# Large-scale landslides at volcanoes in Kuril-Kamchatka region

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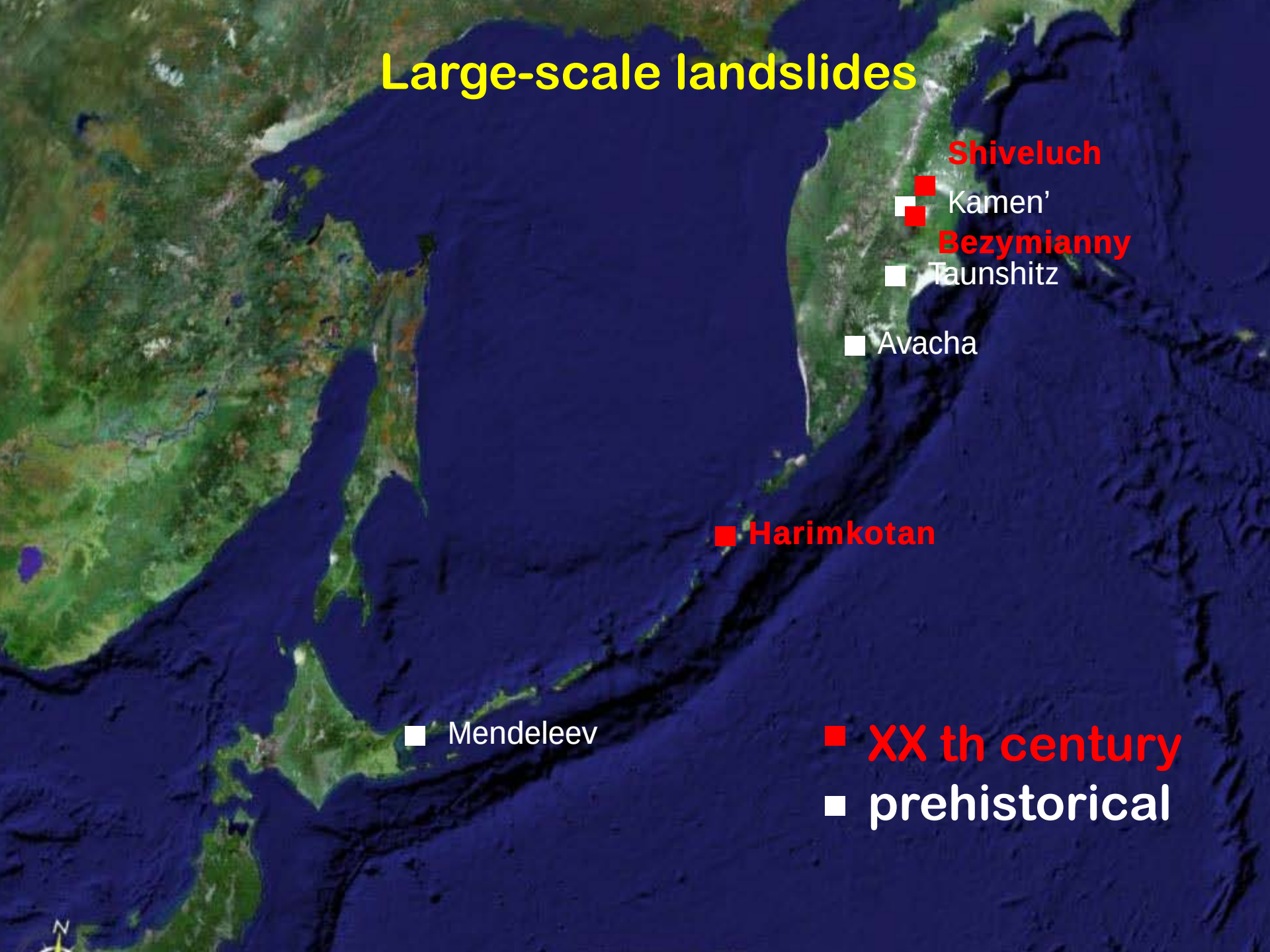
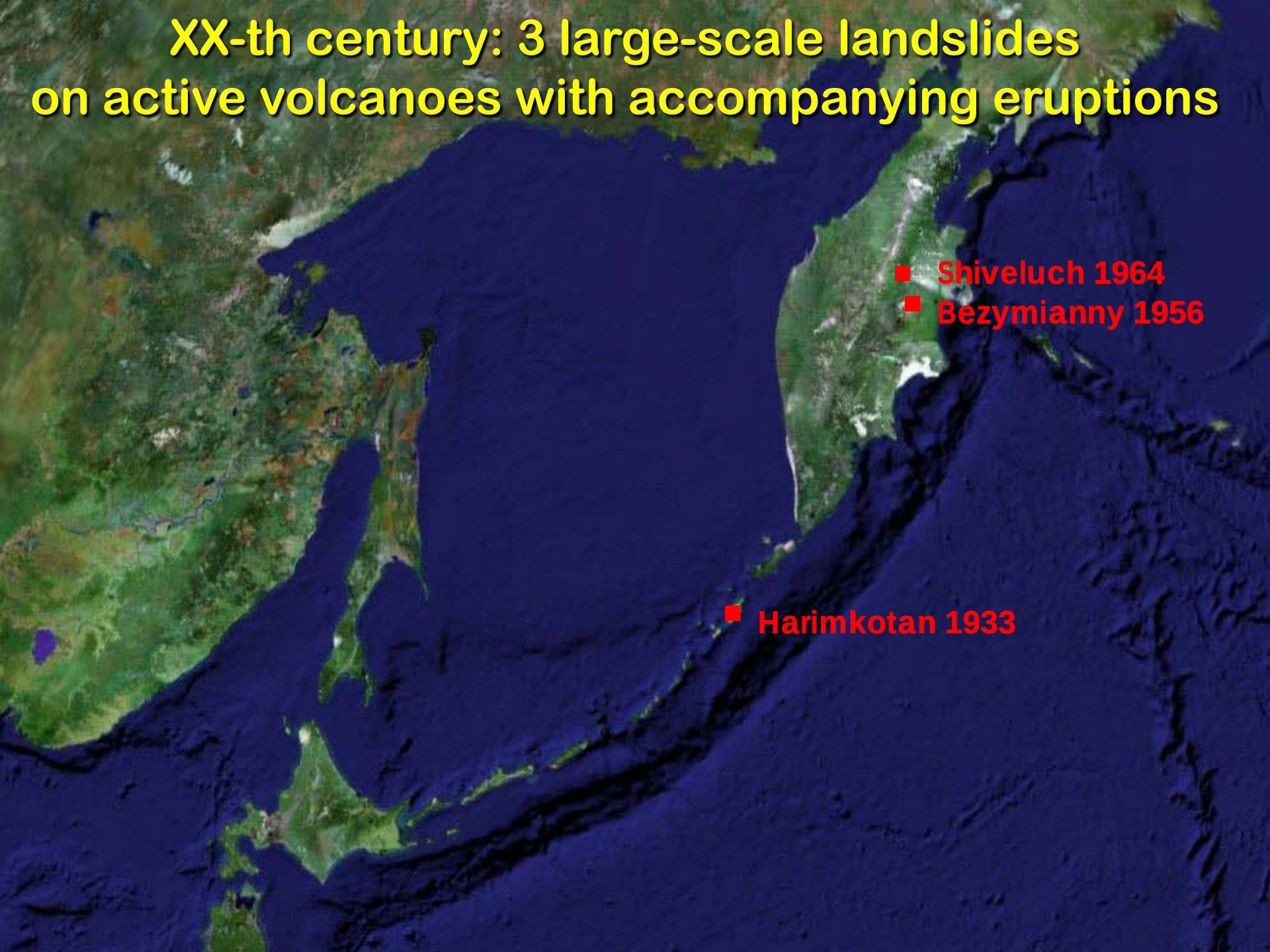

