Hydrochemical behavior of waters in a Tunisian hill reservoir watershed and reservoir impact on alluvial aquifer

J P MONTOROI[1], O GRÜNBERGER[1], S NASRI[3]

RESUME

El Gouazine reservoir (35°55' N, 9°45' E) is one of the five Tunisian experimental sites monitored in the UE Hydromed project focused on the improvement of Mediterranean hill reservoirs (Albergel et Rejeb, 1997).

This paper consists in overviewing the main results of a two years field study. Initially the main objectives were characterising spatial water chemistry at a given time (flow and dry periods), identifying geochemical tracers explaining the relationships between reservoir water and groundwater table and, modelling the water-soil-rock interactions.

In May 1998 and April 1999, systematic water sampling (surface water, groundwater and reservoir water) was done within and beyond the 18 km^2 El Gouazine catchment located in Central Tunisia. Filtrated water was analyzed for major, trace and isotopic (^{18}O et ^{2}H) elements. X-ray diffraction and chemical analyses (major and trace elements) were conducted for the main pedological and geological formations of the watershed, including lacustrine deposits and alluvial materials.

The relevant results are as follows (Grünberger et al, 1999; Montoroi et al, 1999, 2000):

(i) Three groundwater types can be distinguished in relation with the bedrock (limestone, marl, gypsiferous marl, gypsiferous argillite, sandstone). In the upper part of the watershed, groundwater has highly Ca^{2+} and CO_3^{2-} rates resulting from limestone weathering. Groundwater located in the marly lowlands between the limestone outcrops has lower Ca^{2+} and CO_3^{2-} rates coupling with higher Mg^{2-}, Na^+ and Cl^- rates. In the lower part, groundwater is draining gypsiferous deposits and is dominated by Ca^{2+} and SO_4^{2-} ions. The groundwater is less concentrated in the downstream part of the dam suggesting that an upstream groundwater flow is diluted by reservoir water.

(ii) The interpretation of the hydrological data (reservoir balance, piezometric fluctuation and stable water isotope content of the downstream groundwater) leads to quantify the underground leakage from the reservoir to the alluvial aquifer. A 300 $m^3 j^{-1}$ outflow at the highest level of the reservoir water (> 4.5 m) and a 170 $m^3 j^{-1}$ outflow at the lowest level (<4.5 m) are counterbalanced by a 50 $m^3 j^{-1}$ inflow. Pedological data confirm the infiltration pathway throughout the reservoir deposits.

(iii) Ba, Cr, Mn and Sr are the most reliable trace-elements characterizing the bedrock-groundwater interactions. In dry season, the alluvial aquifer is influenced by other distinct aquifers intersected by the riverbed. In the downstream part of the reservoir, the influence of the dam leakage through ~~the reservoir deposits, and the~~

crossed effects of the dilution by surface water and the contact with alluvial material is described and commented.

(iv) Geochemical modelling leads to evaluate, on the one hand, how the different geological and pedological parts of the watershed contribute to the chemistry of the reservoir water and, on the other hand, how reservoir water contributes to aquifer recharge.

Albergel, J., Rejeb, M., 1997. Les lacs collinaires en Tunisie : enjeux, contraintes et perspectives. Comptes-Rendus Acad. Agric. Fr. 83, 2, 77-88.

Grünberger O., Montoroi J.P., Albergel J., 1999. Evaluation par bilan isotopique de la recharge d'un aquifère induite par le fonctionnement d'une retenue collinaire. Premiers résultats sur le site d'El Gouazine (Tunisie centrale). In K. Zouari : "*Colloque international, Apport de la géochimie isotopique dans le cycle de l'eau, Hammamet (Tunisie), 6-8 avril 1999*". Volume des abstracts, Enis, Sfax, 52-53.

Montoroi J.P., Grünberger O., Nasri S., 1999. Water chemistry of a small reservoir catchment in central Tunisia. Preliminary results of water-soil-rock interactions. In R. Berndtsson (Ed.) : "*Proceedings of the international seminar Rain water harvesting and management of small reservoirs in arid and semiarid areas, 29 June - 2 July 1998, Lund (Sweden)*". Orstom/Hydromed-Sarec-Nfr-Lund University, Lund, Report 3222: 107-121.

Montoroi J.P., Grünberger O., Nasri S., 2000. Caractérisation chimique et isotopique des eaux et des formations superficielles du bassin versant du lac collinaire d'El Gouazine (Tunisie centrale). Rapport scientifique de la campagne de mesures 1998. Multigr., Ird/Dces/Inrgref, Bondy, 90 p. + annexes.

1. IRD, 32 Avenue Henri Varagnat, 93143 Bondy, France, montoroi@bondy.ird.fr, grunberger@bondy.ird.fr
2. INRGREF, rue Hédi Karray, 2080 Ariana