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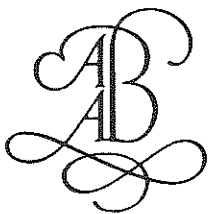
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Karstic sources in Malatya Province, east of Turkey

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ABSTRACT: Turkey has karstic terrains due to the fact that limestones which had formed during the all geological times are widespread. Most of them occur along the southern part of Turkey. These areas are also rich in karstic sources or springs some of which feed some rivers and obtain the drinking water of settlements and irrigation water for agricultural lands. One of the most important karstic source areas is found in the vicinity of Malatya Province, located in the eastern part of Turkey. Here there are a lot of karstic sources. The big one named Pınarbaşı (Turkish: head of the source) gives the major part of the drinking and irrigation water of the Malatya Province and its discharge is more than $10 \text{ m}^3 \text{ s}^{-1}$. The major part of the Malatya agricultural land totalling more than 50 km^2 area is irrigated by the Pınarbaşı spring.

INTRODUCTION

As it is known, human life in the karstic land mostly depends on the existence of the karstic springs and/or sources. Such springs determine the settlements and economic activities of inhabitants especially in the arid and semi-arid regions. Indeed some rivers which are mostly fed by karstic springs and springs give adequate water both for irrigation and drinking. For example, karstic springs mostly emerging on the edge of Taurus Mountain belt provide both irrigation and drinking water of Malatya city and the other settlements living totalling 500 000 population.

Malatya Basin is under the continental arid climate. Mean annual precipitation is over 300 mm, minimum is under 200 mm. This figure increases on the mountainous areas. A major part of the precipitation falls during the winter and spring. Severe drought prevails during summer season. Agricultural activities of the Malatya Plain, in which arid climate prevails have been done thanks to karstic sources. Especially apricot which is famous in the world grows in the Malatya Plain.

GEOLOGIC and GEOMORPHIC PROPERTIES

Malatya and its surroundings area is located within the Taurus Mountains belt and Malatya Plain occur at an altitude of 850-1000 m on the plateau surfaces in the northern section of the Taurus

Mountains. Bey Mountain which is the main branch of the Taurus Mountains abruptly rises on the southern edge of the Malatya Plain. The highest peaks exceed 2500 m. Relative altitude between Malatya Plain and Bey Mountain is over 1500 m.

The foundation of Bey Mountain is generally made up of Paleozoic epi-metamorphic schists such as phyllite and clayey schists. Gneiss and mica schists belonging to Lower Paleozoic are outcropped in the southern part of the mountains.

The upper part of the Bey Mountain is composed of crystallized and cracked limestones belonging to upper Paleozoic. Cretaceous clayey limestones and marl are common in the lower part of the mountains and lies discordantly on the Paleozoic terrain. Eocene clayey and hard limestones, inclined as a monoclinic structure towards the north, mostly occur in the northern part of the mountains.

Bey Mountain mass was uplifted and partly folded during the Alpine orogenic period and then vertical tectonic movement occurred so that Malatya Basin was collapsed via the fault lines extending northern and western part of the mountains.

Rivers which had been set up on the upland areas have cut deeply their own valleys according the Malatya Basin level. Pre-Neogene basement associated with schists were outcropped along the deeply incised valley on the mountainous areas. Malatya Basin which was filled with fluvio-limnic materials is deeply cut by the streams joining the Euphrates River. And plateau appearance come into scene.

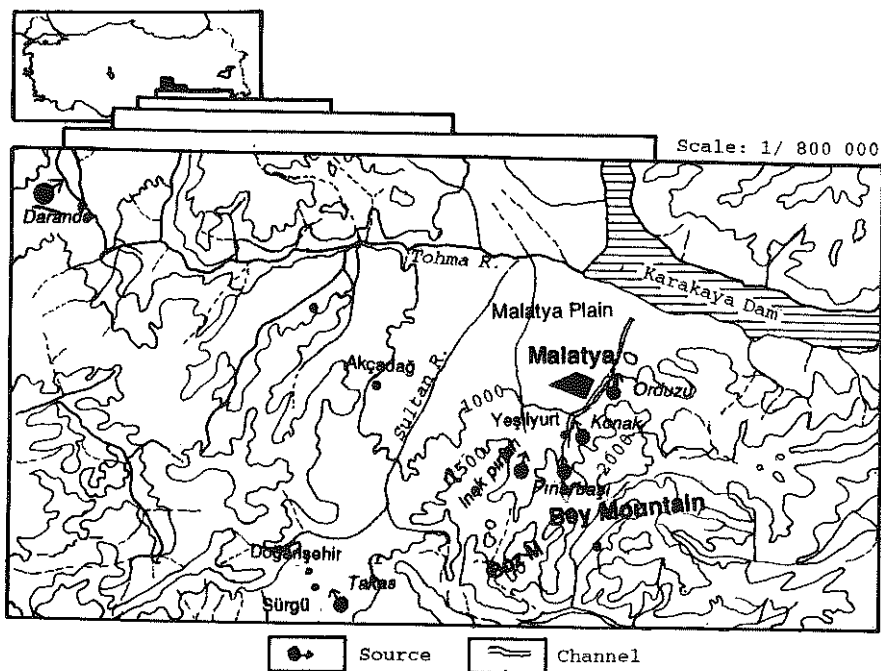


Figure 1: Location and topographic map showing karstic sources in the vicinity of Malatya Province.

Karstification process has begun at least at the end of the Mesozoic so that some streams originating from the upland areas have been shifted so that partly underground drainage system has been formed.

