

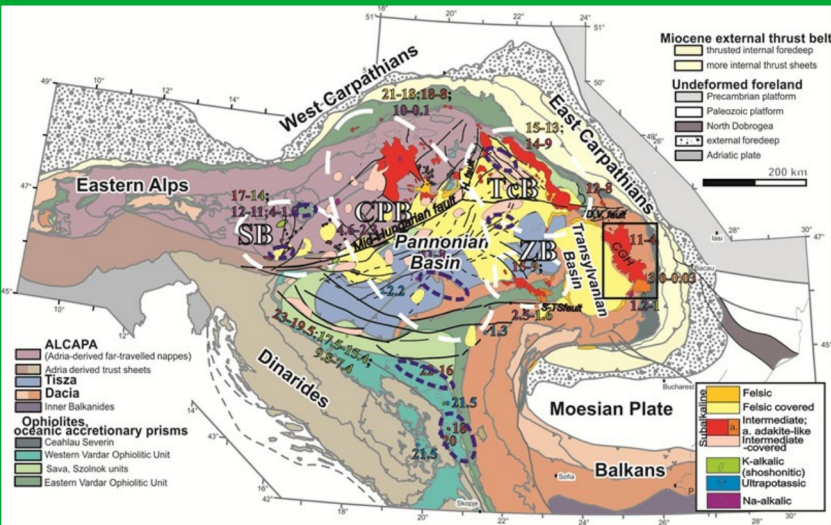
Volcanoes morphology of the North Harghita (Romania) Volcanic chain segment: similarities and differences

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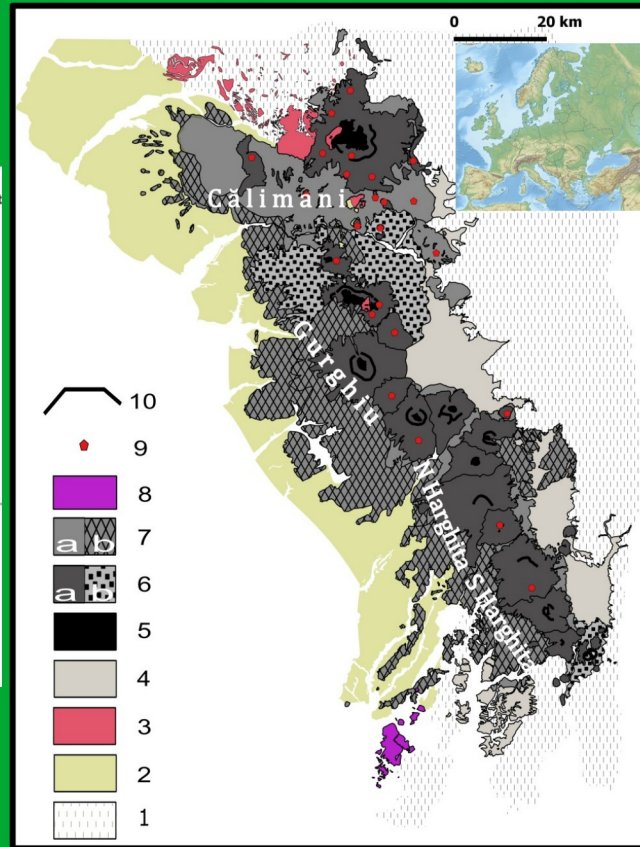
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Area discussed in CPR and CGH range



