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Extended Abstracts

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Geophysical, geological and geochemical methods in groundwater exploration

title: **Geophysical and geochemical groundwater exploration (Essaouira Basin, Morocco)**

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INTRDUCTION

The coastal town of Essaouira located on the Atlantic Ocean is exclusively supplied of drinking water mobilized from springs and wells situated in the valley of the Ksob river. The history of the search for new underground water resources to satisfy the increasing demand of the city is marked by several failures about the two aquifers which exist in the zone.

The hydrogeologic study of reference is that carried out in 1976 by Mousanif which has the merit to cover a large territory but remains of order general and consequently incapable to direct research able to mobilize other water resources, The purpose of the study undertaken was to work in a restricted area and proximal of the town of Essaouira in order to improve our state of hydrogeologic knowledge of the system in the neighbourhoods of the town of Essaouira.

HYDROGEOLOGICAL SETTING

The zone of study covers a surface of 300 km² and seems to draw a hydrogeologic unit well individualized (Figure 1) limited to the West by the ocean, in the south by an intermittent wadi said Tidzi wadi, in North by the Ksob river which is perrenne in its down stream part, and in the east by the diapiric accident. The zone of study belongs to the large secondary basin of l Essaouira characterized by a succession of synclines and anticlines, disturbed locally by triassic diapiric formed by clays and salts.

The secondary rocks do not totality show on the surface of the basin, since a band of marine plioquaternary deposited hide them in the western parts.

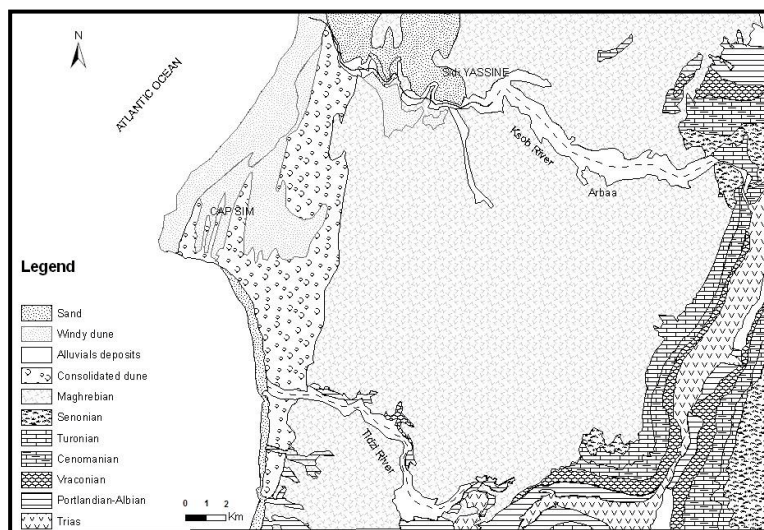


Figure 1. Geological map

A piezometric map was elaborate (Figure 2) starting from the measurements taken on the level of the existing wells in the zone of study. we note in this respect that the wells are very few and badly distributed, with an almost total absence in the Western part dominate by consolidated dunes and barkhanes.

This map shows a flow which is carried out in a total way of the south east towards western north in agreement with the map worked out in 1976, the hydraulic gradient increases in the direction of flow, the ksob river feed the aquifer in its perennial part upstream.

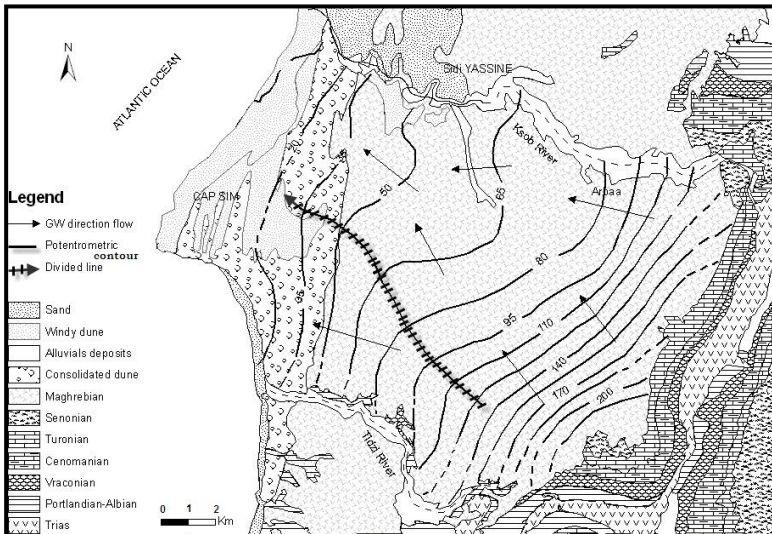


Figure 2. Groundwater levels map.

In parallel an electric map of conductivities was elaborate (Figure 3) starting from the measurements taken on the ground, shows a regular increase as of its values in the direction of the flow what appears a normal phenomenon of with the interaction prolonged of the contact of water with the matrix. However in the southern part one notices concentric curves of equal values which cannot be explained suitably (Fekri, A. 1993).

