The 'Little' Fish Canyon Tuff in Romania: **Rejuvenation of granodioritic crystal mush resulting in homogeneous dacite recorded by the Haramul Mic lava dome (Ciomadul)**

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See also: D1545 I EGU2020-19199
Szabolcs Harangi et al. : The role of basaltic magma in the petrogenesis of the Late Pleistocene Ciomadul dacite, Romania

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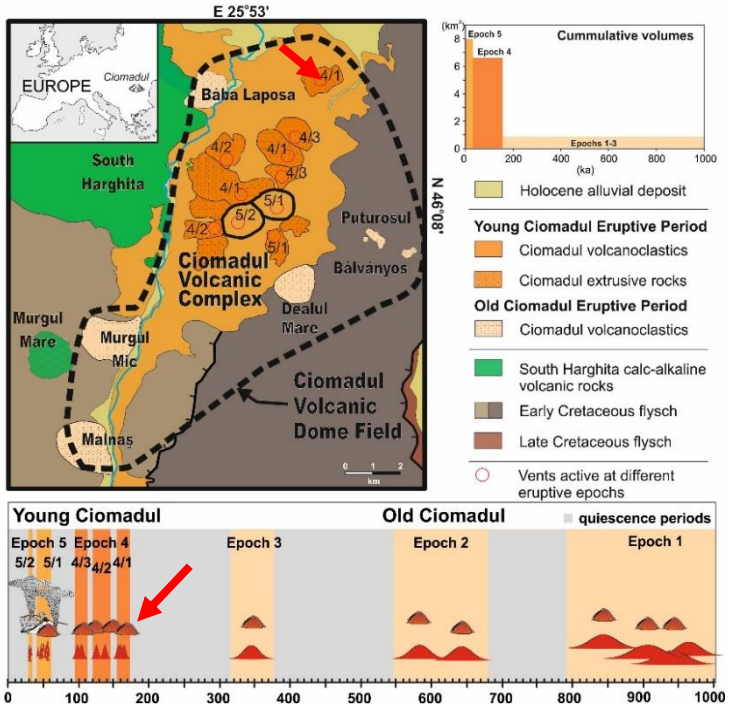
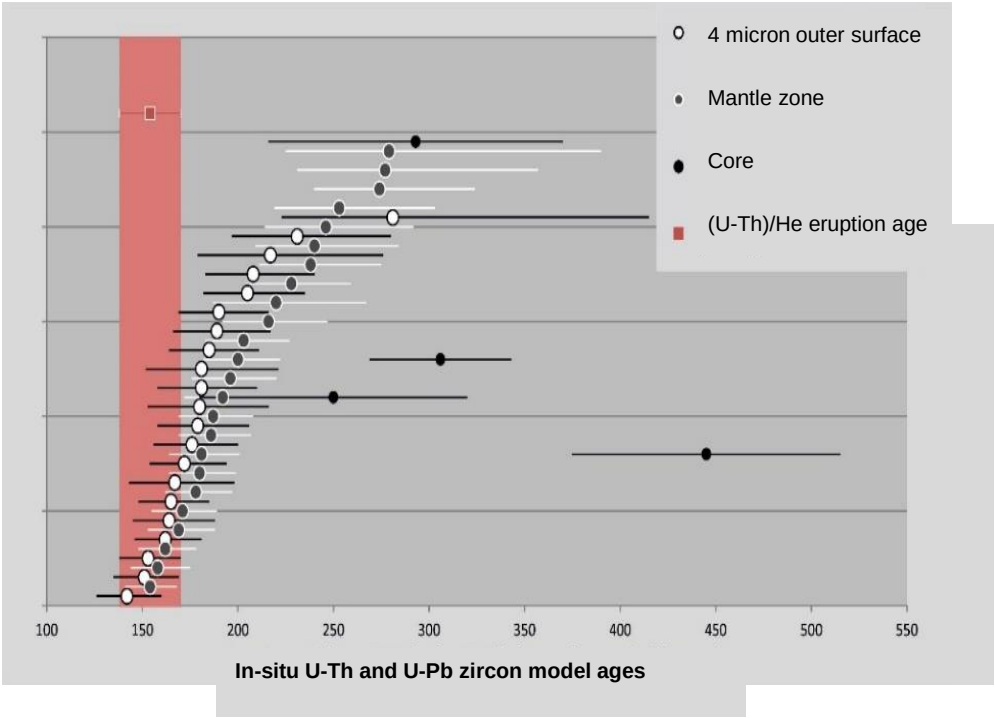
Haramul Mic lava dome



(after Molnár et al, 2019)



(after Lukács et al, 2018)

Ciomadul is the youngest volcano of eastern-central Europe. It is a dacitic lava dome field with a central volcanic complex. Eruption started 1 Ma with intermittent lava dome extrusions separated by long repose times. The Ciomadul Volcanic Complex developed from 160 ka and the last eruption occurred 30 ka.
The eruption products are dominantly potassic, crystal-rich dacites with fairly homogeneous petrological and geochemical character.

Haramul Mic:

- 157 ka dacitic lava dome
- the first volcanic product of the Ciomadul Volcanic Complex after long (>150 kyr) quiescence

Principal question: pre-eruption magma storage conditions and eruption trigger of the renewed volcanic activity

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Haramul Mic lava dome

- 157 ka dacitic lava dome
- the first volcanic product of the Ciomadul Volcanic Complex after long quiescence
- ca. 0.15 km^3 erupted volume at 1.1 km^2 area

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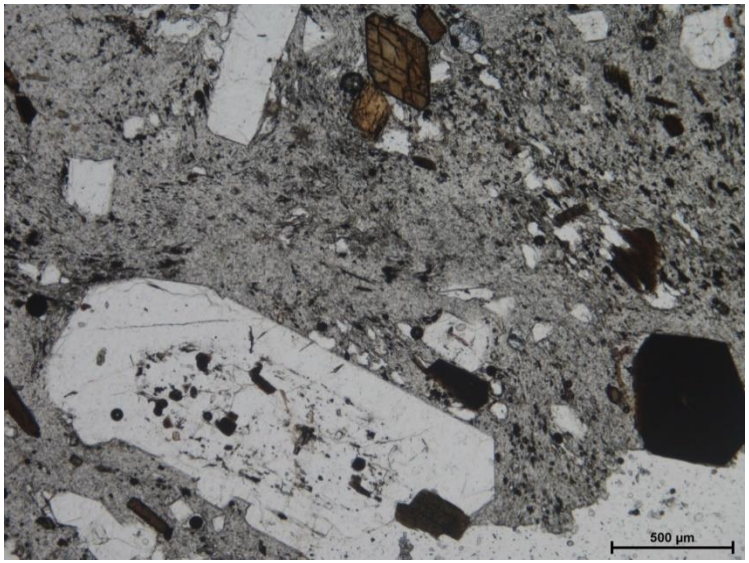
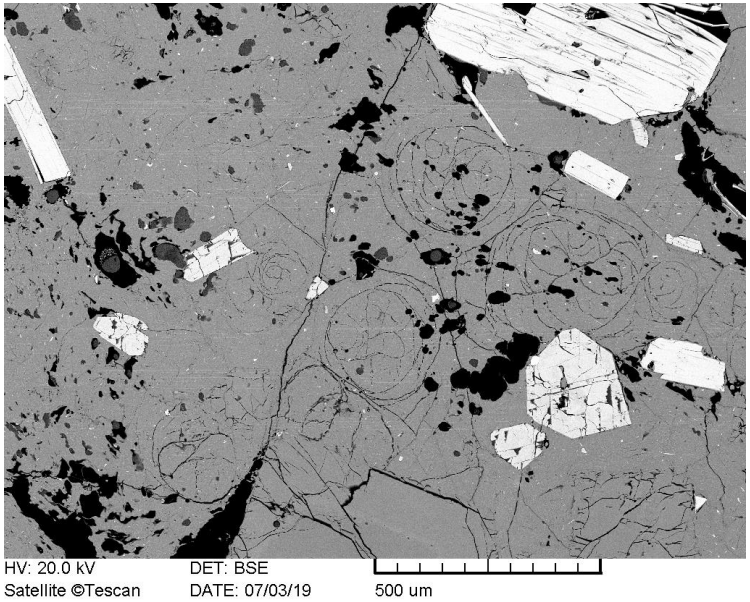
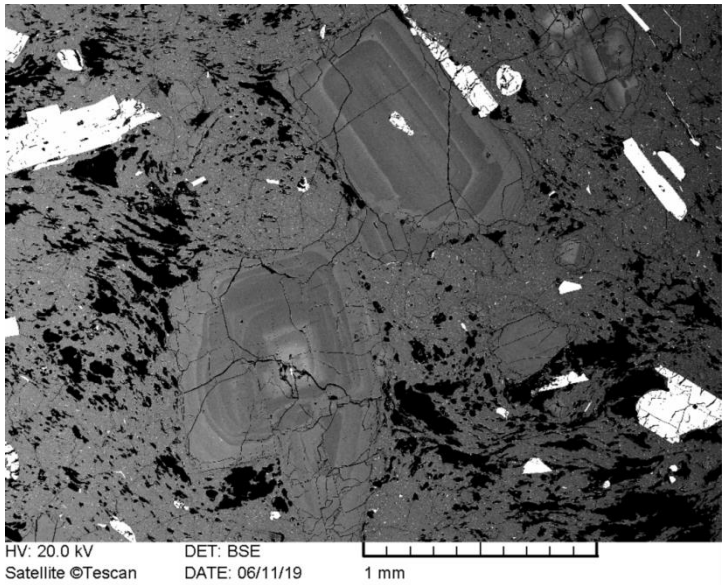
Haramul Mic dacite