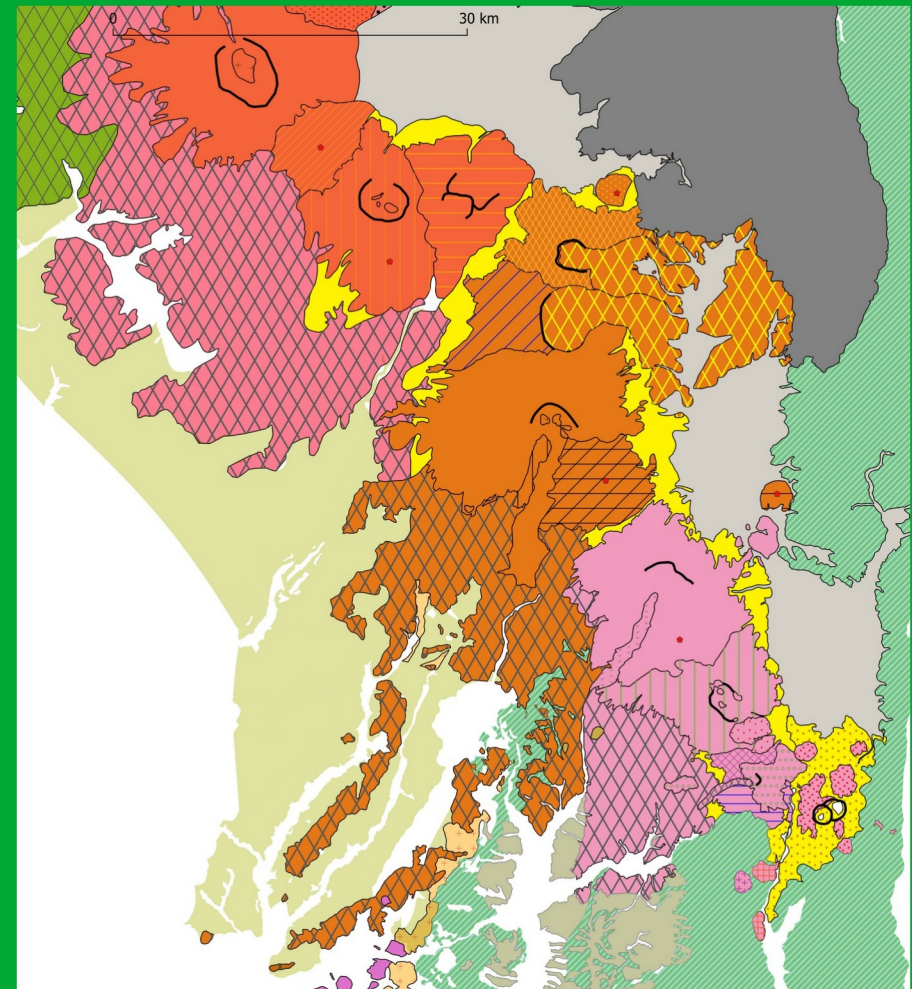
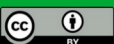
modified after Seghedi et al., 2017



Simplified volcanic facies map of CGH. Inset shows location in Europe, frame indicates the studied area (Seghedi et al., 2019)

Legend:

1. East Carpathian basement;
2. Transylvanian Basin formations;
3. Subvolcanic intrusions;
4. Intra-mountain Basins;
5. Volcanic edifices: 5. Central facies;
6. Proximal facies: a. dominantly effusive; b. dominantly explosive;
7. a. medial-distal facies; b. debris avalanche deposits;
8. Perșani Mts. alkali basaltic field;
9. Volcanic center;
10. Caldera/crater/edifice failure rim.



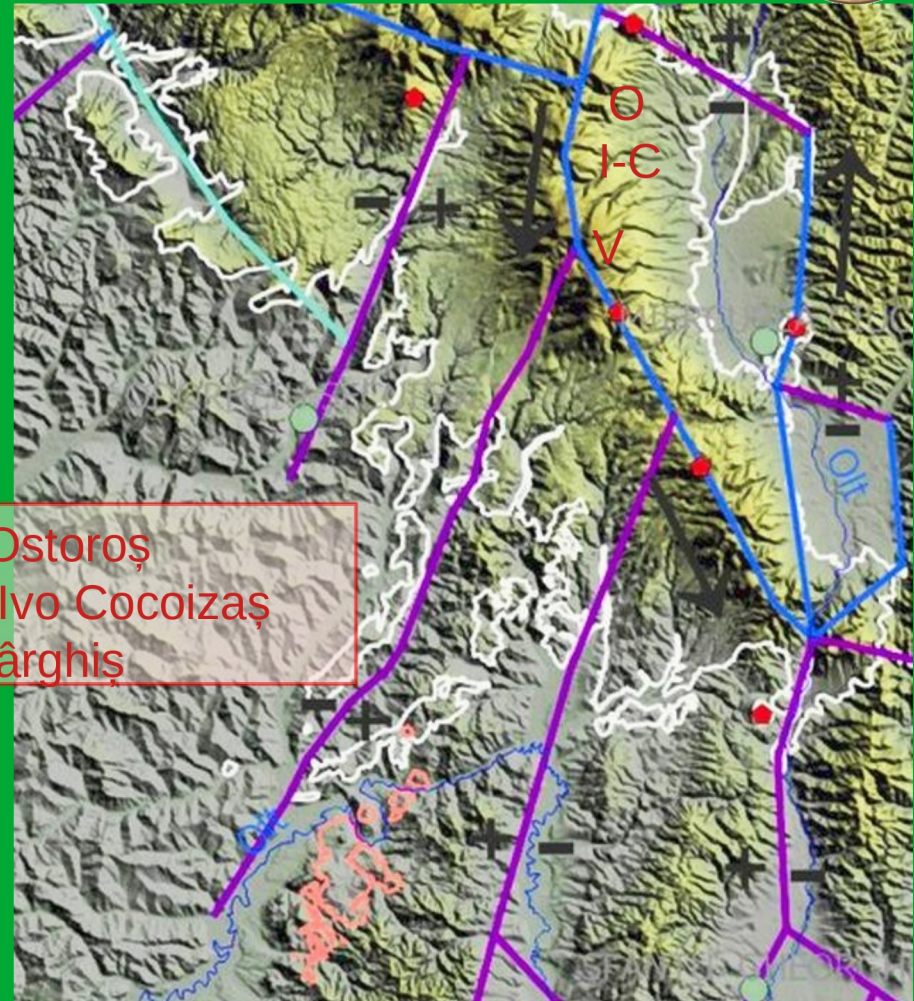
Tectonic setting of the North and South Harghita Mts.



