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High-temperature acid magmatic rocks from the Late Cretaceous suture zone between European plate and Adria microplate (Croatia)

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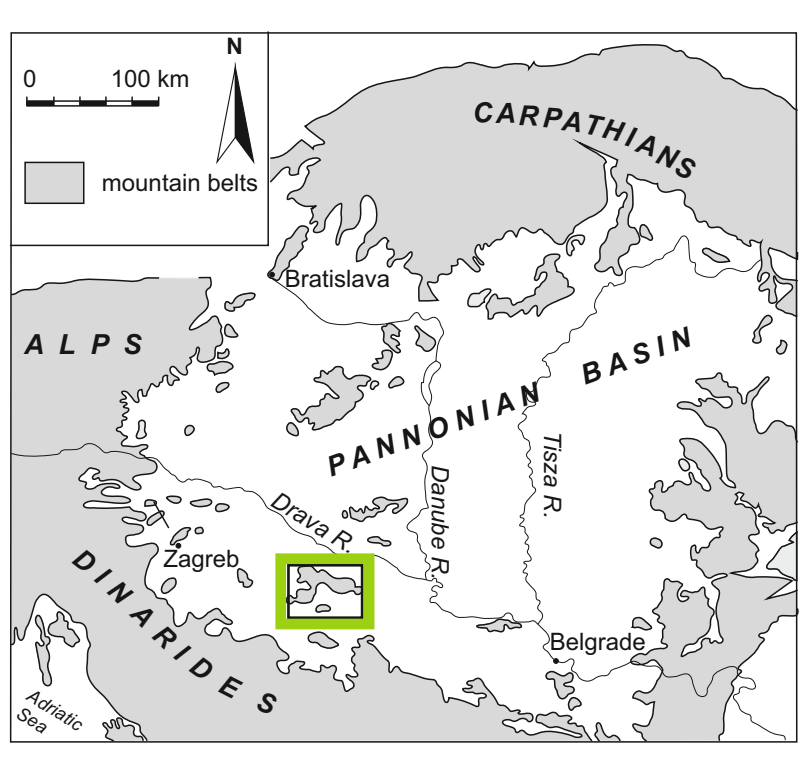
Introduction

The Late Cretaceous magmatic rocks within the southwestern part of the Pannonian Basin basement (Croatia) occur in two areas: **Voćin volcanic mass (VVM)** at the northwestern part of Mt. Papuk (near town of Voćin) and v**olcanic mass of Mt. Požeška Gora (PVM)**. Both volcanic masses consist of basalts and rhyolites, and in lesser extent of pyroclastic material. Granite can be found it the PVM.

Interconnection of this two masses and Late Cretaceous ages have been proposed based on the petrography and mineralogical features of previously studied samples and rather arguable data: K-Ar dating on basalts from VVM (~73−52 Ma;) and Rb-Sr isochron age on granite and rhyolite from PVM (~72 Ma) (PAMIĆ, 1987; PAMIĆ & LANPHERE, 1991). The age has been recently refined with the zircon LA-ICP-MS age dating (~82 Ma; SCHNEIDER et al., 2019), but the magma source of this bimodal formation, geotectonic position, setting and its regional importance still have not been explained in detail.