Large-scale landslides
Shiveluch
Kamen’
Bezymianny
Taunshitz
Avacha
Harimkotan
Mendeleev
XX th century
prehistorical

# 3 main types of large-scale landslides on volcanoes:

- on active volcanoes, associated with eruptions (XXth century – Harimkotan 1933, Bezymianny 1956, Shiveluch 1964)

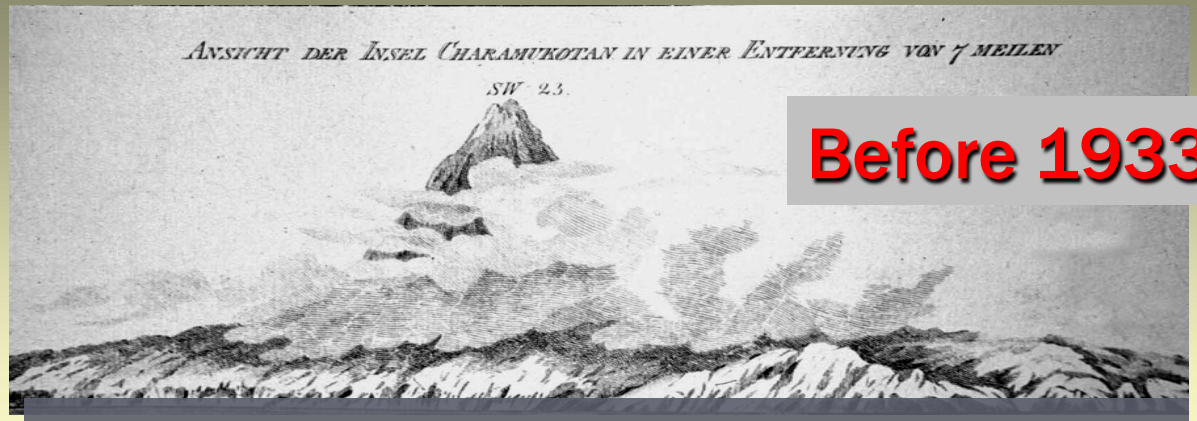
- on active volcanoes, but without proved deposits of associated eruptions (Avacha 30,000 BP, Taunshits 7000BP, Mendeleev –early Holocene)

- on extinct volcanoes (Kamen' volcano 10,000 BP)


XX-th century: 3 large-scale landslides
on active volcanoes with accompanying eruptions
Shiveluch 1964
Bezymianny 1956
Harimkotan 1933

# Harimkotan, January 8, 1933 landslide and eruption

Harimkotan 1933 eruption was studied by Miyatake K, 1934; Nemoto T, 1934 Gorshkov, 1967

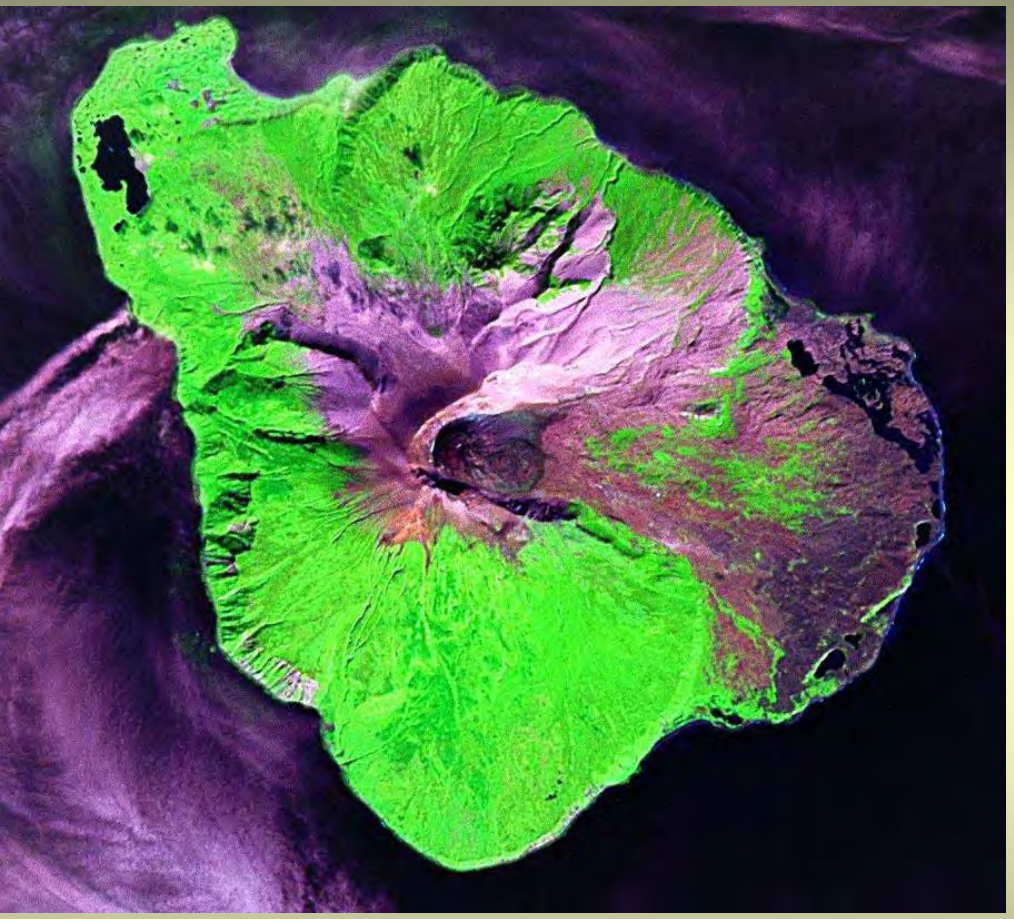



Expedition of captain Kruzenstern (1805)