- The North-South-directed spatio-temporal evolution of North Harghita volcanic edifices reflect the southward propagation of strike-slip and normal faulting, following the post-collisional events in the East Carpathians (Seghedi et al, 2019).

Sketch of transcurrent (deep blue lines) and normal (violet lines) fault system. The fault represented in light blue is associated with salt diapirs (after Seghedi et al, 2019)

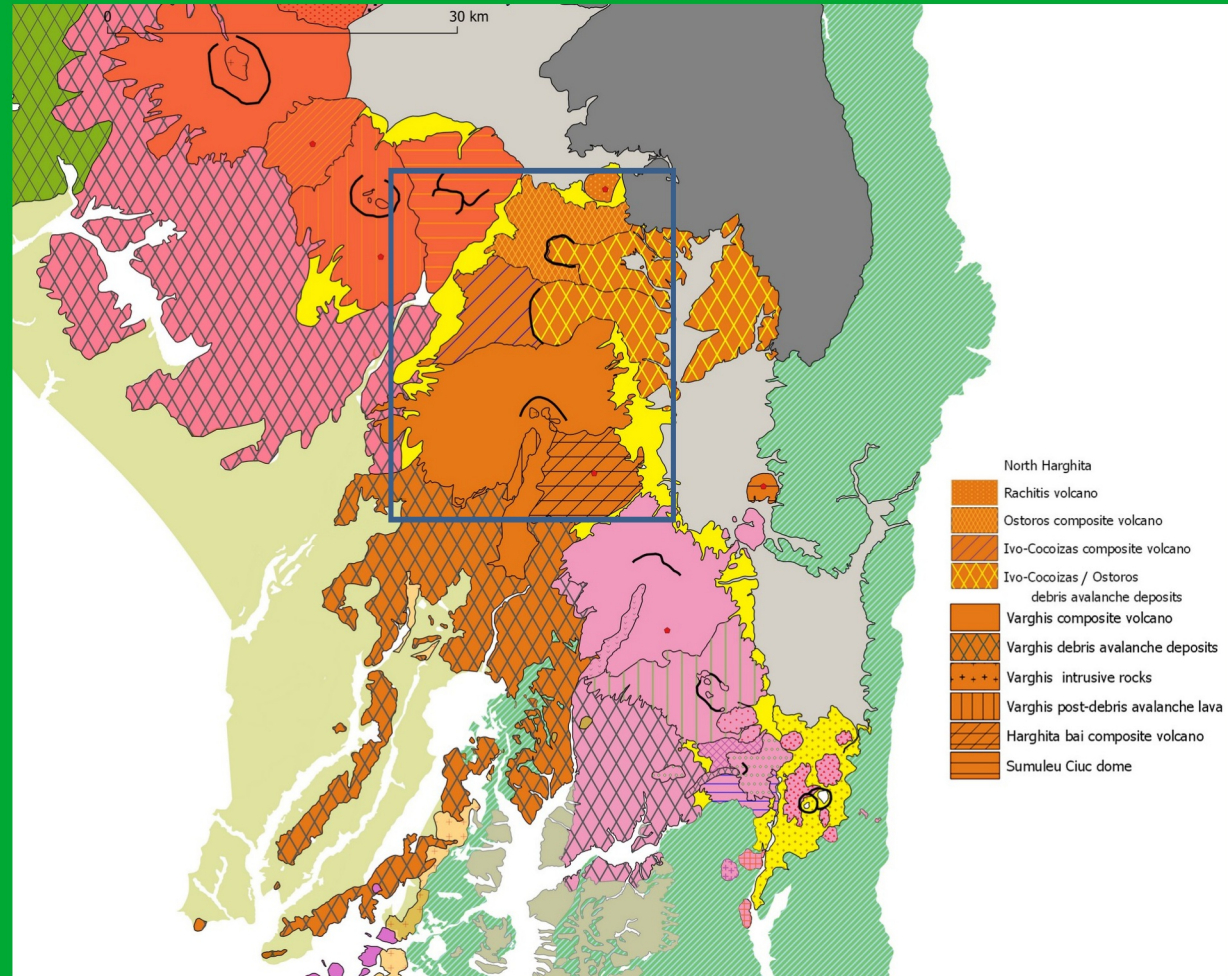
O : Ostoros
I-C : Ivo Cocoizaş
V: Vârghiş