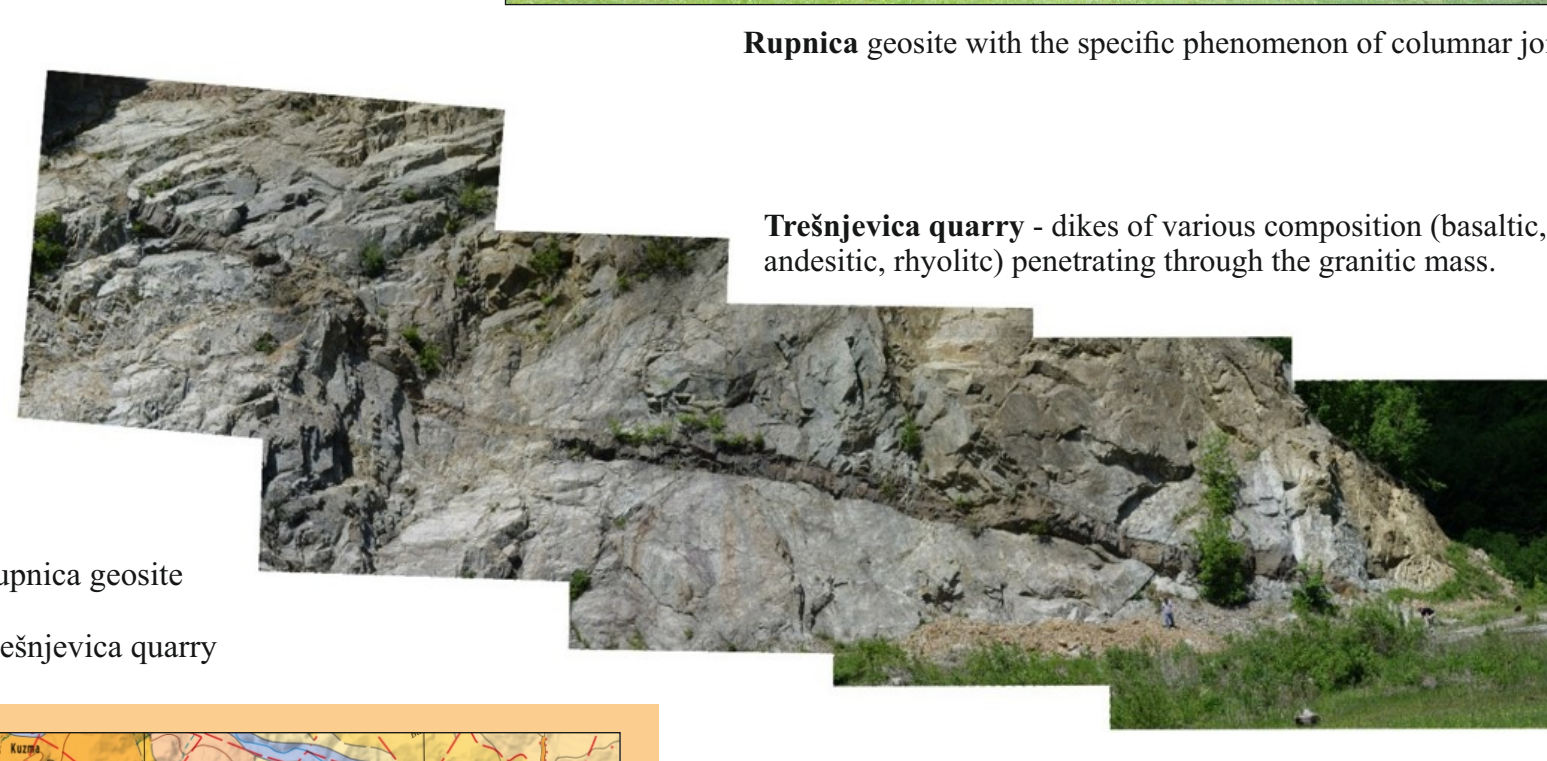
Geotectonic framework



Rupnica geosite with the specific phenomenon of columnar jointing

Samples

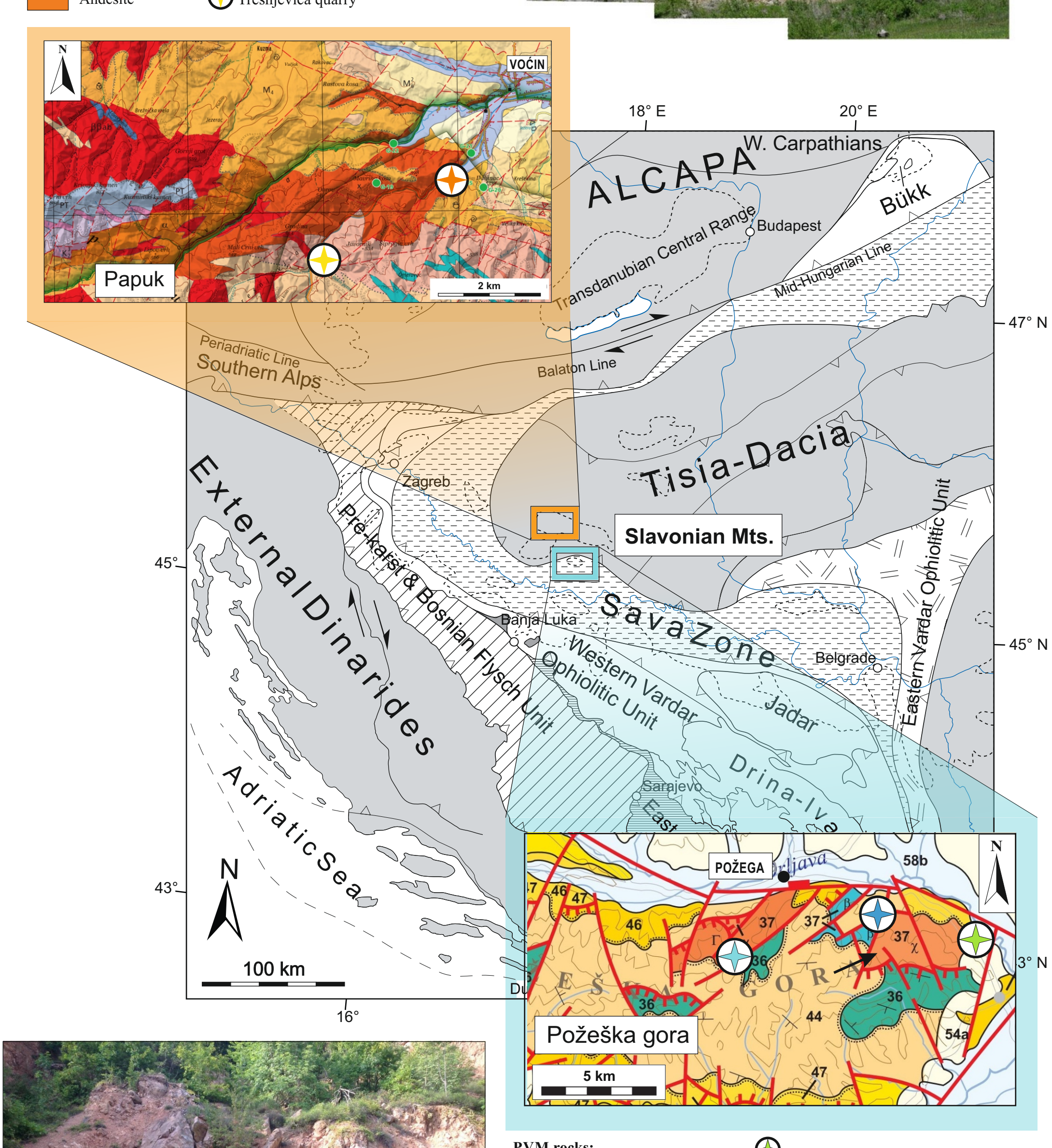
In order to conduct preliminary research, two localities with **acid** effusive rocks were sampled from the VVM (Rupnica geosite and Trešnjevica quarry), and three more from PVM (near the village of Vesela, Pakao Creek and the granite from quarry near the village of Gradski Vrhovci).



