4th International Symposium on Karst, Málaga, Spain, 27th-30th April 2010

FIELD TRIP BY EASTERN COASTAL AREA OF MALAGA PROVINCE, 29th April 2010
Maximum distance to Malaga city: aprox. 70 km
Departure: 9:00 **Arrival:** 18:30

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LOS CANTALES

The cliffs between Cala del Moral and Rincón de la Victoria, located about 10 km east of Malaga city, contain the best-preserved remains of deposits of paleo-beaches, which fill the cavities and fissures formed in the limestone materials of the Maláguide coverage. These can be seen continually along the route between the above locations and in the tunnel excavations for a inactive railway line.

At a height of 10-12 m above the current sea level, there are beach deposits formed by sands and gravels with abundant remains of marine fauna. Isotopic dating by the Uranium-Thorium series method has enabled us to distinguish two marine episodes, the earlier occurring 360,000 ± 41,000 years ago, and the more recent, 240,000 ± 5,000 years ago.

At a lower height, at about 5 m a.s.l., there are the remains of a marine platform containing signs of borings into the calcarous material made by lithophages.

Below this microplatform, and also filling some cavities, there are marine deposits at 1-3 m a.s.l., sealed by karstic deposits and stalagmitic flowstones. Notable among the fauna observed is *Strombus bubonius*; the presence of this gastropod is indicative of a warmer climatic situation than that of the present-day Mediterranean. The existence of warm-climate fauna, together with the datings obtained from the karstic deposits that seal them, enable us to identify these levels with global sea level rises occurring between 130,000 and 95,000 years ago, that is, during the periods of greatest warming during isotopic stage 5.

NERJA CAVE

The Nerja Cave is a experimental site to study of non-saturated zone in the Mediterranean karst and has been investigated by the Hydrogeology Group of the University of Málaga (GHUMA) since 1991. The cave is located in Andalusia (southern Spain), in the province of Málaga, about 5 km east of the coastal town of Nerja.

The cave extends almost horizontally between limits of 123 and 191 m a.s.l. and occupies a volume of about 300.000 m^3. The largest galleries are mainly oriented N35E in the tourist area and N-S in the restricted areas, which coincides with the principal fracturation lines.

The climate outside the cave is typically Mediterranean, with a mean annual temperature of 17.3ºC, ranging from 8.1ºC in January to 27.8ºC in August. Mean annual rainfall is 500 mm, although it is irregularly distributed, with a wet season from October to February and a dry season during the summer.

The Nerja Cave is one of the most visited natural sites in Andalusia (on average, 500,000 visitors per year), and so requires extensive research into environmental parameters and the physical and chemical characteristics of the water, both within the cave and outside it.

CERRO GORDO

Here, the dolomitic marbles of Sierra Almijara descend to the Mediterranean Sea, forming a coastline with steep slopes and small beaches and coves.

The southern limit of Sierra Almijara comprises a rock wall, falling 150 m to the sea and another 20 m below the sea surface. At the base of the wall is seen a number of islets, formed by large blocks detached from this relief.

The rock face, both above sea level and 8-9 metres beneath it, is marked by the effects of the continuous erosive action that has created caverns such as Cueva de las Palomas, large enough for small boats to enter.

Cerro Gordo area

MARO SPRING

The Maro spring is the main natural discharge point in the southern sector of the Almijara Unit, with a mean flow of nearly 250 l/s, at 120 m above sea level. The hydrogram of the spring presents large increases in flow volume in response to rainfall, due to the significant degree of functional karstification within the system.

The water drained by the spring is of variable chemical type, from bicarbonate to sulphate calcium-magnesium type. The high sulphate content is apparently related to the existence of evaporites in the Alpujárride carbonate series, deduced from the close relation observed between the content of Ca^{2+} and SO_4^{2-}, the main determinants of water mineralisation. Average electrical conductivity is 700 µS/cm and the mean temperature of the spring water is 18.8 ºC. The water is saturated in calcite (SIcal = 0.43) and in dolomites (SIdol = 0.48). The temporal evolution of the chemical characteristics of the spring water reveals a dilution effect that is particularly evident in the conductivity and in the content of Ca^{2+} and SO_4^{2-}. This dilution coincides with the increase in flow volume after rainfall, which confirms the typically karstic discharge regime of the spring.

Maro spring