Geophysical Research Abstracts, Vol. 7, 01448, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01448

Isotopic Study and relationship between surface and ground Waters in Souss river catchment's (south Morocco)

Author(s)

L. Bouchaou (1), Y. Hsissou (1), Kh. Dindane (1), C.B. Gaye (2), Qurtobi (3) & H. Marah (3)

(1) Laboratoire de Géologie Appliquée et Géo-Environnement (LAGAGE), Faculté des Sciences, Université Ibn Zohr, B.P 8106, Cité Dakhla, 80000 Agadir, Morocco

(2)Isotopic hydrology section, IAEA, Wien, Austria;

(3) CNESTEN, Rabat, Maroc.

Text of Abstract

The Souss river flow situated between the high Atlas Mountain in the north and Anti-Atlas in the south is closely related to the rain fluctuations and shows inter annual variation, seasonal regime from year to year. The climate is semi-arid to arid, the rainy season extending from November to March and the dry season from April to October. The rainfall and the average runoff vary in time and space, ranging from 200 mm/y in the plains (mean altitude: 460 m a.s.l.) to 600 mm/y in the mountains (altitude $>$700 m a.s.l.). The long-term mean annual precipitation decreased in 20 years from 343 mm in Aoulouz (700 m a.s.l.) to 232 mm in Taroudant (232 m a.s.l.). The temporary Souss River is the main collector of superficial waters in the basin. The location near mountains (with high rainfall) allows an important inflow by its tributaries especially those coming from the High Atlas Mountain. This flow coming from a high altitude is infiltrated in the piedmont area and in the beds of rivers which present high permeable conglomerates.

The shallow aquifer of the plain is the main resource for drinking, irrigation and industrial water in the region. In order to improve the management of these precious

resources, several studies, to better understand the hydrological functioning of the aquifer system and define the relationship between surface runoff (rivers and dams) and groundwater, have been carried out during the last years.

This study summarizes the application of isotope hydrological tools to infer water sources in this part of the Souss region. The isotopic contents of waters are ranged from - 8‰ & to -5.2‰ for $d^{18}O$, from -52‰ to -34‰ for ^{2}H, and from 0 to 5.5 TU for tritium.

Hydrogen and oxygen isotope signatures reveal a significant infiltration before evaporation, indicating a recent recharge through fractures in Atlas Mountain crystalline and limestone rocks and infiltration of surface water in the alluvial cones at the margin of the Atlas basins. ^{18}O, ^{2}H and tritium values indicate a mixing between recent and old groundwaters; the latter were recharged under more humid climatic conditions than that at present. The old groundwater encountered in deep wells are not connected to modern recharge, indicating that water followed a long flow path. The slight evaporation recorded by stable isotopes in water from the southern margin close to the Anti-Atlas mountains indicates that there groundwater are subject to a drier climate, marking the Anti-Atlas Mountains, which form a barrier against the influence of the Sahara.

The upstream watershed, which is the place of condensation and the beginning of the Atlas Mountain, shows more characteristic ^{2}H and ^{18}O-depleted waters. This finding can be explained by the altitude and the continental effects. On the other hand, ^{2}H and ^{18}O-enriched waters values towards the ocean, show an evaporation effect near the condensation source or the irrigation returns, especially in the irrigated perimeters. The rain isotope values indicate a main recharge from the Atlasic Mountain (figure 1), whereas the contribution of the local rains is negligible in downstream. The ^{2}H-^{18}O relationship displays straight lines with variable slopes on an upstream-downstream movement. The slopes, which are below 8 in certain areas, represent the evaporation during the infiltration either by runoff or by irrigation returns. Besides, the different values of slopes correspond to the variables isotopic values observed at a regional scale within the basin.

Key words: Isotope tools, surface waters, groundwater, semi-arid climate, recharge, Morocco

References

Hsissou Y., Mudry J., Mania J., Bouchaou L. et Chauve P. (1999) - Utilisation du rapport Br/Cl pour déterminer l'origine de la salinité des eaux souterraines : exemple de la plaine du Souss (Maroc). C. R. Acad. Sci. Paris, 1999. 328, 381-386.

Boutaleb S, L. Bouchaou, J. Mudry, Y. Hsissou, J. Mania et P. Chauve, (2000) - Aquisition of salt mineralisation in semi-arid watershed. The case of oued Issen (Western Upper Atlas, Morocco. *Hydrogeology Journal (2000) Vol. 8, pp. 230-238.*

Hsissou Y., L. Bouchaou, J. Mudry, J. Mania, P. Chauve (2002) - Use of chemical tracing to study acquisition modalities of the mineralization and behaviour of unconfined groundwaters under a semi-arid climate: the case of the Souss plain (Morocco). *Env Geol (2002) 42: 672-680.*

Bouchaou L., Qurtobi M., Y. Hsissou Et Boutaleb S. (2002) - The underground river of win Timdouine (Agdir region, High Atlas): a contribution to the inventory geological heritage in Morocco. Kart and Environment. pp. 273-279, Nerja, Spain

K. Dindane ^{A}, L. Bouchaou $*^{A}$, Y. Hsissou ^{A} And M. Krimissa ^{A,B} (2003) - Groundwater in the Souss upstream basin, southwestern Morocco: evidences to its chemical evolution and origin. JAES, 36, pp. 315-327.

Ahkouk, Hsissou, Bouchaou, Krimissa, Mania (2003) – Impact des fertilisants agricoles et du mode d'irrigation sur la qualité des eaux souterraines (cas de la nappe des Chtoukas, bassin du Souss-Massa). Africa Geoscience Review, Vol. 3, n°4.

Bouchaou L., Qurtobi M., Gaye C.B., Hsissou Y., Ibn Majah M., Michelot J.L., Marah H., Safsaf N. & El Hamdaoui A (2003)- Isotopic investigation of salinity and water resources in the souss-Massa basin (Morocco). International Symposium on isotope hydrology and integrated water resources management 19- 23 May, 2003, Vienna, Austria.

Elmouden A., L. Bouchaou & M Snoussi, (2004) - Clay Minerals Use As Envirnement Indicators And Sedimentary Tracers In Semi – Arid Zone: The Case Of The Souss Basin (Morocco). Geodynamica Acta, Spain (Sous press).

Bouchaou L., Y. Hsissou, M. Krimissa, S. Krimissa et J. Mudry (2004) – ^{2}H and ^{18}O isotopic study of ground waters under a semi-arid climate. Accepted in environnemental Geochemical.

Accepted in Environmental Geochemistry, Springer.

Agoussine M. et L. Bouchaou (2004) - Les problèmes majeurs de la gestion de l'eau au Maroc. Science et changements planétaires / Sécheresse. Numéro 15, volume 2, 187-94.