V INTERNATIONAL SYMPOSIUM ON KARST

MALAGA, SPAIN 14TH - 16TH OCTOBER 2014

Annual meeting of IGCP 598 Project of UNESCO

INTRA-SYMPOSIUM FIELD TRIP 1

Torcal de Antequera-Alta Cadena karst massifs

15TH October 2014

This guide has been edited by
Academy of Sciences of Malaga

UNIVERSIDAD DE MÁLAGA FACULTAD DE CIENCIAS · CEHIUMA CENTRO DE HIDROGEOLOGÍA DE LA UNIVERSIDAD DE MÁLAGA

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club del agua subterránea

Intra-symposium field trip to Torcal de Antequera and Alta Cadena Karst systems

Key features

Departure: Wednesday 15th October (8.30 am) from Malaga city (Hotel Malaga Palacio)
Return: Same day 15th October (7:30 pm approx.)
Number of places: 12 (minimum) - 30 (maximum), by rigorous order of inscription
Registration deadline: 1stSeptember 2014
Price: included in registration fee (both trip and lunch)

General description

The intra-conference field trip 1 will be held the 15th October 2014, coinciding with other intra-symposium field trips. Guided by hydrogeologists from the Centre of Hydrogeology of the University of Malaga (CEHIUMA), the participants will have the opportunity to visit some of the most fascinating Karst Systems located in Malaga province (Andalusia, S Spain):

- Torcal de Antequera
- Alta Cadena Mountain Range

Panoramic view of Sierra de Camarolos (Alta Cadena Mountain Range)

Both areas are constituted by Jurassic limestones and dolostones in which karstic processes have developed, giving rise to a great variety of karst features such as karrenfields, sinkholes, dolines and uvalas and nice springs (with different hydrogeological functioning). Karst features are especially significant in Torcal de Antequera, showing one of the most spectacular and unusual karstic landscapes in Spain. During the visit to the Torcal de Antequera and Alta Cadena areas, the main discharge points of aquifers will be visited.

Karstic landscape in Torcal de Antequera

Provisional list of stops

- ✓ **El Torcal de Antequera**: the first stop of the field trip will be in this spectacular area with high geomophological interest since it presents a spectacular exokarstic development of landforms; consequence of the lithostratigraphy and the geological structure of the Mesozoic rocks that constitute the massif. Sub-horizontal Jurassic limestone beds are made up of oolitic limestones, stratified into thick layers, ranging from few centimetres to several metres. The alternation of compact oolitic limestones with more erosionable nodular and brecciated rocks is an essential feature in the morphology of Torcal de Antequera.

The exokarstic morphology is one of the most characteristic aspects of El Torcal de Antequera. Above: View of "El Tornillo" (the screw).

Geological structure and fracturing are other remarkable aspects that have contributed to develop the karstic landscape in this massif. The first correspond, in general terms, to an oriented NE-SW anticline fold, with sub-horizontal beds in the upper part, and sub-vertical or even inverted flanks at the southern and northern borders. This structure has been affected by more recent fractures, mainly oriented N40-60E and N110-120E.

Aerial view of Torcal de Antequera, showing the fracture system networks that affect limestones, and its influence on karst development.

- ✓ **La Villa spring:** located at the northern border of Torcal de Antequera, this spring constitutes the main discharge point of the carbonate aquifer, which is used for water supply of the nearby urbanized area of Antequera. This spring, with calcium-bicarbonate facies, has an estimated mean discharge of 425 L/s, although highly variable flow, from 0 to 2.000 L/s. It is currently regulated by boreholes.

La Villa spring (April, 2010)

- ✓ **View and geological description from Villanueva del Trabuco area:** taking advantage of the nice view from this site, the major geological and hydrogeological characteristics of Alta Cadena aquifers will be introduced. In hydrogeological terms, the Alta Cadena mountain range has approximately a total surface of 65 km². They are constituted of Jurassic dolostones and limestones, fractured and karstified, which at the northern, southern and eastern borders are adjacent to marly and clayey materials of low permeability. Recharge of carbonate aquifers takes place through rainwater infiltration (exceptionally snow melt water), while groundwater drainage occurs mainly through springs situated on the northern border of carbonate outcrops. Taking into account geological and hydrogeological information obtained during the last years, four aquifers have been differentiated in the Alta Cadena from west to east: Sierra de las Cabras, Sierras de Camarolos and del Jobo, Sierra Gorda de Villanueva del Trabuco, and Sierras de San Jorge and Tres Mogotes.

