Vías, J. M., Andreo, B., Perles, M. J., Carrasco, F., Vadillo, I. and Jiménez, P. 2002. Preliminari proposal of a method for contamination vulnerability mapping in carbonate aquifers. In: Carrasco, F., Durán, J. J. y Andreo, B. (Eds.) *Karst and Environment.* 75-83

Preliminary proposal of a method for contamination vulnerability mapping in carbonate aquifers

J. M. Vías[1], B. Andreo[2], M. J. Perles[1], F. Carrasco[2], I. Vadillo[2] and P. Jiménez[2]

[1] Department of Geography, University of Málaga. 29071 Málaga, Spain (jmvias@uma.es)
[2] Department of Geology, University of Málaga. 29071 Málaga, Spain (andreo@uma.es)

RESUMEN

Se presenta una propuesta metodológica (método COP) para evaluar la vulnerabilidad a la contaminación de las aguas subterráneas en acuíferos carbonatados, siguiendo el *European Approach* de la Acción Europea COST620. El método COP tiene en cuenta la combinación de tres factores: la capacidad de protección que de modo natural tiene el acuífero según las capas que constituyen su zona no saturada (factor O), la existencia de concentración de flujos y de infiltración rápida a través de conductos kársticos que reduce la capacidad natural de protección del acuífero (factor C) y, finalmente, las características pluviométricas (factor P) que determinan el transporte del contaminante, por el agua de lluvia, desde la superficie hasta la zona saturada del acuífero. Se ha desarrollado una propuesta de puntuación de los tres factores anteriores y se ha aplicado satisfactoriamente a dos acuíferos carbonatados del Sur de España (Sierra de Líbar y Torremolinos) cuyas características hidrogeológicas muy diferentes.

Palabras clave: acuífero carbonatado (kárstico), cartografía de vulnerabilidad, protección de agua subterránea

ABSTRACT

A methodological approach (COP method) to evaluate the vulnerability to contamination of groundwater in carbonate aquifers, following the *European Approach* defined in European Action COST620, is presented. The COP method takes three factors into account: the natural protective capability of an aquifer provided by the layers making up its unsaturated zone (O factor), the existence of flow concentrations and of rapid infiltration through karstic features, which reduce the aquifer's natural protective capacity (C factor), and finally, the pluviometric characteristics (P factor) that determine the transport of contaminating agents by rainfall from the surface to the saturated zone of the aquifer. A rating procedure for these three factors has been developed and successfully applied to two carbonate aquifers in southern Spain (Sierra de Líbar and Torremolinos), which have very different hydrogeological characteristics.

Key words: carbonate (karstic) aquifer, groundwater protection, vulnerability mapping

1. BACKGROUND

The European Union, in the framework of the COST Program (European Cooperation in the field of Scientific and Technical research), supports Action 620 (Vulnerability and risk mapping for the protection of carbonate –karst- aquifers). In the framework of this Action, a *European Approach* for vulnerability mapping has been developed (Daly *et al.*, 2002), but this does not establish scores or weights of the variables; neither does it stipulate how the variables should be combined to obtain a vulnerability map. The Group of Hydrogeology in the University of Málaga (GHUMA) has been working on this topic for several years, applying different vulnerability mapping methods to carbonate aquifers in southern Spain. These methods include GOD (Foster, 1987), AVI (Van Stempvoort *et al.*, 1993), DRASTIC (Aller *et al.*, 1987) and EPIK (Doerfliger, 1996). This has enabled us to compare the applicability of the methods and to establish which of the variables considered are most suitable for inclusion in contamination vulnerability mapping (Vías, 2000; Vías *et al.*, 2001; Longo *et al.*, 2001; Brechenmacher, 2002). From the results obtained in earlier studies, and according to the *European Approach*, GHUMA has developed a methodological proposal for contamination vulnerability mapping. The objectives of the present article are: (1) to report the principles of the new method (COP method) of contamination vulnerability mapping, which has been specially developed for the protection of groundwater resources in carbonate aquifers, and (2) to present the results of applying this method to two carbonate aquifers in southern Spain with very different hydrogeological characteristics.

2. DESCRIPTION OF THE COP METHOD

In the framework of COST Action 620, *Intrinsic vulnerability* has been defined as the sensitivity of groundwater to contamination, determined by the geological, hydro-