

# HYDROGEOLOGICAL STRUCTURES AND SPATIAL LOCATION OF AQUIFERS IN BOSNIA AND HERZEGOVINA

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**Abstract:** The scope of the work perceives hydrogeological structures and spatial location of aquifers on the territory of Bosnia and Herzegovina. Four hydrogeological structures are selected which are spatially extended in northwest – southeast direction. Each of structures is specially adapted with basic hydrogeological characteristics.

**Key words:** hydrogeological structures, geotectonic unit, yielding aquifer and aquifer.

During the research work of hydrogeological characteristics of rock masses of different areas on the territory of Bosnia and Herzegovina, the need for realizing of hydrogeological structures and spatial location of aquifer appeared.

Considering previous researching it could be accepted the fact that there is abundance of documentation, which describes aquifers, mostly in small local regions, as there was an interest for water.

With complete realization of the problems, which is hard to observe only for territory of Bosnia and Herzegovina, hydrogeological structures especially dealt with accumulation of ground waters are selected.

The essence of ground waters, which belongs to the mineral resources, according to the low, puts on the need for defining of disposition of waters according to the mineralisation and heat characteristics.

## HYDROGEOLOGICAL STRUCTURES AND SPATIAL LOCATION OF AQUIFERS

Analyzing geotectonic zones in Bosnia and Herzegovina it could be separated four hydrogeological structures with approximately similar basic hydrogeological characteristics. Inside of these structures could be selected greater or smaller hydrogeological units.

These units are water supply on global or local level or usage of thermal, thermomineral and mineral waters.

Based on analyses there are four hydrogeological structures (Fig.1)

1. Northern Bosnian hydrogeological structure

2. Banja Luka–Kladanj–Visegrad hydrogeological structure
3. Middle Bosnian hydrogeological structure
4. West and East Herzegovina hydrogeological structure

Structural–tectonic relations and lithological composition of rock masses globally caused re–allocation of ground waters from yielding aquifers, which are formed directly from rainfalls, in one hydrogeological cycles inside of dinarides on one hand and occurrence of thermal, thermomineral and mineral waters (which balance is not in direct function with rainfalls) on the other hand.

#### 1. North Bosnia Hydrogeological structure

Terrain of this hydrogeological structure are built mainly of quarternary and tertiary formations, but smaller part has been built of Paleozoic and Mesozoic formations.

North border of this structure is Sava River and south border makes the line Kostajnica–Kozara–Laktasi–Doboj–Zvornik.

Terrain is mostly built of rocks with intergranular porosity with scale of coefficient of filtration from  $k = 1 \times 10^{-3}$  m/s to  $k = 1 \times 10^{-7}$  m/s. Mostly these rocks present alluvial formations in rivers Sava, Una, Vrbas, Bosna, and Drina.

Rock masses with fissured porosity are granites and granodiorites of Prosara, Motajica and tertiary sediments with aeolian sandstones, conglomerates, marlstones and subordinate limestone.

Tortonian and sarmatian formations are mostly in facies of water impervious or very permeable limestone. Fissured and karstified limestone masses do not present continuous aquifers but laterally dip and strike in North direction turning into sandstone terrenes and marlstones. Limestones are separated in many aquifers caused by lateral changing of water impermeable complexes and tectonic processes.

They have larger space in synclines formed between Prosara and Kozara in B.Bijela–Gradacac area and Prnjavor basin.

In this region in the terrains formed of limestone so called panonic type of karst is present. Karstification is manifested as small diameter sink–holes without regular disposition that means that only one age stadium of karstification is present. It is noticeable into the terrain that the limestone which are separated with waterimperbeable formations are karstificated in many levels.

#### 2. Prijedor–Banja Luka–Kladanj–Visegrad Hydrogeological structure

This hydrogeological structure includes Paleozoic and central ophitic zone. North border is on the line Kostajnica–Kozara–Laktasi–Doboj–Zvornik and South border is on the line Novi Grad (Bosanski Novi)–Prijedor–Banja Luka–Olovo–Rudo.

Ultra basic eruptive masses and diabase–cherk formation rocks in this region are forming the zone starting from Novi Grad across Kozara till Banja Luka spreading into central (Konjuh and Ozren area) and east part of Bosnia and Herzegovina (Visegrad, Vardiste and Rudo area).

Contact of these areas (North and South border) causes all phenomena of thermal, thermo mineral and mineral waters. Appearance of these waters is in connection with deep fault zones such as `Busovacka` and `Sprecanska`.

Inside the hydrogeological structure there are regions where significant accumulation of cold water are formed. These parts of terrain are solely built of limestone and dolomites. Between the regions of great importance it is important to mention Romanija, Devetak and Javor massif which are giving a considerable amount of ground waters of crucial significance for water balance of Drina and Bosna water current.

### 3. Middle Bosnian Hydrogeological structure

Hydrogeological structure is overlapping geotectonic unit of Paleozoic slates and Mesozoic limestone. The terrain is a complex fabric with different lithologic elements. Here are included Paleozoic clastic rocks and metamorphites magmatic eruptive and intrusion rocks from ultra basic to acid varies, sedimental flysch formations Jurassic–cretaceous age and limestone and subordinate dolomites mostly Triassic age and partially Jurassic–cretaceous age.