Trešnjevica quarry - dikes of various composition (basaltic, andesitic, rhyolitc) penetrating through the granitic mass.

VVM rocks:

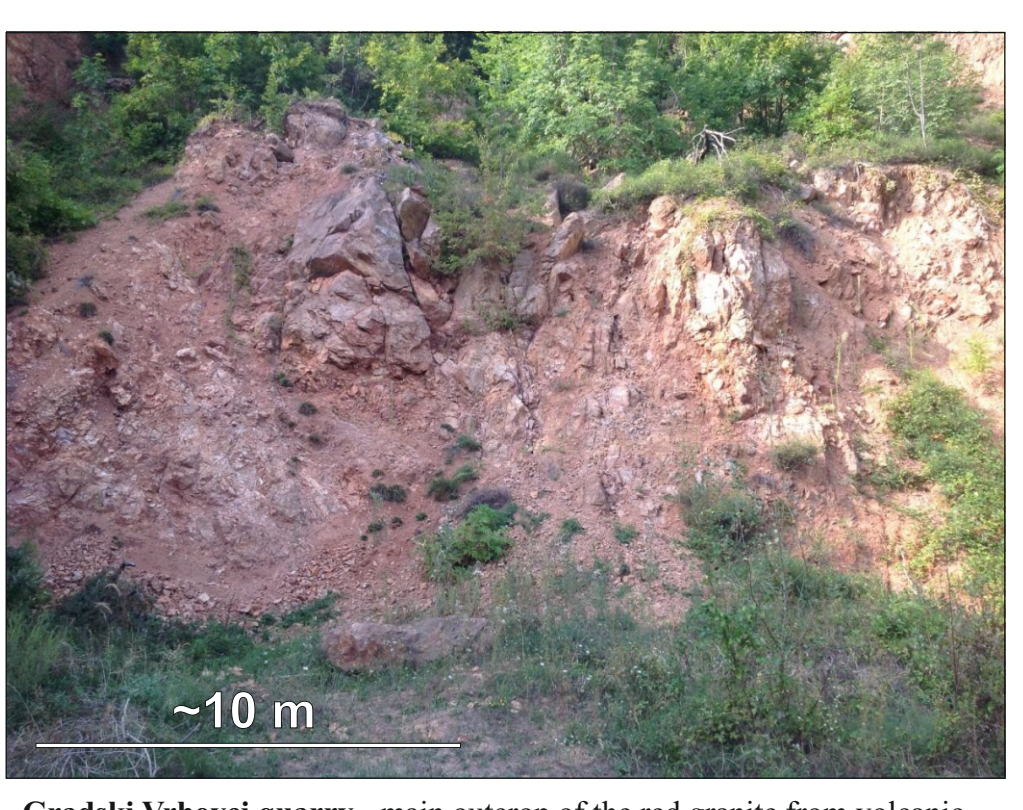
- Albite rhyolite
- Andesite
- Rupnica geosite
- Trešnjevica quarry



PVM rocks:

- β - basalt
- χ - rhyolite; Γ -granite
- Vesela village
- Gradski Vrhovci quarry
- Pakao Creek

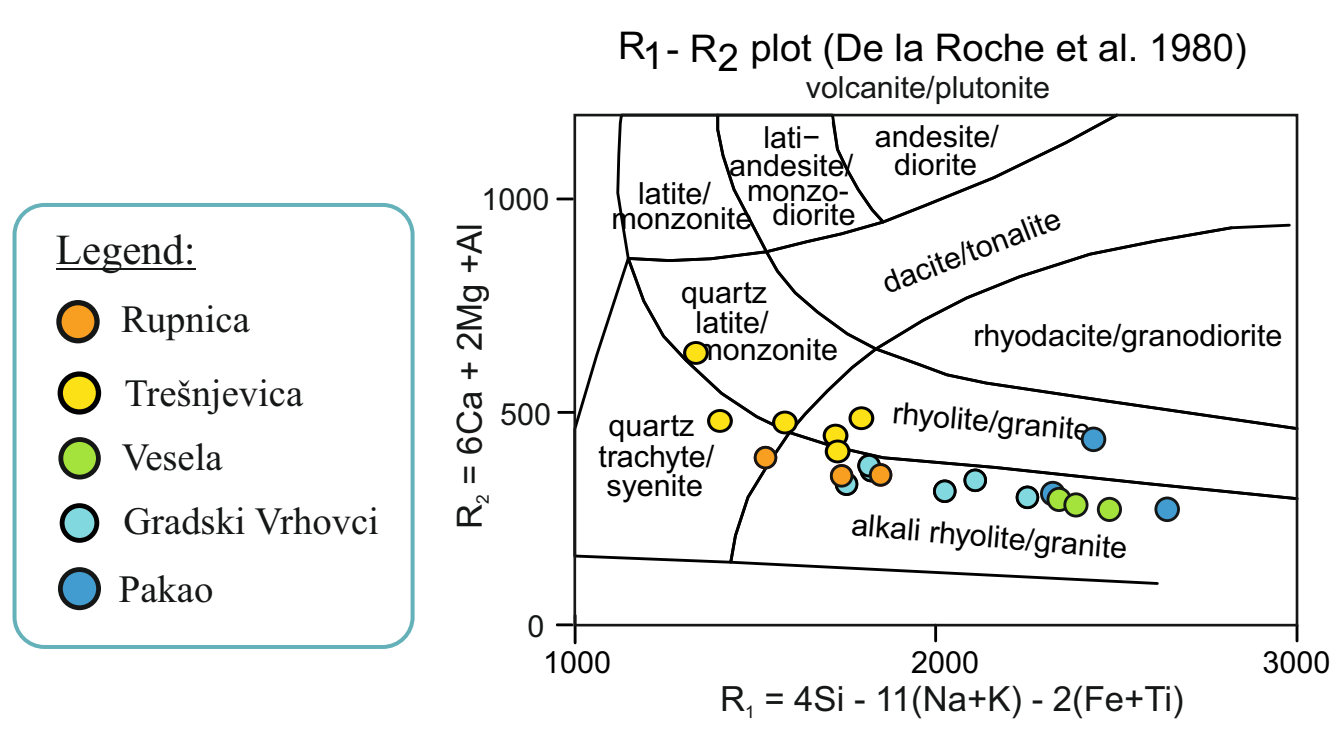
Simplified geotectonic map of the Dinaride-Alpine-Pannonian region showing the major structural units after SCHMID et al. (2008) with insets from the Basic geological map, and marked localities of the interest in preliminary research.

