



Diagnosis of Soil and Water Salinity evolution to Assess the Sustainability of New Agricultural Systems in Arid and Saharan Areas (Ouargla, Algeria)

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Introduction

Context of the Food Security Challenge

- The food security challenge drives the exploration of new agricultural lands.
- These lands are primarily located in arid and Saharan climatic zones.

Problems Associated with New Agricultural Lands

- These lands are situated in dry regions with poor soil and water quality.
- Additional issues include inefficient drainage systems and high groundwater levels in some cases.
- Soil salinity origin is primarily geological and secondary due to irrigation with poor-quality water

Importance of Oases

- Oases are fragile ecosystems requiring special attention.
- Major concerns include water and soil salinity, water table rise, and pollution.

Study Objective

- The study aims to assess the salinity of the soils from a shallow groundwater table.
- This assessment is intended to analyze the sustainability of new agricultural systems in arid and Saharan areas.

Results & Discussion

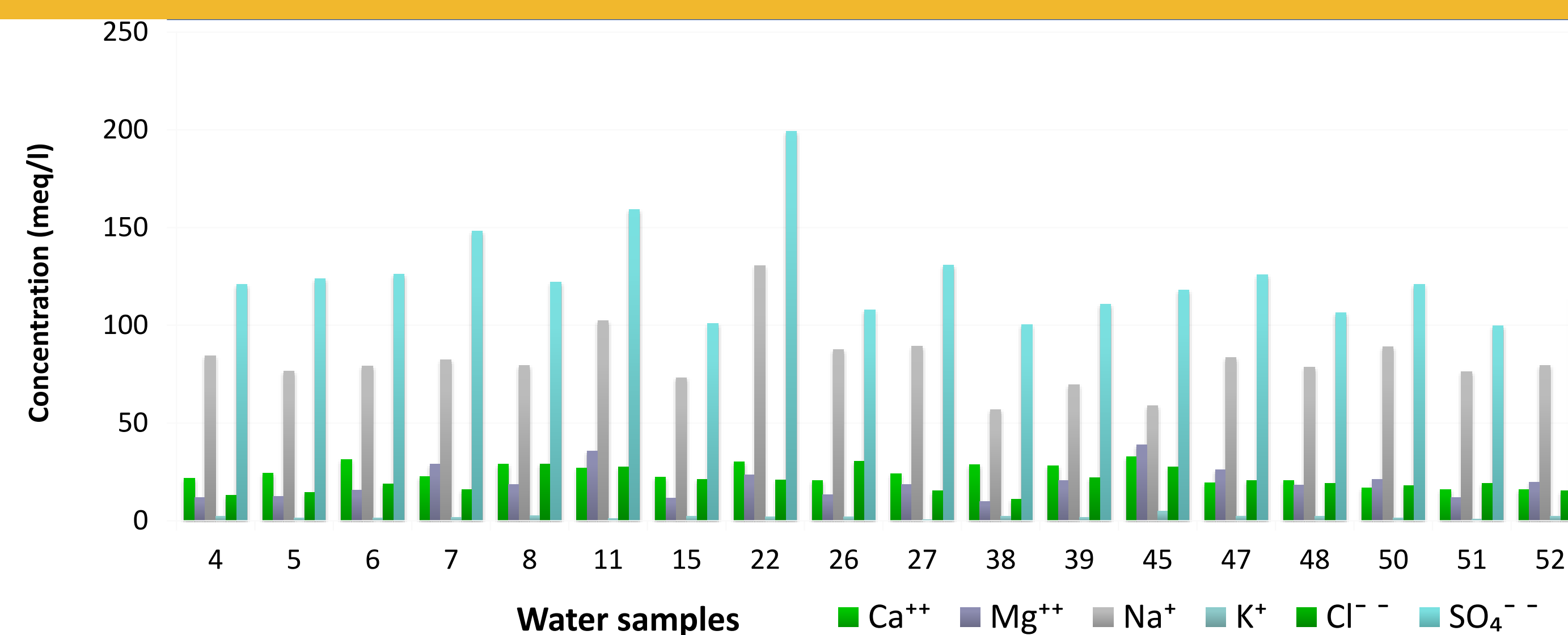


Figure 2. Frequency histogram of the chemical elements in the saturated zone waters