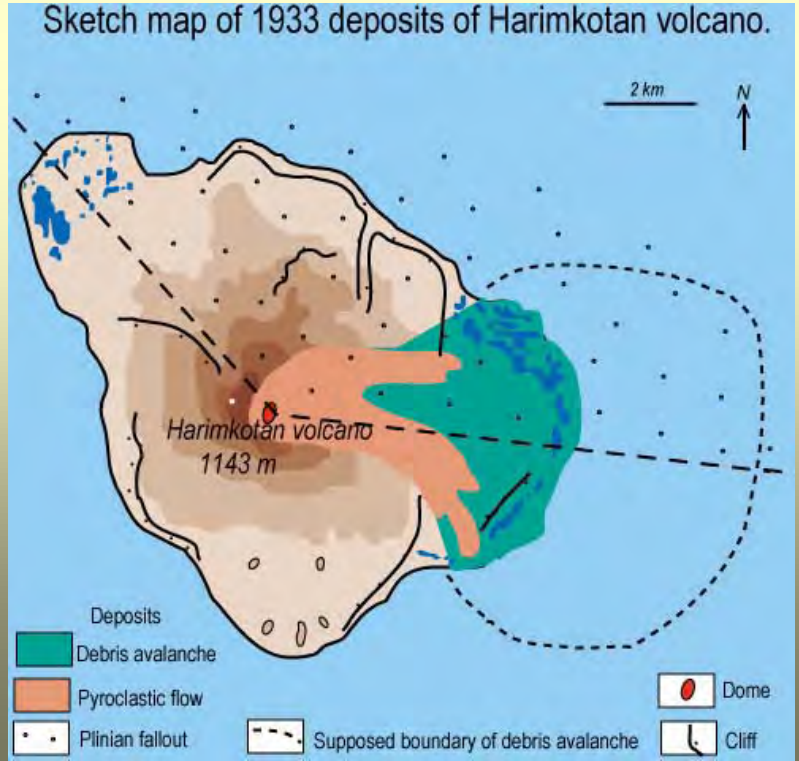
For reconstruction of eruptive events we used diary of Takaki family who witnessed the eruption


Crater with the 1933 dome

# Characteristics of the 1933 Harimkotan debris avalanche



L (max length) > 7 km
H (dropped height) – 1.25km
S (area) > 20 sq. km
V (volume) > 0.5 cub. km
(4% of edifice)
Thickness - 10-15 m



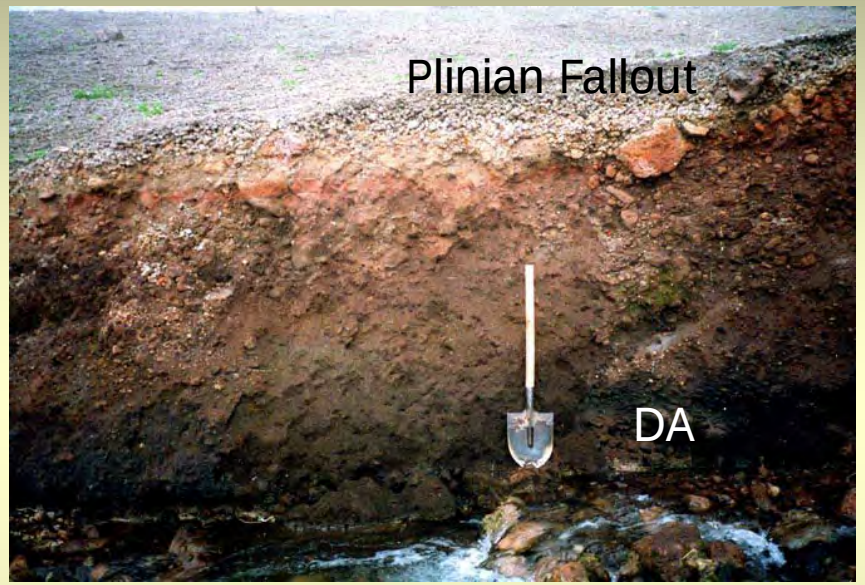
New shore formed by the 1933 DA

Hummocky surface

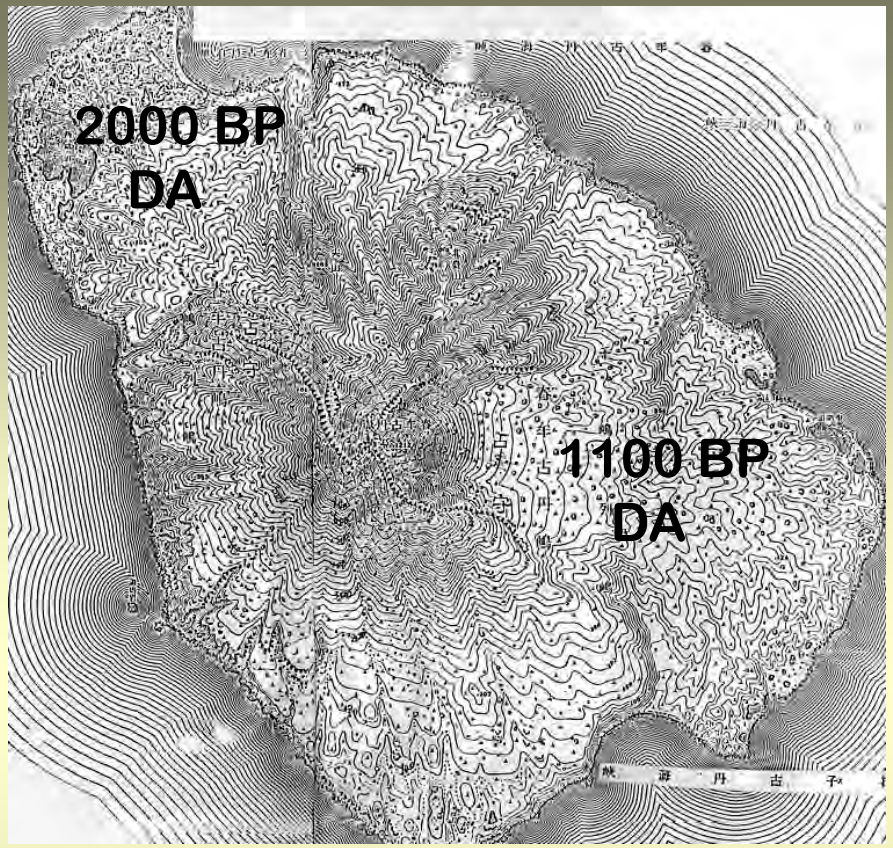

Tsunami deposits connected with entrance of the 1933 debris avalanche itto the Pacific Ocean