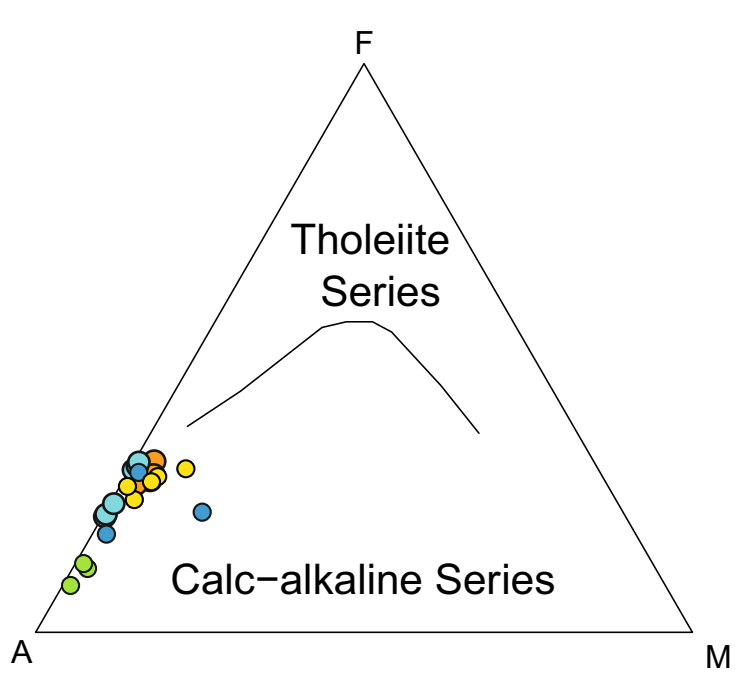


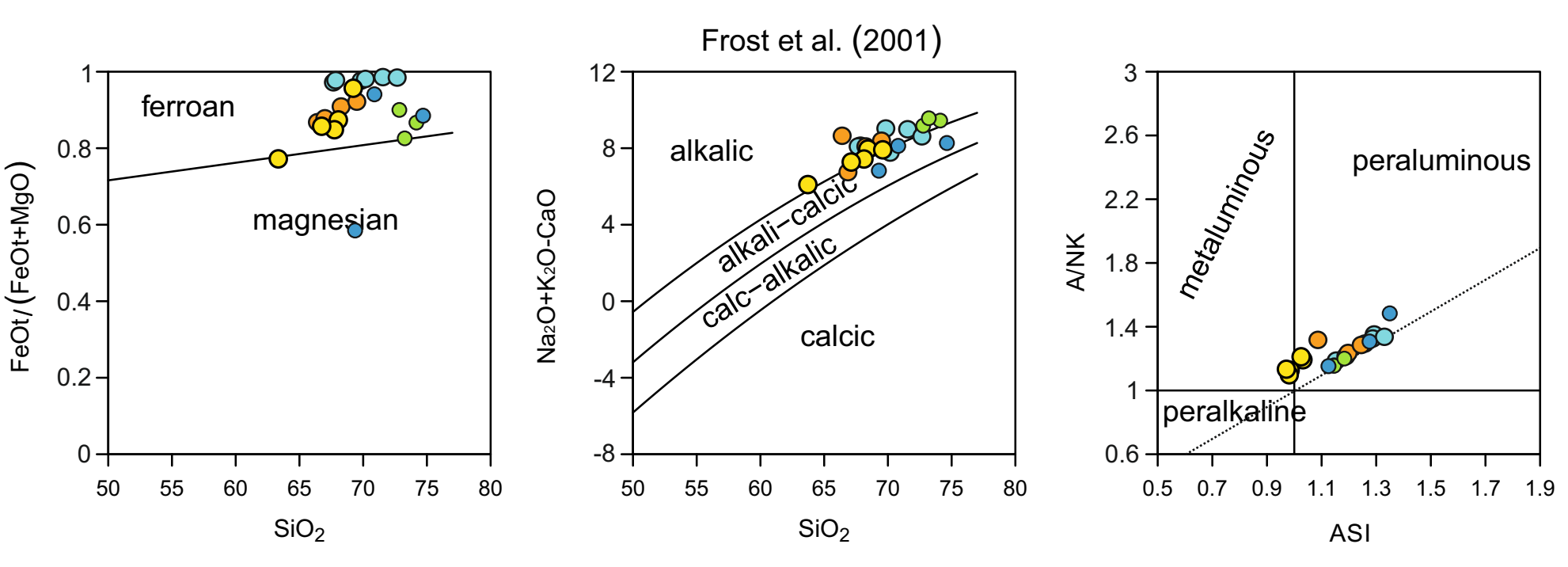
Gradski Vrhovci quarry - main outcrop of the red granite from volcanic mass of Mt. Požeška Gora.