North Harghita volcanic chain-characteristics



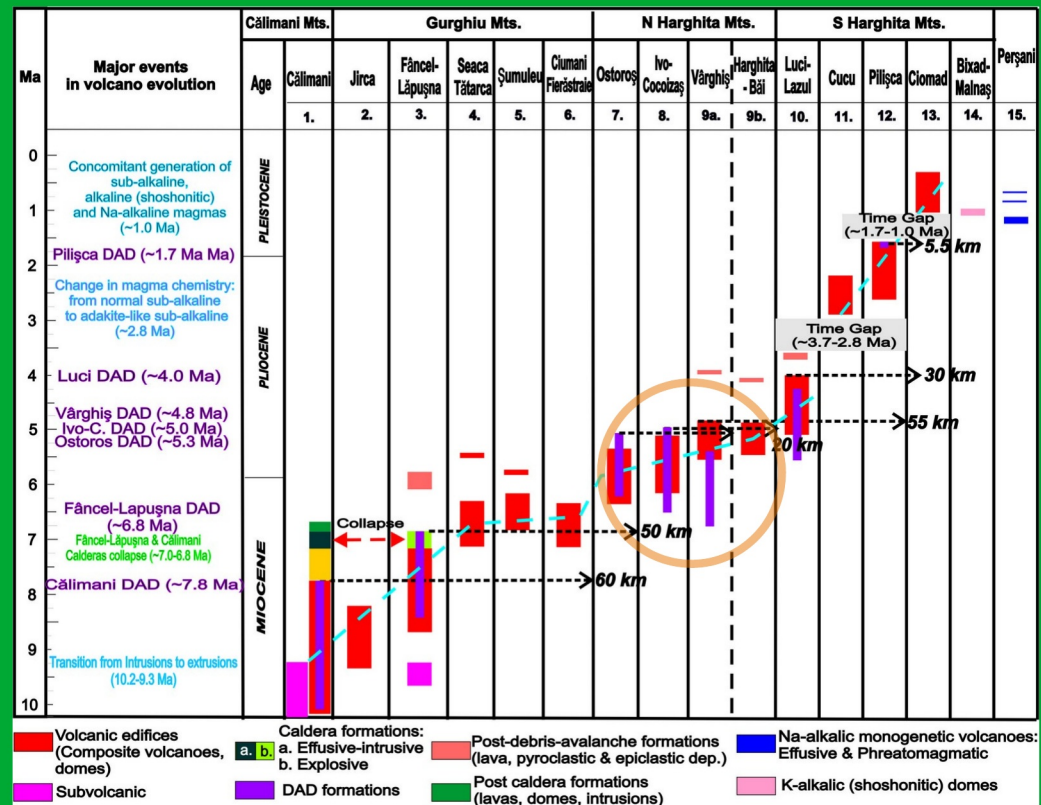
- North Harghita is a chain segment of the Călimani - Gurghiu - Harghita (Romania) volcanic range, composing by row of volcanic of partial overlapping edifices. It is formed from north to south by the following volcanic edifices: Răchițiș (small monogenetic aphanitic dacitic shield volcano) and the Ostoros, Ivo-Cocoizaș, Vârghiș (including Harghita Băi) andesitic (dacitic) composite volcanoes (Szakacs and Seghedi, 1995)



Time sequence of the major events in the North Harghita and in the evolution of the C-G-H volcanic chain (acc. Pecskey et al, 2006; Seghedi et al., 2017)



