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Late Cretaceous short-lived magmatism and related metallogenesis in the Carpathian area (Romania): connections with Balkans

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The first magmatic event that post-dates the Meso-Cretaceous orogeny in the Carpatho-Balkan area took place in the Upper Cretaceous at the same time and after the formation of Gosau-type molasses basins, the whole being controlled by an extensional tectonic transpressive-transtensive type (Schuller, 2004; Schuller et al., 2009; Drew, 2006; Georgiev et al., 2009). This tectonic regime controlled the spatial and temporal distribution of both magmatites and metallogenesis associated with the main feature discontinuity.

This aspect is suggested by gravimetry and magnetism studies (Andrei et al., 1989), and also structural studies (Schuller et al., 2009; Drew, 2006; Georgiev et al., 2009).

The age data attest to the temporal sequentially of Upper Cretaceous magmatism's evolution in the Carpathians and the Balkans. The most accurate age data (using geochronometers of zircon U-Pb and molybdenite Re-Os) suggest a very narrow evolutionary range (70.2-83.98 Ma, after Nicolescu et al., 1999; Galhofer, 2015 and 72.36-80.63 Ma, after Ciobanu et al., 2002; Zimmerman et al., 2008), which is characteristic to short-lived magmatism. In contrast, the same magmatism exists between 84-86 Ma in Serbia (Bor-Madjanpek district) and between 86-92 Ma and 67-70 Ma in Bulgaria (Srednogorie massif) in the Rhodope massif (von Quadt et al., 2007).

The magma volumes have been significant several times, so much so that we have circumstances such as that in Vl□deasa (Apuseni Mts), and not only, in which sedimentary deposits of the Gosau type are "suspended" at high altitude, "behind" the granodiorite intrusions. According to Lin & Wang (2006), there are two approaches to explain this situation in the Carpathians during Upper Cretaceous: (1) mechanical convective ablation of the lithosphere, as suggested by Bird (1979) for North American mountain ranges, or (2) detachment of a large piece of the lithospheric mantle, as suggested by Houseman et al. (1981). The thin crust can be explained in an extensional context, regardless of the adopted model, which facilitates rapid ascents of magmas induced by adiabatic detente at the base of the lithosphere and/or in the asthenosphere.

Irregular variations in La_N/Yb_N, Eu/Eu*, Ce/Ce*, and initial $^{87}Sr/^{86}Sr$, and $^{143}Nd/^{144}Nd$ ratios that are in the range between 0.704957-0.706774 and 0.512456-0.512538 respectively, suggest that the banatites were generated by partial melting of the LCC, with the involvement of mantle-derived

magmas.

The metallogenesis associated with banatitic magmatism is characterized by a great typological variety of metalliferous accumulations forming mineral deposits with main commodities of Fe, Cu, Pb, Zn, ± Au, Ag, W, Mo, B, Mg, Te, Bi, Sb, spatially dominated by transpressive-transtensive tectonics. The most common forms of mineralization is skarn, porphyry copper, massive sulfide, and veins. These mineral deposits exibit complex paragenesis of more than 200 minerals, some of which were first described: ludwigite, szaibelyite, dognacskaite, rezbanyite, veszelyite and csiklovaite. The main mineral deposits associated with the Romanian banatites are Baita Bihor (Mo-Bi-W-Cu-U-Pb-Zn-B), Baisoara (Fe-Zn-Pb), Ocna de Fier-Dognecea (Fe-Cu-Pb-Zn-Bi), Moldova Noua (porphyry Cu±Au-Ag-Mo), Oravita-Ciclova (Cu-Mo-W-Bi) and Sasca (Cu-Mo).

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