TEMPERATURE DIFFERENCES OF SPRING WATER THE RIVER ZDENA AND DABAR

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TEMPERATURNE RAZLIKE U IZVORSKOJ VODI REKA ZDENA I DABAR

Abstrakt

Prema mjerenju parametara izvorskih voda rijeka Zdena i Dabar, analizirane su moguće temperaturne razlike na uzorcima koji su uzimani u isto doba dana i pri istoj temperaturi zraka. Kod ovih rezultata mjerenja upoređivanjem temperatura konstatuje se da postoje bitne temperaturne razlike ovih dviju voda.

Na osnovu ovih rezultata može se zaključiti da ove vode ipak imaju drugačije uslove tečenja i zadržavanja unutar različitih struktura terena kroz koji prolaze.

Ključne reči: *Zdena, Dabar, kraš, temperaturna razlika.*

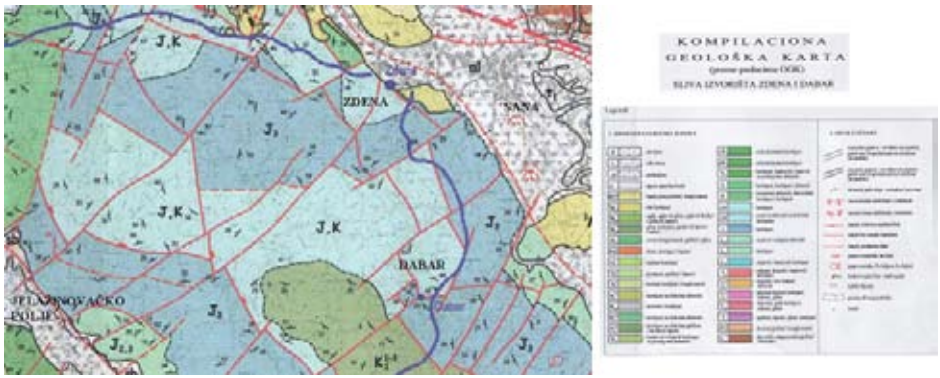
Extended abstract

By measuring the parameters of spring waters of rivers Zdena and Dabar, an analysis of possible temperature differences in the samples were taken at the same time of day and at the same temperature air. When these test results comparing the temperature it is concluded that there are significant temperature differences between the two waters. Based on these results, it can be concluded that these waters do have different conditions of flow and retention within the various structures which pass through the courts.

Zdena source, the central and the second largest source of drinking water, and located northwest approximately 2 km from the city center, a karst spring Zdena river which flows through the city. For many years this source has been the most dominant source of water supply throughout the municipality Sanski Most. Significant water resource in this region is a large karst spring Dabar, located from the city center about 10 km, with a minimum estimated yield of approximately 400 l / s. The development of long-term projections of Sanski Most, provides the abstraction and hot water supply for Dabar *(Institute of Hydro-GF in Sarajevo (1998))*.

Citing the earlier measurements of parameters of spring water river Zdena and Dabar, analyzed the possible temperature difference measurements on samples taken at the same time of day and at the same temperature air.

In taking on some samples was recorded to assess the profile of water flow. Measurement and assessment of profiles highlighting the sources was done in extreme cases. Recorded profiles and flows are different for different situations. Monitoring and analysis of the temperature of water in karst allows answering numerous questions related to the circulation of water, its origin, time spent in the underground, etc. In the rubble, there are favorable conditions for the application of geothermal research because the existence and functioning of karst channels through which the transport takes place underground water causes the temperature anomalies can be observed even on the surface. *(Bonacci, O. (2001))*



Slika 1. Kompilaciona Geological Map Zdene i Dabra
(*Đerkovic B., Đordevic D., Hohrajn J., i ostali, Sarajevo, (1975))*