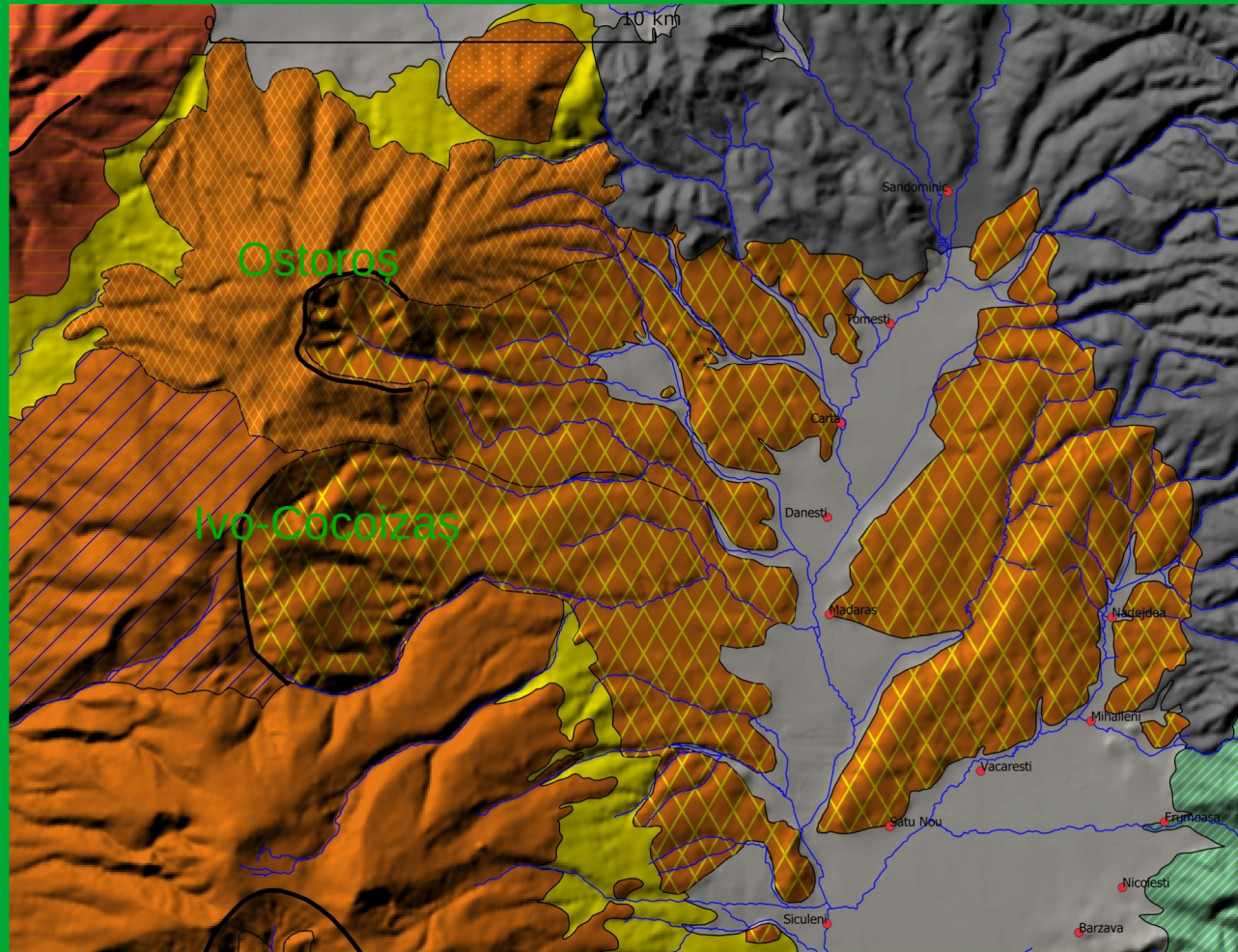
The Miocene-Pliocene calc-alkaline volcanism developed in the North Harghita Mts. for ca. 2.4 Ma (6.3-3.9 Ma). The Răchițiș monogenetic volcano has been generated at ~ 5.8 Ma. The volcanic edifices of Ostoros and Ivo-Cocoizaș were build up in the same time interval (6.3-5.0 Ma), lasting ~1.5 Ma each; Vârghiș main edifice indicate a <1 Ma-long activity (5.5-4.8 Ma), however dated debris avalanche suggest longer duration.