- **crystal-rich homogeneous high-K dacite**
- average crystal content: 35-40%
- Plagioclase, amphibole, biotite, zircon, apatite, titanite, Fe-Ti oxides
- groundmass: perlitic, vesiculated glass with microlites







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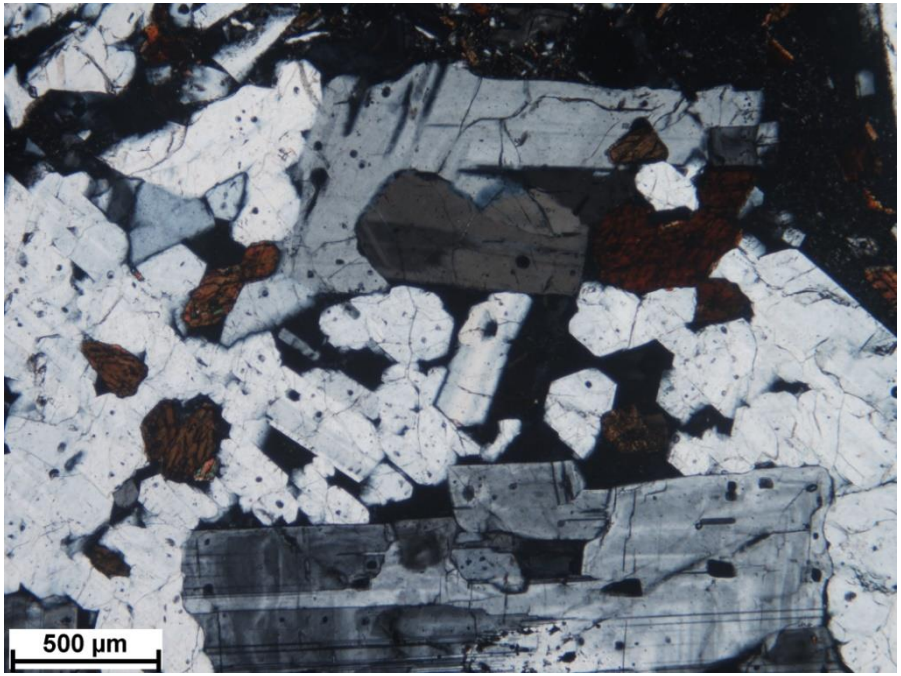
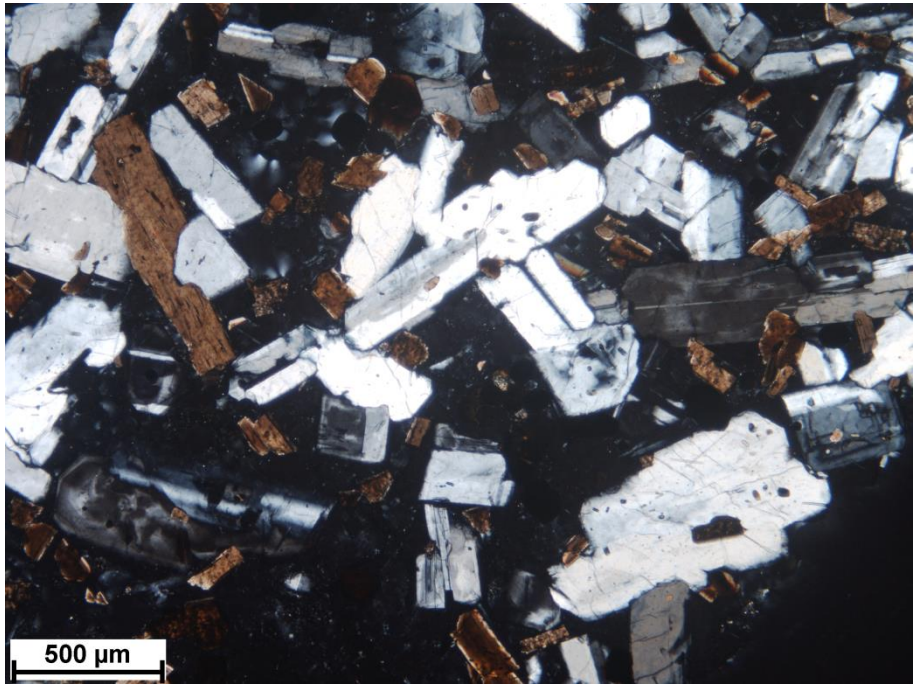
Haramul Mic dacite

- **felsic crystal clots**:
  plg+hbl+bt+interstitial vesicular glass





- **bt-rich mafic enclaves** with plg+hbl:
  K-rich, shoshonitic bulk composition

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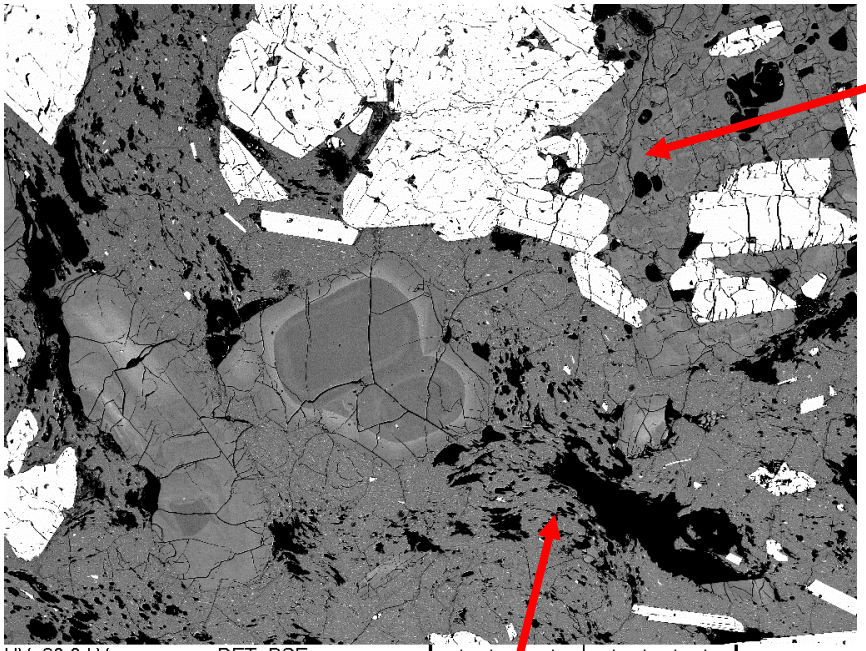
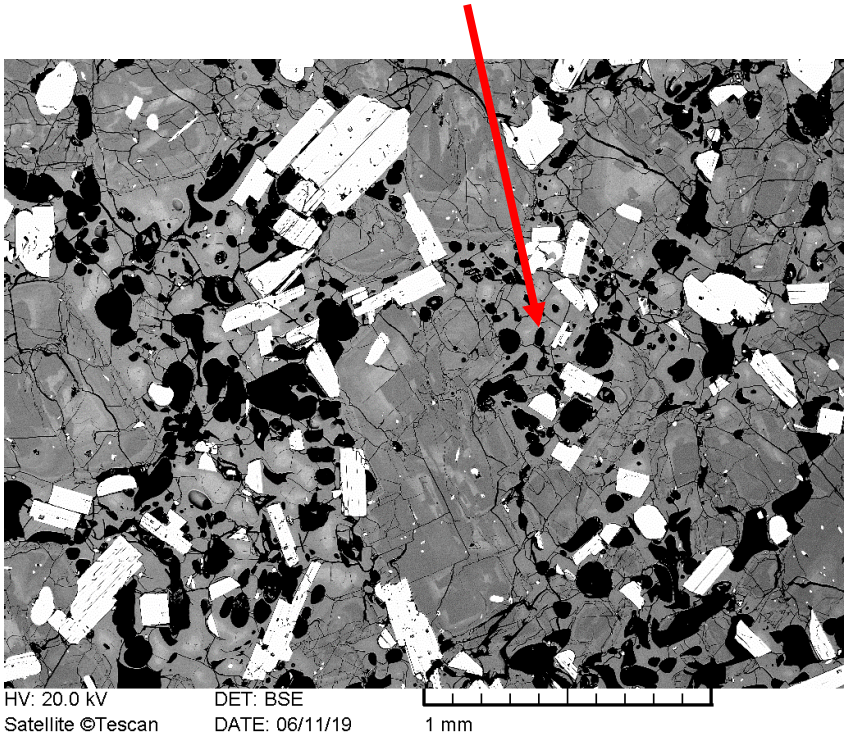
Haramul Mic dacite: glass type chemical composition



