ÖKÜZINI CAVE IN GEOLOGICAL CONTEXT

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INTRODUCTION

The area investigated is located in southern Turkey near Antalya. Its importance is due to the presence of two large caves developed in Cretaceous limestone (Karain and Öküzini) which are the focus of ongoing excavation by the Universities of Ankara and Liège. Both caves are filled with sediments containing long prehistoric sequences.

Öküzini Cave is located at the base of the Katran Dagı Mountains (Fig. 1). Cave sediments were tested by the 1989 German expedition.

MORPHOLOGY OF THE AREA

The area under consideration is built of two completely different morphological zones. The first is represented by mountains (Katran Dagı) with the highest hill elevated about 1450 meters above sea level. The morphology of the mountains is sharp. Slopes are cut by short valleys, vertical walls and high ridges.

Mountains are in contact with a flat plain. The difference between the elevation of the mountains and the plain is about 1100 m. The plain itself is about 350 m above sea level and the morphological surface is nearly flat or slightly dipping to the west. This area is cut by valleys seasonally filled with water and artificial canals conducting water for agriculture.

Surface water comes down from the mountains seasonally. When rivers reach the plain, they lose velocity and force of transportation. This phenomenon causes the abrupt deposition of detrital material near the base of the hills on the plain. This material is deposited in the form of sedimentary cones and is transported a maximum of a few hundred meters from the hills.

The plain continues in the direction of the coast (to the east) and is tectonically cut by a large fault near the city of Antalya.

GEOLOGY AND STRATIGRAPHY

The morphology of the area is a result of geological phenomena (tectonic activity) as well as the lithostratigraphy (Fig. 2).

Radiolarites (R)

The main type of siliceous rocks represents cretaceous radiolarites. They are the oldest sediments observed between Yeniköy and Bıyıkı villages. Natural outcrops of radiolarites are observed near Çakmak Tepesi (Fig. 3) where one can observe a 40-m thick formation of these rocks. The formation is even thicker but the base is not observable at the investigated area.

The radiolarite formation is composed of thin layers of siliceous rock (Fig. 4), undulated and cut by faults of different size. Layers of the radiolarites are intercalated with thin layers of gray claystones. The thickness of individual radiolarite layers is maximally 25-30 cm. Radiolarites are craked tectonically and the size of the faults is probably up to hundreds of meters. The direction of the faults is oriented primarily north-south with deviations to the east-west. Faults are vertical or near vertical.

Together with the faults are overthrusts oriented north-south, with undulations oriented east-west. The amplitude of the undulations is differentiated.

The part of the faults cutting the radiolarites continues through the overlying cave-bearing Cretaceous limestone. This fact documents tectonic activity in the area after deposition of Cretaceous limestone. Tectonic activity is observed even today as earthquakes.

The top of the radiolarite series is cut by erosion that was active before the deposition of Cretaceous limestone. This observation documents the break between deposition of radiolarites and limestone.

Limestone (L)

The limestones overlying the radiolarites are more than 1200 m thick. They are represented by micritic modification and include zoogenic horizons containing molluscs, gastropods, etc. These layers document the oscillation of the bottom of the sea during the process of limestone deposition, when chemical deposition was replaced or supplemented with the deposition of skeletons of organisms.

Uplifting of the mountains began after the Cretaceous, during the Alpian orogenesis.

Erosion and development of the karstic system in the Katran Dagı Massif occurred just after the uplifting.

Paleogene, Neogene and Quaternary sediments were deposited on the eroded morphological surface of Cretaceous limestone.

In brief, one can state that the radiolarites are dipping under the limestone massif, but are present as pebbles in secondary position in younger sediments overlying the limestone (i.e., Paleogene, Neogene, Quaternary). These younger sediments were the source of radiolarite pebbles further transported by water to be deposited within the caves (tertiary position).

One can also state that tectonic activity played an important role during the formation of the karstic system.