Ostoroș and Ivo-Cocoizaș volcanic edifices



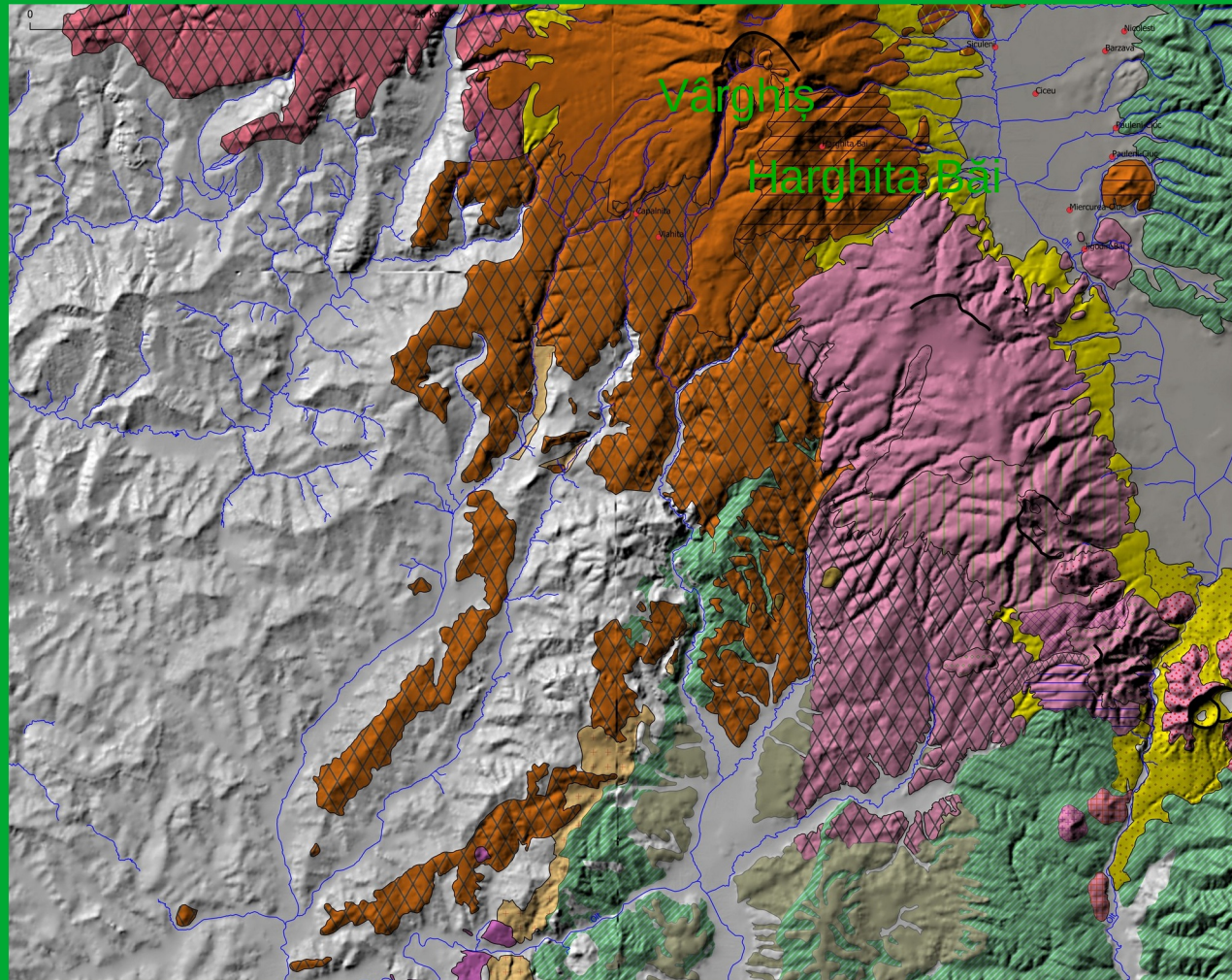
The Ostoroș and Ivo-Cocoizaș volcanic edifices after the build-up stage (6.3-5.0 Ma) were followed by destructive east-oriented debris avalanches events (~ simultaneous) and eruption activity stopped



Vârghiș complex volcanic edifice



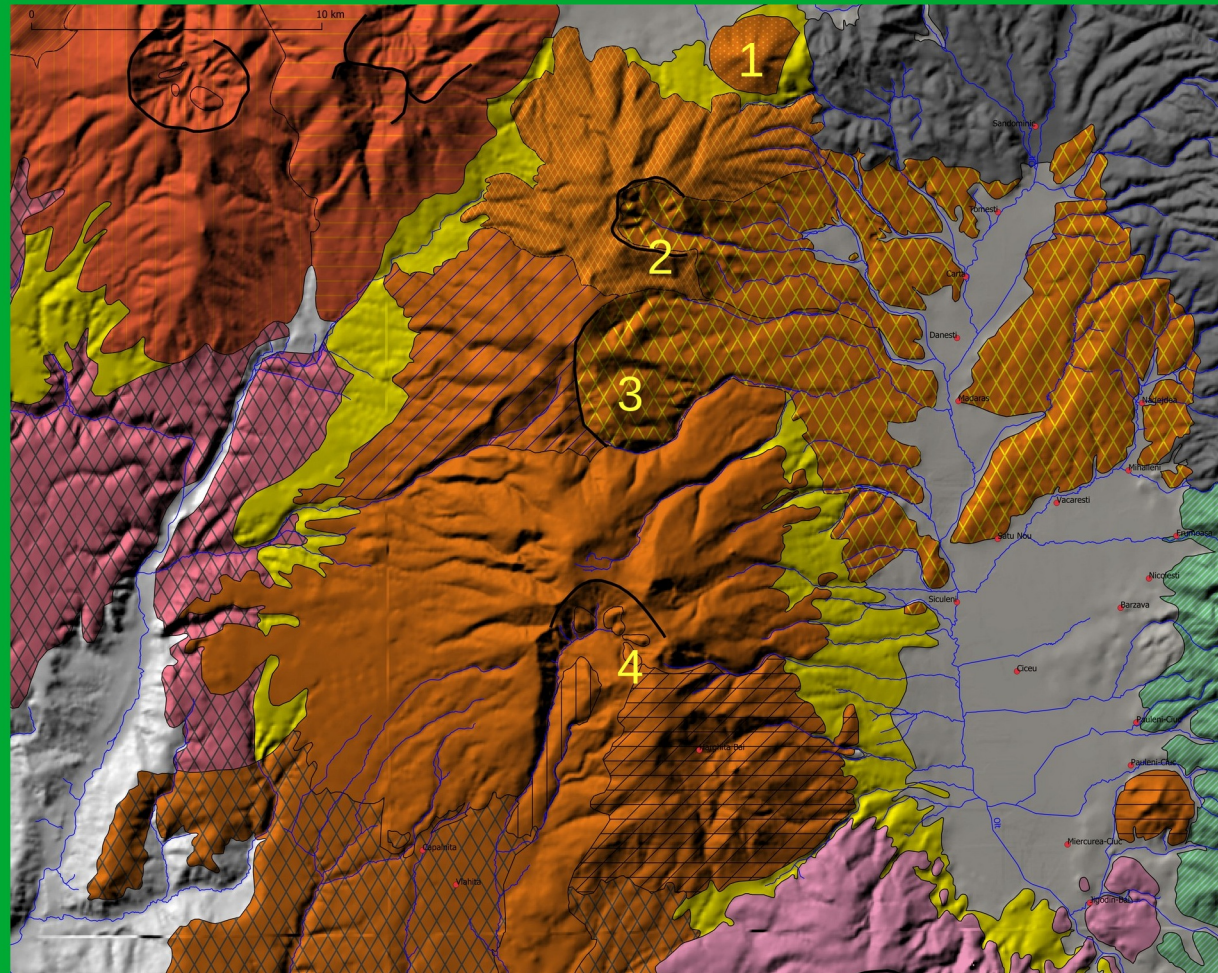
The Vârghiș edifice (including Harghita Băi volcano- (5.5-4.8 Ma), experienced an intense build up stage followed by a south-west-oriented debris avalanche failure event. The southernmost Rupea basaltic andesite mega-block is 6.8 Ma old and can be attributed to the Vârghiș volcano suggesting a much longer duration for the volcano lifespan; later at 3.9 Ma a small effusive event was generated in the failure crater.