Vesiculated interstitial glass in the felsic clot

Groundmass glass of the host dacite

Vesiculated interstitial glass in the mafic enclave



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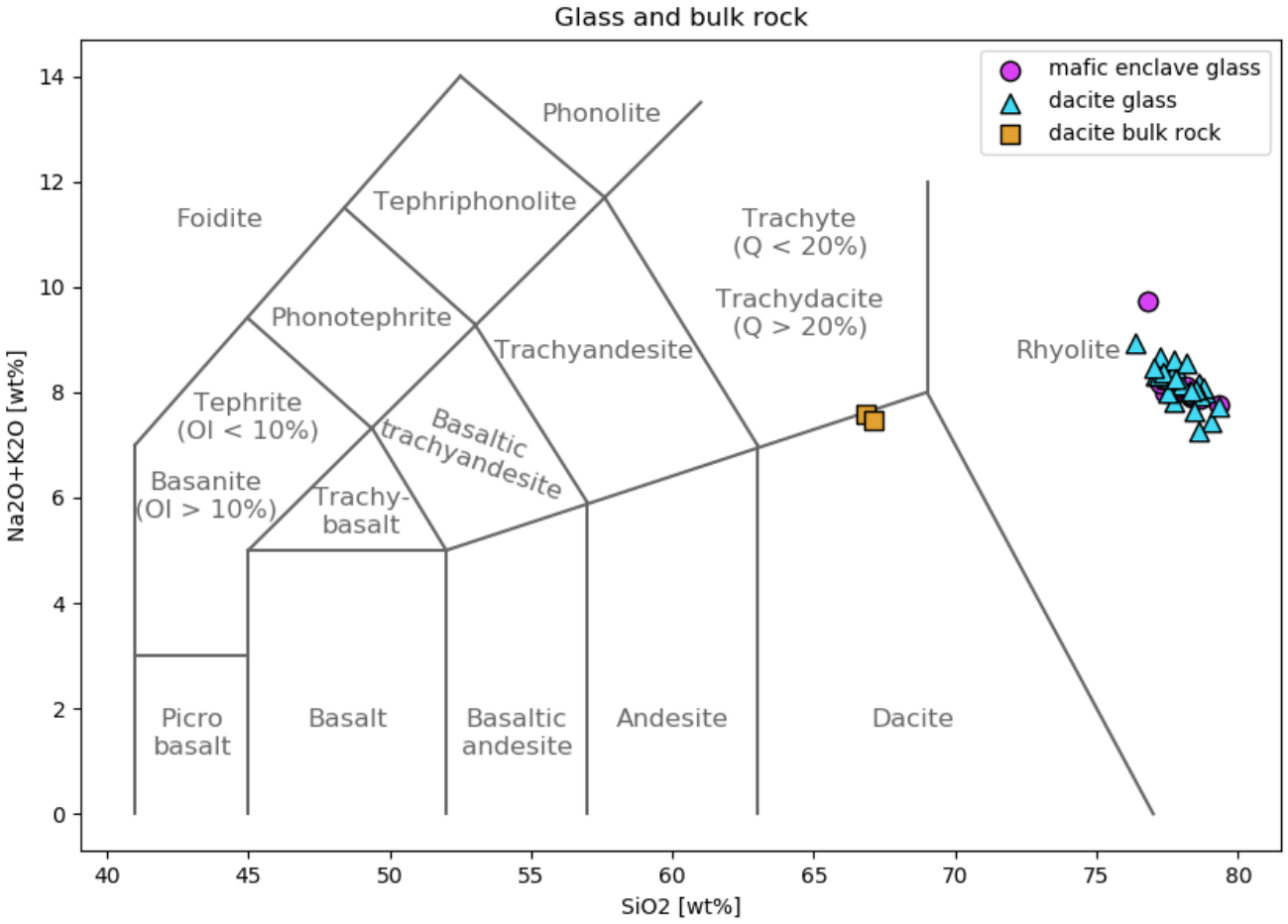
Haramul Mic dacite

Homogeneous potassic dacite with high-SiO_2 rhyolitic glass



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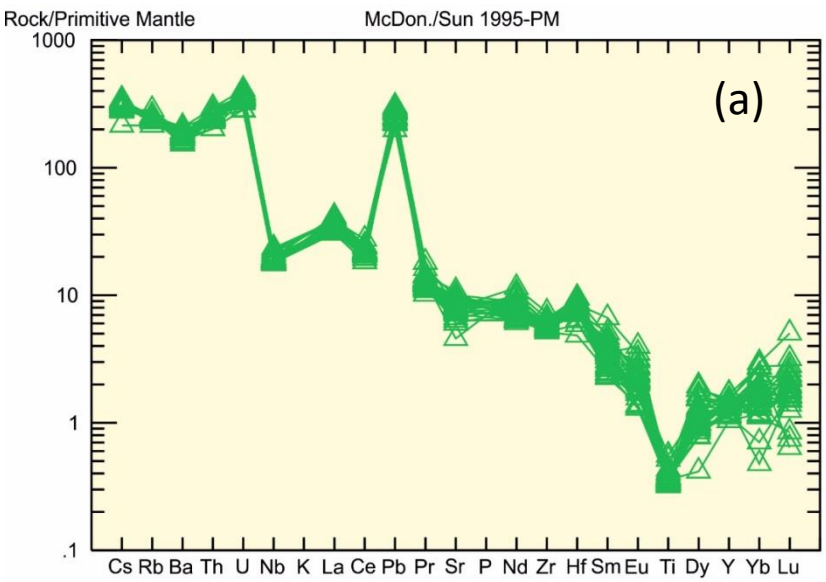
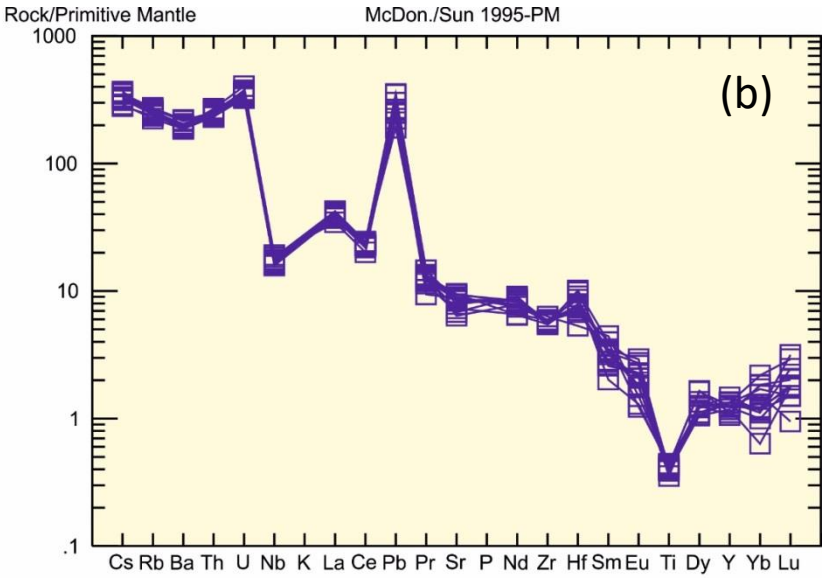
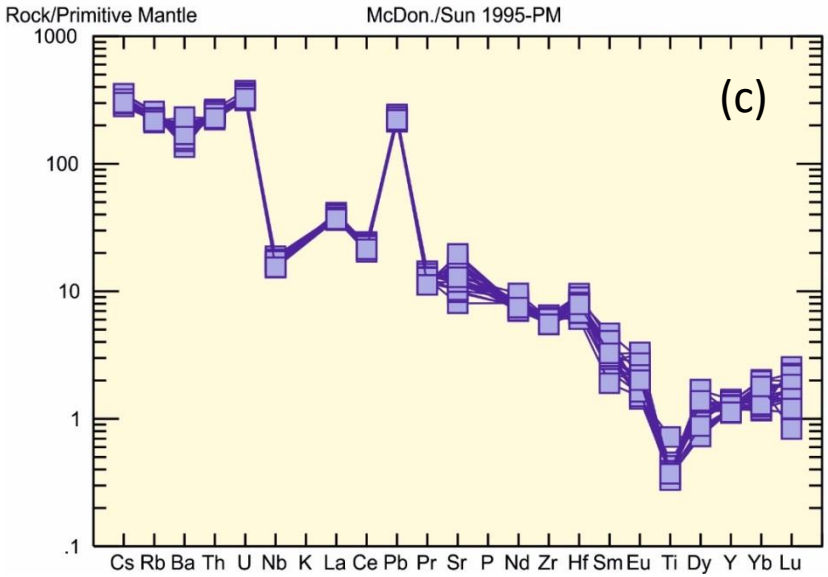
Glass trace element composition







Trace element composition of glasses from
(a) Mafic enclave; (b) Felsic clot and
(c) the dacite groundmass
has the same pattern – they are indistinguishable from each other!

