

## DEVONIAN OF THE SERBIAN CARPATHO-BALKANIDES

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**Abstract:** The Devonian deposits in the area of the Serbian Carpatho-Balkanides are located in the several large Alpine geotectonical units. The different Devonian sedimentary and volcanogeno-sedimentary rocks represent the Hercynian basement in those units. This shows that previously separated blocks of the Earth's lithosphere which today make this part of the Carpatho-Balkanides, have the different geological history.

**Key words:** Devonian, lithostratigraphy, paleomagnetism, Serbian Carpatho-Balkanides.

Various sedimentary and volcanogeno-sedimentary rocks represent the Hercynian basement located in the several large Alpine geotectonical units of the Serbian Carpatho-Balkanides. These units are: **Stara Planina – Poreč** (Upper Danubicum), **Kučaj** (Gethicum), **Lužnica** (Kraishte), and **Ranovac – Vlasina** (Supragethicum; Fig. 1 and 2). Each unit is characterized with specific depositional environment – continental slope sediment, deepwater preflysch and flysch sediments, sediments of carbonate shelf and back-arc sedimentary deposits.

In the **Stara Planina-Poreč Unit** (Upper Danubicum, east part of the Serbian Carpatho-Balkanides), marine metaclastics of Lower Paleozoic, dominantly of Devonian age (Inovo Formation), are exposed in northwestern area of Stara Planina Mt. These rocks discordantly lie over preexisting Upper Proterozoic to Lower Cambrian volcanogeno-sedimentary rocks, regionally metamorphosed under the greenschists facies conditions. The Inovo Fm. is unconformably overlain by Westphalian lacustrine volcanogeno-sedimentary rocks. The Devonian marine sediments consist of varied metaclastics, from conglomerate to siltstone, and mudstone. They include quartz, feldspar, occasionally mica and abundant fragments



of magmatic acid and basic rocks and intraclasts. The geologic column is a succession of thick, dominantly coarse-grained clastics and turbidites, thin-bedded fine-grained sediments and olistostromes. On the basis on numerous typical sedimentary structures and textures (grading: normal, inverse, inverse-normal; pebble imbrication; horizontal, cross (tabular, planar, tabular – asymptotic) bedding; load casts, flute and groove marks etc), the clastics are interpreted as continental slope (lower slope or base of slope) deposits, formed by a variety of mass gravity transports: debris flow, turbidity current, density-modified grain-flow, and grain-flow, intermittently combined with traction currents or laminar flows. With minor dispersion, paleotransports are directed to east or southeast. As the lower slope sediment flow are transversal to the axis of the basin, it can be expected further to the east. It may be inferred that the basin, with its western slope exposed in the west of Stara Planina Mts is completely independent from the Kučaj-Zvonce flysch basin, which is located west from the Stara Planina-Poreč Unit.

The Upper Silurian to Lower (possibly Middle) Devonian deposition range of the Inovo Fm. has been distinguished on the basis of the content of pteridophyta spores, phytoplankton remains of acritarchs and chitinosoans and remains from Incertae sedis group designated as *Pullovicenites devonicus* SCHUSTER.

In the **Kučaj Unit** (Gethicum, central part of the Serbian Carpatho-Balkanides) the graptolite schists lie below the younger Devonian sedimentary rocks. The graptolite schists are dominantly of the Silurian age, except their uppermost levels with two Lower Devonian, Lochkovian graptolite zones (*uniformis* and *hercynicus*). The sedimentation conditions rapidly changed after the hercynicus Zone. The graptolite schists, which marked a balanced basinal sedimentation of a flat relief prograde upward into an association of inequibrated preflysch sedimentation. The preflysch represents the 100 meters thick deposits of channeled slope with hemipelagic shales and siltstones cherts, limestones and channel sandstones with occasional turbidite sets. These sediments have range from Upper Lochkovian to Upper Frasnian, as dolomitic limestones with conodonts of Upper Frasnian *gigas* and *linguiformis* zones lie at the top of the column. Preflysch sedimentation was replaced by a trough flysch deposition in the upper half of Upper Devonian (Famennian-Visean). Flysch (about 600 m) is represented by various turbidite facies and their associations, and is composed of conglomerates, greywackes, arkoses, subgreywackes, siltstones and shales, dominated by sandstones and siltstones. The flysch column generally indicates a retrogradational system of fans (lower slope – inner fan – mid fan and channeled suprafan – outer fan – basin), rare progradational trend from the basin to lower slope. The sequences are rich in internal structures : gradation and lamination (horizontal, cross, wavy and convolute). The structures on bedding surfaces are flute casts, groove marks, load casts, brush casts,

current lineation and ripple marks. Bouma's sequences are well developed, the most common being  $T_{bcd}$ , common  $T_{abcd}$ , and uncommon  $T_{bcde}$ . The flysch sediments contain sparse allochthonous fauna transported by turbiditic currents from the source of accumulation, and Upper Devonian Cyclostigma- Archeopteris flora floated into the upper sequence levels where also rich Upper Devonian and transitional Upper Devonian-Lower Carboniferous palynological associations exist. The species characteristic of the period Famennian-Tournaisian are: *Auroraspora hyalina*, *Grandispora cornuta*, *G. famenensis*, *Raistrickia variabilis*, *Spelaeotriletes lepidophytus*, *Dictyotriletes papillatus* and *D. trivialis*.