Tabela 1. REZULTATI FIZIČKO KEMIJSKIH ANALIZA VODE IZ IZVORIŠTA "ZDENA" - SANSKI MOST

Parametar / Uzorak	MDK	1	2	3	4	5	6	7	8	9	10	11
Datum		30.05.97	24.06.97	15.07.97	08.08.97	22.01.98	01.04.98	23.04.98	15.05.98	28.05.98	16.06.98	26.06.98
Vrijeme uzimanja uzorka		13:00	12:00	10:00	10:00	10:00	14:00	10:00	14:00	15:00	14:00	14:00
Protok Q (m^3/s)		0.827	0.484	0.355	0.205	1.280	0.710	2.1		1.91	1.48	1.19
Temperatura zraka (°C)						-1.0	9.1	15.2	21.0	20.5	18,0	29,0
Temperatura vode (°C)	8 - 12	11.7	11.5	11.8	11.6	10.4	10.2	10.7	11.0	11.0	11,0	11,3

Tabela 3. REZULTATI FIZIČKO-KEMIJSKIH ANALIZA VODE IZ IZVORIŠTA "DABAR" - SANSKI MOST

Parametar / Uzorak	MDK	1	2	3	4	5	6	7
Datum		08.08.97	01.04.98	23.04.98	15.05.98	28.05.98	16.06.98	26.06.98
Vrijeme uzimanja uzorka		12:00	13:00	11:00	11:00	13:00	12:00	12:30
Protok Q (m^3/s)				29.6		21.80	8.35	4.61
Temperatura zraka (°C)		24	9.0	15.5	21,2	19,5	17,0	28,5
Temperatura vode (°C)	8 - 12	9.4	8.9	9.5	9.5	9.9	9,9	11,8

Slika 2. Table of results of some source parameters Zdene i Dabar
(*Institut za hidrotehniku GF u Sarajevu, (1998)*

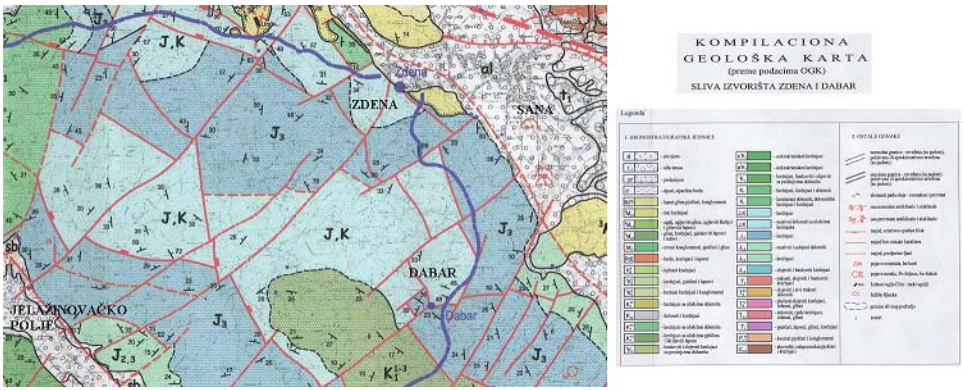
The available hydrogeological background can be concluded that the structure and tectonic layers of the same origin. According topografik map shows that these two sources apart barely 10 kilometers and that are on the same left bank of the river Sana, and that they and the length of the pouring into the river Sana both short and less than 3 kilometers. For the same substrate show that faults that are found on this site are in-

terchangeable between the reticulated Jelašinovačko field that has multiple sinks and sources Zdene and Dabar. Inserting fluoroscentih color was proved by the connections between sinks and sources Jelašinovačkom field Zdene and Dabar. What is interesting here, and it is often the case with the source that pass through the karst terrain, is that the water temperature at the exit from these sources differ.

Comparing the results of measuring the temperature of spring water Zdene and Dabar for the same day at the same time and at the same temperature it is concluded that there are significant temperature differences between the two waters. Based on these results, it can be concluded that these waters do have different conditions of flow and retention within the various structures which pass through the courts.

