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Investigating the effect of various stratigraphy on karst development and variability of karst springs discharges, Kermanshah Province

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Abstract

In karstification phenomenon of carbonate formations various factors are involved which the most important of them are lithology, precipitation, stratigraphic characteristics, structural factors and the topography of the region. Thick and massive limestones have much higher potential for the development of karst and, as a result, the formation of karst features. In this research, four important karstic springs have been investigated, the name of these springs are Ravansar, Kabotarlaneh, Sahneh and Kashanbeh. The catchment areas of these springs are located in the different geological formations with various lithologies and ages. The discharge of springs and its variability depends significantly on the lithology of the aforementioned formations. The average annual discharge of the Ravansar, Darband Sahneh, Kashanbeh, and Kabotarlaneh springs in the hydrological year 2016–2017 is 1932, 462, 166 and 771 lit/s, respectively. Moreover, the coefficients of variation of these karst springs are 1.07, 0.30, 0.49 and 0.48 and the maximum to minimum ratio of these springs were calculated 20, 2, 7 and 4, respectively. The Ravansar and Kabotarlaneh springs have three discharge coefficients, while the springs of the Sahneh and Kashanbeh have two, which are related to stratigraphy and lithology of their basins. The largest of the aquifer storage from these springs is dedicated to the Ravansar spring, and the smallest is Kashanbeh; the discharge of these springs also confirms it.

Keyword: Stratigraphy, Karst Development, Karst spring, Kermanshah

Introduction:

“Karst” refers to terrain with distinctive landforms and a largely subsurface drainage system, arising from the high solubility of certain rocks in natural waters (Karami 2002). Although karstic areas mainly develop on carbonate rocks (limestone in particular), they are not limited to these rocks and can also develop on other soluble rocks (e.g. gypsum, anhydrite, and halite). Several factors are involved in karst development, the karst development is mainly controlled by lithology, precipitation, stratigraphic characteristics of structural factors and the topography of the area. Among them, the lithology and stratigraphic characteristics of carbonaceous formations are of particular importance. Thick and massive carbonate rocks have a higher degree of karst development and, as a result, more obvious karstic features. There are many karst springs (that is called “Sarab” in the local lingo) in Kermanshah province (more than 200 springs). The mean annual discharge of these springs is relatively considerable (the average annual discharge some of them is

up to 3000 lit/s). In this study, karstic springs have been selected from different regions of the province and their characteristics related to the stratigraphy of spring's basin have been studied. The purpose of this study is to investigate the stratigraphic role of different formations on discharge fluctuations of the selected springs in the study area.

Material & Methods:

For achieving the aim of this research as the initial evaluation, geological maps in the area were concerned and then springs were selected whose catchment area are located in different carbonate formations or have different lithologies status. In the fieldwork electrical conductivity and water temperature of springs has been measured. Spring's water was sampled monthly during a water year (2016–2017) and concentration of major ions of samples was determined in the hydrology laboratory of the Shahrood University of Technology by titration method, then the results were randomly re-measured at the Freie Universität Berlin (FUB)

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by ion chromatography, which showed high precision results. After following the steps mentioned above estimating recharge potential zone in the study area was estimated and the catchment area of the springs was determined. Finally, the effect of various stratigraphy on karst development and variability of karst springs discharges and groundwater flow in karst aquifers was investigated.

Discussion of Results & Conclusions

The role of stratigraphy in karst aquifers is very important and plays a major role in karst development and the creation of various conduits and dissolution spaces in the aquifer of springs. This theme is well visible in the evaluation of the four springs of Ravansar, Kabotarlaneh, Darband, and Kashanbeh. Ravansar spring's basin due to the Bistoon Formation has high karst development and consequently high fluctuations in discharge, electrical conductivity, and temperature. Many studies have been carried out to determine

the flow type and thickness dynamics of a karstic aquifer, mainly evaluating the physical and chemical properties of springs. Changes in the physical and chemical properties of the water of the selected springs are different and are influenced by the stratigraphy and geological characteristics of the catchment basins of these springs. The discharge coefficients and variations of the measured parameters for Ravansar spring indicate that conduit flow system is dominant in karst aquifer feeding this spring. According to the characteristics of the Kabotarlaneh spring, the conduit system in its aquifer has become less developed in comparison to the Ravansar spring which is related to its different stratigraphy. The characteristics of catchment areas of the Darband are similar to the Kabotarlaneh spring, which has caused the flow system of the Darband spring to be similar to the Kabotarlaneh spring. According to characteristics of Kashanbeh Springs, it has a diffuse-conduit flow system.