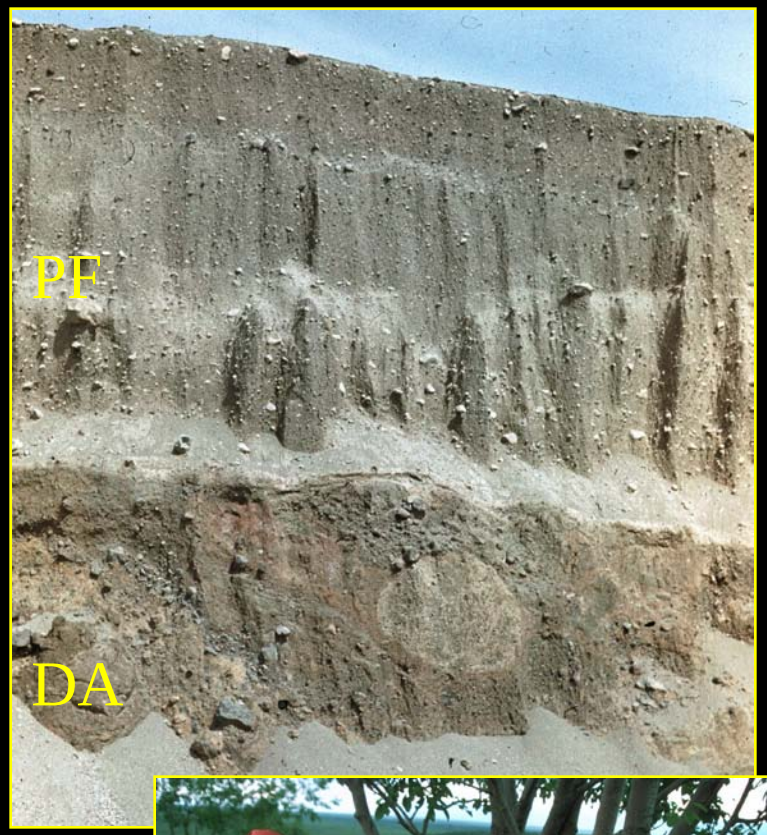
Debris avalanche deposit

Pre-climactic ash

Examples: Bezymianny 1956; Mount St.Helens 1980; Soufriere Hills Montserrat 1996

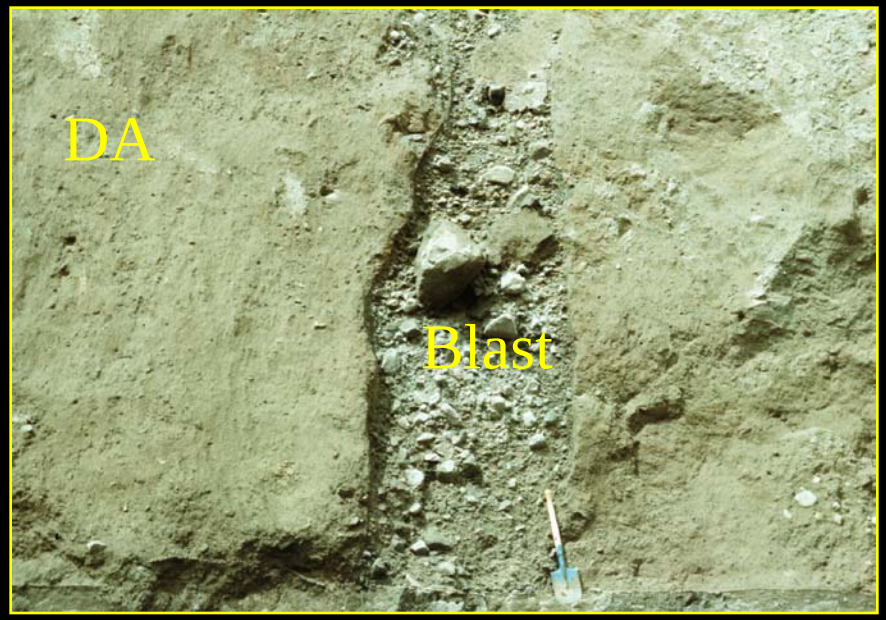
Bezymianny 1956

1. Sector collapse
2. Directed blast
3. Vertical eruption (Deposition of PFs)



Bezymianny 1956

Stratigraphic relations and character of contact between debris avalanche and blast deposits indicate that their deposition was closely spaced in time.

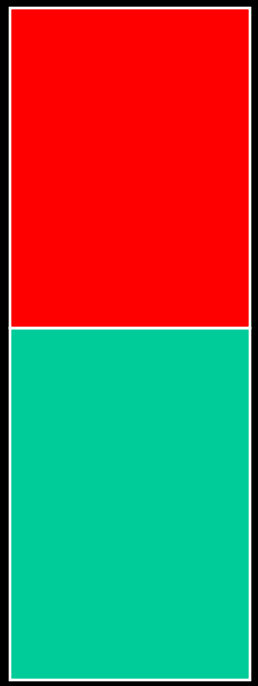


Time gap between failure and magmatic eruption was short

Two types of stratigraphy

deposits of failure-related eruptions

1

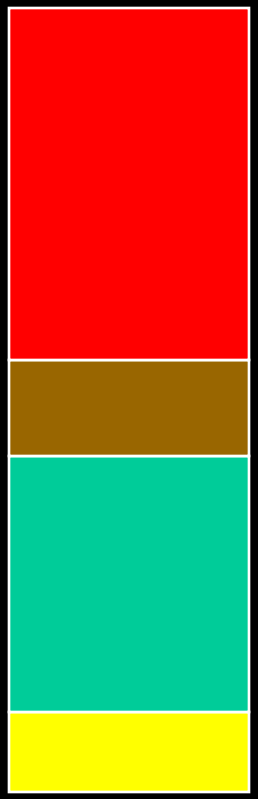


Pyroclastic flow and fallout deposits

Debris avalanche deposit

Examples: Harimkotan 1933, Shiveluch 1964

2



Pyroclastic flow and fallout deposits

Directed blast deposit

Debris avalanche deposit

Pre-climactic ash

Examples: **Bezymianny 1956, Mount St.Helens 1980, Soufriere Hills Montserrat 1996**

