Factors controlling Groundwater Quality in transboundary aquifer system in arid zone, Case of Deep Aquifers In Algerian Sahara

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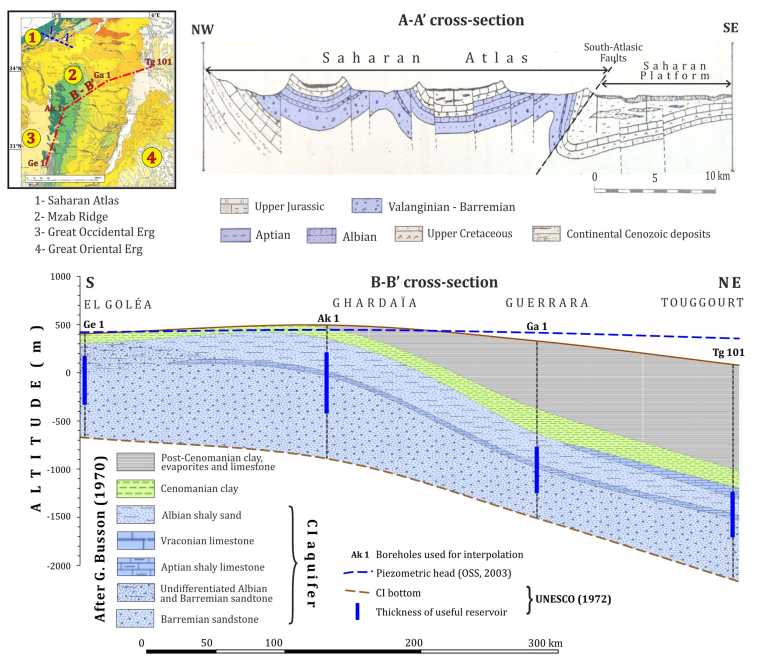
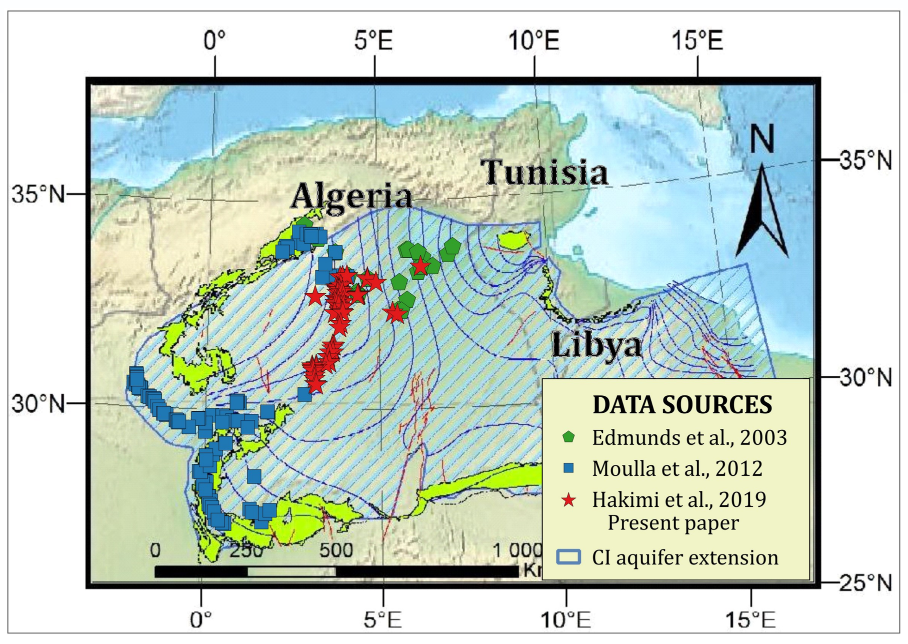


Context

- Sahara: Arid zone⇛ **Groundwater** is the main water resource;
- North-Western Sahara Aquifer System (NWSAS): **Transboundary** aquifers shared between Algeria, Tunisia and Libya; more than 1 million of km^2;
- **Continental Intercalaire** aquifer (CI): Shaly-sand; the largest and the thickest, ≈ 350m ;
- Geological data: **lithological continuity**; Piezometric map: multiple **flow directions**;

This study aims to identify different processes that control hydrochemistry of CI groundwater and to provide information about recharge processes by developing high density sampling network.



