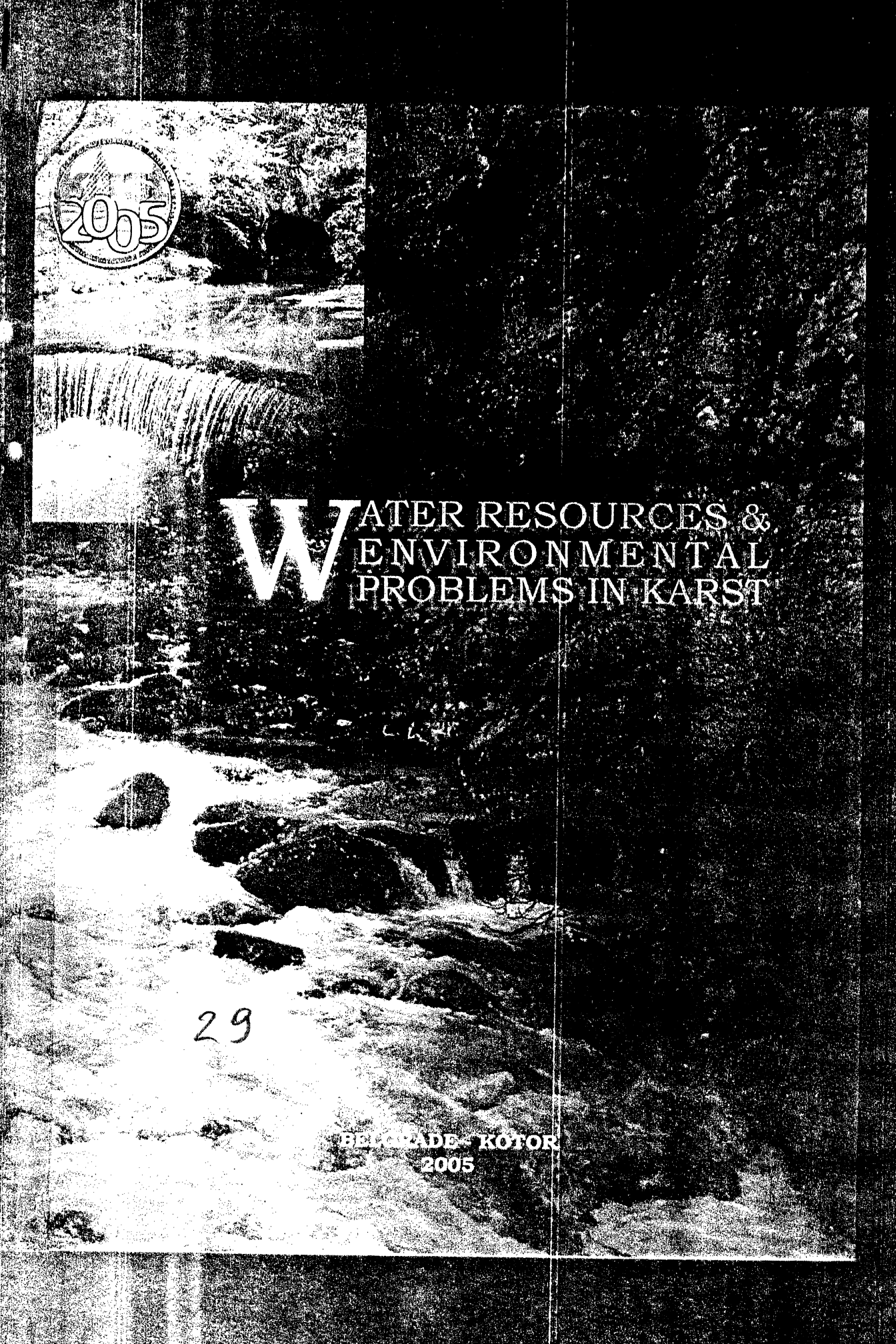

WATER RESOURCES & ENVIRONMENTAL PROBLEMS IN KARST

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WATER SUPPLY FROM THE KARST AQUIFERS IN THE REPUBLIC OF MACEDONIA

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Abstract: The paper presents data on the most important kast aquifers in the Republic of Macedonia whose water is used for the water supply in several municipalities.
Ground waters from karst aquifers are important for the water supply of a number of large cities such as Skopje, Dojran, Kavadrci, Negotino, Gostivar, Ohrid, Kruševo, Prilep, Kičevo, Valandovo, Oslomej, Makedosnki Brod etc. Investigations carried out so far indicate that the waters of karst aquifers have the most promising potential for water supply with safe water.

Key words: Karst aquifers, water supply, Rašce spring, Studenčica, Lukar, Galičica

INTRODUCTION

Karstified carbonate rocks (limestones, dolomites and marbles) in the territory of the Republic of Macedonia are not widespread but contain large amounts of ground waters.

They are most present in the western part of the country, less in the central and almost absent in the eastern. They occur as smaller fractured masses, seldom as large masses such as those in the northern part of the Pelagonian, Zeden massif and that of Mt. Galičica. They have been deposited mostly during the Precambrian, Paleozoic and Mesozoic and less during the Tertiary.

WATER SUPPLY FROM KARST AQUIFERS

The geographic location of karst aquifers, karst springs and the settlements that use karst waters are given in Fig. 1.