INTRODUCTION

Zdena source, the central and the second largest source of drinking water, and located northwest approximately 2 km from the city center, a karst spring Zdena river which flows through the city. For many years this source has been the most dominant source of water supply throughout the municipality Sanski Most. Significant water resource and karst spring Dabar, which is far from the city about 10 km, with an estimated minimum yield of about 400 l/s. The development of long-term projections of Sanski Most, provides the abstraction and hot water supply for Dabar. (*Institut za hidrotehniku GF u Sarajevu, (1998)*)



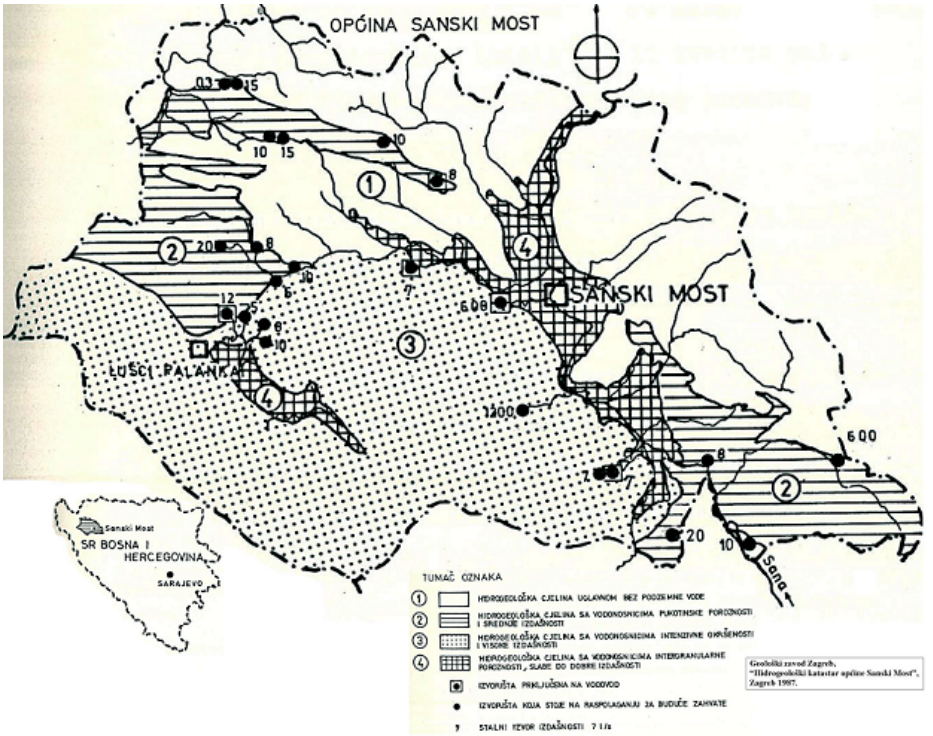
Slika 1. Kompilaciona Geological Map Zdene i Dabra (*Đerkovic B., Đordevic D., Hohrajn J., i ostali, Sarajevo, (1975))*

Sources Zdena and Dabar are fed from the same basin, with very Grmec karst massif, in which, despite all the typical karst forms, exists a large karst depression Lušci palanka field.

Given that this is a karst springs is often blurs in periods of intense rainfall and melting snow, when in the field of water poured through the multitude of periodic sources. Swelling of the water from this region is predominantly done through a large zone of sinking in the southwest edge, near the village Jelašinovci and two small sinks near Lušci Palanka.

Injecting solutions of fluorescent colors in the abysses Jelašinovci demonstrated a direct relationship with water from the fields hot Zdena and Dabar. The mechanism of

swelling and sinking in the basin, as well as the mechanisms of water in the aquifer, and given the way the use of critical areas in the hinterland of the spring, indicating a significant threat to water quality of water resources, the uncontrolled use of certain parts of the immediate catchment.