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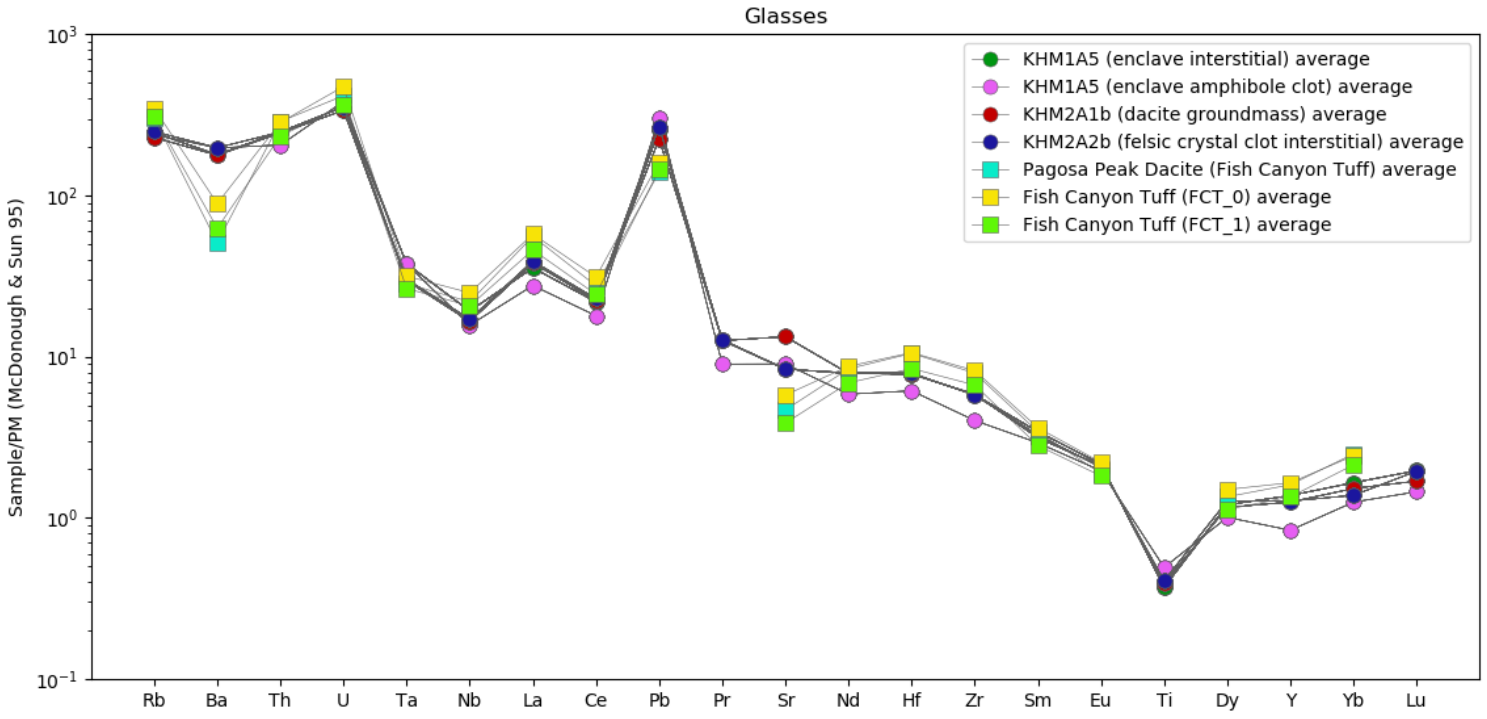
Glass trace element composition



Glass trace element composition similar to that of the Fish Canyon Tuff (Bachmann et al. 2005) except for Ba and Sr

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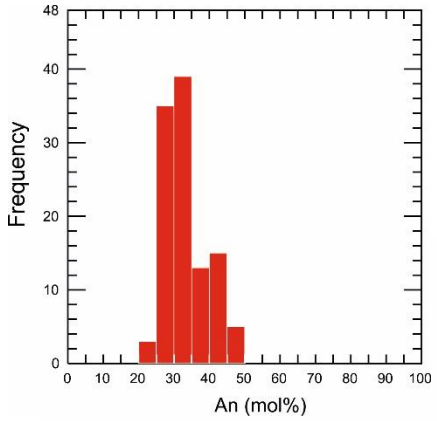
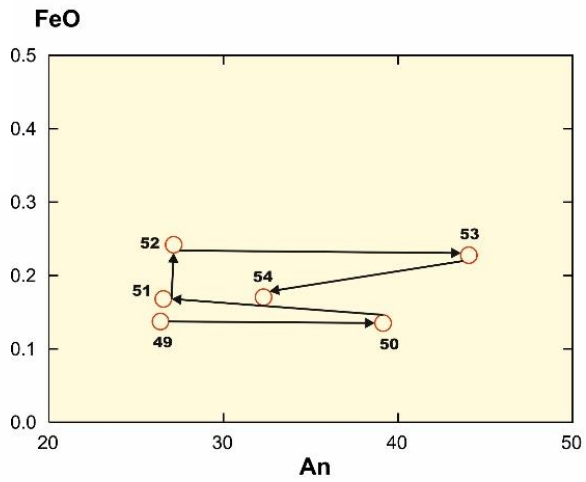
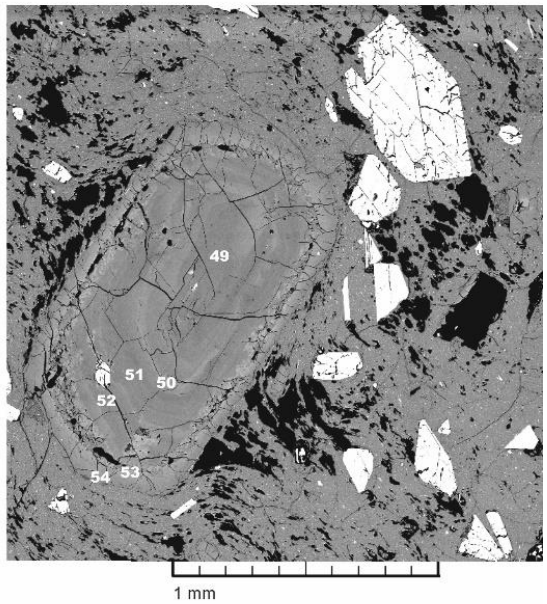
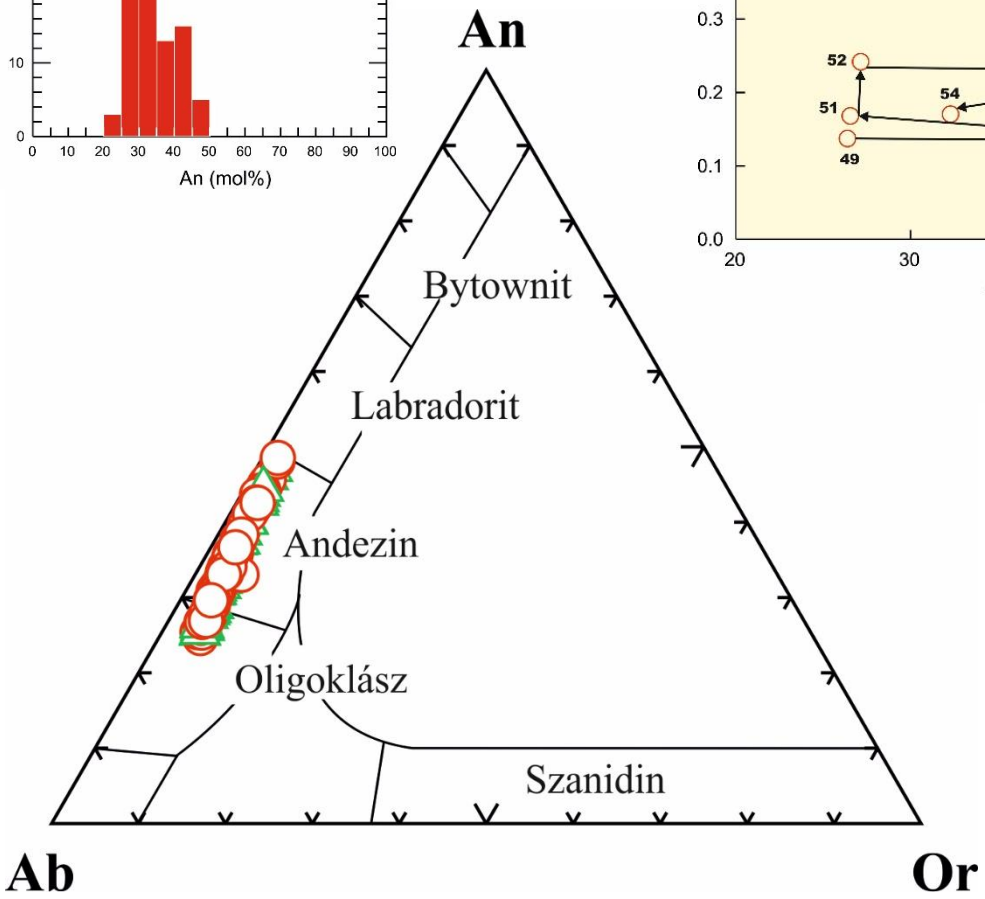
Plagioclase composition









Relatively homogeneous composition with An range from 25 to 45 mol% and no significant FeO variation