# Structure of DA deposits:

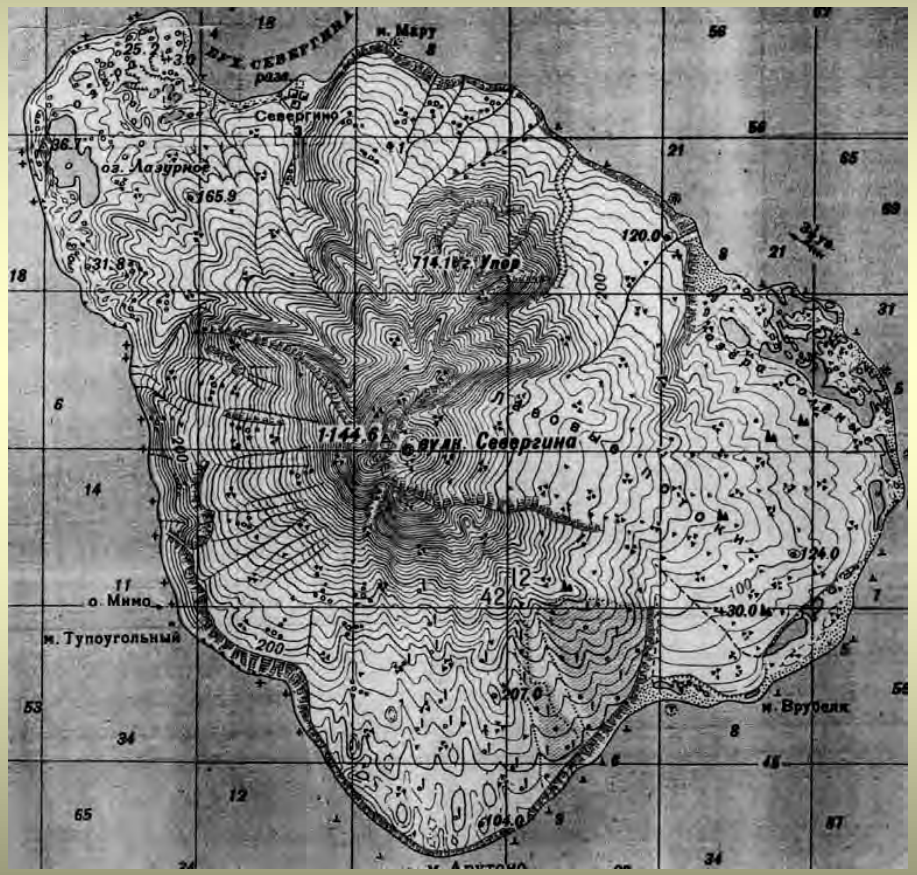
Block facies of the deposit formed by hydrothermally altered material




Deposits of strong explosive eruption associated with 1933 DA




Topographic map, 1916




Topographic map, 1950

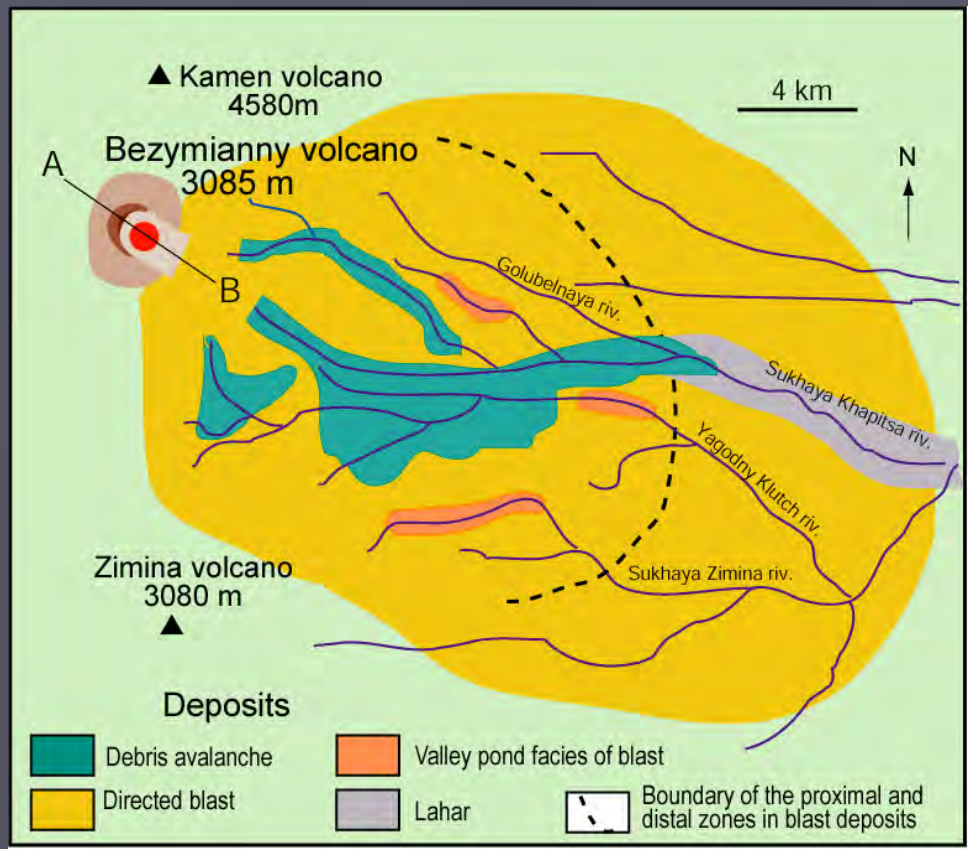
# Large-scale landslide at Bezymianny volcano on March 30, 1956



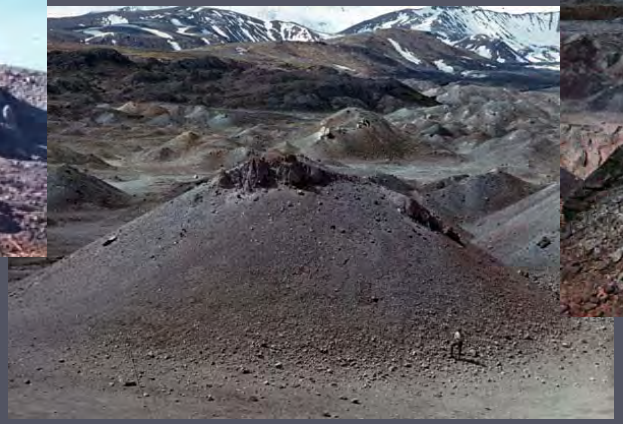
# Characteristics of Bezymianny 1956 debris avalanche

L (max length) -22 km
H (dropped height) – 2.4 km
S (area) – 60 sq. km
V (volume) 0.5 cub.km (10% of edifice)
Thickness – 20-30 m

