Upper Cretaceous magmatic evolution of the Timok magmatic complex (TMC) and Ridanj-Krepoljin zone (RKZ), East Serbia: Implications from geochemistry and geochronology

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Volcanism in East Serbia can be linked to the northward subduction of the Vardar ocean beneath Europe in the upper Cretaceous, followed by major continental collision between Africa and Europe. This mineralized magmatic arc of East Serbia developed along two belts, the Timok magmatic complex (TMC) in the east and the Ridanj-Krepoljin Zone (RKZ) in the west. The composition for the calc-alkaline rocks is ranging from basaltic andesite to granite, and clearly shows subduction zone signatures, i.e. depletion in Nb and Ta, and enrichment in Th, U and Pb.

Literature K/Ar data imply that the magmatic activity extended over the period of 94-60 Ma (Late Cretaceous to Paleocene). However, these ages are not very precise. First high-precision U/Pb single zircon analyses indicate an age of 86-84 Ma for the initial volcanism in the eastern part of the TMC. New obtained LA-ICPMS U/Pb ages show a general younging from east to west in the TMC. Volcanism in TMC ceased with 78 Ma in the Valja Strz area, indicating that magmatism lasted at least 8 m.y. The RKZ in contrast shows ages ranging between 71 and 74 Ma. This new age data clearly represent a time gap of 4 m.y. between these two volcanic complexes.

This time difference can also be seen in the geochemistry of the volcanic rocks. $^{87}Sr/^{86}Sr$ values in TMC are ranging from 0.70339 to 0.70482 whereas RKZ samples have higher isotopic values (0.704156-0.705513), displaying increasing upper crustal component. $^{143}Nd/^{144}Nd$ ratios show the same trend. TMC volcanics are ranging between 0.512695 and 0.512535. RKZ volcanics show lower ratios (0.512658-0.512469) and therefore also indicate the increasing upper crustal contamination. In both volcanic provinces it is noticable that crustal assimilation increases rapidly with SiO_2 contents above 60 wt%. Intense crustal assimilation particularly took place in RKZ which is, besides the isotopes, also notable in trace elements (high Th/Yb$\geq$ 5). The TMC in contrast shows low Th/Yb ratios ($\leq$ 5) but high Sr/Nd ($\geq$ 30) ratios indicating a more subduction zone fluid dominated origin.

As can be seen in other mineralized volcanic arcs, volcanic rocks from eastern Serbia also show adakite-like signatures (e.g. high Sr/Y and low Y). EC-AFC-modelling at a depth of 40 km indicates that amphibole fractionation is most likely to have produced this signature in the majority of the cases. Later upper crustal (10 km depth) fractionation of apatite, clinopyroxene, amphibole, plagioclase and magnetite produced the other trace-element signatures.