

Multi-disciplinary approach to improve the knowledge of southeastern border of Taoudeni sedimentary basin

Denis DAKOURE¹

(1) PEA/GTZ, Ouagadougou, Burkina Faso, Email : denis.dakoure@gtz.de

ABSTRACT

South-west Burkina Faso shares with south Mali a regional scale aquifer which is a part of the West Africa's large sedimentary basin of Taoudeni. This aquifer represents about 40,000 km² inside Burkina Faso with a maximum depth of 2,000 m so that it provides a significant part of the country needs for domestic purposes and irrigation.

The region is characterised by semi-arid climate and more specifically a notable decrease in pluviometry observed in the last 40 years. Demographic explosion added to the climate context lead to highly increased needs of water for human consumption and economic development. In view of this concern, the groundwater management has become a priority not only for the Burkina Faso authorities, but also for the international community.

A hydrogeological multi-disciplinary approach (stratigraphy, hydrodynamic field-data, geochemistry and isotopic techniques) combined with geological and hydrogeological modeling was implemented to improve the knowledge of the aquifer system and the efficiency of its management.

Keywords : Taoudeni, sedimentary basin, hydrogeology.

1. INTRODUCTION

South-west Burkina Faso shares with south Mali a regional scale aquifer which is a part of the West Africa's large sedimentary basin of Taoudeni.

A hydrogeological multi-disciplinary approach (stratigraphy, hydrodynamic field-data, geochemistry and isotopic techniques) combined with geological and hydrogeological modeling was implemented to improve the knowledge of the aquifer system and the efficiency of its management.

2. LOCATION OF TAOUDENI SEDIMENTARY BASIN

Taoudeni basin is the largest sedimentary basin of Upper Precambrian and Palaeozoic age in Africa. It stretches across Mali, Mauritania and the two Guineas and overlaps slightly into Algeria, Senegal, Sierra Leon and Burkina Faso (Fig.1).

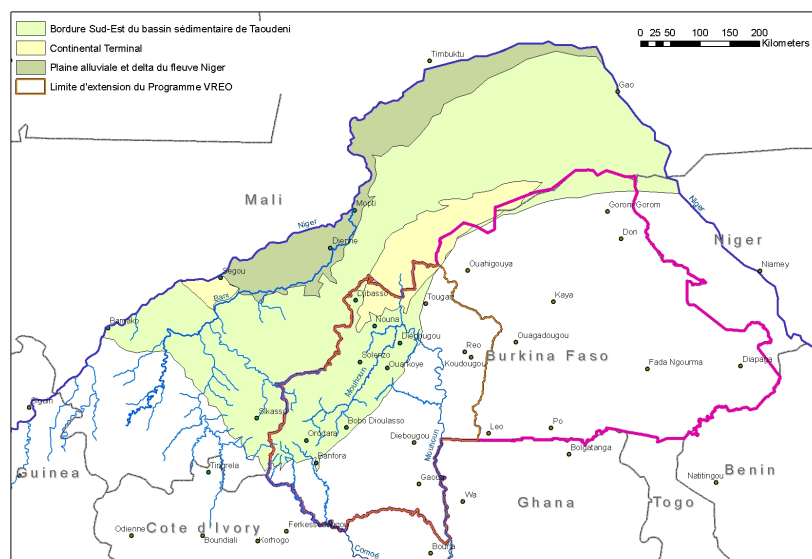


Figure 1. Overall view of the south-eastern margin of the Taoudeni basin.

Overall, its structure is simple: the most recent formations crop out in its sandy centre and the dip rarely exceeds 1°. The surface area of the south-eastern margin of the sedimentary basin (Mali and Burkina Faso) is close to 260,000 km² with 20% in Burkina Faso border. It is partially covered by surface formations of Tertiary and Quaternary among which the so-called Continental Terminal Tertiary formation and the recent and modern claysand alluvia found along the main rivers.

3. HYDROGEOLOGICAL DESCRIPTION OF THE AQUIFER SYSTEM IN THE TAOUDENI SEDIMENTARY BASIN

The hydrogeological characteristics of the Taoudeni sedimentary basin series can be determined toward quantitative and qualitative data collected in the study area. Data come from more the thousand drilled wells and were used either for statistical analyses by formation or analysis of the whole basin.