Hummocky surface of DA



# Hummocky surface of Bezymianny DA

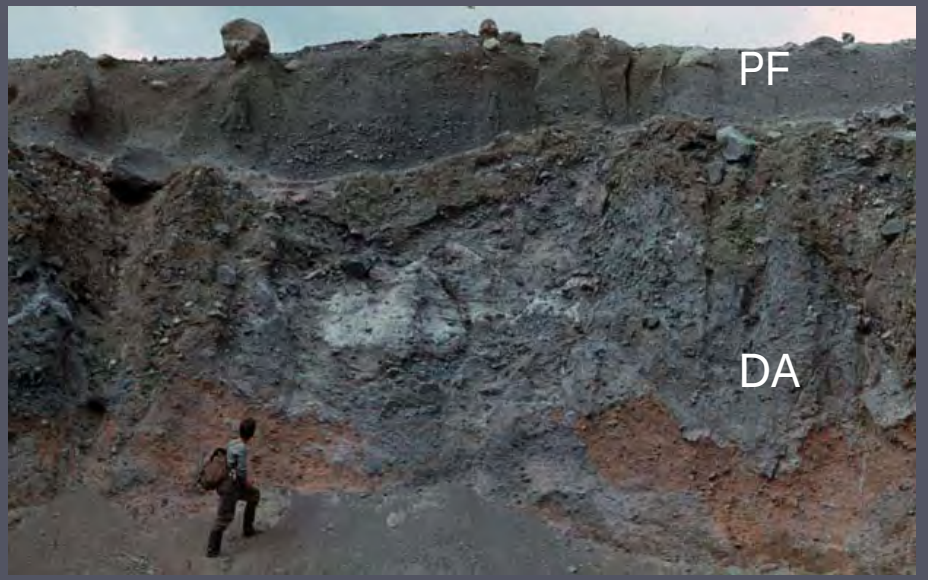


Different kinds of hummocks.

# Structure of the 1956 DA

Block facies

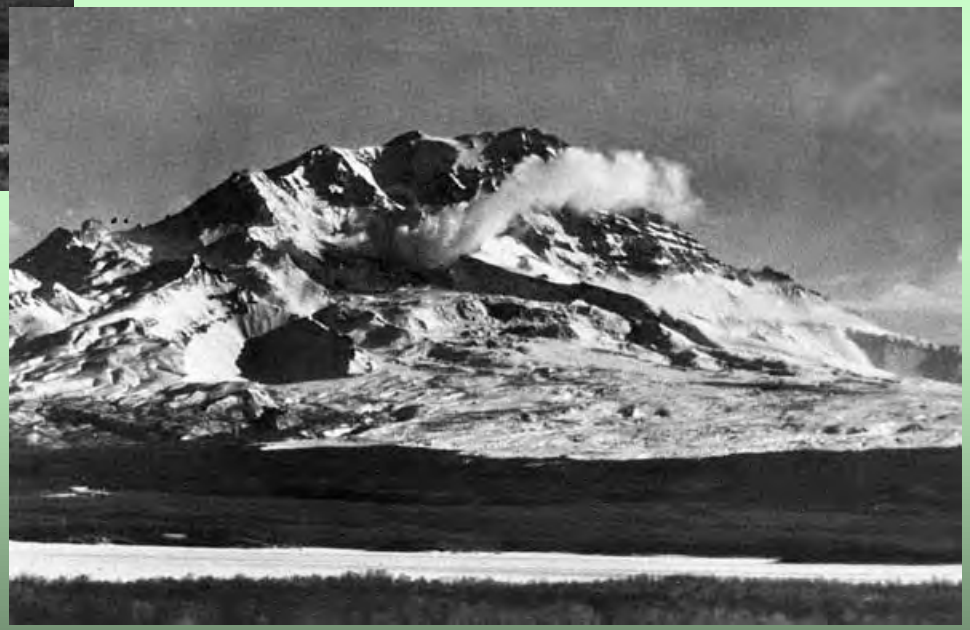

Mixed facies with block inside




Deposits of accompanying eruption

# Large-scale landslide at Shiveluch volcano on November 12, 1964

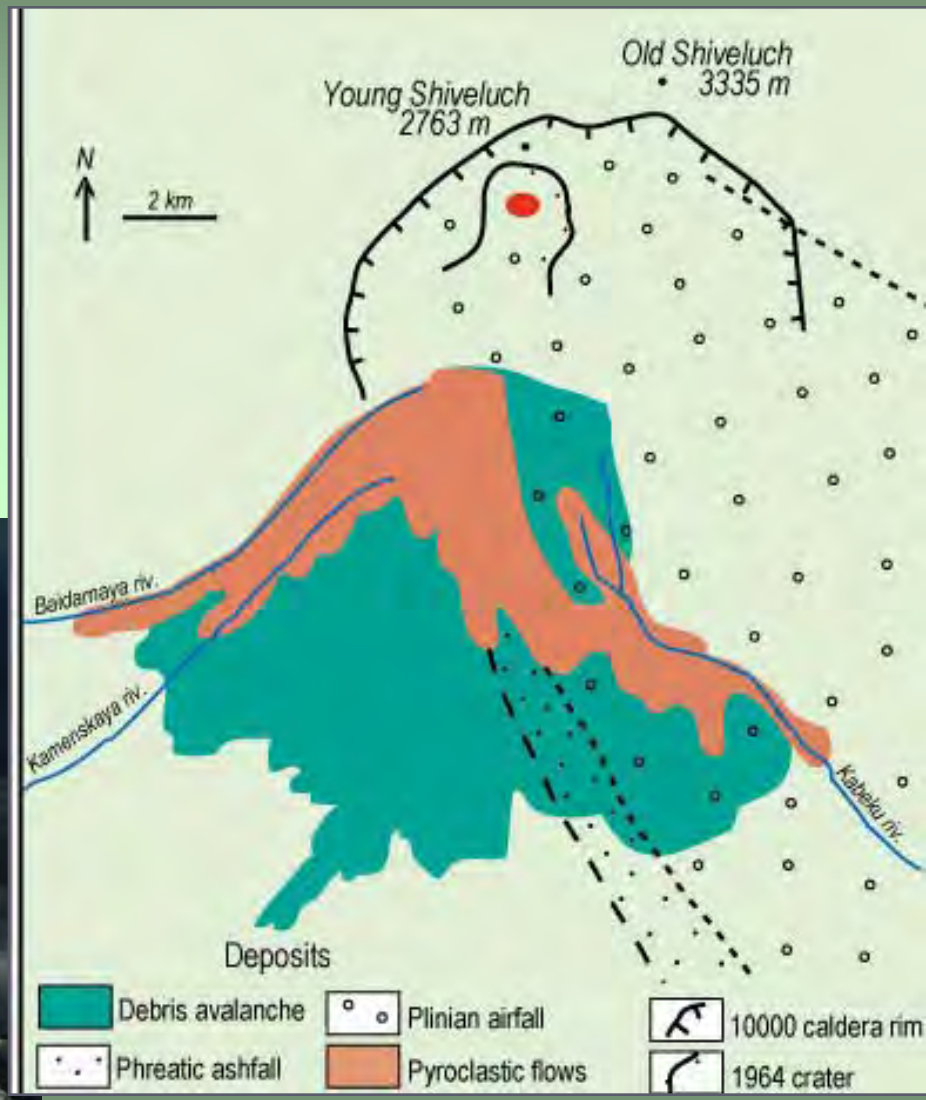
Before 1964



After 1964

# Characteristics of the 1964 Shiveluch DA

L (max length) - 16 km
H (dropped height) – 2.3 km
S (area) – 100 sq. km
V (volume) -1.5 cub.km
(15 % of edifice)
Thickness - 15-20 m