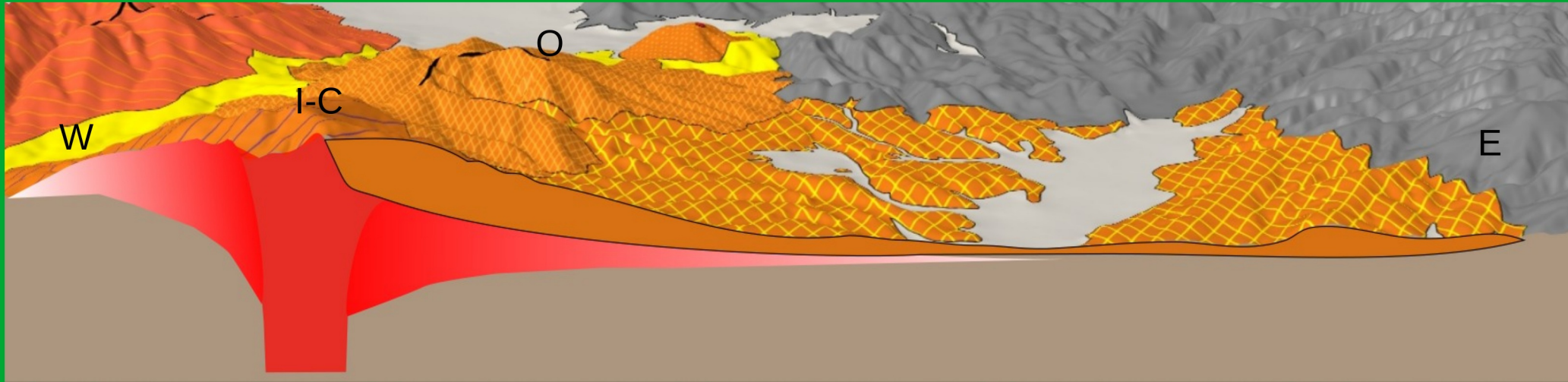
Volume calculations



- DEM volume calculations include present exposed edifices and debris avalanches.
1. Răchițiș is of 0.8 km^3 ;
 2. Ostoros volcano edifice have 16 km^3 and a debris avalanche deposits of 6.1 km^3 suggesting a total volumes of 22.1 km^3 ;
 3. Ivo-Cocoizaș volcano has 18.6 km^3 and its debris avalanche deposits is of 12.6 km^3 , suggesting a total volume of 31.2 km^3 ;
 4. Vârghiș volcano, the southernmost, has the largest volume of 84.9 km^3 (111.7 km^3 including Harghita Băi associated edifice) with a total debris avalanche deposits of 8.7 km^3 with a total volume of 120.4 km^3 .