Basic scenarios

failure-related eruptions

1

1. Sector collapse
2. Vertical eruption (Plinian/Vulcanian)

Examples: Harimkotan 1933, Shiveluch 1964

2

1. Pre-climactic (pre-failure) volcanic activity
2. Sector collapse
3. Directed blast
4. Vertical eruption (Plinian/Vulcanian)

Examples: Bezymianny 1956, Mount St.Helens 1980, Soufriere Hills Montserrat 1996

Differences

Scenario 1

1. No pre-collapse volcanic activity.
2. No blast.
3. Long time span between failure and magmatic eruption.

Shiveluch 1964

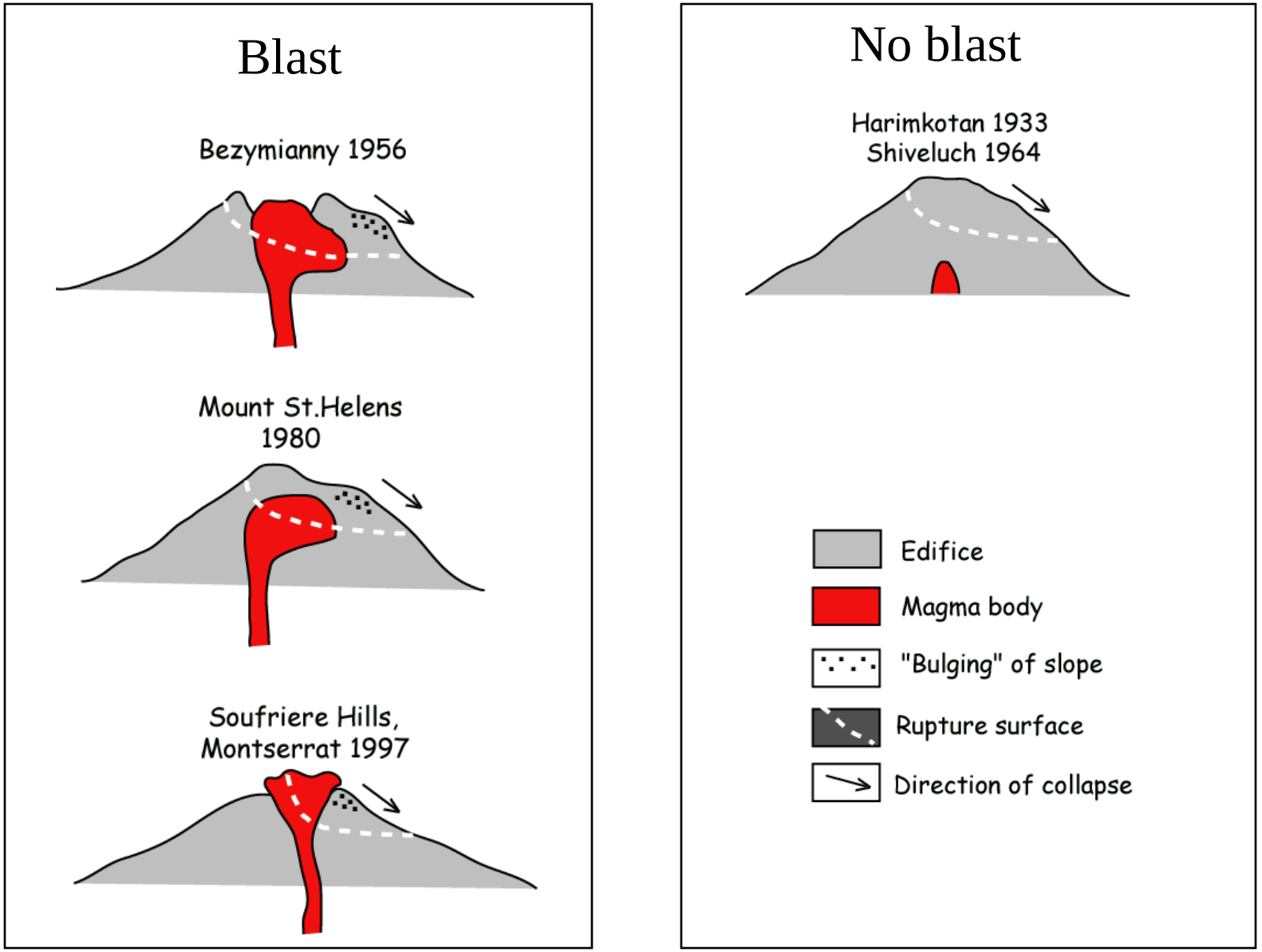
Scenario 2

1. Pre-collapse volcanic activity
2. Blast.
3. Short time span between failure and magmatic eruption.

Mount St.Helens 1980

Position of magma

in the moment of failure



Conclusions

- Two basic scenarios of failure-related eruptions: Shiveluch type (no blast) and Bezymianny type (blast).
- To blast or not to blast depends on a level of magma in the moment of failure: shallow – blast, deep – no blast.
- Interplay between edifice stability and destabilizing effect of the intruding magma determine the scenario.