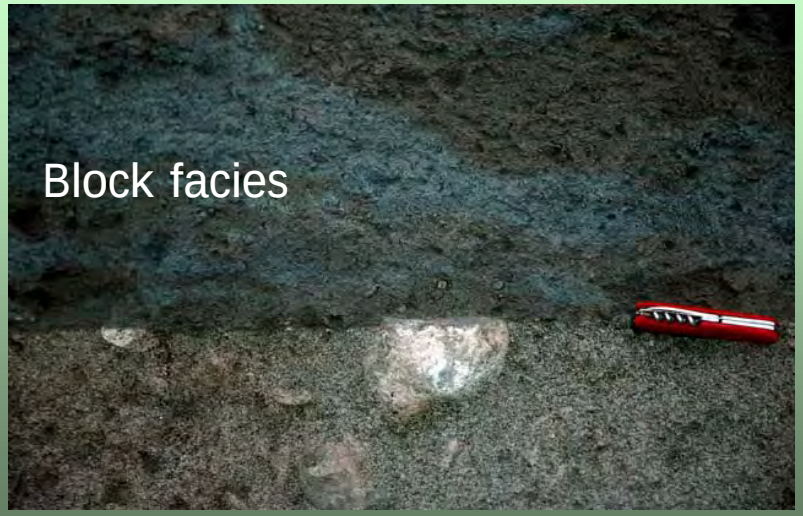
## Hummocks of 1964 DA

## Front of 1964 DA

# Structure of the 1964 DA

## Contact of DA and underlying deposits


Nonerosive basal contact

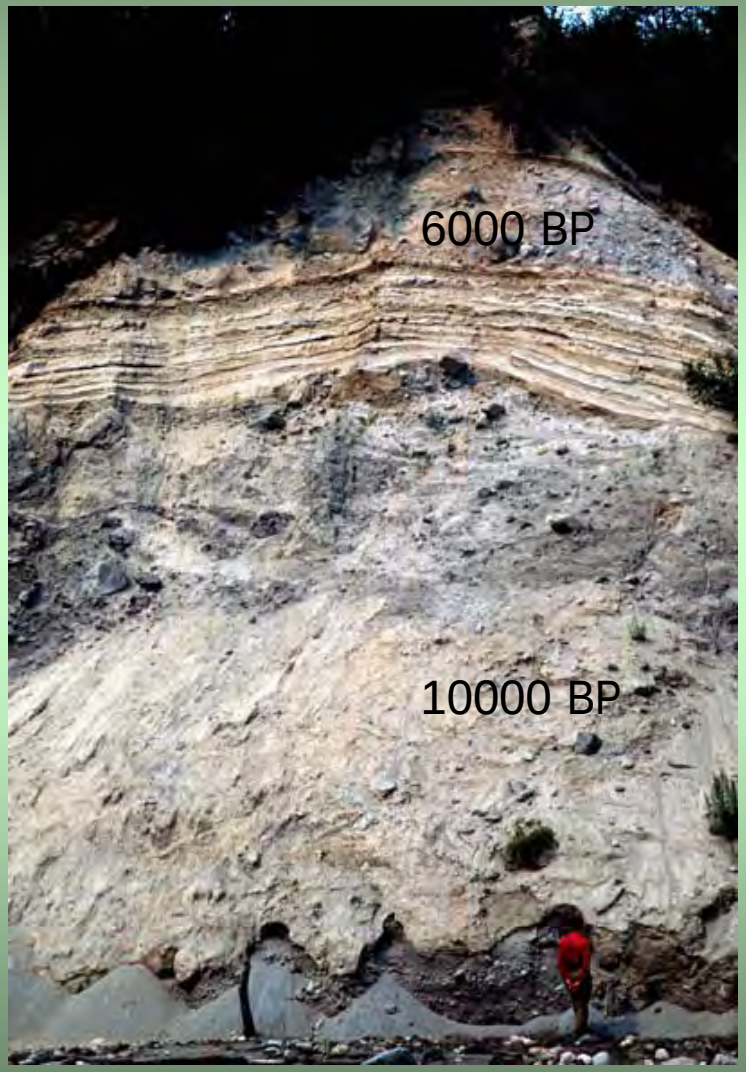


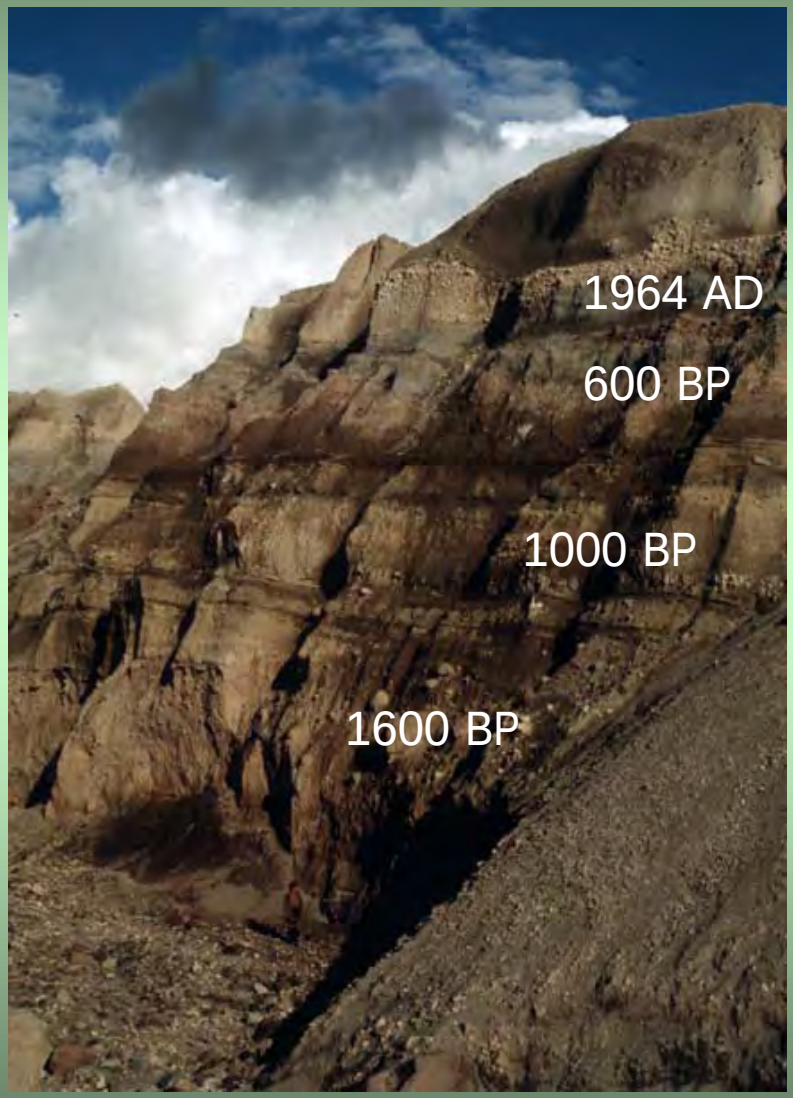

Erosive basal contact

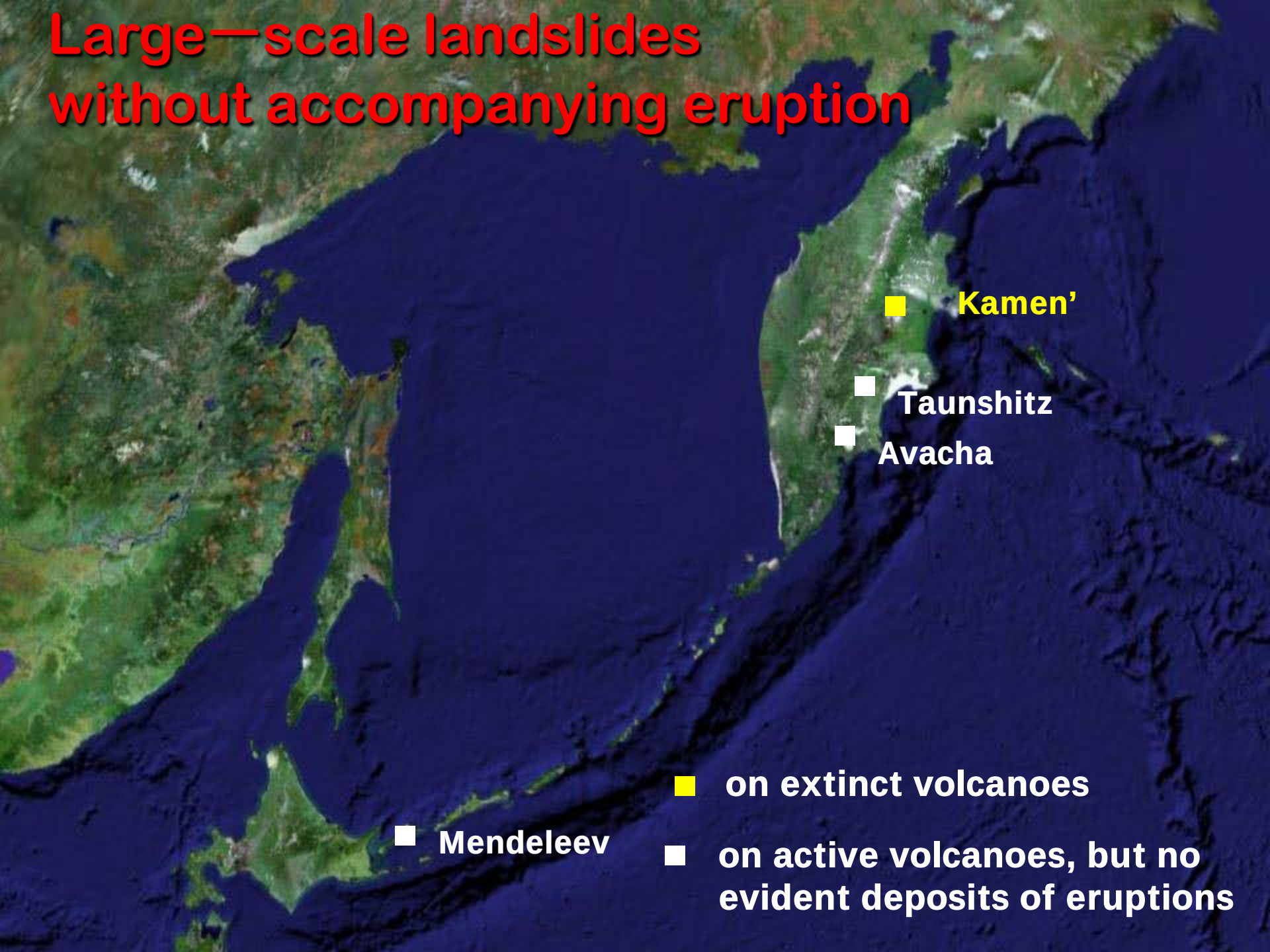