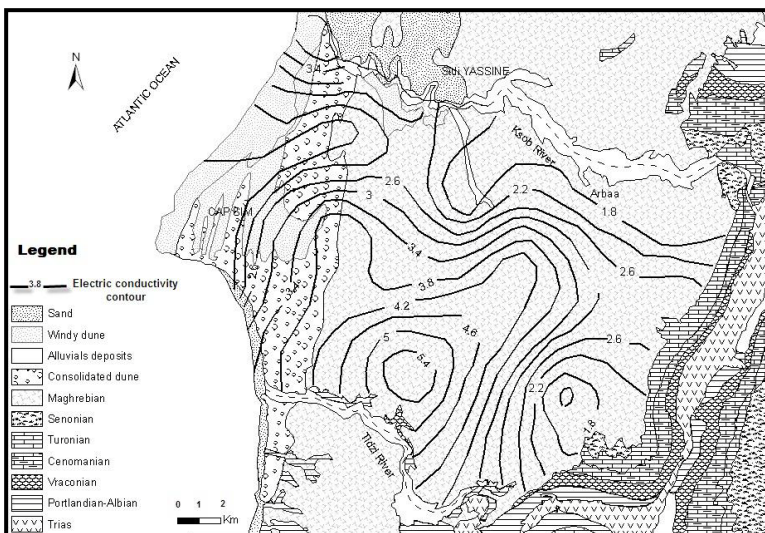


Figure 3. Electric conductivity map ($\mu\text{s}/\text{cm}$).

GEOPHYSIC DOCUMENT

Documents were collected at the ONAREP and of SCP proved very useful especially the map of topography of the substratum (Figure 4) which brings back two facts (i) The Western part whose topography high was always allotted to the dunes is actually due to a rise in the substratum caused by anticlinal due to diapiric tectonics which affects the zone, (ii) The existence of a zone having a directed slope SW.

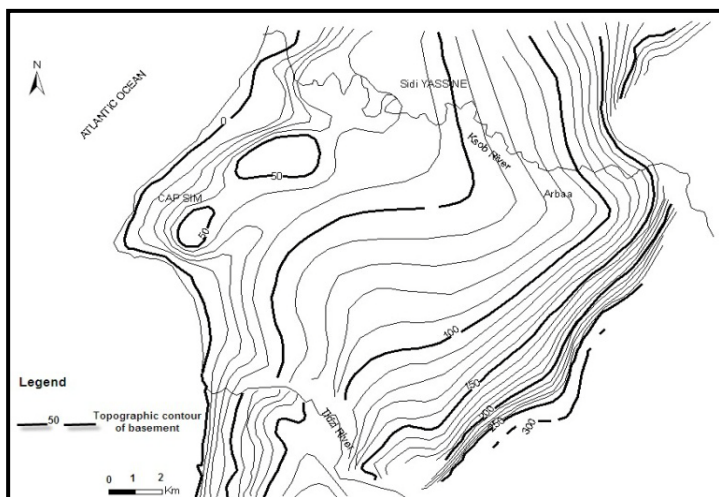


Figure 4. Map of the basement topography.

The confrontation of the piezometric map and that of the topography of the substratum made it possible on the one hand to delimit dry zones materialized by impermeable area (Figure 5) which constitute a barrier to the flow of the plioquaternary groundwater which is reorientate towards the southern part favoured by the already detected slope.

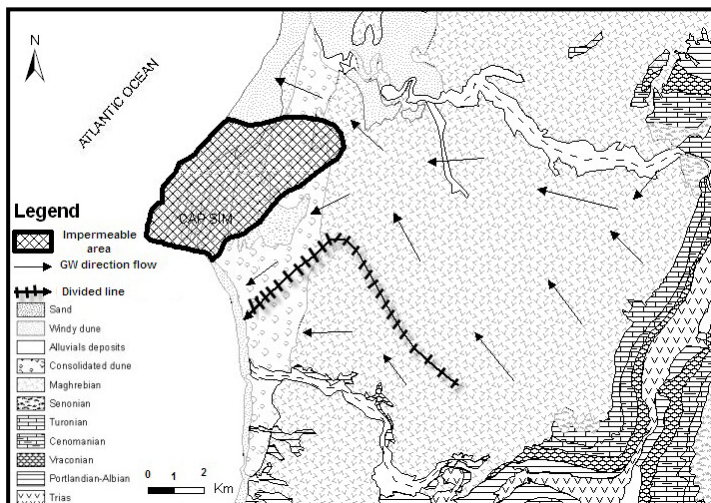


Figure 5. Map of suggested flow direction.

These results led to the establishment of a new diagram of the flows of the plioquaternary aquifer. This diagram seems to be able to correctly interpret the configuration obtained of the curves of equal values of electric conductivity. Water of the northern part being charged is conveyed by the slope towards the south; the forms concentric thus result from the interpolation with higher values which characterize the southern zone.

ISOTOPIC ANALYSIS

It also remains has to determine the origin of the springs in the bed of the Ksob river in the zone known as of Sidi Yassine. The two aquifers being feed by water of the same river the distinction between water of the two aquifers by using this tool proves to be unfruitful and consequently the request of the isotopic tool seems more suitable. Some water points were carefully selected for isotopic deuterium analyses, the points concerned are the ksob river upstream springs of sidi Yassine, a drilled well, a turonian spring, an athor spring whose origin is unknown and a well located in the southern part.

The results of the analyses are distributed according to two groups, turonian and plioquaternary, this difference made it possible on the one hand to confirm the communication between the two parts of the plioquaternary aquifer and to allot a turonian origin to the springs of sidi Yassine and the second spring whose origin was unknown too.

The contribution of this tools used in this study leads to confirm the diagram suggested of the circulation of groundwater in the plioquaternary aquifer and to specify the turonian origin of the ksob river's springs in its downstream.

CONCLUSION

The work undertaken in the zone of study made it possible to improve our state of knowledge of the aquifer system which has leads to the development of a conceptual model.

such a document is useful in the program scheduling of mobilization of new water resources of the town of Essaouira but raises also other questions on certain aspects, such relations between the two aquifers in the zones where they come into contact.

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