1. Discussion of our results

1.1. Physical characteristics

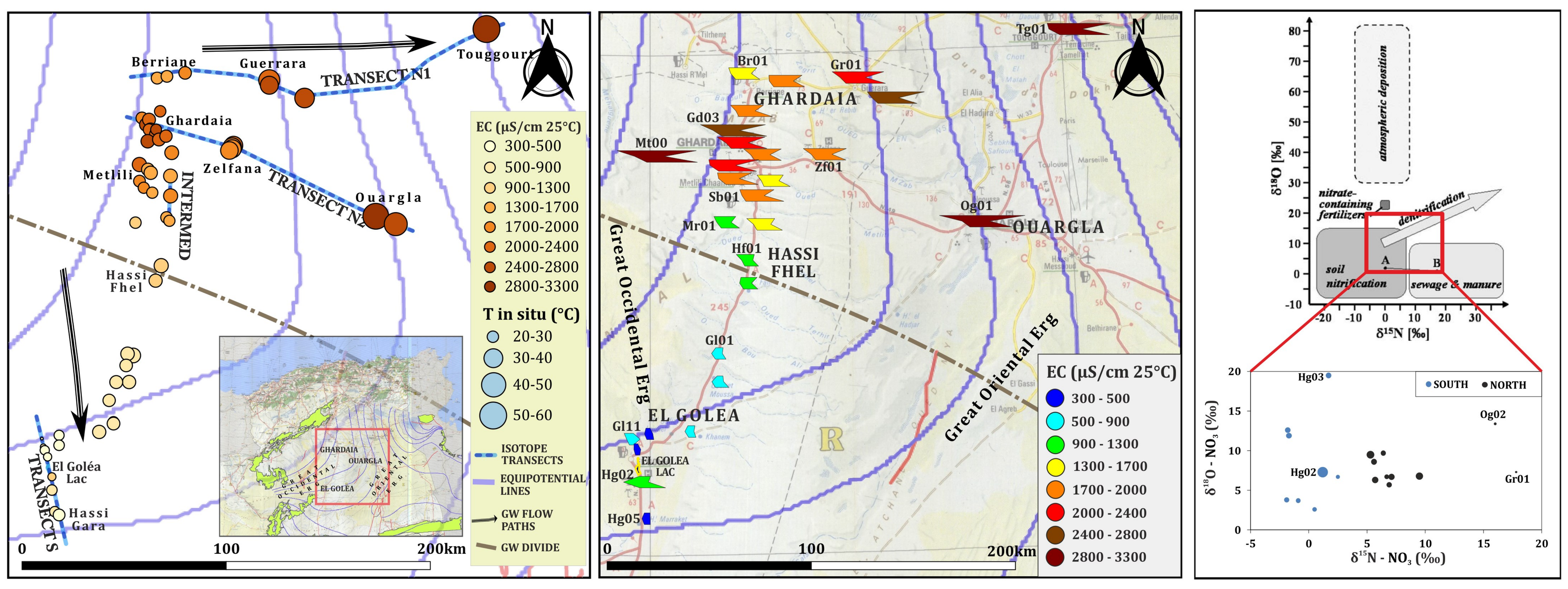
•Increasing of in situ T° and EC in accordance with groundwater flow direction.
•Values higher in N than in S.

1.2. Chemical facies

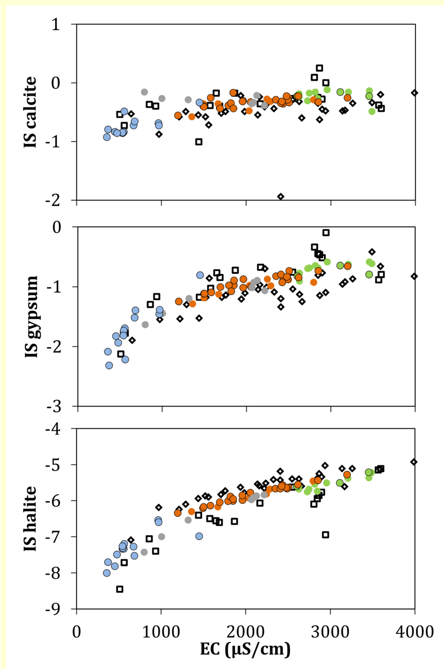
•North (GN): SO_4-Cl-Na type;
•South (GS): HCO_3-Ca-Na type.