DA consists mostly of block facies


PF of accompanying eruption

# Deposits of ancient DAs at Shiveluch volcano



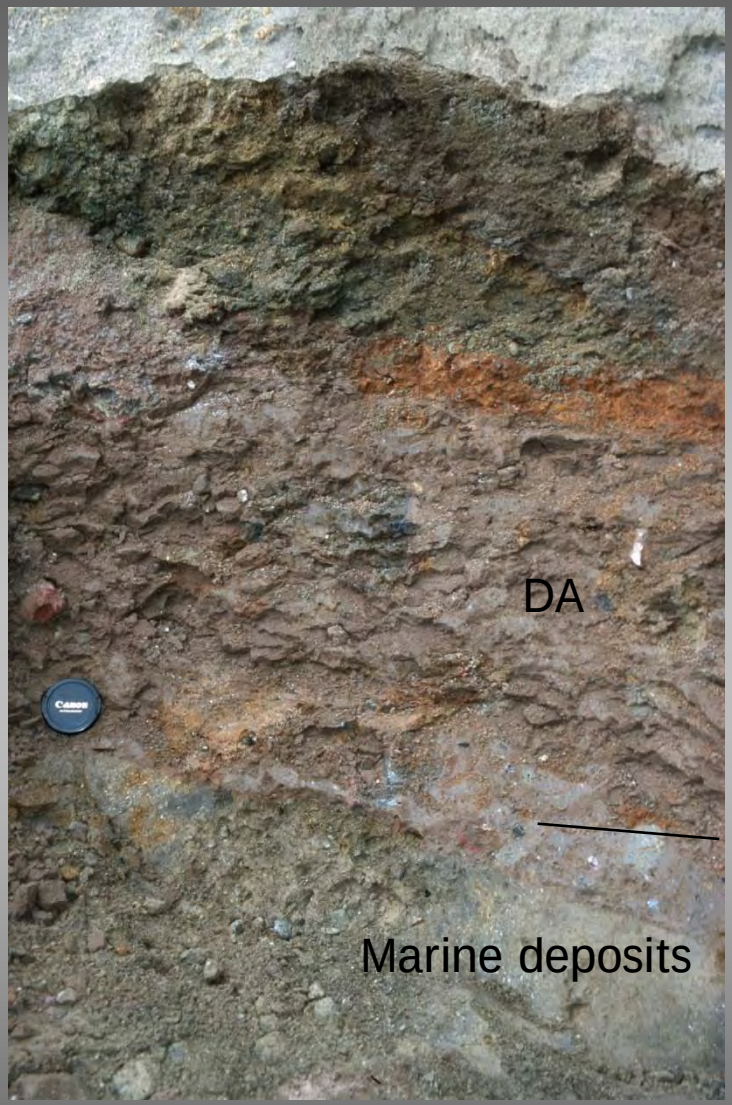




Large—scale landslides
without accompanying eruption
Kamen’
Taunshitz
Avacha
Mendeleev
on extinct volcanoes
on active volcanoes, but no
evident deposits of eruptions