In the **Lužnica Unit** (Kraishte), the Caledonian-Hercynian cycle of sedimentation is entirely different, characterized by mixed carbonate-high and terrigene deposits. The Unit is largely extended in SW Bulgaria, where almost all divisions of the Devonian are proved in carbonate rocks. In southeastern Serbia, it is much reduced tectonically, because it was thrust eastward on to Tithonian flysch and overthrust from the west by the Ranovac-Vlasina-Osogovo Unit (Supragethicum)

Devonian rocks of this Unit are exposed in the nappe zone, between Svodje and Kalna. They form two, carbonate and flysch, series in an undefined relationship. The carbonate series (250 m) is made up of dominantly flagy, stratified, locally thick-bedded limestones in thick sets of tens of metres, interlayered with shale and chert. In the Lower Devonian part of the column (the Vrelski potok near Modra Stena), limestones contain tentaculites (*Paranowakia intermedia*, *P. Geinitziana*, *Nowakia acuaria*), and in Crtovo near Svodje also conodonts (*Icriodus sigmoidalis*, *Pol. Linguiformis foveolata*, *Pan. steinhornensis steinhornensis*). Fossils have not been found in the upper carbonate part of the column. Limestones are overlain by Famennian terrigene flysch of the same character as flysch of the Kučaj Unit.

**In the Ranovac-Vlasina Unit** (Supragethicum, west part of the Serbian Carpatho-Balkanides) marine Paleozoic (Ordovician-Lower Carboniferous) is represented by volcanogeno-sedimentary rocks metamorphosed under the greenschists conditions. The 1600 metres thick upper part of the "Vlasina Complex" crystalline schists, which lies transgressively over the older parts of the complex, belongs to Devonian (and Lower Carboniferous) determined by palynomorphs. The Devonian part of the column deposits is made of phyllite, sericitic quartzite, sericitic and chlorite-sericitic schists which originated from conglomerates, sandstones and clayey sediments. The orthometamorphic rocks (which correspond to the within-plate basalts (WPB) are basic and intermediate volcanic rocks and their pyroclastics: metaspilite, actinolitic, actinolite-epidotite-zoisitic schists, metakeratophyres, metaquartz-keratophyres, metadiabases and albite-chlorite-

epidotic schists. All these rocks were metamorphosed during Lower Carboniferous under the low temperatures (350°C) and low pressure (around 3 Kbar) conditions.

The volcanogeno-sedimentary rocks in Moravica River Canyon (between Soko Banja and Aleksinac) and Kučevo (between Mlava and Pek rivers) contain different palynological association, were very likely deposited in marine depositional environment during Late Silurian to Early Devonian. It is obvious that floristic remains (palynomorphs: *Appiculiretusispora minor*, *Brochotriletes cf. foveolatus* and *Emphanisporites sp.* and tissues of dry land flora) dominate over the planctonic acritarchs. These palynomorphs are more characteristic for Early Devonian.

**Paleomagnetic** results for Lower Devonian sedimentary rocks of the Stara Planina-Poreč, Kučaj and Ranovac-Vlasina-Osogovo Units give the primary positions and distributions of these units during Lower Devonian. The Stara Planina-Poreč Unit (Balta Berilovac) had paleodeclination/paleoinclination 327/7° in the middle part of Lower Devonian. The mean data in sedimentary rocks of the Kučaj Unit (Zvonačka Banja) for the same period are 323/-30°, and for the ones of Ranovac-Vlasina-Osogovo Unit (Kučevo vicinity) – 10/-58°. The northernmost was the primary depositional area of the Stara Planina-Poreč Unit, at about 4° of the northern hemisphere; the Kučaj Unit was far in the South, at about 16° in the southern hemisphere; the Ranovac-Vlasina-Osogovo Unit was far in the South, at about 39° of the southern hemisphere, oriented East of the before mentioned units. The present mentioned units of the Easter Serbian Carpatho-Balkanides were, in Lower Devonian, at about 20-25° distances. The Kučaj Unit had the middle position, it was about 2000 to 2500 km southwards from the Stara Planina-Poreč Unit, and about 2500-2800 km northwards from the Ranovac-Vlasina-Osogovo Unit. There is none of paleomagnetic measurements for Devonian of the Kraishte Unit.

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