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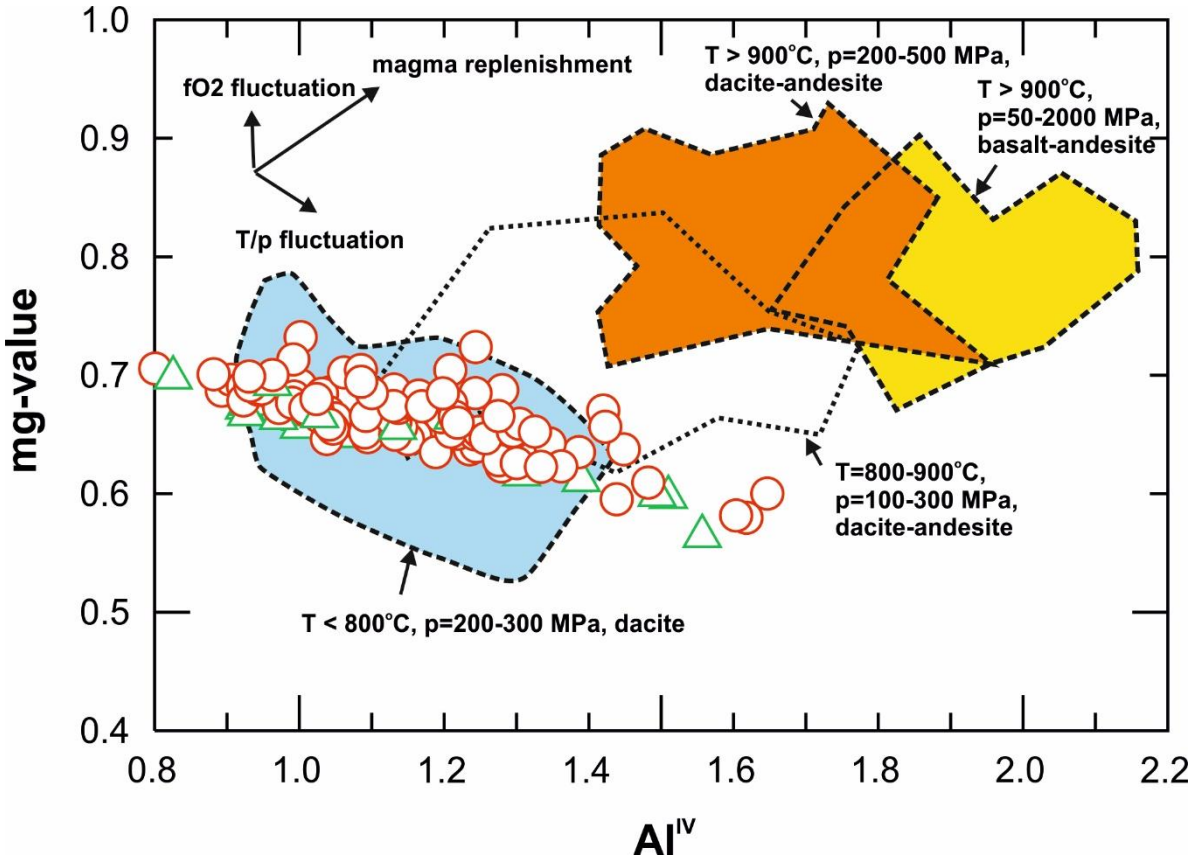
Amphibole composition



Amphiboles from both the host lava dome rock and the inclusions fall entirely in the low-Al hornblende field suggesting relatively low temperature crystallization from an evolved melt (compilation of experimental data is from *Kiss et al. CMP 2014*)

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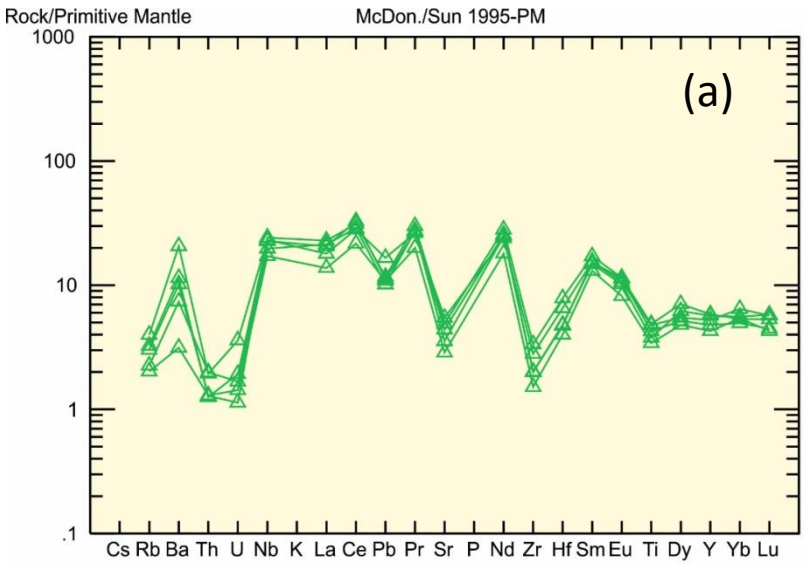
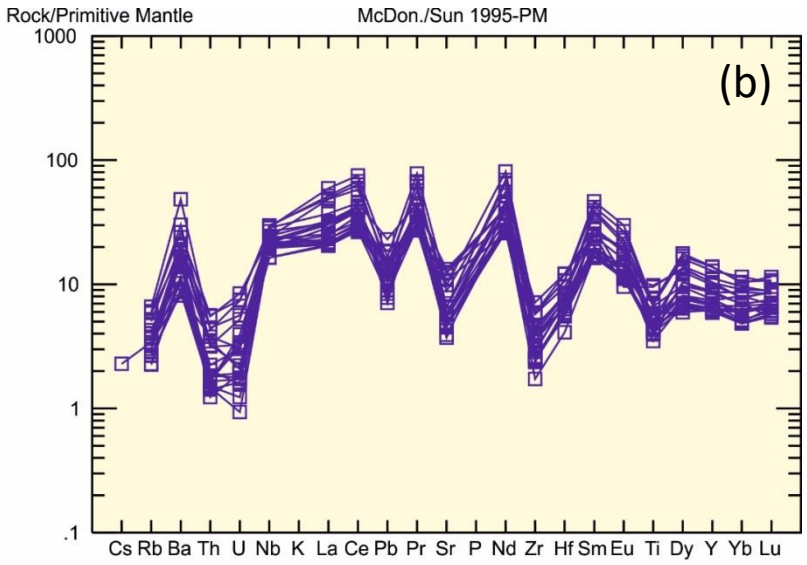
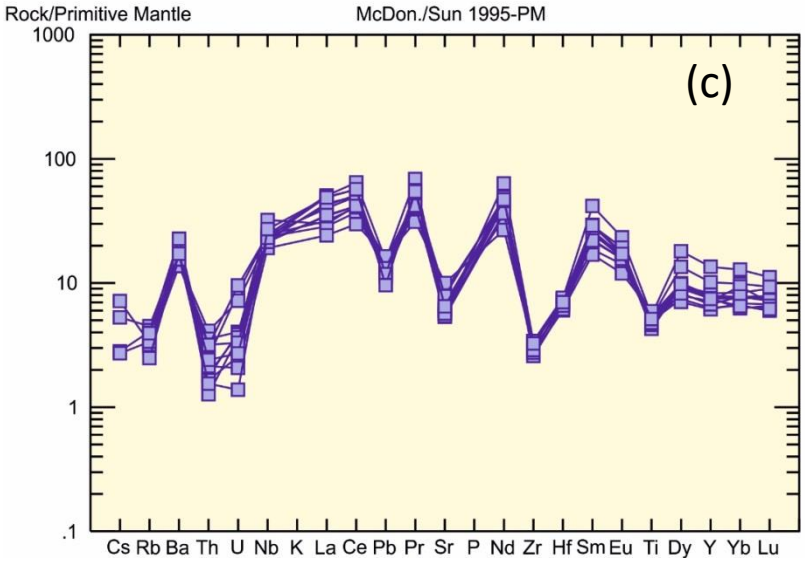
Amphibole composition







Trace element composition of amphiboles from
(a) Mafic enclave; (b) Felsic clot and
(c) the dacite groundmass
has the same pattern – they are indistinuishable from each other!