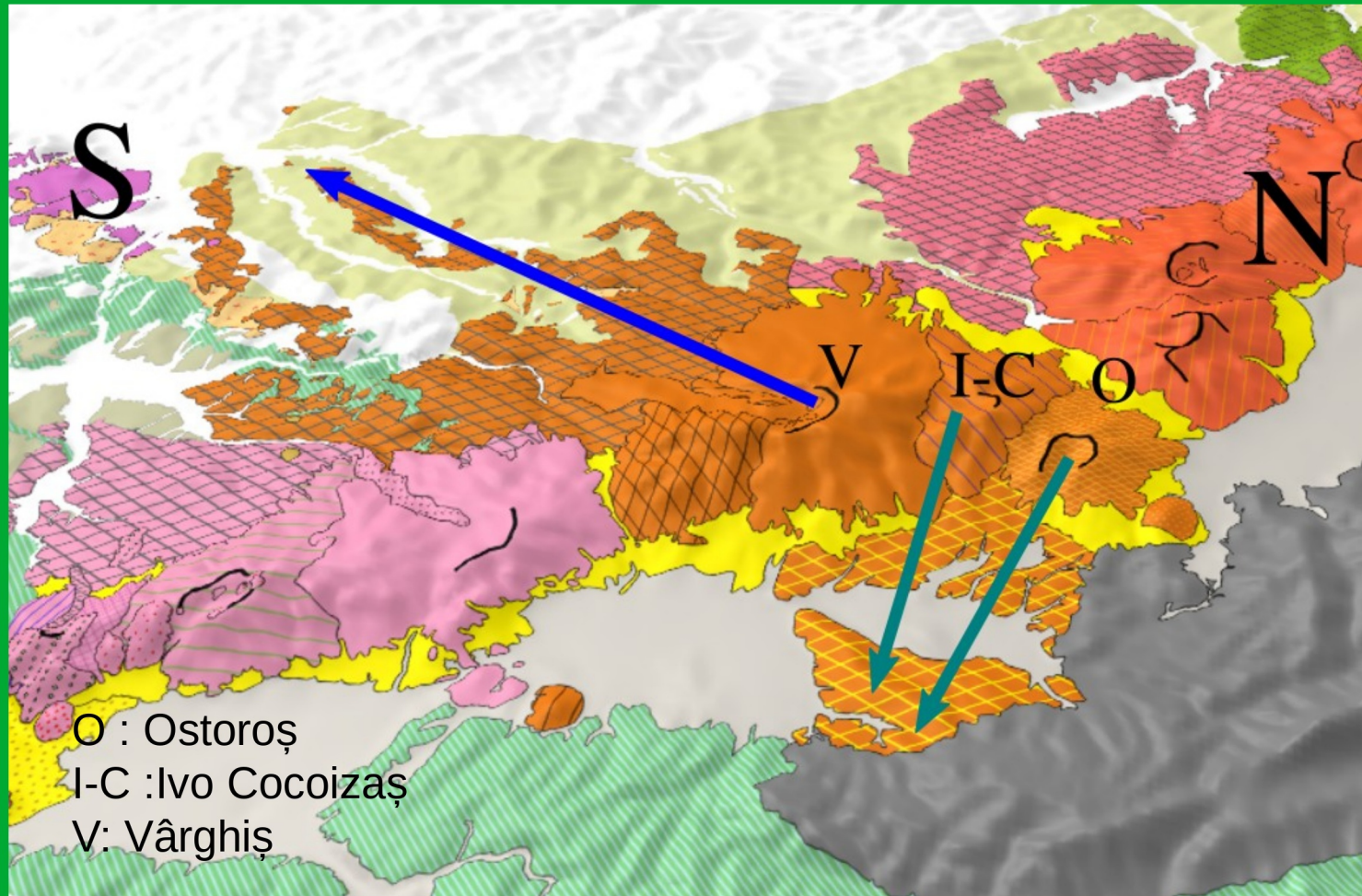
Ostoroş (O) and Ivo-Cocoizaş (I-C) debris avalanches



Ivo-Cocoizaş 3D cross section through debris avalanche deposit

- East-oriented debris avalanches of Ostoroş and Ivo-Cocoizaş travelled up to 20km where has been blocked by a higher morphology. South-west-oriented Vârghiş debris avalanche travelled up to 55km on a lower morphology, and it is much thinner

3D North Harghita view with the development of debris avalanche deposits



Similarities and Differences



- Similarities: Ostoros and Ivo-Cocoizaș volcanic edifices have similar size and volume and after build up stage were followed by debris avalanches events (probably simultaneous), there was not eruption activity to the end.
- Differences: (1) Vârgheș edifice evolution is much voluminous and more complex, after intense build up stage and debris avalanches event was followed by a second-stage effusive activity that built up Harghita Băi edifice.
- (2) The present day volumes of debris avalanches deposits of the Ostoros, Ivo-Cocoizaș deposits are of smaller size, and were less affected by erosion in contrast with Vârgheș deposits that covered a very large area and was strongly exposed to erosion.

Acknowledgements:



This work was supported by a grant of the Romanian Ministry of Education and Scientific Research, CNCS-UEFISCDI, project number PN-II-IDPCE-2012-4-0137 and by grant of Ministry of Research and Innovation, CNCS–UEFISCDI, project number PN-III-P4-ID-PCCF-2016-4-0014, within PNCDI III.

<https://doi.org/10.5194/egusphere-egu2020-7584> EGU 2020 ©Author(s) 2020.

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