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Extended Abstracts

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title: **An application of cluster analysis and multivariate classification methods to evaluate spatial characterization of groundwater chemistry in southeastern of Tunisia: a case study of Jeffara of Medenine**

author(s): **Fadoua Hamzaoui**
(1) Faculty of Sciences Tunis,
(2) National Engineers School of Tunis, Tunisia, fadoua_fst@yahoo.fr

Rachida Bouhlila
National Engineers School of Tunis, Tunisia, rjbouhlila@yahoo.fr

Moncef Gueddari
Faculty of Sciences Tunis, Tunisia, Moncef.Gueddari@fsst.rnu.tn

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The Southeastern of Tunisia depends entirely on groundwater for domestic and agricultural use (Romangey and Guillaume, 2004). The Jeffara of Medenine aquifer system, which represents the unique resource of water for the region (Medenine, Jerba, Zarzis and Jorf cities), is represented by three main aquifers namely, from the top to the bottom: the Miocene (Jorf-Jerba-Zarzis), the Jurassic (Zeuss-Koutine) and the Triassic (Sahel El Abebssa). Sampling surveys were undertaken in January 2004 from 46 wells. 11 variables (temperature, pH, Total Dissolved Solids (TDS), Na^+, Cl^-, Ca^{2+}, Mg^{2+}, SO_4^{2-}, K^+, HCO_3^-, and F^-) of water samples were measured and analyzed.

In this study, hydrogeologic and hydrochemical information from the Jeffara of Medenine groundwater system were integrated and used to determine the main factors and mechanisms controlling the chemistry of groundwaters in the area (Fig. 1).

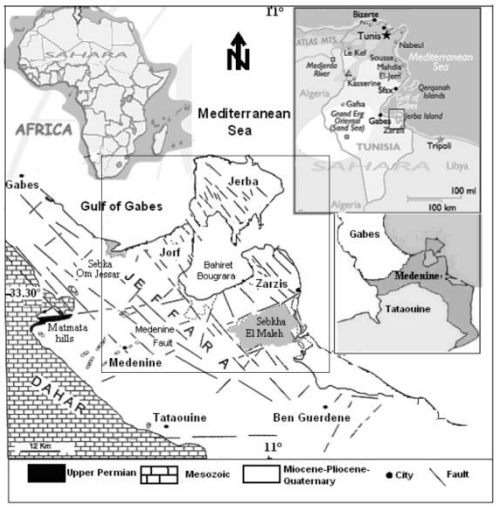

Figure 1. Location and geologic map of the study area.

The large number of data can lead to difficulties in the integration, interpretation and representation of the results. Two multivariate statistical methods, hierarchical cluster analysis (HCA) and principal components analysis (PCA), were applied to analyze the similarities or dissimilarities among the sampling sites (Ragno et al., 2007; Cloutier et al., 2008; Templ et al., 2008) to identify spatial variations in water quality, with the objective of defining the main controls on the groundwater hydrochemistry.

The main processes influencing the groundwater chemistry in the jeffara of Medenine aquifer system are salinisation, mineral precipitation and dissolution, cation exchange and human activity.

Cluster analysis based on major ion contents defined 3 main chemical water types, reflecting different hydrochemical processes (Fig. 2). So, three geochemically distinct clusters, C1–C3, resulted from the HCA. Samples from cluster C1 are mostly located in preferential recharge areas and have low salinity. The majority of these samples have Ca–SO_4. Samples from the other two clusters (C2, C3) are characteristic of an aquifer system under confined conditions. The majority of these samples have Na–Ca–Cl–SO_4 evolved groundwater.

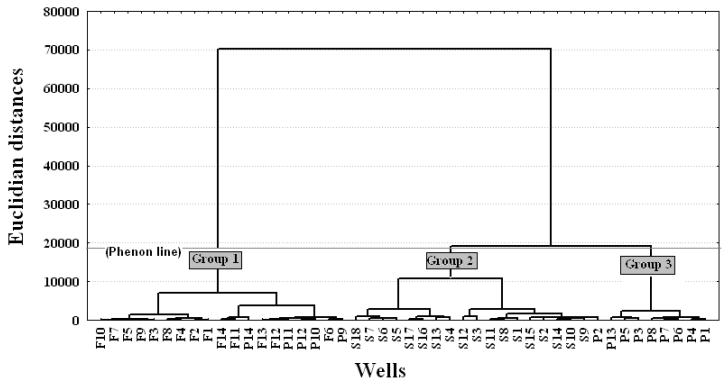

Figure 2. Dendrogram of Q-mode cluster analysis (Ward's linkage method and squared Euclidean distances).

In addition to recognizing the importance of hydrogeological conditions on groundwater geochemistry, the distribution of clusters also showed the importance of the geological formations and hydrodynamic conditions. Results obtained from principal component analyses (PCA) indicate that the variables responsible for water quality composition are mainly related to soluble salts species (Na^+, Cl^-, Ca^{2+}, Mg^{2+}, SO_4^{2-} and K^+).

REFERENCES

Cloutier V., Lefebvre R., Therrien R., Savard M.M., 2008: *Multivariate statistical analysis of geochemical data as indicative of the hydrogeochemical evolution of groundwater in a sedimentary rock aquifer system*. Journal of Hydrology 353, 294–313.

Romagny B., Guillaume H., 2004: *L'accès à l'eau potable dans la Jeffara tunisienne: contradictions et nouvelles perspectives*. La houille blanche, 4, 52–59.

Ragno G., De Luca M., Ioele G. 2007: *An application of cluster analysis and multivariate classification methods to spring water monitoring data*. Microchemical Journal 87, 119–127.

Templ M., Filzmoser P., Reimann C., 2008: *Cluster analysis applied to regional geochemical data: Problems and possibilities*. Applied Geochemistry 23, 2198–2213.

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