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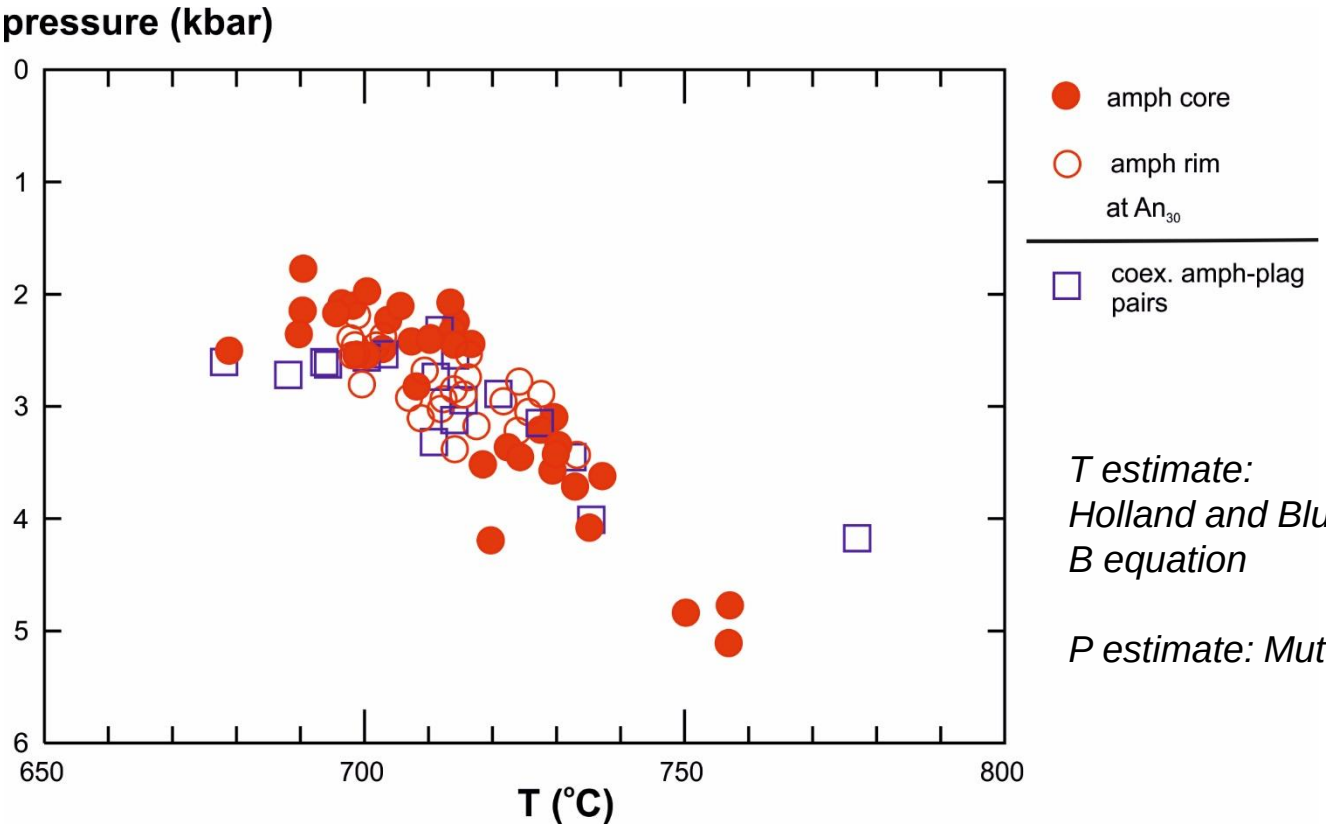
Amphibole-plagioclase thermobarometry



T estimate:
Holland and Blundy 1994
B equation

P estimate: Mutch et al. (2016)

Crystallization of amphiboles and plagioclases occurred between 680-750°C,
i.e. at a relatively cold storage condition,
mostly at 2-4 kbar, i.e. 7-14 km depth

Rim temperatures (eruptive T): 700-730°C

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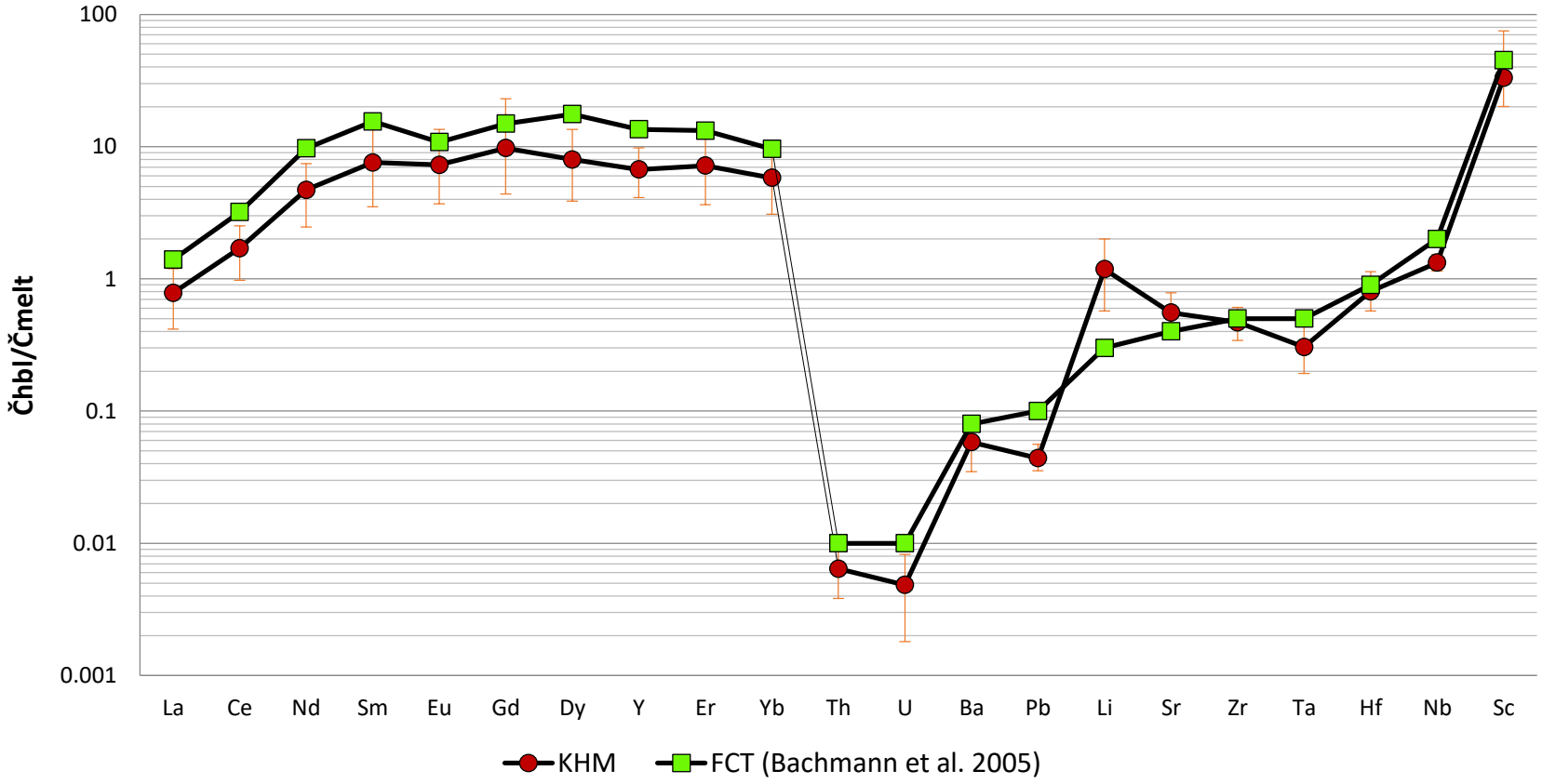
Similarities between Fish Canyon Tuff and Haramul Mic rocks

Partitioning behavior for the Haramul Mic hornblende (average) rims compared to FCT data (Bachmann et al. 2005)



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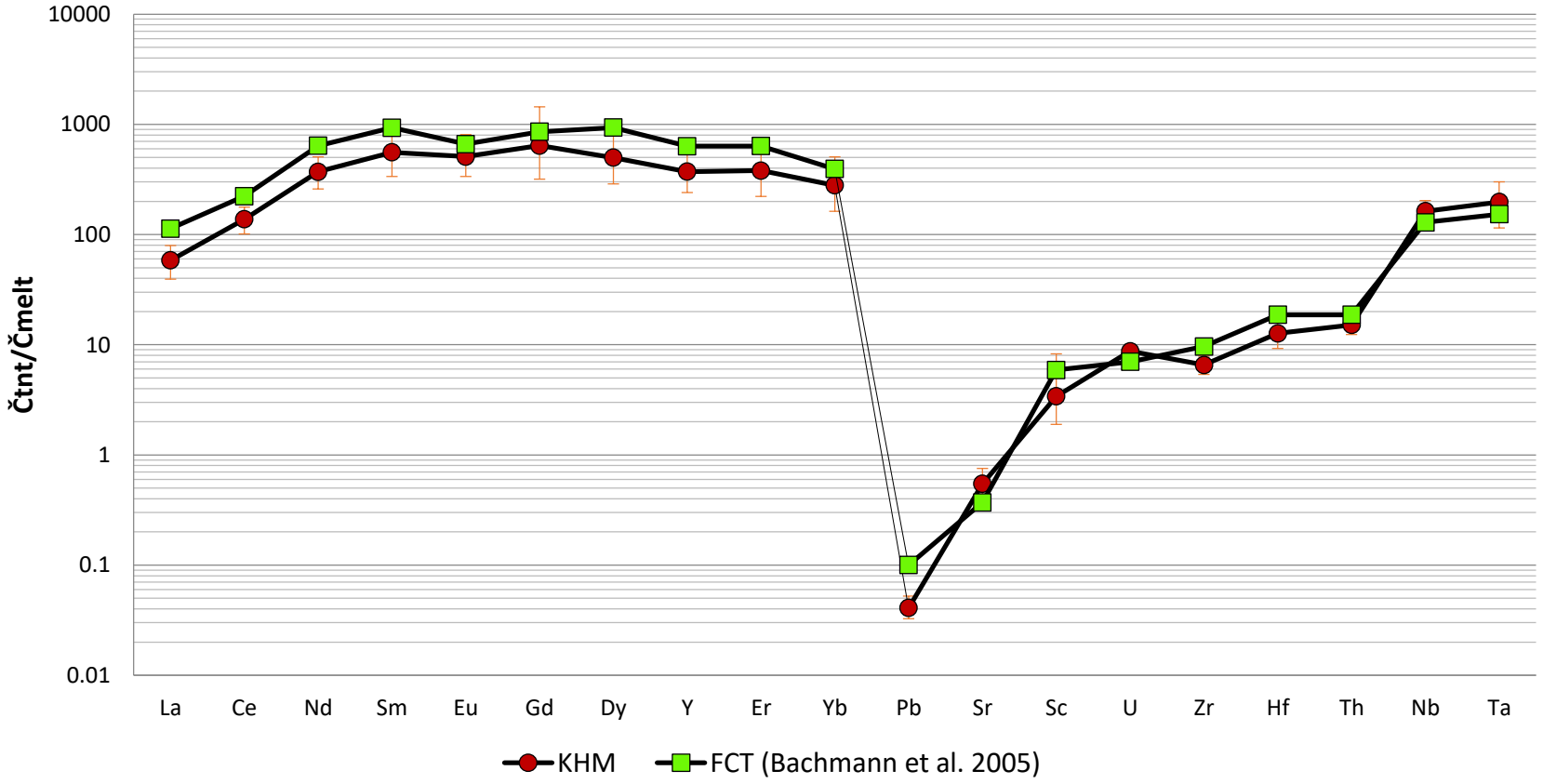
Similarities between Fish Canyon Tuff and Haramul Mic rocks