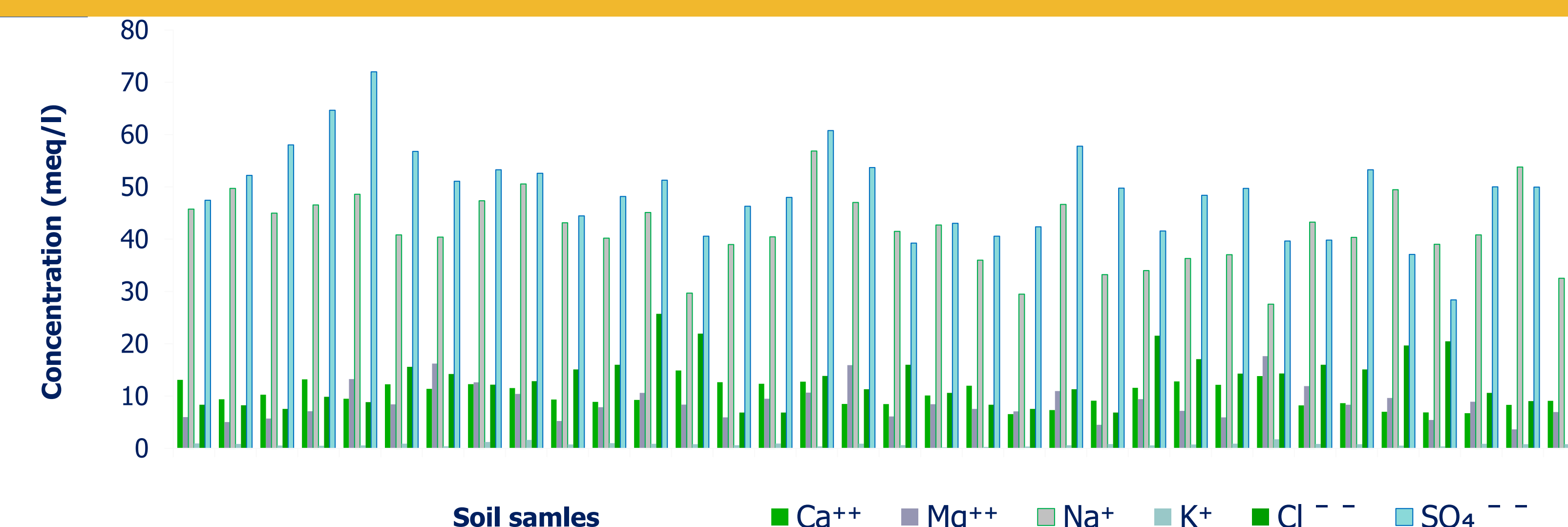


Figure 3. Histogramme de fréquence des éléments chimiques prélevés à partir des échantillons du sol

Methodology

1. Data Collection:

- Focus on soils at different depths on root zone and saturated horizon (03, soil depth levels were explored: 0 to 20 cm, 20 to 40 cm, and 40 to 60 cm total of 64 samples, Water samples are taken from two irrigation wells (Fig. 01)