Spatial interpretation of the piezometry gave the following informations:

- Study area shows mean piezometric heights ranging between 600 and 200 m;
- Administrative border of Burkina Faso and Mali largely coincides with the boundaries of the main surface basin. Boundaries between main watershed basins and hydrogeological basins also coincidence meaning that no groundwater exchanges occur between the two countries along the administrative border. Hence, administrative border between Mali and Burkina Faso follows a hydrogeological ridge playing the role of groundwater divide. This is clearly indicated on piezometric map of the south-west extension of Bandiagara cliff where groundwater divides along the Mali border. Thus, main groundwater exchanges between the two countries are located in (i) the north close, to the Continental Terminal and to the Sourou (ii) in the west at the piezometric trough of Banifing and (iii) in the south-west in the Comoé basin. At the present state of the knowledge, groundwater transport at depth cannot be excluded as another way of boundary exchange.
- Concerning cross-border water resource management, attention should be paid to the fact that no groundwater flow occurs from Mali in the sedimentary formations. All the flow comes exclusively from Burkina Faso and derive from its rainfall recharge.

The evolution over time of the piezometry, albeit based on a small number of observations, shows a general decrease of the water levels over the last five decades.

The groundwater quality was assessed using hydrochemical facies in the different formations. The facies were defined by statistical analysis, interpretation on Piper and Schoeller diagrams and Principal Component Analyses. Data show that majority of the samples are calcium bicarbonate type (86%), indicating a high degree of pollution. Schoeller diagram shows uniformity in data at regional scale and reflects hydraulic continuum across the various basins.

Isotopic studies (Dakouré, 2003) show that most of the sedimentary reservoir water is old (from 50 to more than 1000 years) which is not incompatible with the the present aquifer recharge. Current interpretation proposes a mixing model containing contemporary/recent water with old water.

4. CONCLUSION

On the basis of the results and interpretations of field data, a conceptual representation of the hydrogeological situation was built into a geological (aquifer geometry) model. Further studies on each side of the border separating Burkina Faso and Mali should contribute to validation of some assumptions still being considered as conceptual hypotheses.

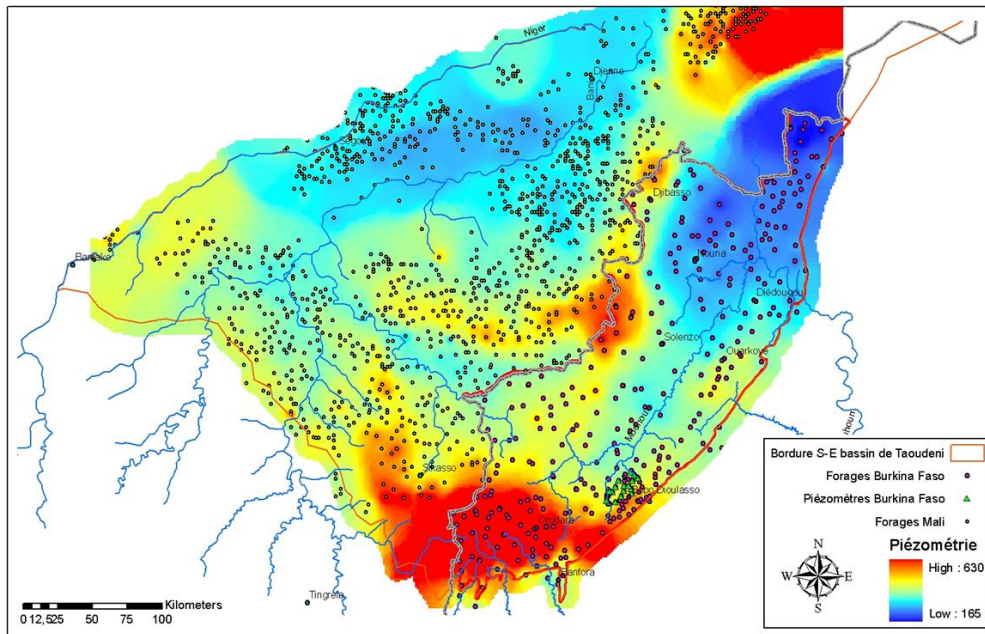


Figure 2: Piezometric map of the southeastern border of Taoudeni sedimentary basin

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