GEOLOGY OF THE BOSNIAN FLYSCH (SARAJEVO – ZENICA AREA, BOSNIA AND HERZEGOVINA) PART 1: AGE AND PROVENANCE

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The Bosnian Flysch is a Jurassic to Upper Cretaceous, 2-3 km thick carbonate-clastic tectonostratigraphic unit of the Dinaride thrust-nappe system. It is thrusted onto the Adriatic-Dinaride carbonate platform and itself is overthrusted by carbonate and ophiolite units of the Inner Dinarides. The Bosnian Flysch is made up of a lower, turbiditic to monotonous pelagic series composed of micritic limestones, marls, shales and siliciclastic-dominated sandstones (Vranduk Formation). The upper succession (Ugar Formation) is carbonate-dominated, comprising thin-bedded marly to micritic limestones and shales alternating with calcareous turbidites and debrites several tens of metres thick. There is a marked increase in the carbonate content in the Ugar Formation.

We present new biostratigraphic (foraminifera and calcareous nannoplankton), and sediment provenance data (whole rock geochemistry, heavy mineral chemistry, and detrital zircon fission track analysis) which are used to reconstruct sediment source rock lithology and provide new constraints on the age of sedimentation in the Bosnian Flysch basin.

A peculiar breccia horizon in the Vranduk Formation contains Urgon facies limestone clasts that are Barremian to Aptian in age. Calcareous nannofossils obtained from the pelitic intervals point to the same age, indicating erosion from a coeval carbonate platform into the basin. Nannofossils of the Ugar Formation mostly show Turonian to Maastrichtian ages but likewise contain Lower Cretaceous carbonate clasts.

X-ray fluorescence analyses of the trace elements Cr, Ni, V, Y, Zr and Sc provide evidence for the predominance of ultramafic and mafic rocks in the source area. Zr/Sc ratios best correspond to an active margin setting of the source crystalline units. This is confirmed by Cr/Ni and Zr/Sc ratios which reveal that sediment recycling has played no major role during the sedimentation and suggest that the trace element pattern is linked to source crystalline lithologies. Cr/V vs. Y/Ni shows that felsic crystalline units were also involved into source area erosion.

The heavy mineral spectra are dominated by Cr-spinel and also comprise much zircon, rutile, garnet, tourmaline, apatite, monazite and titanite whereas kyanite, zoisite, epidote are only locally significant. Chemical compositions of selected heavy mineral species determined by electron microprobe yield additional information on source lithology. Mostly all tourmaline crystals are derived from metapelitic sources. Metamorphic zoning points towards a low-grade Barrovian metamorphic source. Garnet geochemistry indicates a variety of source lithologies. Most dominant are Barrovian type metamorphic rocks and in samples where kyanite, zoisite and epidote are present, a garnet population derived from amphibolite to granulite facies metapelites appears. 60 to 80% of the rutile crystals are of metapelitic origin as deduced from their Cr/Nb ratio, the rest is derived from metamafic lithologies. Zr-in-rutile-thermometry reveals a broad distribution of calculated metamorphic temperatures between 450 to 1050°C but in many samples a clear peak is observed at 550 to 650°C temperatures.

Cr-spinel is the most abundant heavy mineral throughout the Bosnian Flysch. The high amounts of this mineral correspond to the predominance of ophiolite units of the adjacent ophiolite mélange belt. The data allow to discriminate between abundant mantle-derived spinels and a subordinate magmatic-derived population. Most mantle-derived spinels are of harzburgitic affinity. Magmatic Cr-spinels amount only to 2–24% in the entire spinel association.

Detrital zircon fission track data from a single sample from the Bosna river valley shows a wide age distribution (80 to 270 Ma) implying that the burial temperature was not sufficient for reset. The youngest age population lies at 121±21 Ma. This nearly syndepositional cooling may indicate either a relatively rapid exhumation of zircon-bearing felsic lithologies in the accretionary wedge or a contribution from Early Cretaceous volcanism as indicated by significant proportion of euhedral crystals.

Our results indicate a complex source rock assemblage comprising carbonates; low to medium grade, Barrovian type metamorphics that are mostly metapelitic but also metamafic; subordinate high-pressure metamorphics as well as ultramafics. This challenges existing models on the geodynamic evolution of the Bosnian Flysch.