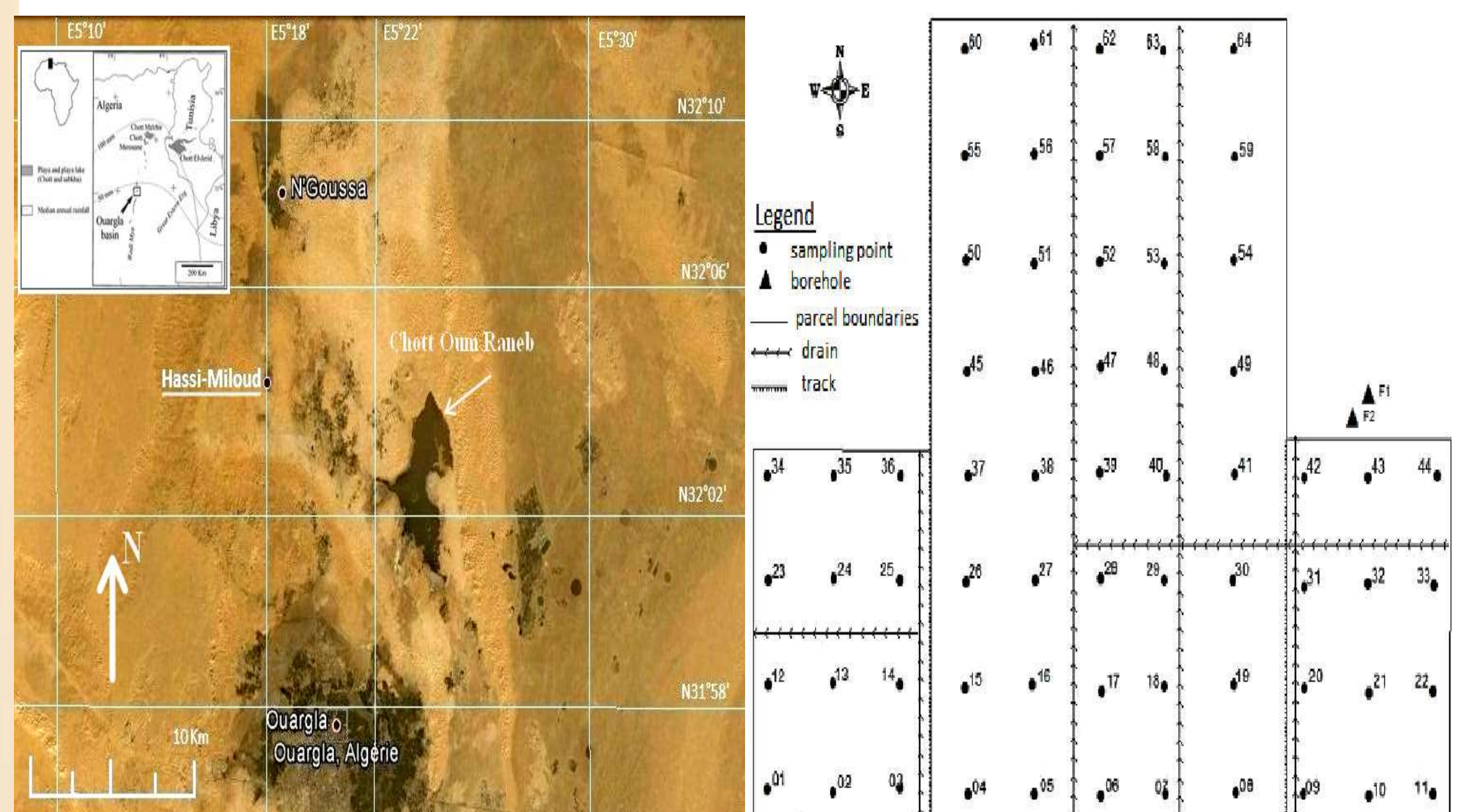


Figure 1. Study area location

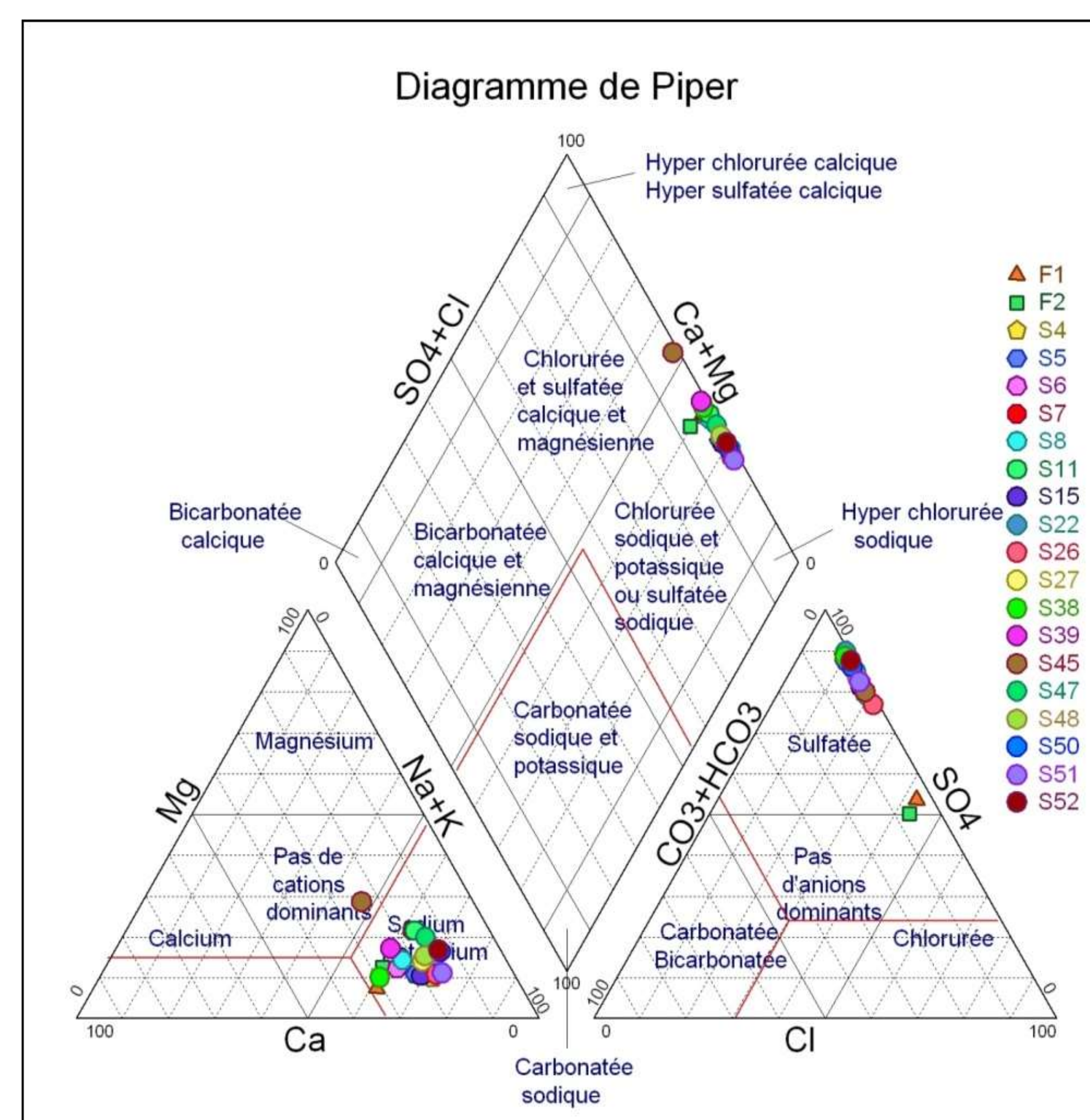


Figure 4: Water analysis on the Piper diagram

The chemical facies is of the sodium sulfate type (Figure 5), with the composition of $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ for the cations and $SO_4^{2-} > Cl^- > HCO_3^-$ for the anions

