GEOLOGY OF THE BOSNIAN FLYSCH (SARAJEVO – ZENICA AREA, BOSNIA AND HERZEGOVINA) PART 2: DEFORMATION AND BURIAL HISTORY

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The Bosnian Flysch is a Mesozoic tectonostratigraphic unit of the Dinarides stretching from the Southern Alps-Dinarides transition in the NW to the Skadar-Peć fault in the SE. Structurally the Bosnian Flysch is underlain by the Adriatic-Dinaride carbonate platform nappes, the Una-Kuči Nappe, and the Mid-Bosnian Schist Mountains. To the NE, it is bordered by the Pannonian-Golija-Macedonian nappe, the Dinaride Ophiolite Zone and the Durmitor-Gashi Nappe.

The Bosnian Flysch consists of two major units. The lower unit (Vranduk Fm.) is composed mainly of Jurassic to Lower Cretaceous micritic limestones, marls, shales and siliciclastic-dominated sandstones. The upper unit (Ugar Fm.) comprises Upper Cretaceous thin-bedded marly to micritic limestones and marls alternating with carbonate gravity-flow deposits. This unit is characterized by high carbonate content and synsedimentary deformational features (e.g. slumping).

The Vranduk Fm. commonly exhibits outcrop-to-map-scale tight folds (inclined and overturned) and thrust faults. Joints perpendicular to bedding are frequent. The Ugar Fm. is dominated by open to tight folds. Fold vergence and top-to-SW tectonic transport indicators in both units are in agreement with the general Dinaridic strike.

Pelite samples for burial history analysis were taken-from the Vranduk Fm., the Ugar Fm. and the black shale matrix of the ophiolite mélange. From each sample, the <2 µm and <0.2 µm grain-size fractions were used to determine K/Ar age, Kübler-Indices (KI), proportions of the illite polytypes, and percent illite in illite/smectite mixed layers. Quantitative clay mineralogy was determined in the <2 µm fraction.

The dominant phase is illite (54–86%) with up to 10% smectite. Chlorite with varying Fe contents amounts up to 46%. Corrensite (<35%) and other chlorite/smectite mixed layers were also found. Kaolinite occurs only in the Ugar Fm., whereas serpentine is restricted to the ophiolite mélange matrix. Corrensite and chlorite/smectite are absent in the Bosna Valley samples. In the <2µm fraction the KI vary between 0.24-0.62°2Θ in the Stavnja Valley and between 0.39-0.45°2Θ in the Bosna Valley. The KI of the <0.2 µm fraction are higher than those of the <2 µm fractions.

Illite polytype quantification of the <2 µm fraction indicates a dominance of $1M_d$ (43–80%) of $2M_1$ (7-53%) illite. There is no regional trend in the illite polytype distribution within the profiles. Illite proportions in illite/EG-smectite exceed 90% in both profiles.

K/Ar ages decrease southwards. Stavnja Valley <2 µm samples range in age, from north to south, from 168.4 +/-3.6 Ma in the ophiolite mélange through 132.6 +/-2.9 Ma in the Vranduk Fm. to 129.7 +/-2.9 Ma in the Ugar Fm. Ages measured on the <0.2 µm fraction range between 149 +/-3.4 Ma and 111.9 +/-2.5 Ma. Bosna Valley samples range between 156.3 +/-3.4 Ma and 138.7 +/-3.3 Ma (<2 µm) as well as 137.8 +/-3.0 Ma and 118.9 +/-2.6 Ma (<0.2 µm). No correlation exists between K/Ar ages and the proportions in 2M1 illite polytypes.

Vitrinite reflectance data from both flysch units and from the ophiolite mélange matrix indicate a maximum overprint temperature of 100–200°C assuming an effective heating time of 10 Ma. Along the Bosna Valley profile, Ro values vary systematically from 1.9% to 0.8% and indicate a southward decrease in thermal overprint. In the Stavnja Valley profile the vitrinite reflectance varies from 1.3 to 2%, with the highest values occurring below the top-to-SW thrust sheets.

K/Ar ages display no correlation with results from the other thermal indicators (KI, Ro%, %I (I/S)) suggesting that the ages result from the coexistence of detrital illite with authigenic illite in the sequence. Therefore, burial depth estimation by means of KI and percent illite in illite/EG-smectite alone is not a reliable tool in the investigated profiles. However, maximum temperatures yielded by vitrinite reflectance measurements suggest a burial depth of 4 to 8 km assuming 25 °C/km geothermal gradient. Due to the presence of some detrital illite and the low thermal overprint, the K/Ar ages are probably slightly older than the main deformation event. Combined with our biostratigraphic data (Christ et al., this volume), deformation of the Vranduk Formation of the Bosnian Flysch took place most likely between 120 and 100 Ma.