# Large—scale landslide at Avacha volcano with age 30,000 BP

V > 10 cub.km)
S > 400 sq.km.
L > 25 km.
Thickness –30 m.

# Structure of Avacha 30,000 BP DA




Block facies of Avacha DA

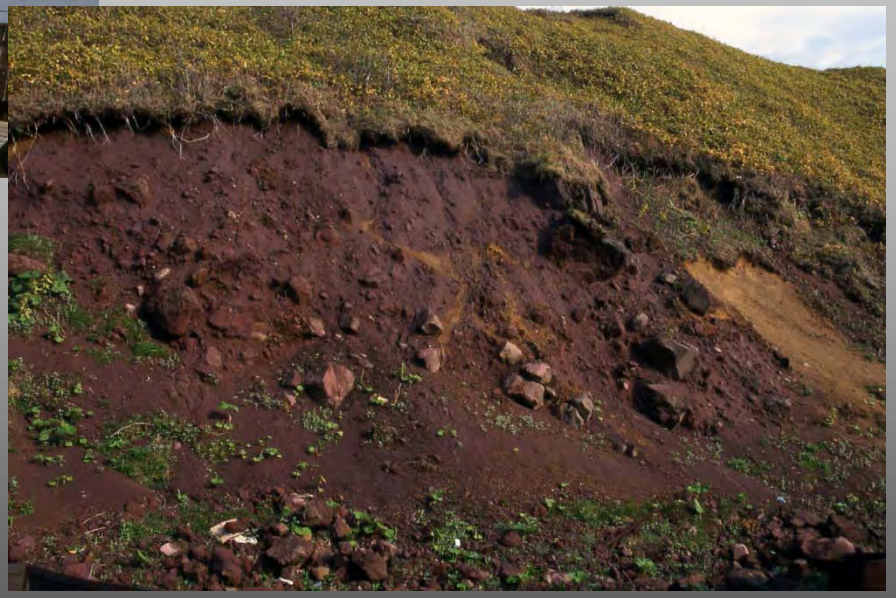
# Large—scale landslide at Taunshitz volcano 7000 BP

Hummock composed by DA block facies

Hummocky surface

# Large-scale landslide at Mendeleev volcano, early Holocene

Mendeleev vocano,
Yuzhno-Kurilsk at the foreground



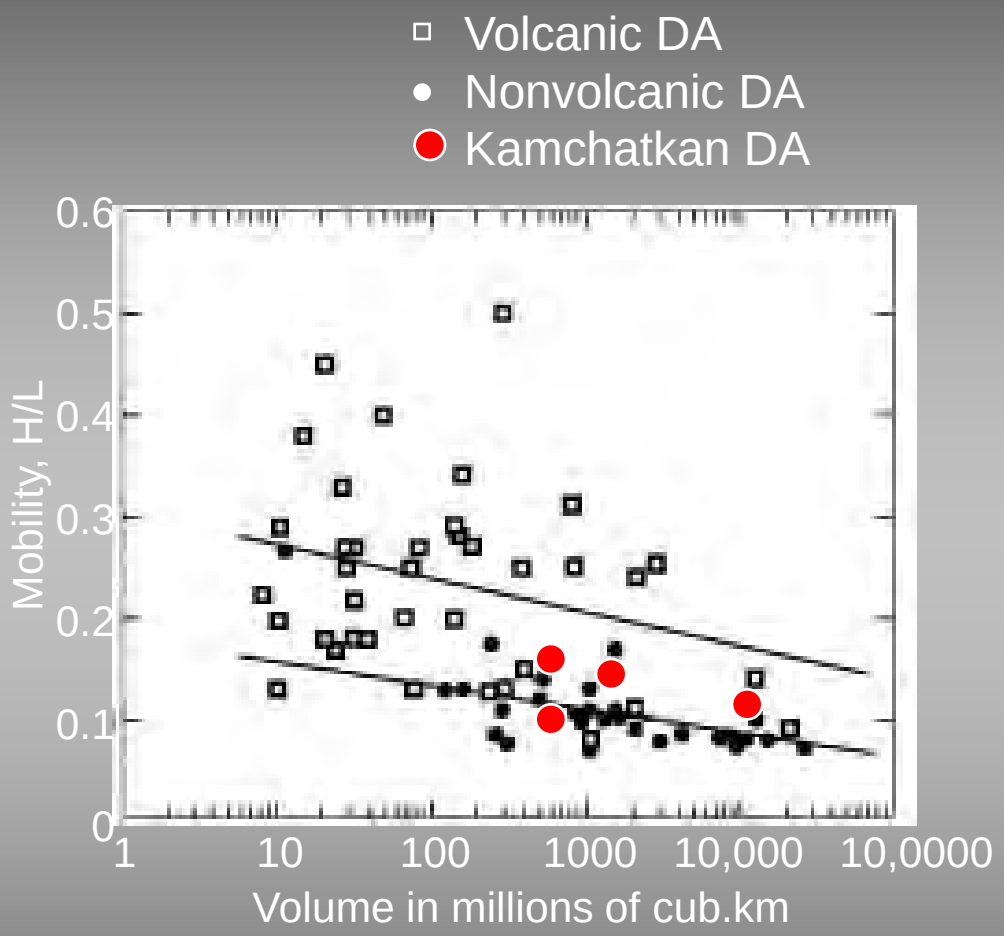
Block facies of DA

# Large-scale landslide at Kamen' volcano 1000 BP

Block facies of DA

The largest bouldery from DA

Hummocky surface of DA


Volcanic DA
Nonvolcanic DA
Kamchatkan DA
Mobility, H/L
0.6
0.5
0.4
0.3
0.2
0.1
0
1
10
100
1000
10,000
10,0000
Volume in millions of cub.km

# Conclusions.

1. Large-scale landslides frequently occurred on volcanoes of Kurile-Kamchatka region.
2. The landslides took place both on active and extinct volcanoes.
3. Most of the landslides which occurred on active volcanoes were associated with strong explosive eruptions.