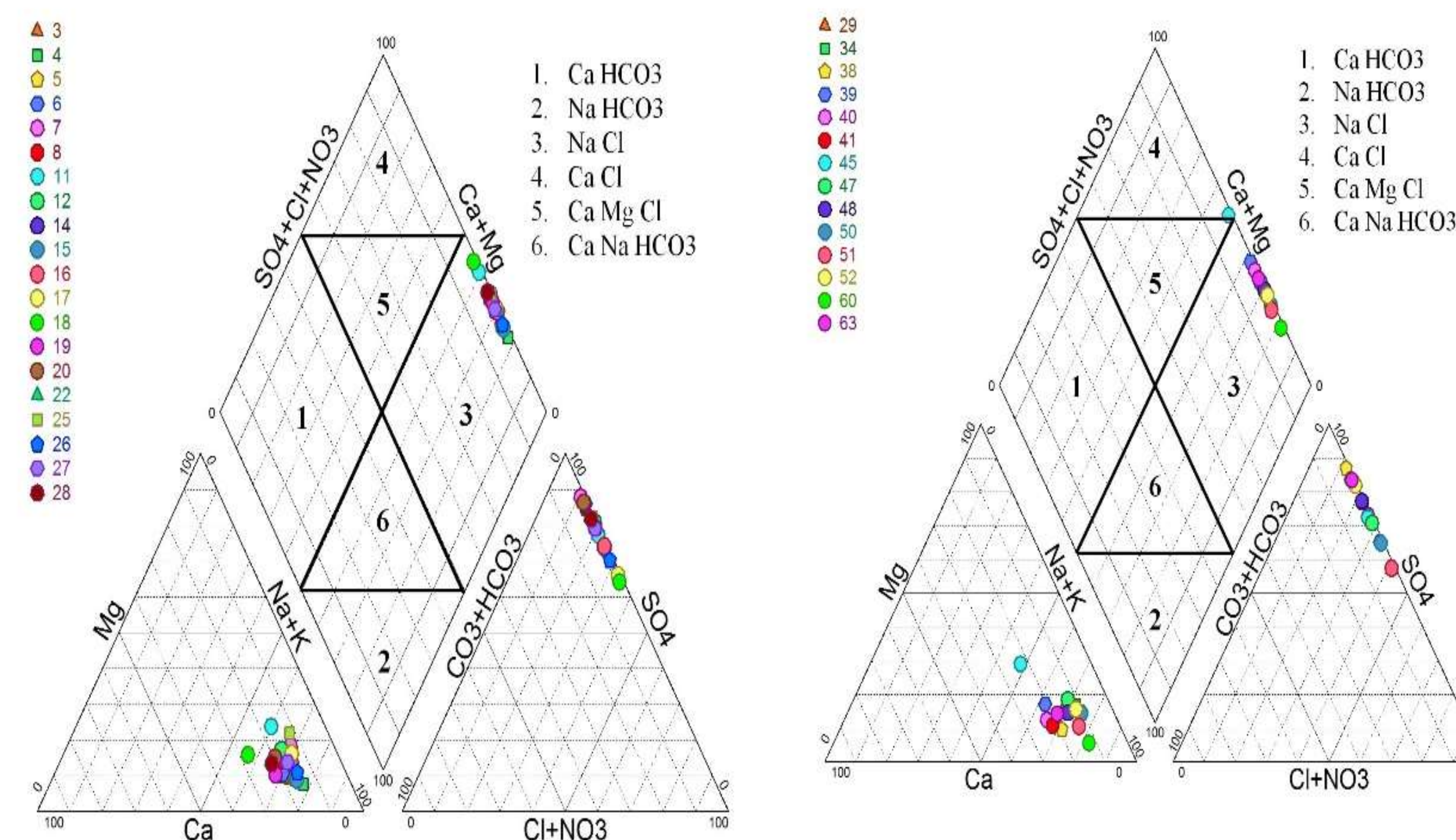


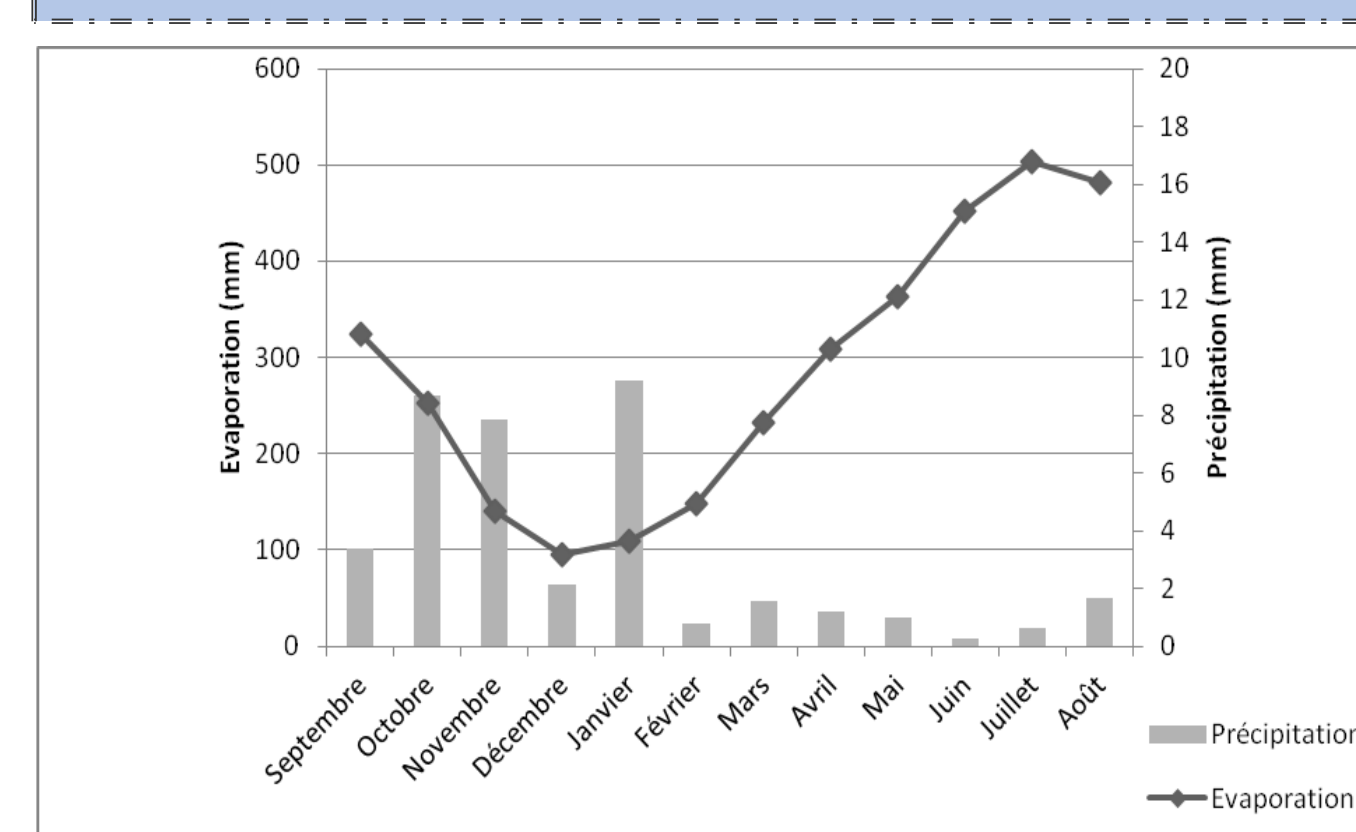
Figure 5: Representation of soil solution analyses on the Piper diagram

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Field survey



Adat and data analysis



| | pH | CE | Ca | Mg | Na | K | Cl | SO ₄ | HC O ₃ | SAR |
|----|-----|-----|------|------|------|------|------|-----------------|-------------------|------|
| F1 | 7,9 | 1,4 | 10,2 | 2,38 | 19,4 | 0,46 | 14,8 | 18,1 | 1,18 | 7,74 |
| F2 | 7,5 | 3,7 | 14,2 | 6,41 | 30 | 0,74 | 21,8 | 25,3 | 3,39 | 9,34 |