1.3. NO_3 origin

- Using Mayer plot (2005), we can deduce that NO_3 has predominantly a natural origin which is soil nitrification;
- Denitrification processes are not much significant despite the fact that CI aquifer is confined, except for the extreme north-east where NO_3 is almost absent.



2.2. Mineralization origin

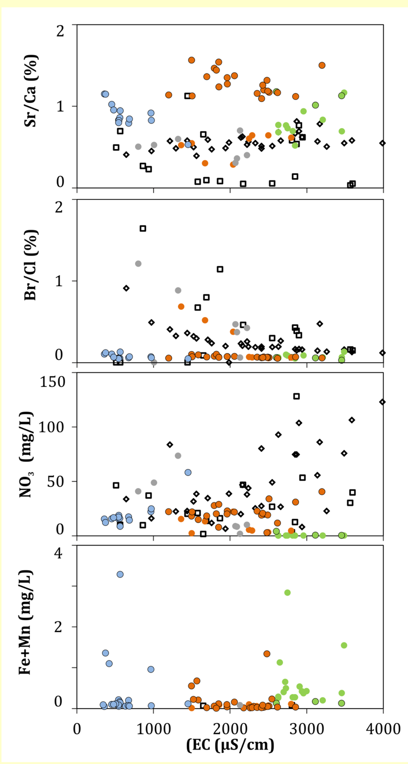


Saturation index :

• <u>EVAPORITES</u>: SI << 1⇛ undersaturated;

• <u>CARBONATES</u>: -0.5 > SI > 0.5 ⇛ in equilibrium;

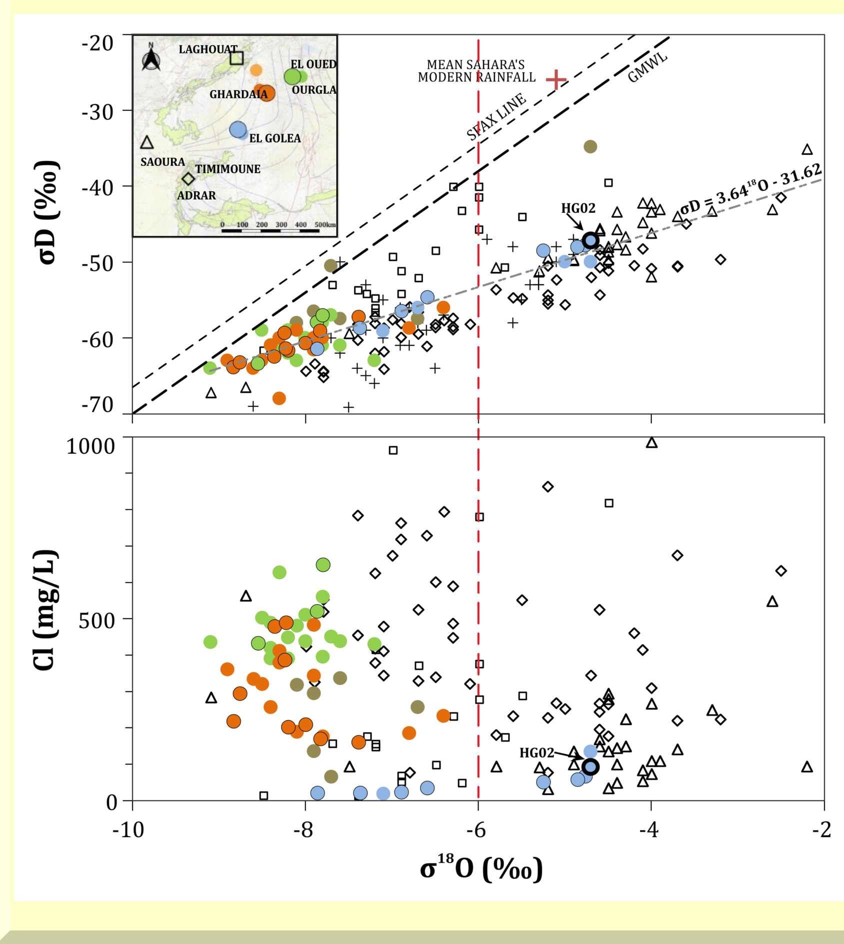
• SI smaller in southern area of confined CI : There, the aquifer is more sand-enriched, transmissivity and effective velocity are higher, so, residence time is smaller.