Results

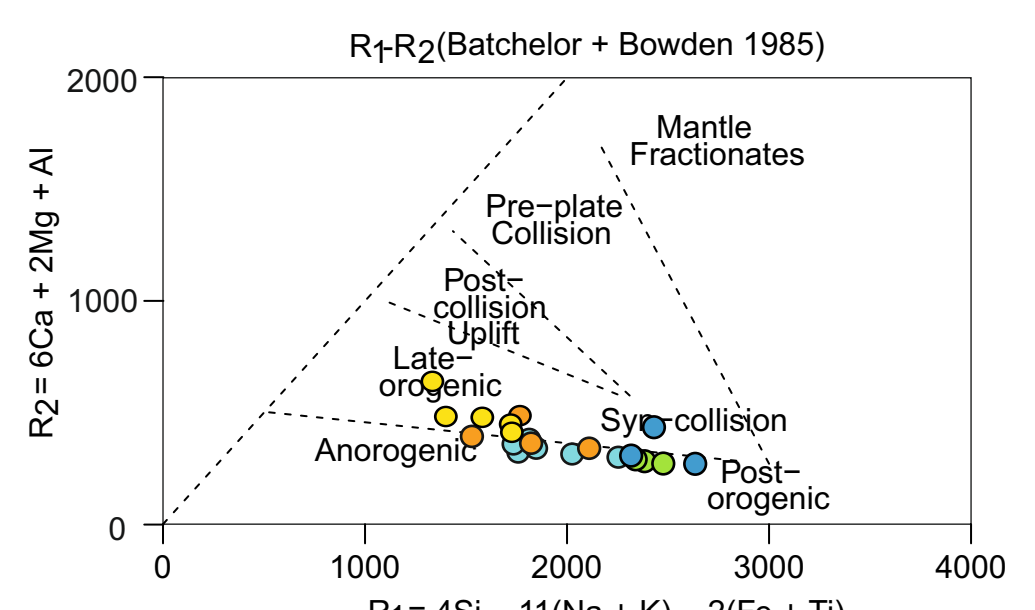
Geochemistry

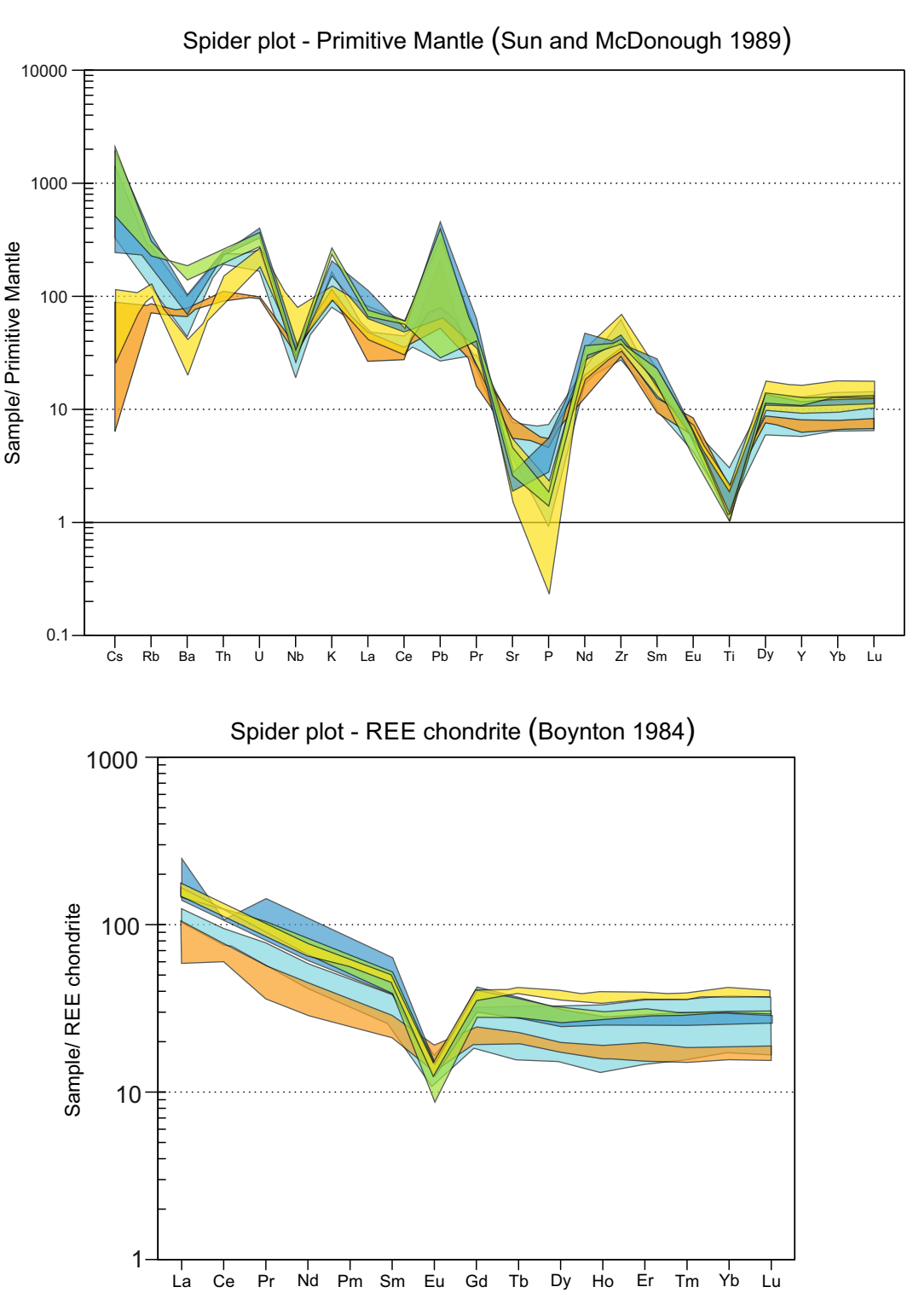


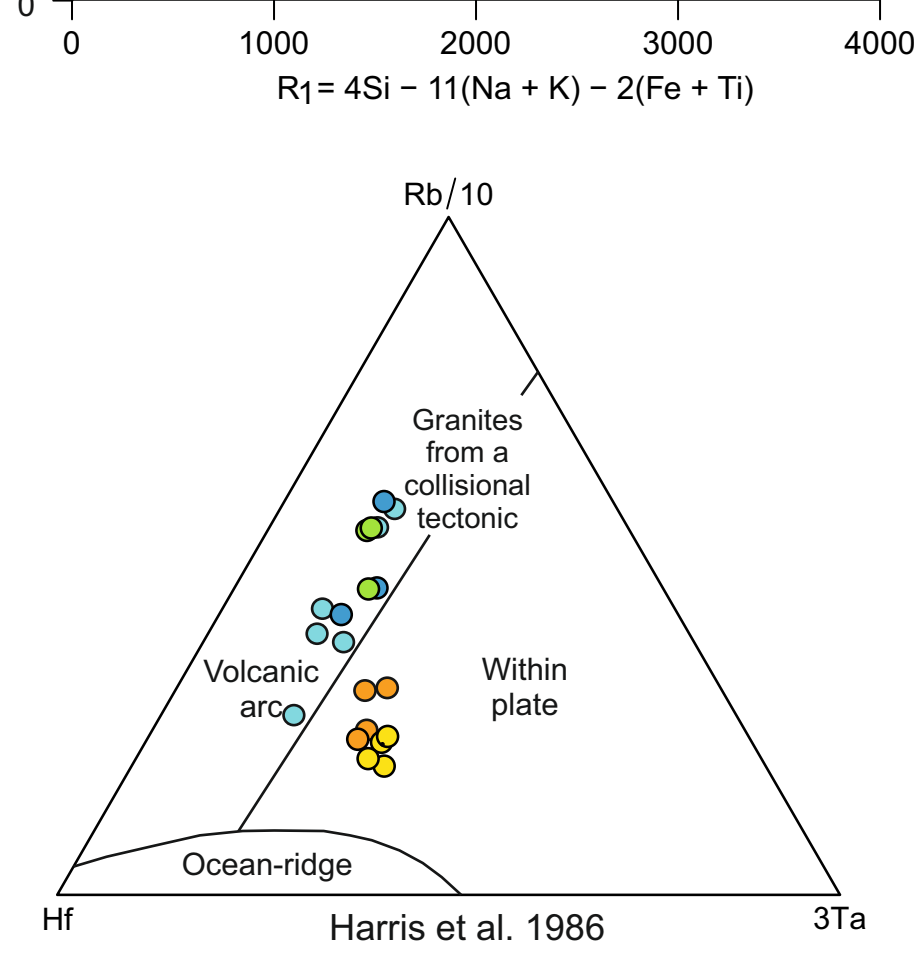




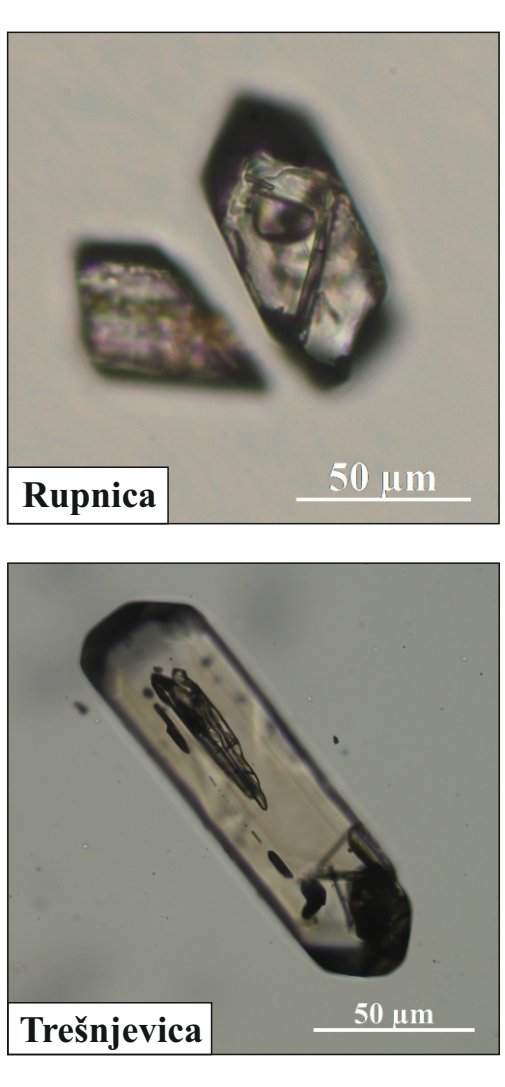
Microelements including REE show that studied rocks have characteristics of **A2-type** of post-collisional/post-orogenic acid rocks (EBY 1992; 2011), most common A-type of rocks formed during rifting caused by extension and thinning of continental crust. According to geotectonic classification diagrams, rocks from PVM show geochemical signature of **volcanic arc**, while VVM shows signature of **within plate environment**.