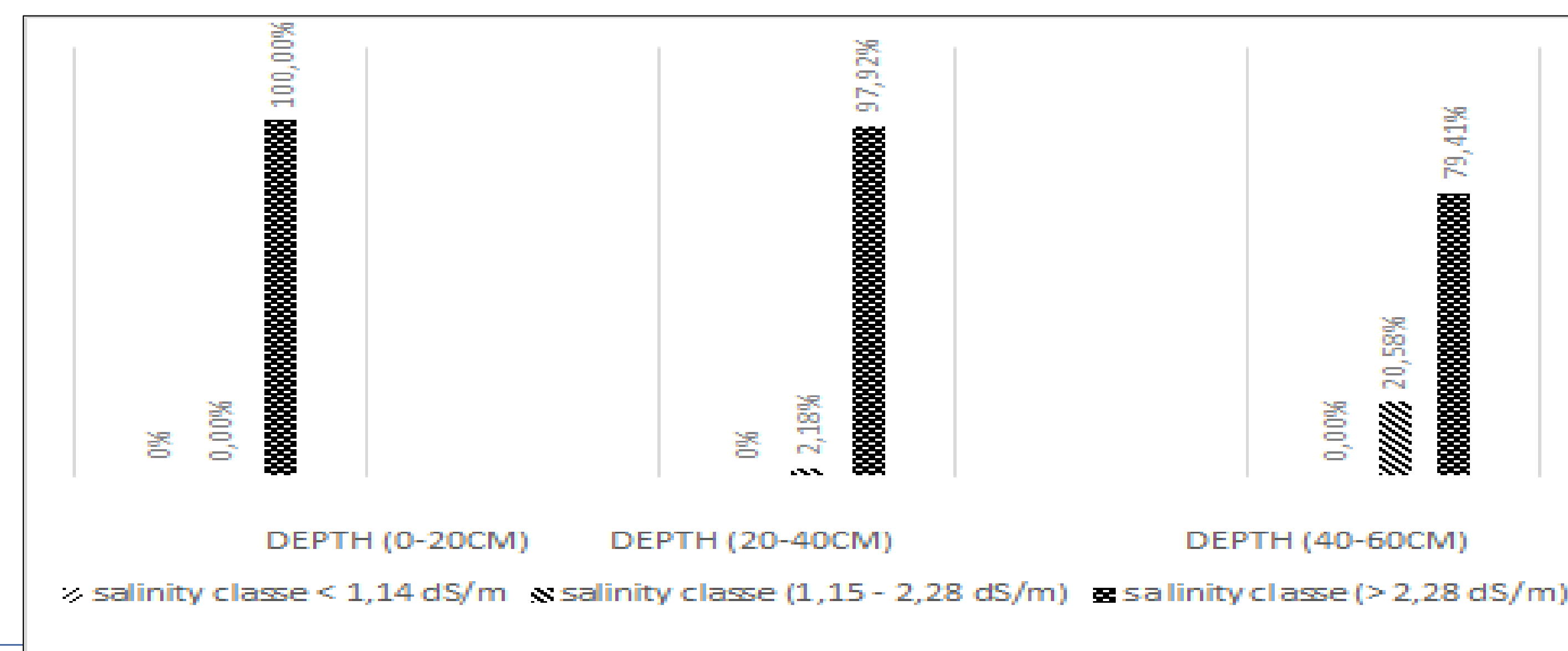


Figure 6. Salinity classes in the three layers

Overall, we observe an increase in salinity levels from the bottom to the top of the profile. The high salinities noted at the surface of the soil are visible in the field through the presence of saline efflorescence's.

Conclusion

- The correlation matrix identified key ions for irrigation and facilitated the prediction of salinity exchanges between the saturated and vadose horizons. The dissolution of minerals contributes to the increasing saline load of the soil. The residual alkalinity of calcite is negative, indicating that the solution contains more Ca^{2+} than alkalinity. This means that during the concentration and crystallization of calcite, the solution will decrease in alkalinity and increase in calcium, leading to a neutral saline pathway. For sustainable agricultural development in these areas, it is crucial to adopt innovative approaches inspired by traditional local knowledge rather than relying on methods used in northern regions.

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