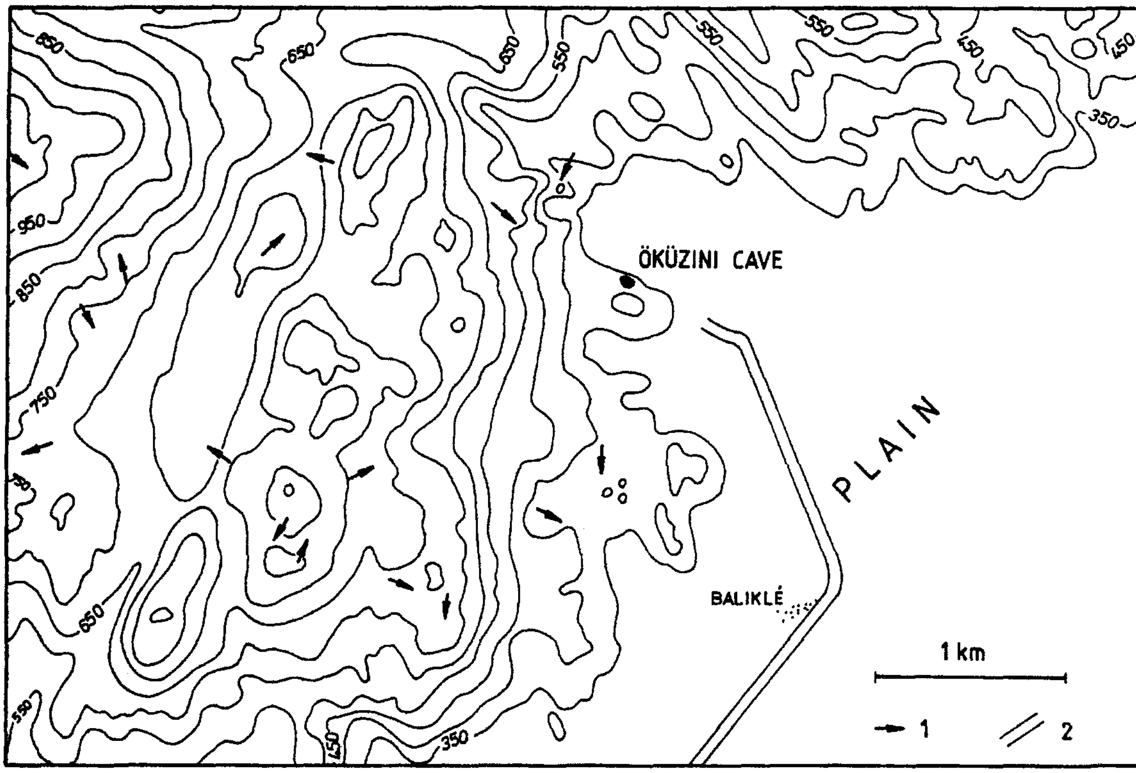

Figure 1. Morphological map of the region of Öküzini cave.
1: arrows showing the entrance of surface water into the karstic system. 2: water canal.

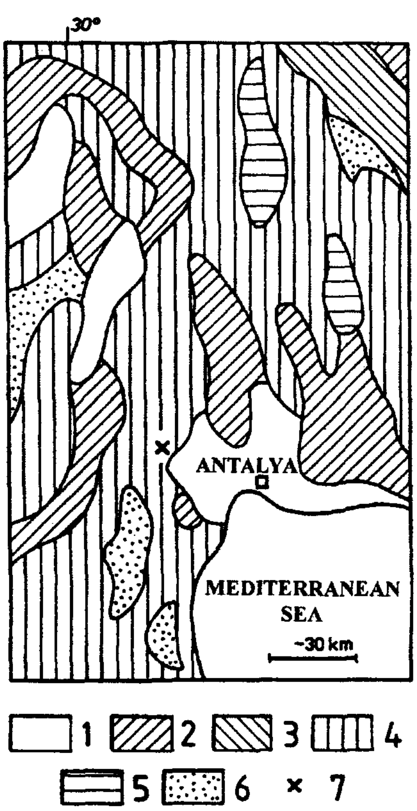

Figure 2. General geological map of the area.
1: Quaternary. 2: Neogene. 3: Paleogene. 4: Cretaceous.
5: Jurassic. 6: Triassic. 7: area investigated.

