



Investigation of groundwater resources in the Komadugu Yobe Valley (Lake Chad Basin, Niger) using MRS and TDEM methods



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ABSTRACT

Groundwater resources quantification and management is a key issue for agricultural development in the Komadugu Yobe (KY) River valley region in the semiarid part of the Lake Chad Basin. To improve the knowledge of available groundwater resources in this poorly-documented area, a geophysical survey across the river valley was conducted near the town of Diffa, southeast Niger. The goal was to estimate the hydrogeological properties of Quaternary formations to a depth of ~100 m. Numerical modeling showed that sedimentary deposits composed of thin clayey, loamy, and sandy layers could not be accurately resolved in detail by non-invasive geophysical methods due to the limited spatial resolution of the methods. The use of the Time Domain Electromagnetic (TDEM) method alone was not sufficient to estimate aquifer parameters and the Magnetic Resonance Sounding method (MRS) was used to supplement the geophysical dataset. A twelve kilometer long profile (117 TDEM and 11 MR soundings) was surveyed across the valley to evaluate changes in hydrogeological properties of the Quaternary aquifer from the middle of the river valley to the surrounding sandy plain area. Our results show that the Quaternary aquifer below the KY valley differs from its surroundings and it can be described as follows: (a) the thickness of the KY aquifer ranges from 30 to ~60 m and is limited at depth by electrically conductive clay layer, (b) at a depth of ~70–80 m, TDEM soundings show a continuous conductive substratum (resistivity is ~2 Ω m), attributed to Pliocene clayey formations, (c) the KY valley aquifer may have a larger volume of unconfined groundwater than the surrounding plain aquifer area (MRS water contents of 20–25% and ~15% respectively), (d) the KY aquifer transmissivity estimated from MRS data is higher than values derived from pumping tests conducted outside the river valley. This study confirms that the Komadugu Yobe valley aquifer represents a significant resource for future agricultural development. In addition, our study shows that the aquifer is not protected by shallow clayey layers; therefore, precautions against contamination should be taken to preserve the quality of this resource.

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