Minor elements

Sr/Ca and Br/Cl ratios show that CI lithology is almost charactersised by **high content of evaporite minerals who are responsible of salinization phenomena**.

Redox conditions : In confined CI, **reductive conditions** predominate in the middle of Mzab Ridge.



2.3. Stable isotope data

σ^{18}O = -6‰ can be taken as limit between two groups of samples according to their isotopic content; the **most depleted** are those from **confined CI**; the **most enriched and heterogeneous** ones are those belonging to **unconfined CI**.

The enrichment is mainly du to **mixing** with hallow aquifer and/or surface water exposed to evaporation.

It seems that CI groundwater **enrichment is inversely proportional to its age**.

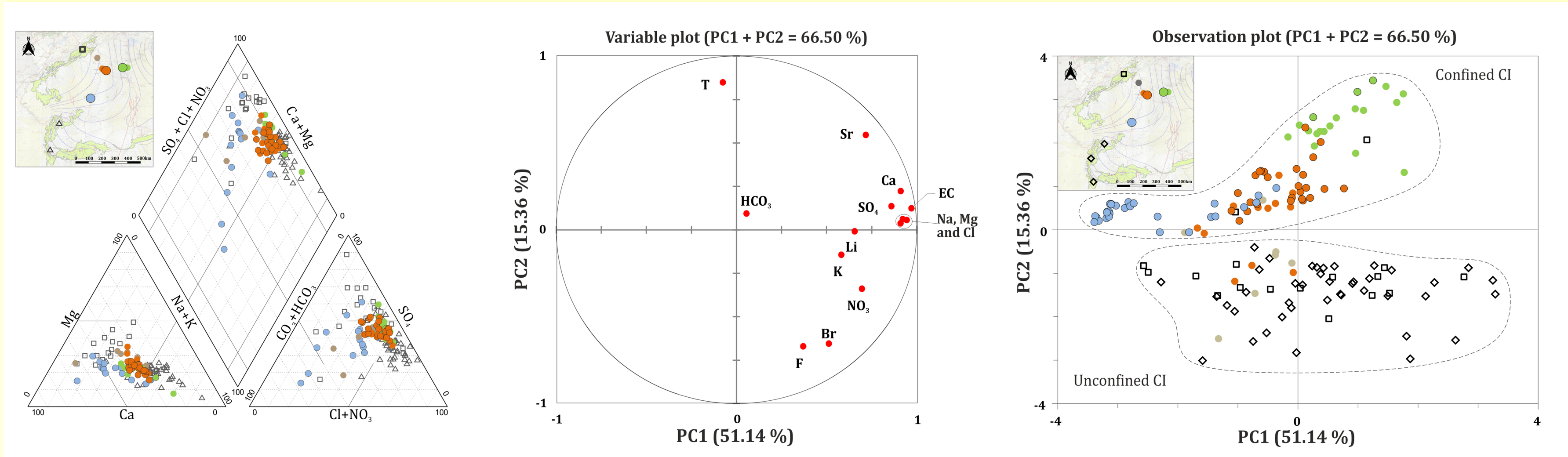
2. Comparison with previous data

2.1. Chemical variation of CI groundwater

<u>Water type in Piper diagram</u>: **SO_4-Ca** in Saharan Atlas, **Cl-Na** in the occidental basin, **Cl - SO_4-Ca-Na** in central basin.