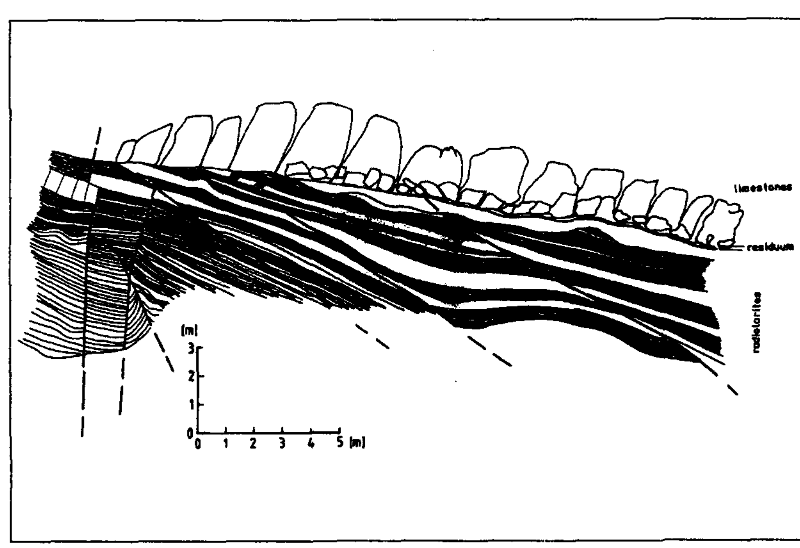

Figure 3. Radiolarite outcrop underlying Cretaceous limestone
(Çakmak Tepesi, Cafebar Karain).
Column is shown in detail in Figure 5.

Faults were the best places for cave development

Sediments younger than the Cretaceous are of mechanical (detrital) and chemical origin.

Detrital sediments cover the plain and are also present in the mountains (Fig. 2).

Radiolarite and limestone were the most important sources of the material for these sediments. Conglomerates, sands and clays are the most frequent rocks representing secondary deposits of radiolarite and limestone.

The slopes of the mountains are covered with clastogenes composed of sharp blocks of limestone mixed with red clay (terra rossa) and are of gravitational origin.

Similar sediments transported by water contain rounded limestone blocks mixed with terra rossa.

The beds of the rivers cut limestones and radiolarites. They are filled with a mixture of limestone and radiolarite pebbles. The size of these pebbles and the degree of rounding depends on the distance they have been transported by water. In the mountains they are represented by conglomerates, on the plain by sands.

Terra rossa is observed in primary position as residuum developed on limestone (Fig. 5) or, more often, in secondary position as red clays redeposited by water on the plain or in caves.

Mixtures of the three types of sediment described above are very common in the zones investigated (Fig. 6).

Sands, composed of quartz, and sometimes mixed with limestone grains, are also observed. They are present on the plain in front of the mountains. Their origin is due to the weathering of the soft sandstones observed in the tectonic cliff near Antalya.

Sediments of chemical origin are represented by travertines. This type of rock is deposited during the crystallization of calcite from water draining through karstic spaces in the limestone. The crystallization of calcite is the result of the change in the chemical balance of the water after exiting closed spaces of the karstic forms. This process is connected with the removal of part of the CO from the water and reduction of the solubility of calcite in water. Crystallizing in this way, the calcite cements various materials which may be present (sand, pebbles, archaeological material, etc.). After years, soft calcite recrystallized into hard travertine. In addition, flowing carstic water continually transports detrital material.

This travertine has been observed in Karain Cave as well as at some places on the plain.

GENESIS OF ÖKÜZINI CAVE

Öküzini cave was formed at the base of the Katran Dagı Mountains, at the contact of the base of the hills with the plain. It was formed by the outflow of waters conducted through the karstic system and enlarged by flowing water.

Observations indicate that the cave was at one moment blocked, probably as a result of tectonic activity (Fig. 7). Part of the roof collapsed and blocked the interior of the cave as well as the area near the entrance. Large limestone blocks are still observable today.

The blocks resulting from roof collapse caused the direction of the water flow to change. At this moment, water began to flow in another direction, i.e., to a cave located near Öküzini cave, where we can today observe the intensive outflow of waters from the karstic system.

Öküzini cave, from the moment of tectonic blocking, began to be dry and thus useful for human occupation.

CONCLUSIONS

Understanding of the general geology of the area around Öküzini cave is important in order to explain the phenomena involved in its origin and filling. The cave was filled with sediments deposited in many phases which were separated by erosion phases. These processes contributed to the destruction of anthropogenic structures observed in the archaeological horizons.

The geological sequence can be used to interpret phenomena at the Pleistocene-Holocene transition.