Significant phenomena of thermal and thermo mineral waters are characteristic for North border of the structure. The most extended aquifers of cold water in north–west part of Bosnia and Herzegovina are Triassic and partially cretaceous limestone in Manjaca, Cricici, Cemernica and Vlastic. Middle and south–east part are mostly composed of Triassic limestone of Bjelasnica, Treskavica, Zelengora and Lelija. Each of these regions presents separate accumulation of ground waters karst type aquifers which have significant influence on rivers Una, Vrbas, Bosna, Drina, Neretva and Cetina.

The rainfalls solely fill up these accumulation.

### 4. Hydrogeological structure of West and East Herzegovina

Hydrogeological structure of North–West Bosnia and East Herzegovina make the part of holokarst terrain which could be separate entity with complete karst evolution. According the almost all authors which have done regionalisation of Bosnia and Herzegovina this part of terrain (Dinarian karst) is specified as a terrain with intensive deep karstification of carbonate formations.

The main lithological elements in this structure are limestone. They are composed of fissures, caverns, differential settled caves depending on tectonic processes from period of Alpes–Orogeny phase.

These rock masses are significant collectors of ground waters which are pouring out on limestone and clastic contacts.

Special characteristics of karst terrain are karst fields morphologically and hydrogeologically very different because of surface storage in it. During the tectonic time, intensive sedimentation were going inside karst fields.

Therefore these formations locally presented hydrogeological barriers, so we have wells on one side of the field and sink holes on the other side. Generally observing waters from this structure are flowing to Adriatic basin.

## CONCLUSION

On the Bosnia and Herzegovina territory there are four hydrogeological structure with spatial location in northwest–southeast direction.

In all structures significant amount of ground waters from fresh to mineral, thermal, thermo mineral water are accumulated.

Rock masses which form the hydrogeological structures are quartial and tectonic to Mesozoic and Paleozoic age.

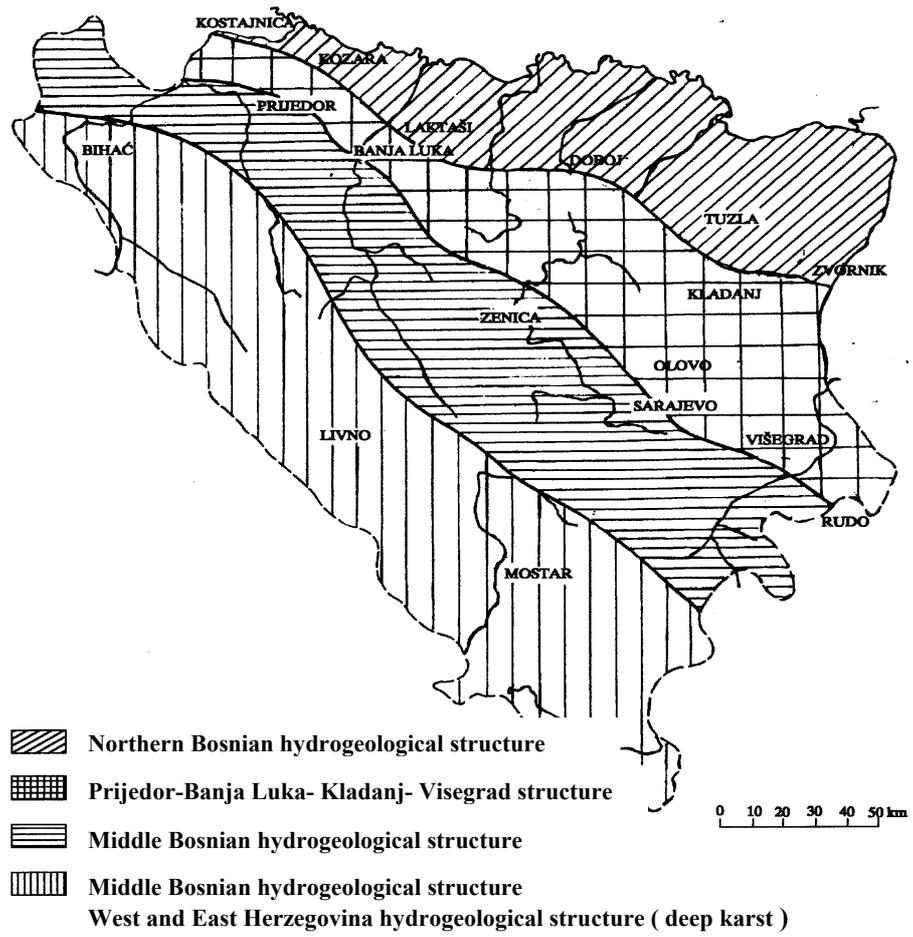
Structural relations and rock composition caused aquifers directly depending on waterfalls such as aquifers in deep zones in which mineral, thermal and thermo mineral waters are accumulated.

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**Fig. 1.** Hydrogeological structure of Bosnia and Herzegovina

Fig. 1.



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