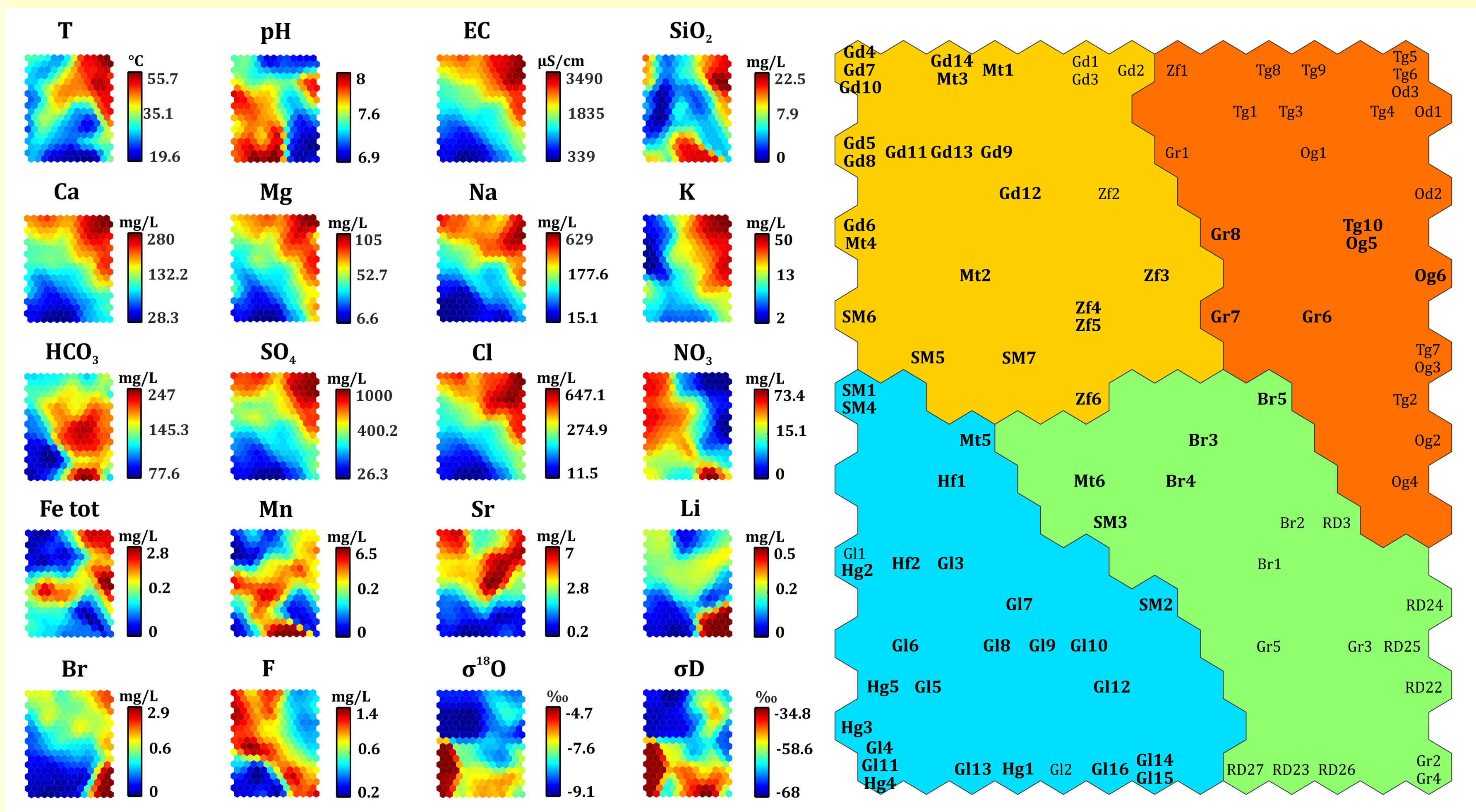
<u>PCA variables:</u> **EC** and major elements control **PC1** (51.84%); **PC2** (15.23%) is correlated with the **temperature**.

<u>PCA observations:</u> Two clusters depending on whether CI is **confined or unconfined**. Good continuity in confined area; much important variability in unconfined CI.



<u>As for SOM,</u> only samples for confined area are used for running scripts. Results show the main correlation of **EC with evaporites minerals** and the effect of **residence time** on hydrochemical variations.

Clusters depend on relative location of samples compared to equipotential lines, spatial variation of aquifer lithology and hydrochemical characteristics of CI groundwater.



Conclusions and perspective

The present paper comes completing the gap of knowledge about Continental Intercalaire aquifer hydrogeochemistry in the occidental basin and Mzab ridge. The major conclusion that we can retain is that **groundwater in confined area of CI aquifer operates separately than the unconfined zone**.

Thus, two groups of factors control CI groundwater quality:

1. Interactions with aquifer lithology
2. Residence time and aquifer depth.

As a perspective for this work, we are planning to use **cosmogenic isotopes (^{14}C, ^{36}Cl)** to constrain residence time of CI groundwater as well as **noble gases** to have idea about climatic conditions during its recharge in order to check some hypothesis advanced above.