Partitioning behavior for the Haramul Mic (average) titanite compared to FCT data (Bachmann et al. 2005)



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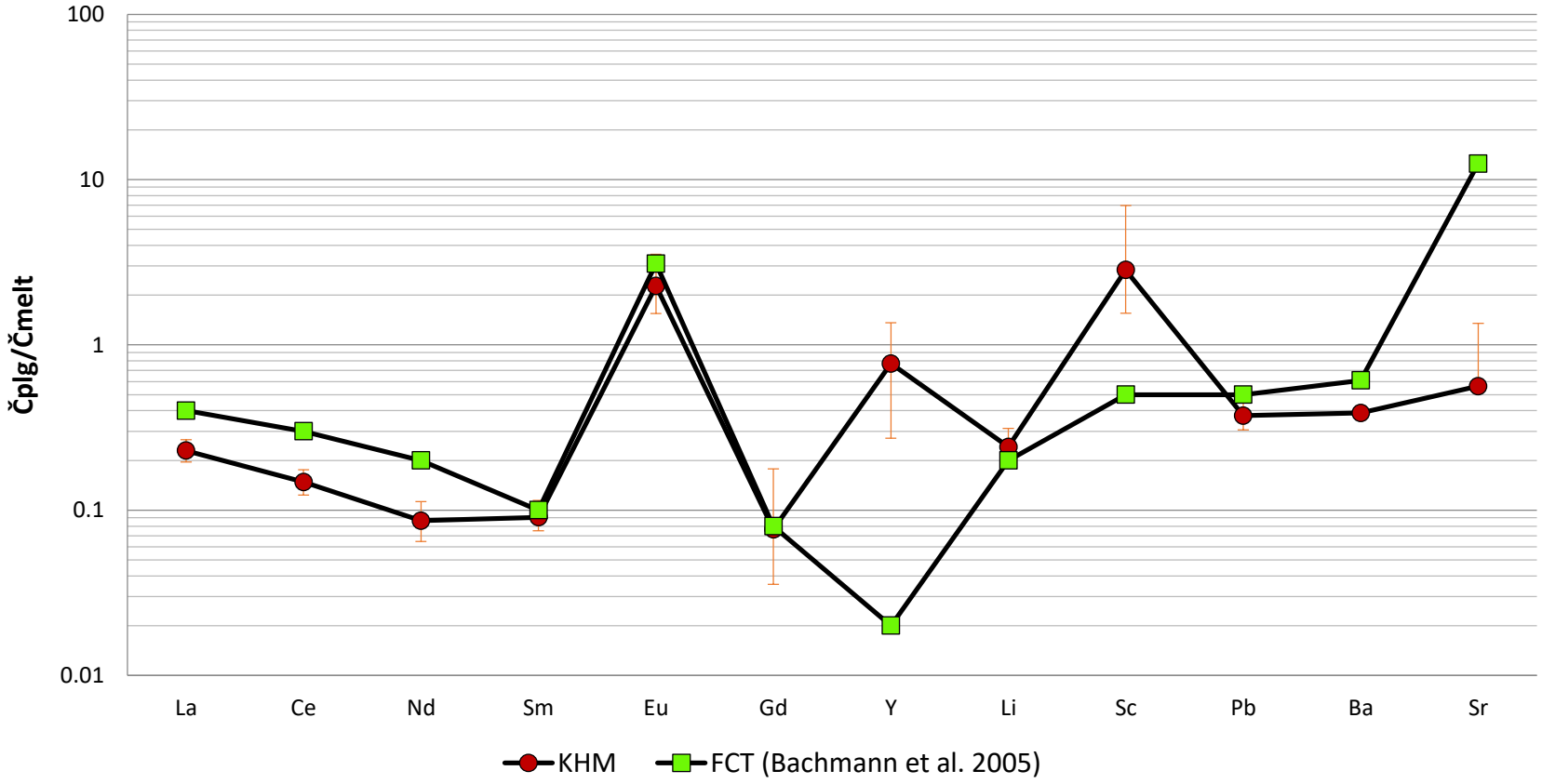
Similarities between Fish Canyon Tuff and Haramul Mic rocks

Partitioning behavior for the Haramul Mic (average) plagioclase rims compared to FCT data (Bachmann et al. 2005)



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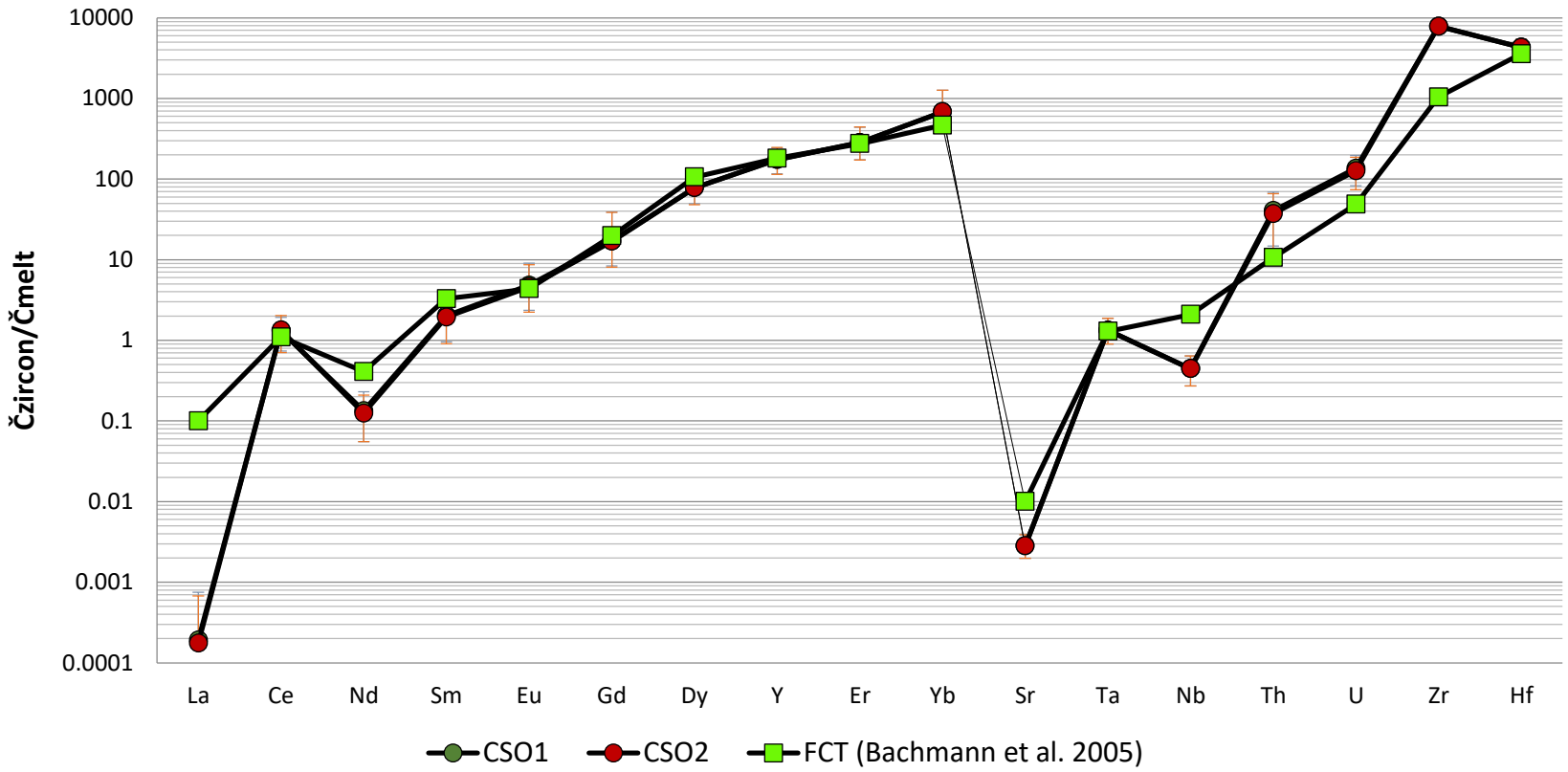
Similarities between Fish Canyon Tuff and Haramul Mic rocks

Partitioning behavior for the Haramul Mic (average) zircon compared to FCT data (Bachmann et al. 2005)