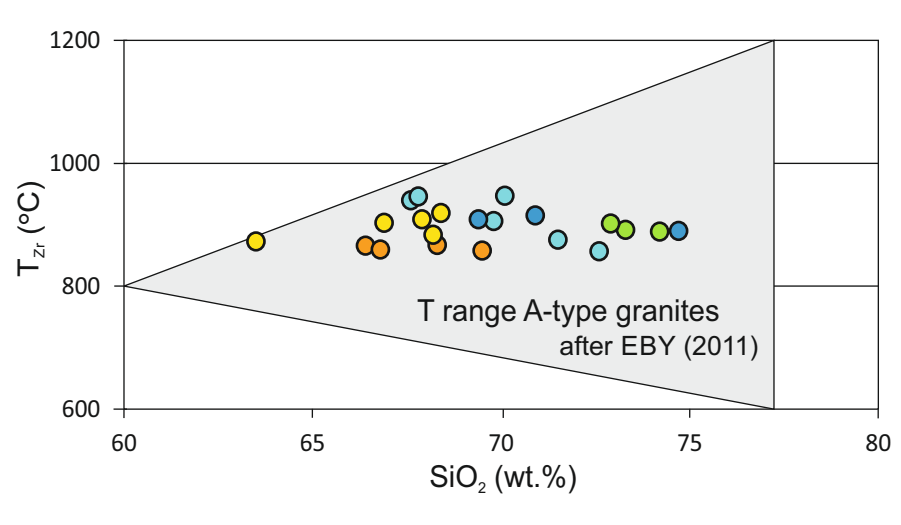
Zircon

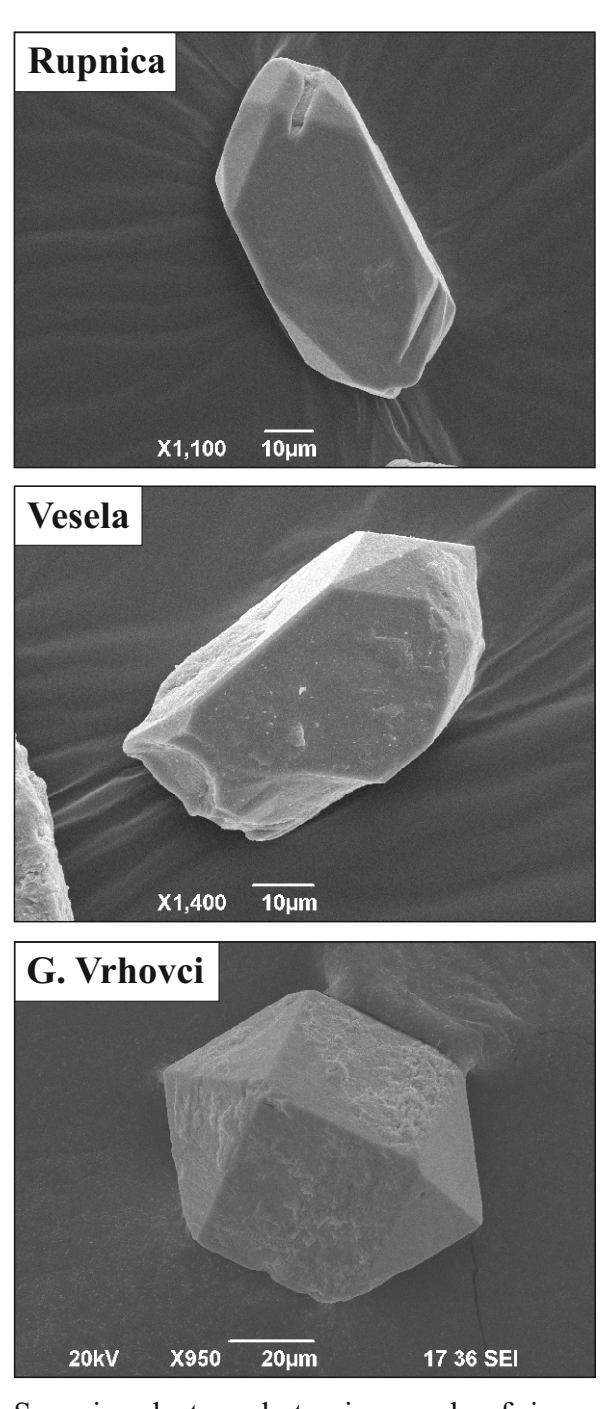


Plain-plarized transmitted-light photomicrographs of zircon from Rupnica and Trešnjevica showing variety of fluid and mineral inclusions.

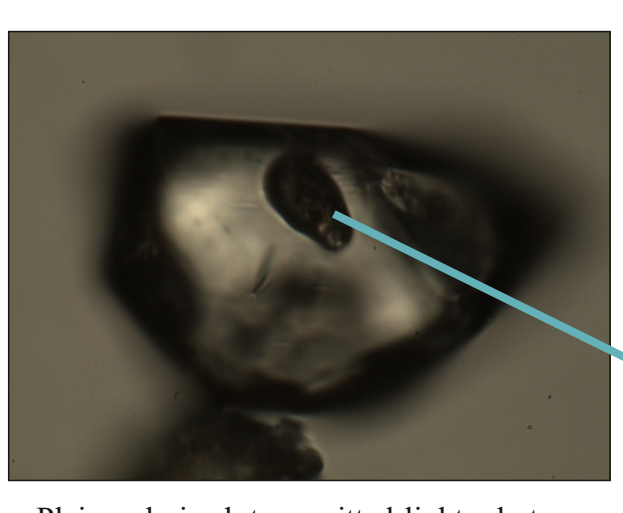
External zircon morphology seems to be uniform with prevailing J3−J5-type for rhyolites and D-type for granite (after PUPIN, 1980) and with average ratio of 2.2:1. Those types are characteristic for the high-temperature magmas (confirmed with the calculated Zr-saturation temperature of **850−930°C**, after WATSON & HARISSON, 1983; GERVASONI et al., 2016) originating from the lower crust or even upper mantle.