Slika 2. Hydrogeological sketch of Municipalities Sanski Most, (*Geološki zavod Zagreb, (1987*))

Tabela 1. REZULTATI FIZIČKO KEMIJSKIH ANALIZA VODE IZ IZVORIŠTA "ZDENA" - SANSKI MOST

Parametar / Uzorak	MDK	1	2	3	4	5	6	7	8	9	10	11
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Parametar / Uzorak	MDK	1	2	3	4	5	6	7
Datum		08.08.97	01.04.98	23.04.98	15.05.98	26.05.98	16.06.98	26.06.98
Vrijeme uzimanja uzorka		12:00	13:00	11:00	11:00	13:00	12:00	12:30
Protok Q (m^3/s)				29.6		21.80	8.35	4.81
Temperatura zraka (°C)		24	9.0	15.5	21,2	19,5	17,0	28,5
Temperatura vode (°C)	8 - 12	9.4	8.9	9.5	9.5	9.9	9,9	11,8

Slika 3. Table of results of some source parameters Zdene i Dabar (*Institut za hidrotehniku GF u Sarajevu, (1998))*

MATERIALS AND METHODS

Citing the earlier measurements of parameters of spring water river Zdena and Dabar, analyzed the possible temperature difference measurements on samples taken at the same time of day and at the same temperature air. In taking on some samples was recorded to assess the profile of water flow. Measurement and assessment of profiles highlighting the sources was done in extreme cases. Recorded profiles and flows are different for different situations.

Slika 4. The results of measurements of temperature and flow

Temperature differences of spring water the river Zdena and Dabar

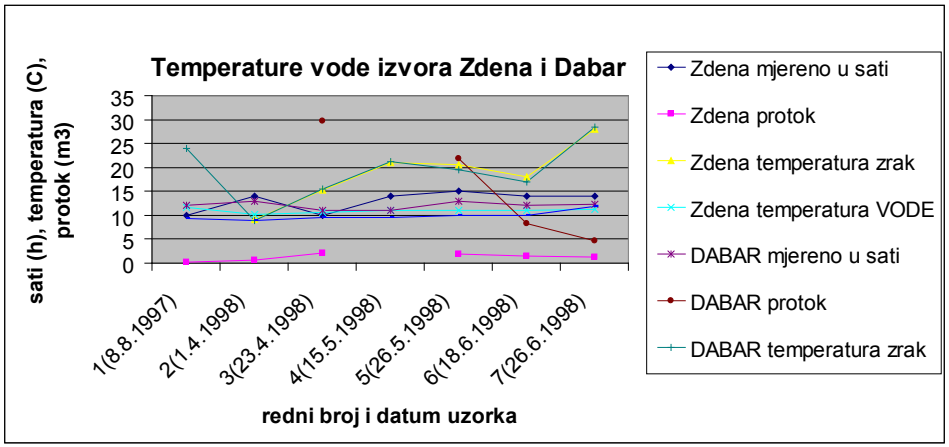
Naziv parametra / datum uzorka	8.8. 1997	1.4. 1998	23.4. 1998	15.5. 1998	26.5. 1998	18.6. 1998	26.6. 1998
redni broj uzorka	1	2	3	4	5	6	7
Zdena mjereno u sati (h)	10	14	10	14	15	14	14
Zdena protok Q (m^3/s)	0,205	0,71	2,1		1,91	1,48	1,19
Zdena temperatura zrak (ºC)		9,1	15,2	21	20,5	18	28
Zdena temperatura VODE (ºC)	11,6	10,2	10,7	11	11	11	11,3
DABAR mjereno u sati (h)	12	13	11	11	13	12	12,3
DABAR protok Q (m^3/s)			29,6		21,8	8,35	4,61
DABAR temperatura zrak (ºC)	24	9	15,5	21,2	19,5	17	28,5
DABAR temperatura VODE (ºC)	9,4	8,9	9,5	9,5	9,9	9,9	11,8

