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# Hydrochemical and isotope evidences of recent recharge of the Continental Intercalaire transboundary aquifer through the Occidental basin, north-west of Algerian Sahara

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The northern Sahara contains vast transboundary aquifer systems shared between Algeria, Tunisia and Libya. The "Continental Intercalaire (CI)" aquifer is the most important and the main water resource for these regions. It covers an area of more than 1 million km$^2$ with 350m thick in average. The aquifer is formed by continental deposits (mainly sandy-clay to sandstone).
In Algerian part, piezometric map shows that groundwater flow direction in north is west-east; in south, it is north-south; both come from the "Occidental basin" the principal recharge area of CI aquifer. However, recent studies have demonstrated, using mathematical modelling, that CI aquifer should receive more important recent recharge below dunes of occidental basin, where CI in unconfined, than it was expected in older studies.
This study aims to identify the different processes that control hydrochemistry of CI groundwater and to provide information about recharge processes using classical methods of hydrochemistry, isotope evidence and classification techniques. It is the first work which addresses this question in the North-West of Algerian Sahara (Ghardaia region and its neighbouring cities) by developing high density sampling network.
Our hydrochemical and isotopic data identify two distinct groups, according to geographical localisation as differentiated by flow direction; dissimilarities are much contrasted. Samples situated between 31.55° and 31.57°N of latitude represent a transition within the occidental basin. This finding corroborates previous observations from regional piezometry suggesting groundwater divide situated in this zone.
In north, samples are highly mineralized and are SO4-Cl-Na type; in south, they are poorly mineralized and predominantly belong to $HCO_3$-Ca type. Actually, in north, CI aquifer is clay and gypsum-enriched, however, toward south it is almost totally sandy.
Stable isotope data ($\delta$18O and $\delta$2H) shows that all samples are much depleted in both $\delta$18O and $\delta$2H comparing to actual rainfall isotopic signature, but in south CI groundwater are more evaporated than in north. Such pattern suggests that CI groundwater has infiltrated under climate regime cooler than the current one. Moreover, southern samples seem to indicate a mixture with recent evaporated water . Toward north, samples are more enriched in both isotopes. We expect an additional recharge coming from Saharan Atlas (Laghouat region).
$NO_3$ concentrations can reach 40 mg/L, which may be considered as high for such confined aquifer. $NO_3$ stable isotope analyses ($\delta$18O-$NO_3$ versus $\delta$15N-$NO_3$) show that $NO_3$ has predominantly a natural origin which is soil nitrification. However, denitrification processes are not much significant except toward north-east where $NO_3$ is almost absent.
Toward south, some samples show highly anomalous $NO_3$ content likely due to contamination of CI groundwater with recent and shallow water exposed to evaporation and pollution.
As perspective, we are planning to use cosmogenic isotopes (14C, 36Cl) to constrain residence time of CI groundwater. Also, we propose to give much interest to extreme north-west zone near to recharge area.