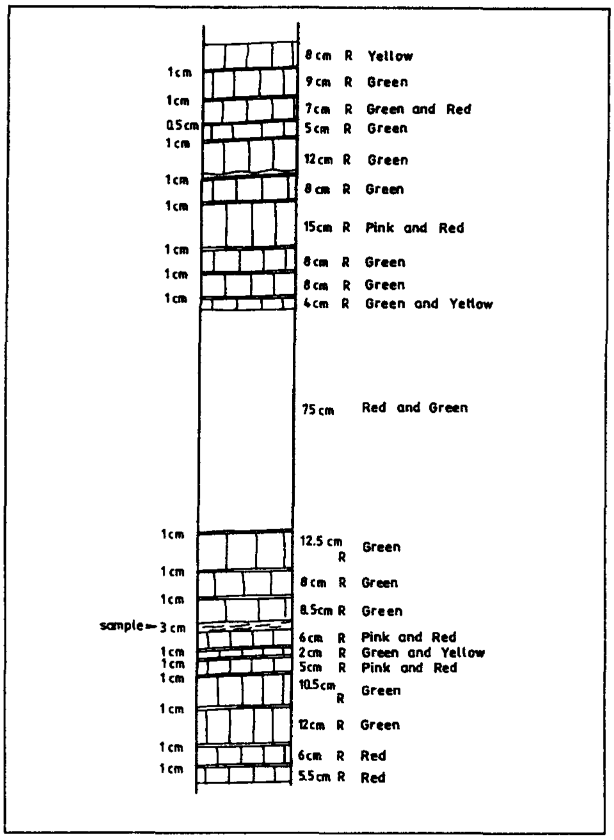

Figure 4. Detail of radiolarite sequence shown in Figure 4.

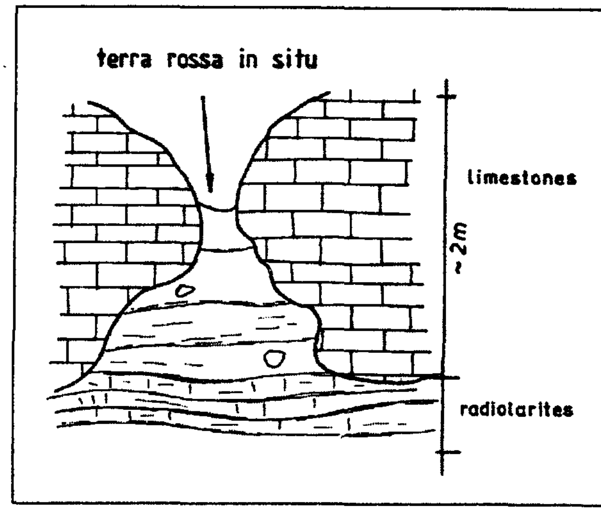

Figure 5. Terra rossa *in situ* between limestone blocks.