Monitoring and analysis of the temperature of water in karst allows answering numerous questions related to the circulation of water, its origin, time spent in the underground, etc. In the rubble, there are favorable conditions for the application of geothermal research because the existence and functioning of karst channels through which the transport takes place underground water causes the temperature anomalies can be observed even on the surface. *(Bonacci, Ognjen, (2001))*

RESULTS AND DISCUSSION

The available hydrogeological background can be concluded that the structure and tectonic layers of the same origin. According topografkoj map shows that these two sources apart after only 6 kilometers and is located on the same left bank of the river Sana, and that they and the length of the flow entering the river Sana both short and less than 3 kilometers.

For the same substrate show that faults that are found on this site are interchangeable between the reticulated Jelažinovačko field that has multiple sinks and sources Zdene and Dabar. Inserting fluoroscentih color was proved by the connections between sinks and sources Jelašinovačko field Zdene and Dabar. What is interesting here, and it is often the case with the source that pass through the karst terrain, is that the water temperature at the exit from these sources differ.



Slika 5. Graph of temperature and flow

Slika 6. Photo source Dabar i Zdena (*Geološki zavod Zagreb, (1987*))

When defining the size of the basin water resources Zdena and Dabar calculated the total balance of the fallen and swollen water sources Zdena and Dabar, which was calculated to be served and the size of catchment area to form:

$$F_{sl} = \frac{Q_{sr\ Z+D} \cdot T}{\eta \cdot P_{sr}}$$

where:

$Q_{sr\ Z+D}$ = 4,86 m^3/s - cumulative average flow Zdene and Dabar determined by comparison with r. Sana on V.S. Ključ.

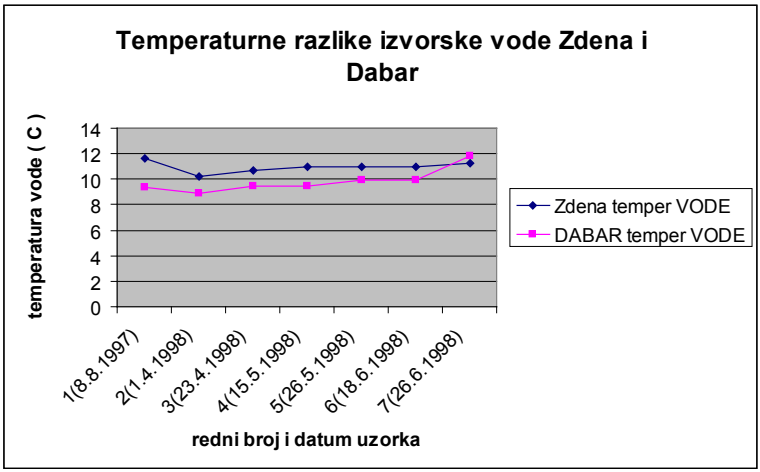
Average flow only Zdene Qsr_Z = 0,4 m^3/s,

and Dabra $Q_{sr\ D}$ = 4,44 m^3/s;

P_{sr} = 1170 mm - The average height of precipitation throughout the basin;

η = 0,5 - runoff coefficient for the medium water (passed)

Using these values was obtained by a joint catchment area Zdene and Dabar, F = 262 km2, which is approximately the size of the estimated basin F = 270 km2, which is obtained by analysis of geological and hydrogeological relations. (*Institut za hidrotehniku GF Sarajevo, (2004.))*.