Panoramic view of Alta Cadena mountain range (from the east).

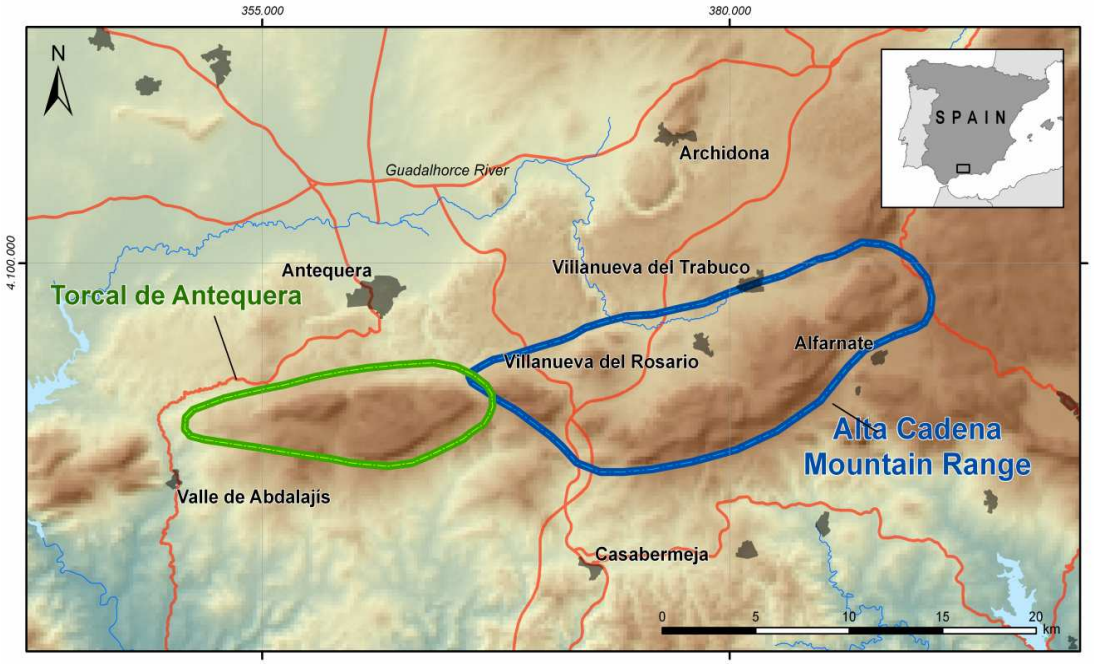
- ✓ **Cien Caños spring:** drains most of the Sierras de San Jorge and Tres Mogotes aquifer water resources (5.4 hm^3/year). This spring, with an estimated mean discharge of 105 L/s, is located in the northern border of the aquifer. The surrounding area has been substantially modified recently. Small variations recorded in temperature and in the contents of the chemical components of the water coming from Cien Caños spring suggest a moderate-low degree of development of karst drainage in the sector of the aquifer that it drain, although shows also rapid increases of flow rates during periods of recharge.

Cien Caños spring in high water conditions

- ✓ **Villanueva del Rosario spring:** this spring, together with a nearby overflow spring, constitute the main discharge points of Sierras de Camarolos and del Jobo aquifer, and the Alta Cadena as a whole, with a mean annual drainage of 9.5 hm^3. Villanueva del Rosario spring responds rapidly to precipitation (flow velocities even 200 m/h), with sharp, significant increases in discharge rates and with decreases in water mineralization. This is due to the existence of a high degree of functional karstification, typical of conduit flow systems, with rapid drainage and a low capacity for natural regulation.

Northern border of Sierras de Camarolos y del Jobo aquifer, where is located Villanueva del Rosario spring (right)

Location map



All pictures by Centre of Hydrogeology of the University of Malaga.