KARSTIC SPRINGS

As a general rule, karstic springs are found on the edges of the mountains and contact lines in places where between limestone and impervious layers composed of schists, clayey limestone and marly strata which are exposed along the deeply cut valley.

Main karstic springs and their formations are as follows:

Pınarbaşı Spring

This karstic spring emerges at an altitude of c. 1200 m in the bottom of the valley named Kozluk along the contact line between clayey schist and the paleozoic limestone. Paleozoic limestones covering the Bey Mountain are the main supplier of the spring (Fig. 2). Indeed, underground flows originating northern sections of the of limestones collect along the valley in the Bey Mountain. In addition to this, the water derived from the southern slopes of this mountain supplies the water of Lake Abdulharap.

Pınarbaşı spring's discharge changing with precipitation is more than $10 \text{ m}^3 \text{ s}^{-1}$. Maximum attains $20 \text{ m}^3 \text{ s}^{-1}$. The water of this spring also works hydroelectric power plant which is established at Kapuluk place, 5 km north of Pınarbaşı. Pınarbaşı spring's water flow throught the cannel from emerging point to near Euphrates river in order to realize both irrigation and drinking water of settlements such as Gündüzbey, Yeşilyurt, Yakınca, Tecde, Malatya, Battalgazi, etc.

Takas (Sürgü) Spring

It appears at an elevation of c. 1000 m SE of Sürgü Town at the edge of western part of Boz Mountain. This spring feeds considerably the Sultan Stream which is the main tributary of Euphrates in Malatya Basin.

Darende Spring

This spring is among the main karstic spring of study area with a mean flow of $10 \text{ m}^3 \text{ s}^{-1}$. It exits at the valley bottom at an elevation of c. 1100 m. This spring is in exsurgence characters. That is deeply incised karstic valley collects seepage water through the karstic rocks and feeds considerably the Tohma Stream which is the main tributary of Euphrates in the Malatya Plain.

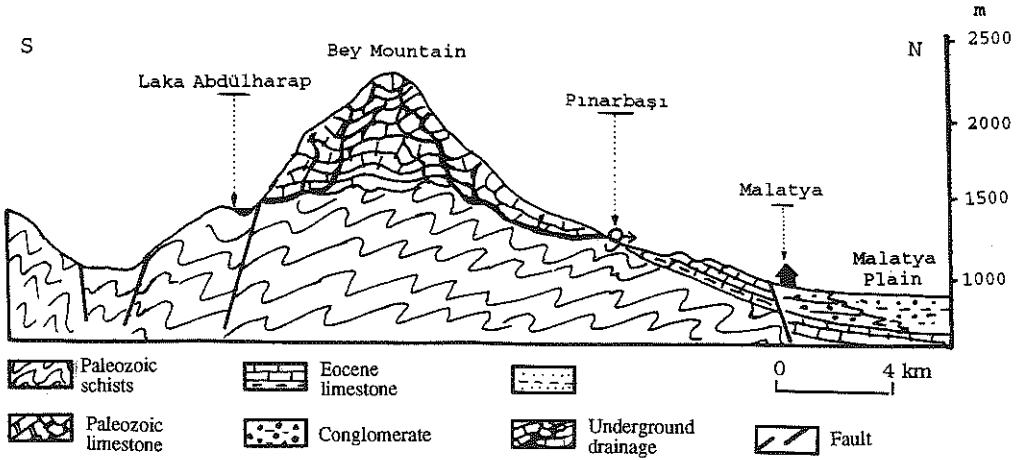


Figure 2: Cross-section of Bey Mountain and the formation of Pınarbaşı karstic source.

Konak Spring

This spring is one of the another karstic sources of Malatya Province. It appears at the bottom of the valley in places where the contact line between limestone and marly layer is exposed at the edge of Bey Mountain (Figure 3). Its flow is about $3 \text{ m}^3 \text{ s}^{-1}$.

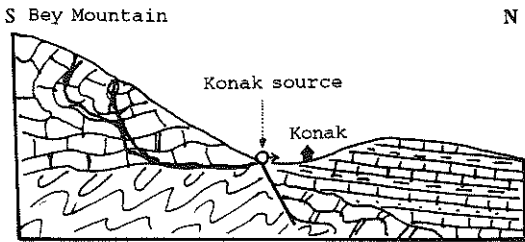


Figure 3: The formation of Konak Spring.

Inek Pınarı (Cattle spring)

It emerges in the lower slope of valley and it is one of the main supplier of Atmalı streams (Figure 4). The flow of this source changes considerably according to the amount of precipitation and changing of groundwater flow. Its flow increases when underground karstic hole is plugged by fine transported material. For this reason this source can be termed as a exsurgence type. Maximum flow is more than $6 \text{ m}^3 \text{ s}^{-1}$.

Orduzu Spring

It is found 2 km in the eastern part of Malatya. It

appears on the impervious clayey limestone in the karstic depression like doline. Seepage water derived from the eastern part of the Bey Mountain feeds this spring.

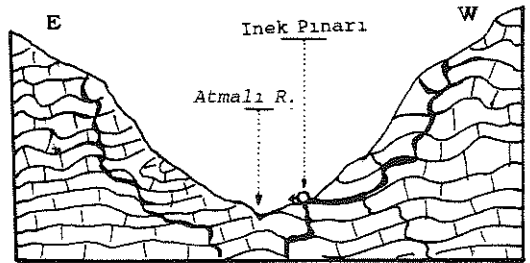


Figure 4: The formation of Inek Pınarı Spring.

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