Slika 7. Graph of water temperature

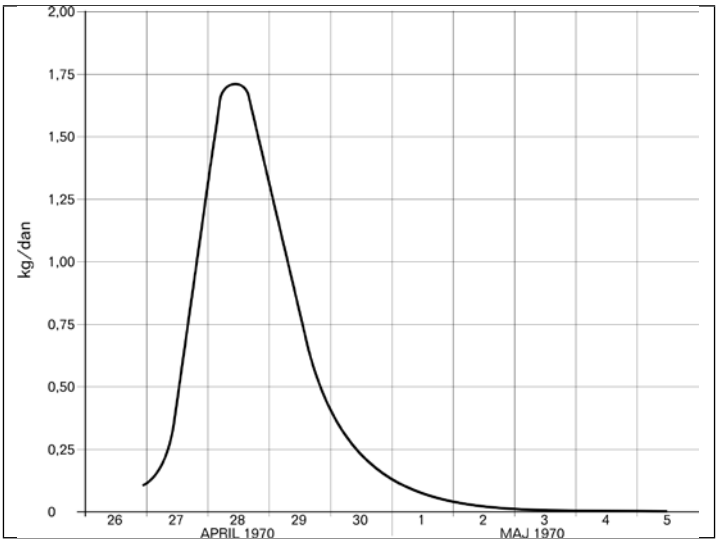
The effective rate of groundwater flow and the flow velocity of water particles is considered to be equivalent to the transport speed of a known content of the gripper through the underground facility. Velocity of groundwater in the aquifer Zdena calculated in April 1970th year, by the Republic Hydrometeorological Institute from Sarajevo, through the implementation of the project defining the Una River basin. On 23.04.1970. , in the sinking zone located in the southeastern part Lušci palanaka fields near the village Jelašinovci, inserted the 40 kg of sodium fluorescein, which was previously dissolved in an appropriate ratio of alcohol, ammonia and water. At the time of launch colors, the abyss Jelašinovci, penetrated volume of 3.62 m3 / s, while at the same time the source Zdena stressed volume of 1.15 m3 / s. Any color is countersunk into the abyss of 15-17 hours in the day. Zdena on hot colors appeared 27.04.1970. in 14 hours or 93 hours after insertion into the abyss. Coloration spring lasted until 05.05.1970. in 10 hours or seven days and 20 hours. Color appeared before the boiling Dabar, where he expired, and the greatest amount of color. Zdena the source, the maximum appeared after 4 hours of the first appearance of color and it is up 3.23 kg color or 8.1% of the total amount injected. Straight-line distance from the oblivion to hot Zdena is 12 kilometers and 10 kilometers Dabar. (*Republicki hidrometeoroloski zavod, Sarajevo, (1970))*

The effective rate of groundwater wells in the basin Zdena i Dabar

Slika 8. The effective rate of flow of groundwater, obtained from the results described staining sinks Jelašinovci (*Institut za hidrotehniku GF Sarajevo, (2004.))*

Lokacija bojenja	Datum bojenja	Mjesto pojave	Udaljenost (m)	Vrijeme putovanja (sat)	Efektivne brzine (m/sat)
		Zdena	12 000	97	123,7
Ponor Jelašinovci	23.04.1970.	Dabar	10 000	81	123,4

The diagram shows changes in dye concentration in time, registered at the source Zdena (*Republicki hidrometeoroloski zavod, Sarajevo, (1970)*).



Slika 9. Diagram of changes of concentration of Na-fluorescein at a time when the source Zdena staining sinks Jelašinovac (*Institut za hidrotehniku GF Sarajevo, (2004.))*