Inclusions of hematite, F-apatite and anatase have been detected with Raman spectrometry in zircon from all samples, with the most significant findings of **kumdykolite** and **kokchetavite** inclusions detected in samples from Vesela and Gradski Vrhovci. Latter inclusions are metastable phases crystallized from enclosed melt and are indicators of a rapid cooling of the host magma (FERRERO et al., 2016; FERRERO & ROSS, 2018).

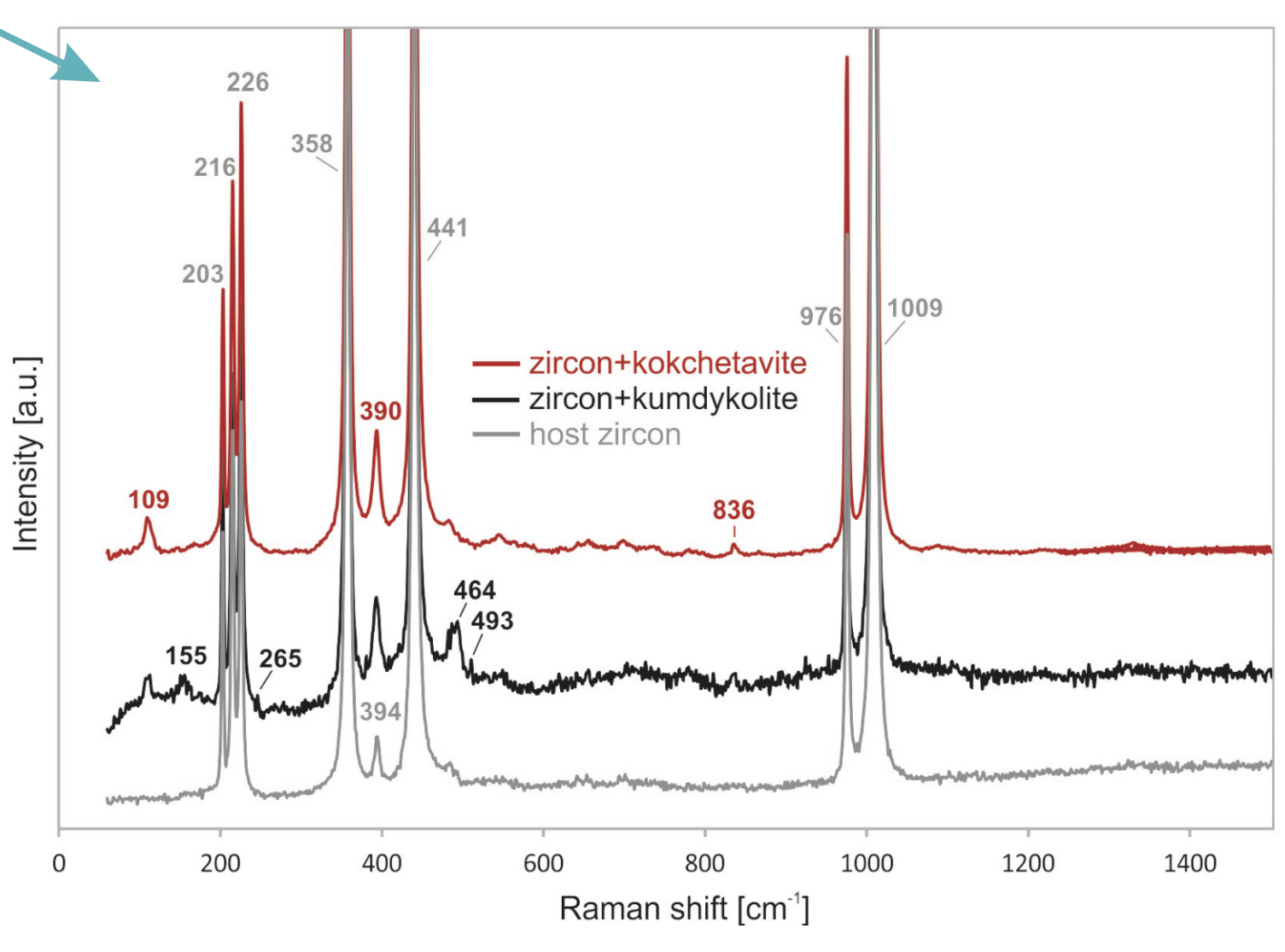




Scanning electron photomicrographs of zircon from Rupnica, Vesela and Gradski Vrhovci.



Plain-polarized transmitted-light photomicrograph of zircon from Vesela with mineral inclusion and its Raman spectra showing presence of kumdykolite and kokchetavite. Inclusion size approx. 10 µm in diameter.



Conclusion

According to the results presented here, acid rocks show rather uniform geochemistry, which speaks in favor of the early ideas of the unique magmatic complex, although today at the surface they are separated by ~35 km in distance. Those rocks, althouhg small in volume (covering areas of max 30 km^2) show potential to be of great regional importance bearing new information about the evolution in the Late Cretaceous in the area of **Sava Zone**, a suture zone between Tisia Mega-Unit (European plate) and Adria microplate, which spatially and temporally marks the closure of the **Neotethys Ocean**.

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