

## **4th International Symposium on Karst, Málaga, Spain, 27<sup>th</sup>-30<sup>th</sup> April 2010**

### **MAIN STOPS OF FIELD TRIP IN THE WESTERN PART OF MALAGA PROVINCE, 29th April 2010**

**Maximum distance to Malaga city:** aprox. 140 km

**Departure:** 8:00

**Arrival:** 20:00

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### ***SIERRA DE LAS NIEVES***

#### **LLANOS DE LA NAVA**

This a wide depression situated in the western part of Sierra de las Nieves, 4'5 km of length and 1'5 km of width (Lhénaff, 1998). This polje has developed in the axis of a sinclinal stucture, in which extensively crops out Brecha de la Nava. Nowadays, this polje is drained by two streams, but also there are some swallow holes and dolines, whose bottom can be flooded in the rainy periods. From the hydrogeological point of view, this area is very important due it constitutes, as the closed depressions, an area of infiltration and recharge preferentially.



Overview of Sierra de las Nieves from Nava polje

## GENAL SPRING

The Genal spring is situated at the south border of the Nieves hydrogeological unit (700 m asl). It shows a fast and strong reaction to rainfall events and the typical fluctuations of karst water springs. The maximum outflow can reach more than  $7 \text{ m}^3/\text{s}$  while minimum outflows as low as  $0.02 \text{ m}^3/\text{s}$ . The average outflow is more than  $0.375 \text{ m}^3/\text{s}$ , the annual discharge is approximately  $12 \text{ hm}^3$ . The hydrochemical facies of the water is bicarbonated calcic and moreover it is characterised by low mineralization and rapid chemical variations; the frequency curves of hydrochemical data show a wide variation range and are predominantly plurimodal. The spring is captured partially for water supply of the Igualeja village.



Genal spring

## RONDA

The Tajo de Ronda allows a magnificent observation of the sediments deposited in the meridional margin of the miocenic basin of Ronda. It is constituted by conglomerates in the lowest part and calcareous sandstones towards the top, deposited in shallow coastal environments. In the Tajo de Ronda appreciates that the sediments are arranged horizontally, which they indicate that have not suffered valuable deformations. As soon as the region remained emerged, the stream erosion acted intensely in the area of Ronda, largely favored by the elevation of the region. This has given place to the formation of the Tajo and the deep canyon of the Guadalcobacín river.



El Tajo in Ronda city

## HUNDIDERO

In this point is possible to see a dam that was built upstream of the Gadaures river in order to produce energy, but as the water now infiltrates diffusely into the karst, the water level at the dam never rises to more than a few metres.

The Hundidero-Gato complex is 8 kilometres length and it is the largest underground karst features of the Sierra de Líbar. Before the building of the dam, the Gadaures river disappear into the large underground canyon Hundidero from where it crosses the semi-horst structure

and reappears in the Gato cave. Since the construction of the dam, water of the Gadares infiltrates already upstream of the dam.

### CUEVA DEL GATO SPRING

This spring is situated in the cave of the same name, Cueva del Gato, about 25 metres above the talweg of the Guadiaro river. It is alimented by the underground continuation of the Gadares river as well as other karst water flows. It shows a fast and strong reaction to rainfall events and the typical fluctuations of karst water springs. The maximum outflow can reach more than  $20 \text{ m}^3/\text{s}$  while minimum outflows as low as  $0.02 \text{ m}^3/\text{s}$  were measured in September of 2000. The average outflow is approximately  $1.5 \text{ m}^3/\text{s}$ , the annual discharge between  $60$  and  $65 \text{ hm}^3$ . The spring itself is not captured for water supply.



Cueva del Gato spring

## PUERTO DEL VIENTO

This karstic relief (1190 m a.s.l.) constitutes a natural continental water divide, to the west waters goes to Guadiaro river basin and, to the east, waters drain towards Guadalhorce river watershed. Geologically, represent a syncline fold as part of shape-box folds structural style, NE-SW direction, which dips toward NE. Marly limestones outcrops are located in syncline cores and function, together Triassic deposits, such as impervious layers. This permits the division of the main karst aquifer in two sectors: Sierra de los Merinos aquifer (north) and Sierra Blanquilla aquifer (south). From the point of view of geomorphology, in this area it can be observed singular exokarstic features (karren and ruiniform landscapes such as Torcal type), as a result of intense karstification on surface.



Panoramic view of recharge area of Sierra Blanquilla aquifer (left) and Sierra de los Merinos aquifer (right)

## FUENSANTA-EL BURGO SPRINGS

Both springs are located in the Natural Park of Sierra de las Nieves, included in the UNESCO Biosphere Reserve. They are the main outlets of Sierra Hidalga and Sierra Blanquilla aquifers, respectively. Fuensanta spring brings from a large marly-limestones outcrop (impermeable), but it has clear influence of a deep jurassic limestone aquifer due to the quick and wide hydrochemical responses observed, as reaction to rainfall events, and because of the high discharge rate measured (outflow range between 0,01 and 0,3 m<sup>3</sup>/s). This source of water was used during years in an ancient waterwheel to supply a religious community. Actually, Fuensanta spring area is an attractive recreational site.



Fuensanta spring in the ancient waterwheel

El Burgo is the most important spring in the discharge area of Sierra Blanquilla. The outlet is produced towards Turón river (which flows into Guadalhorce river) to the south border of the aquifer, and it is constituted by (less to more altitude) El Burgo and Hierbabuena spring, situated upstream of two artificial dams, and several intermittents spring. The average discharge value is  $1 \text{ m}^3/\text{s}$  with maximum values higher than  $5 \text{ m}^3/\text{s}$ . Hydrochemical responses in El Burgo spring are lower than in Fuensanta spring, frequency distribution curves of electrical conductivity show a different degree of functional karstification in both springs. Fuensanta spring flow is through karstic conduits, whereas El Burgo spring drains a less karstified aquifer. El Burgo spring is the main water supply for El Burgo village.



El Burgo spring and one of the numerous dams in the Turón river