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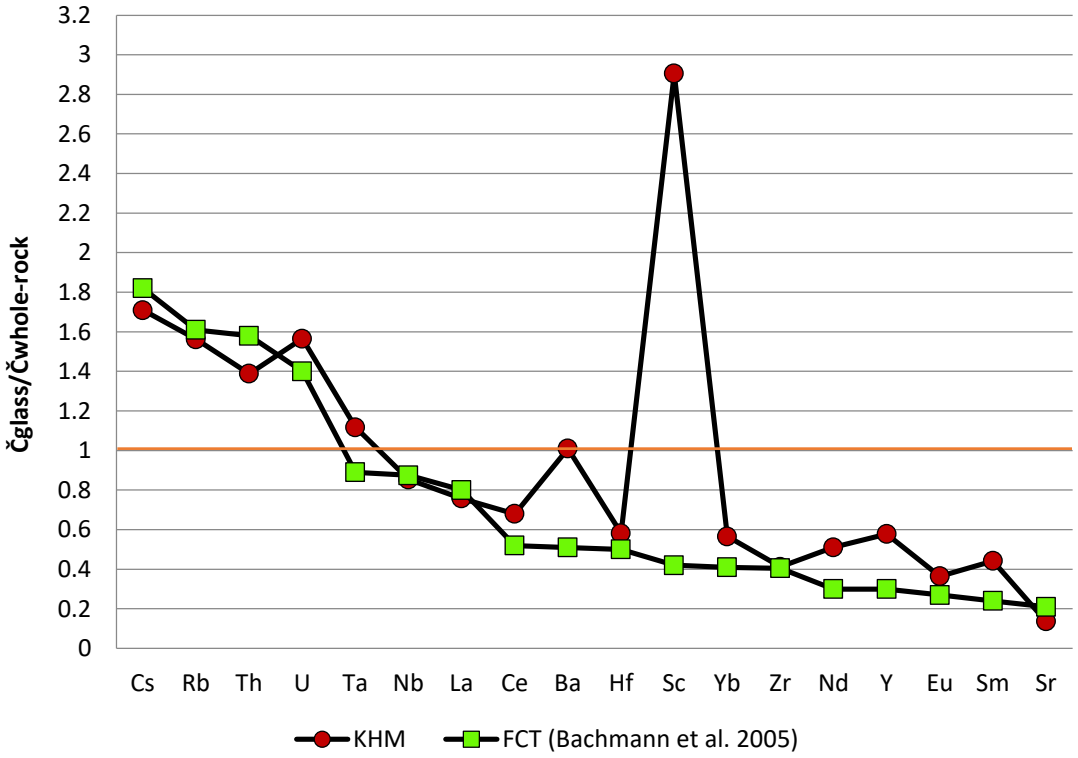
Fish Canyon Tuff and Haramul Mic – the Sc anomaly

Ratios of average trace element concentration in glass vs. concentration in the whole rock for Haramul Mic compared to FCT data (Bachmann et al. 2005)



Failry similar patterns,
but differences in the behaviour of Ba, Sc

Possible explanations:

- No late Ba incorporation into amph
- Melting of biotite results in Sc enrichment in melt (glass)
- Ba enrichment in the rock is a source feature
- If Ba was in K-fp, it entered entirely into melt before eruption, in contrast to Sr that was retained in plg

Eruption trigger could be enhanced by biotite melting and by that volatile enrichment in the melt

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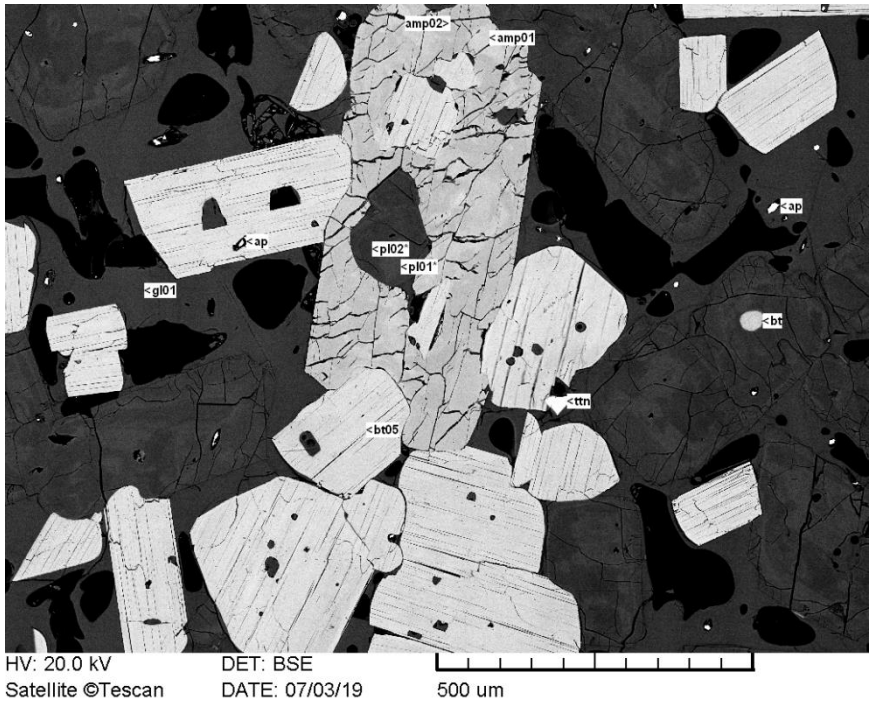
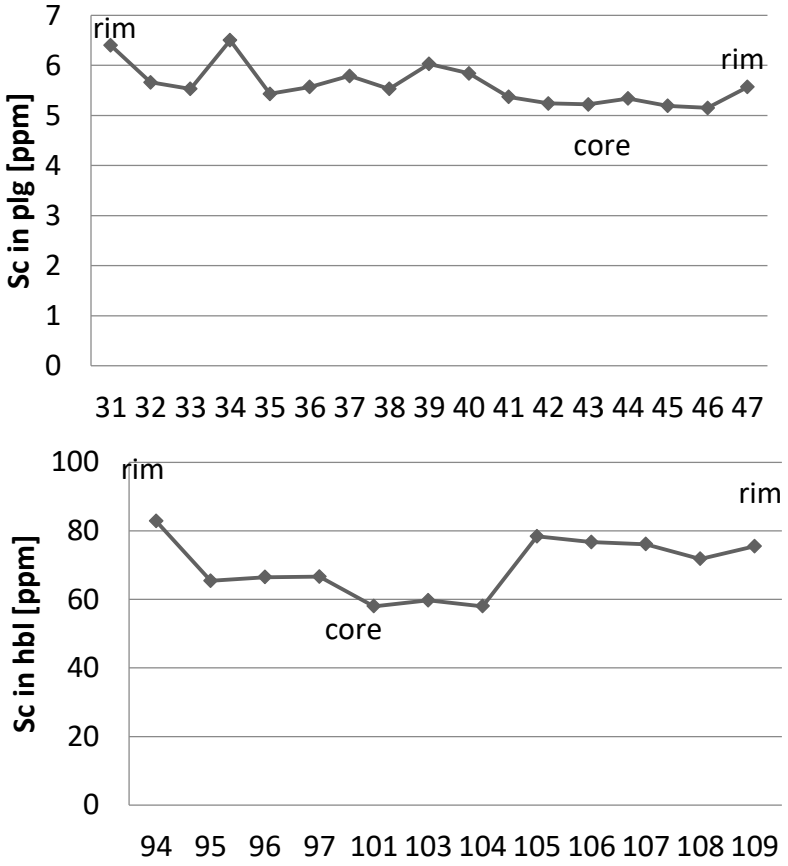
Possible explanation for the Sc anomaly

Biotite resorption as possible source of Sc in the melt – rimward enrichment in Sc observed in plagioclase and hornblende profiles



resorbed biotite crystals surrounded by melt



Eruption trigger could be enhanced by biotite melting and by that volatile enrichment in the melt

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Conclusions

What caused the rejuvenation of the viscous granodioritic crystal mush?

- role of mafic magma in the rejuvenation of some Ciomadul Volcanic Complex members

BUT in Haramul Mic dacite

- no evidence for magma mingling or mixing
- no evidence for heating (homogeneous crystallization temperature in hornblende)
- **volatile-driven rejuvenation might have occured due to underplated mafic magma**

Similar major and trace element contents of mineral phases, glass and bulk rock composition observed in FCT and Haramul Mic dacite

↓

wet oxidised calc-alkaline magmatic system

↓ So easy to maintain and remelt?...

Despite the enormous volume differences, magmatic systems might have similar characteristics.

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References

- Bachmann and Dungan (2002): Temperature-induced Al-zoning in hornblendes of the Fish Canyon magma, Colorado. American Mineralogist (2002) 87 (8-9): 1062–1076.
- Bachmann et al (2005): Insights into shallow magmatic processes in large silicic magma bodies: the trace element record in the Fish Canyon magma body, Colorado. Contrib Mineral Petrol 149.
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- Kiss et al. (2014): Amphibole perspective to unravel pre-eruptive processes and conditions in volcanic plumbing systems beneath intermediate arc volcanoes: a case study from Ciomadul volcano (SE Carpathians). Contrib Mineral Petrol 167, 986.

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