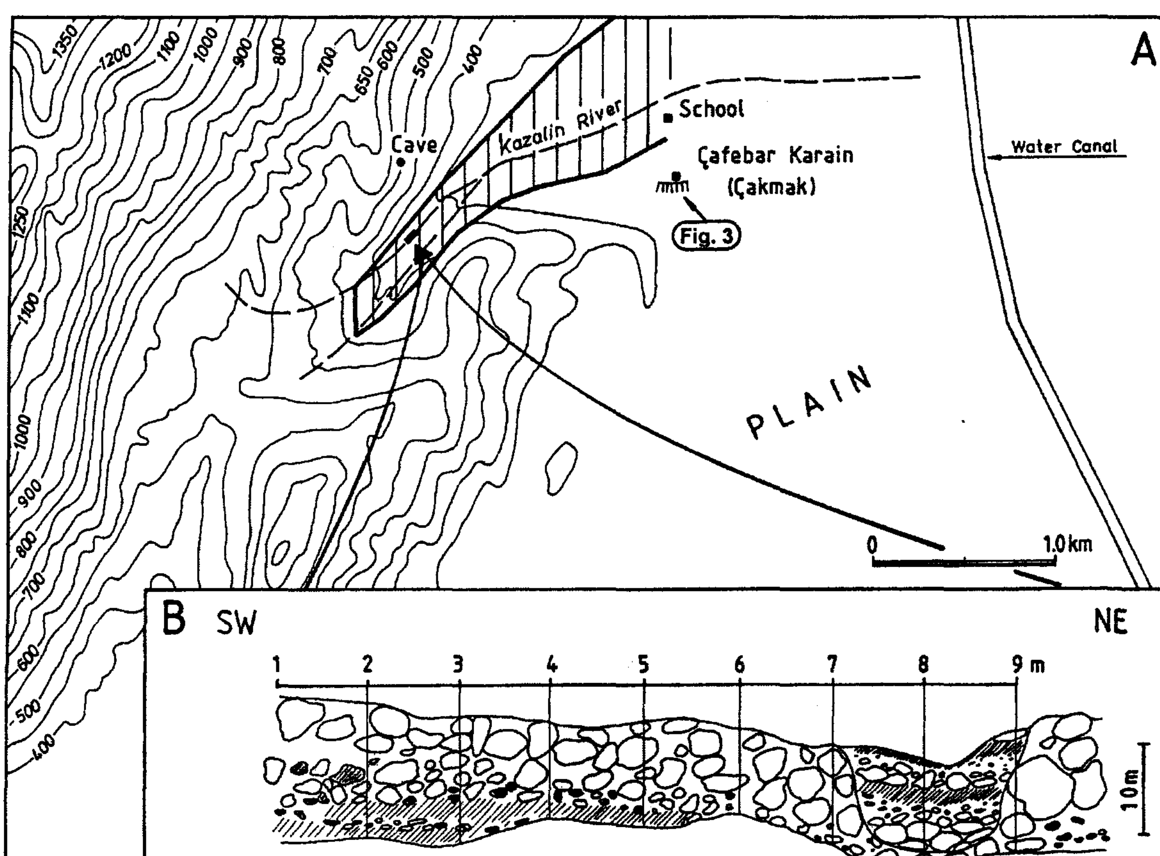

Figure 6. A: Zone containing radiolarite outcrops and river sediments (Kızılin river) containing radiolarite blocks (marked) which were used for lithic production at Karain and Öküzini caves. The radiolarite outcrop (Figs. 4 and 5) is shown. B: Sediments transported by water, containing limestone and radiolarite pebbles mixed with terra rossa in secondary position.

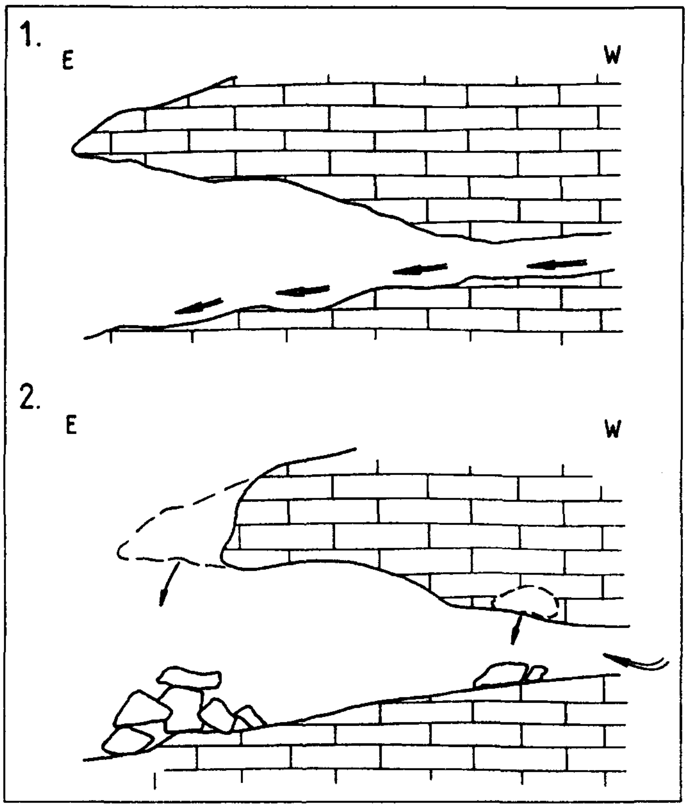

Figure 7. Schematic presentation of the blocking of Öküzini cave. 1: phase of the functioning of the cave for the outflow of karstic waters. Cross-section W-E. 2: Phase of the blocking of the cave. Direction of flowing karstic waters has been diverted to a new outflow near Öküzini cave.