CONCLUSION

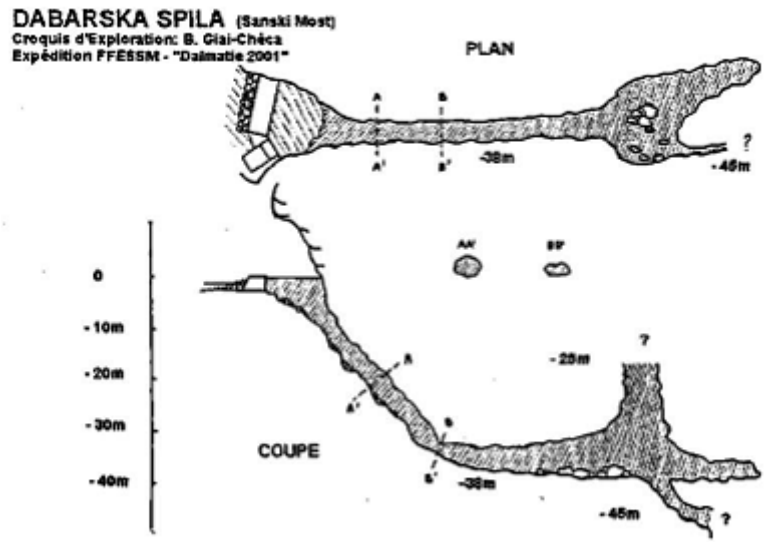
Comparing the results of measuring the temperature of spring water Zdene and Dabar for the same day at the same time and at the same temperature it is concluded that there are significant temperature differences between the two water.

Slika 10. Table of temperature difference

Temperature differences of spring water the river Zdena and Dabar

datum uzorka	1 (8.8. 1997)	2 (1.4. 1998)	3 (23.4. 1998)	4 (15.5. 1998)	5 (26.5. 1998)	6 (18.6. 1998)	7 (26.6. 1998)
Zdena temperatura VODE (ºC)	11,6	10,2	10,7	11	11	11	11,3
DABAR temperatura VODE(ºC)	9,4	8,9	9,5	9,5	9,9	9,9	11,8
razlika temperatura (ºC)	2,2	1,3	1,2	1,5	1,1	1,1	-0,5

Based on these results, it can be concluded that these waters do have different conditions of flow and retention within the various structures which pass through the courts.

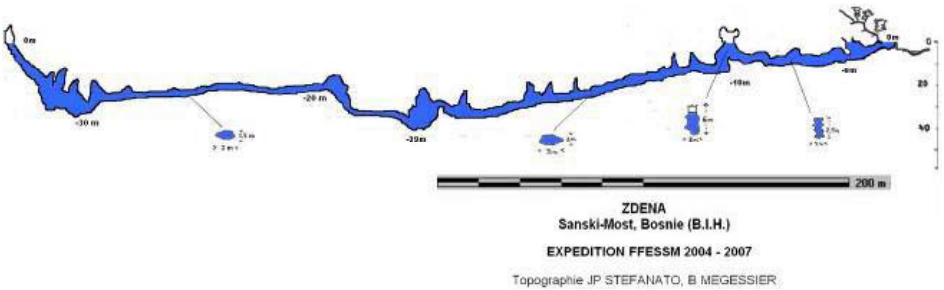


Slika 11. Dabar caves (*F.F.E.S.S.M., (2009))*

The direction of further research is necessary to make a comprehensive action plan on what would be any monitoring and recording of new data. This is certainly not enough to consider the abyss in Jelašinovačko field. On the south side of the field there estavelles from which the water rapidly and in large quantities appears somewhere after the fifth day after the sudden melting of snow or heavy rain. For this estavelles is interesting that during calm weather the water is withdrawn at a certain constant amount below which you never fall, regardless of summer heat. For this water estavelama is interesting to them and teperatura constant 9°C, or something deeper 8ºC, and abundant flora, such as Proteus and other fish. Slightly more than Jelašinovačko fields located in the south of the mountain behind Trovare Petrovačka field, and the West fewer Radanovo field with abysses and other karst forms. In further research should take into

account the possible paths of underground water and the chemical composition of rocks where the water comes in contact.

We should not exclude the possible effects of thermal springs are located east and west at a distance of about 15 to 20 kilometers. It is certainly a bit close to mine coal and iron ore 50-10 kilometers northwest of the catchment area Blihe, Zdena, Dabar and Sane.



Slika 12. Underground Stream Zdene (*F.F.E.S.S.M., (2009))*

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