Water supply of Skopje

The capital town of the Republic of Macedonia Skopje receives water (2500 l/s) mainly from the Rasce spring situated 15 km north-west of the city (Fig. 1). The spring drains the ground waters of a karst aquifer developed in Paleozoic marbles of the Zeden massif situated 25 km north-west of city. Its yield is from 2,6 to 7,7 m^3/s. The waters are of HCO_3-Ca type, mineralization of 300 mg/l and pH 7,6. Total hardness is 16,5 °dH. Water temperature of 13 °C is constant over the year.

Fig. 1. Location of karst aquifers, karst springs and settlements that use water from karst aquifers

Water supply of Gostivar

The town of Gostivar receives water by partial capture of the Vrutok karst aquifer with the capacity of some 280 l/s. The spring is located 20 km south-west of the town (Fig. 1). The spring is also the spring of the River Vardar. It comes out from a karst aquifer developed in karstified Paleozoic marbles of the Krasta massif. Marbles seldom occur on the surface. The spring has the capacity from 0,5 to 5 m^3/s water. The waters are of HCO_3-Ca type, with mineralization of 155 mg/l and hardness of 5 °dH.

Water supply of Kavadarci and Negotino

The towns of Kavadarci and Negotino, and a number of settlements, receive water mainly by capture of the Lukar fractured karst spring in the amount of 100 to 150 l/s. The largest springs are Lukar-1 and Lukar-2 and Kosmatec. The springs flow out of a karst aquifer developed in karstified Upper Cretaceous limestones located 50 km south of Kavadarci and Negotino in Mt Kozuf (Fig. 1). The capacity of the karst springs is from 253 to 105 l/s in Lukar-1,51 to 22 l/s in Lukar-2 and 72 to 40 l/s in Kosmatec.

The waters are hydrocarbonate calcium in composition. Total mineralization ranges from 207 mg/l and hardness from 4 to 8 °dH.

Water supply of Kicevo, Oslomej, M. Brod, Krusevo and Prilep

The towns of Kicevo, Oslomej, M. Brod, Krusevo, Prilep and the settlements in the surroundings receive water from the Studencica karst spring situated 10 km north-east of Kicevo on the south slopes of Mt Bistra (Fig.1). The regional water supply pipeline is 70 km long and the capacity of spring is 1,5 m^3/s. The aquifer is developed in marbelised Paleozoic (Devonian) platy marbles. The yield amounts from 0.45 to 4,3 m^3/s.

The water is hydrocarbonate-calcic in composition with hardness of 5 ° dH.

Water supply of Dojran

Dojran receives water from the karst aquifer developed in the Paleozic karstified marbelised limestones widespread in a large mass close to the saut-west of the town. Water is pumped by exploitation wells in the Debiras site the capacity from 10 to 20 l/s, the total capacity being 60 l/s.

The water is hydrocarbonate-calcic, with hardness of 14 °dH.

Water supply of Ohrid

Ohrid satisfies its water demands (particularly during the summer period) from the ground waters of a karst aquifer developed in karstified Triassic limestones comprising Mt Galičica, situated to the south between Lake Ohrid and Lake Prespa (Fig. 1).

The karst aquifer drains through numerous springs the most important being those of St. Naum (the capacity from 5 to 15 m^3/s), Biljanini Izvori (from 0.2 to 1 m^3/s). Bej Bunar (from 40 to 100 l/s), Vevcani (from 1.5 m^3/s), Sum (of 1 m^3/s), Beli Vodi (300 l/s). The town of Ohrid receives its water by partial capture of the karst springs near Bej Bunar, Biljanini Izvori as well as by exploitation well in the karst with total capacity of 150 l/s.

Water supply of Gevgelija

At present the town of Gevgelija receives water for the water supply system from the ground water of the alluvion of the River Konska (120 l/s). Investigations carried out on the karst in Mt Kožuf indicate that Gevgelija can solve the issue of safe water supply from the karst aquifer developed in the karstified Triassic stratified and massive limestones and Precambrian marbles and cipolines of Mt Kožuf.

Water supply of Valandovo

Valandovo receives water from the karst aquifer developed in Early Paleozoic marbles north-west of Valandovo (Fig. 1). Ground waters are used by partial capture of some springs the capacity of 20 l/s and exploitation wells in the karst the capacity of 40 l/s.

QUALITY OF WATERS OF THE KARST AQUIFERS

The carbonate terrains, in which karst aquifers are developed, represent mainly mountainous areas with no population or very scarcely populated. The areas are not industrialized or industry is at low level. However, it appears to be the major pollutant of both surface and ground waters.

To the present time, ground waters of the carbonate karst in the Republic of Macedonia have not been polluted. As karst waters are prone to pollution, it is necessary to point out the causes of pollution in the areas. Attention should be paid to contamination of rivers that pass through karstified carbonate terrains, particularly through those parts that during the course appear as permanent sinking waters.

CONCLUSION

Groundwaters in karst aquifers in the Republic of Macedonia play a major role in the water supply systems in a number of towns.

Investigations show that karst terrains accumulate large amounts of safe water that has not been utilized and can be used in the future for water supply of the towns.

Ground waters in carbonate rocks are characterized by high quality since they have not been polluted and care should be taken to protect them from possible pollution.

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