Use of hydrodynamic and hydrochemistry to characterise carbonate aquifers. Case study of the Blanca–Mijas unit (Málaga, southern Spain)

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Abstract To validate the geological and piezometric subdivision of two carbonate massifs in southern Spain, and to carry out a characterisation of aquifer behaviour, 23 representative springs and wells were monitored at the end of the dry season. Temperature, pH and electrical conductivity and major ions were measured. Calcite (SIc) and dolomite (SId) saturation indexes, P_{CO2} and cation exchange index (CEI) were calculated with the SOLUTEQ code. Water flow and electrical conductivity were also monitored at the eight main springs. Sierra Blanca and Sierra Mijas constitute an important carbonate hydrogeological unit in southern Spain, supplying water to 250,000 people on the Costa del Sol. Hydrochemically, two basic types of aquifer behaviour can be distinguished: conduit and diffuse flow systems. The former are found in the calcareous marbles of the western Sierra Blanca. They present a calcium-bicarbonate hydrochemical facies with low mineralization, and with quick outflow and water chemistry variations in response to rainfall; hydrochemical time series present frequency distributions with several modes. The diffuse flow systems are characteristic of the dolomitic marbles of eastern Sierra Blanca and Sierra Mijas. These waters are more highly mineralised and present a calcium-magnesium bicarbonate facies. They are characterised by slight discharge fluctuations, with nearly unimodal frequency distributions. Aquifer behaviour affects groundwater exploitation in terms of the success of boreholes and the specific yield of the pumping wells, which are less in the conduit flow systems in western Sierra Blanca.

Keywords Conduit and diffuse flow systems · Groundwater exploitation · Hydrochemistry · Southern Spain

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Introduction

Sierra Blanca and Sierra Mijas constitute an important hydrogeological unit in the Costa del Sol area (Malaga Province, South Spain), and they have been exploited during decades for urban water supply. At present, groundwater resources are managed to supply an average population of 250,000 in various municipalities. The population, however, varies from less than half this value in winter to more than double during the summer. For appropriate exploitation and management of the groundwater from Sierra Blanca and Sierra Mijas, it is necessary to identify the number of aquifer systems, the recharge area and groundwater path-flow within them and, especially, the aquifer behaviour.

In carbonate rocks, the results of drillings (success rate and specific yield) can vary greatly, according to karstification processes. Thus, the main objectives of this study were to (1) characterise the karstification status of different carbonate hydrosystems on the basis of their geological features and their hydrodynamic and hydrochemical responses (Andreo 1997), and (2) validate a geological subdivision into separate hydrosystems to determine the exploitation capability of these different aquifers (recharge fluxes, exploitable yields) in Sierra Blanca and Sierra Mijas in the province of Málaga, southern Spain.

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