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Subsurface thermal regime to delineate the paleo-groundwater flow system in an arid area, Al Kufra, Libya

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KEYWORDS

Al Kufra;
Libya;
Subsurface temperature;
Groundwater flow system;
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Abstract The purpose of this study was to understand the groundwater flow system in Al Kufra basin, Libya, as a case study of arid areas using subsurface temperature. The temperature-depth profiles and water levels were measured in eight boreholes in the area. Well 6 is considered a recharge type profile with low geothermal gradient (0.0068 °C/m) and an estimated paleo-temperature around 19.5 °C. The other profiles are of discharge type with higher geothermal gradient (0.0133 to 0.0166 °C/m). The constructed horizontal 2D distribution maps of the hydraulic heads and the subsurface temperature measurements reveal that the main recharge area is located to the south with low temperature while the main discharge area is located to the north with higher temperature. Vertical 2D distribution maps show that location of well 4 has low hydraulic heads and higher temperature indicating that the fault defined in the area may have affected the groundwater flow system. The estimated groundwater flux ranges from 0.001 to 0.1 mm/day for the recharge area and from −0.3 to −0.7 mm/day in average in the discharge area.

1. Introduction

Around 30% of the earth surface area is dry or semi-dry where potential evapotranspiration surpasses precipitation (McKnight and Hess, 2000). In dry and semi-arid areas, the measure of water recharge of an aquifer is much more important to the maintainable utilization of water than it is in humid districts. In spite of this, no much said about the amounts of water that are required to economically recharge aquifers in such locales. In North Africa and the Arabian Peninsula, where fossil water is mined and not recharged, the rate of utilization of water for farming watering system is high and leads to the aquifers draining. By definition, in those areas, potential evapotranspiration ordinarily exceeds normal rates of precipitation (Kinzelbach et al., 2002).

The aquifer recharge is irregular and the capacity to estimate and analyze the groundwater flow system is extremely restricted. These elements are exacerbated by variations in

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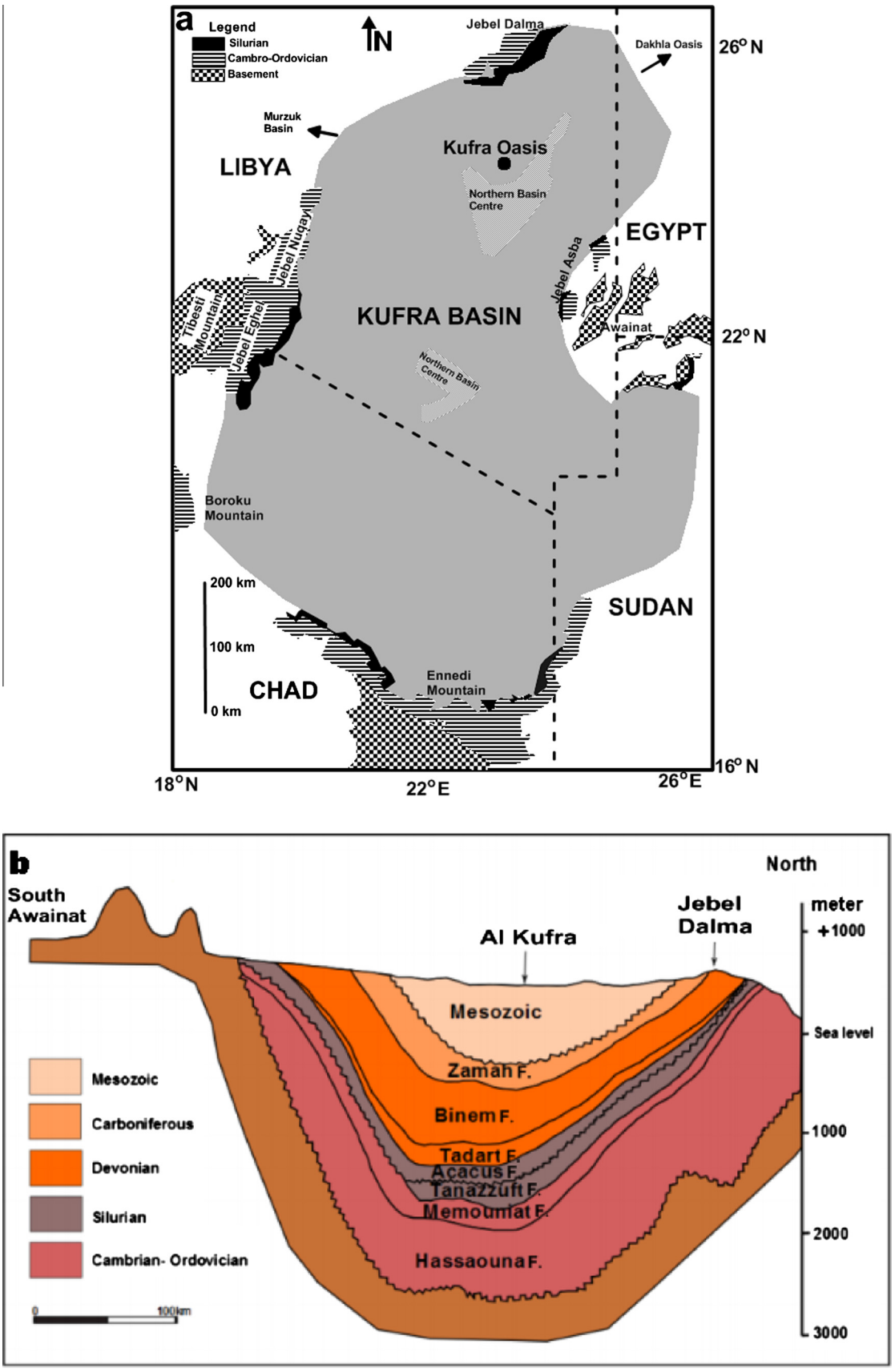

Figure 1 (a) Location map of the study area and Kufra Basin with its confining basement highs (modified from Luning et al., 1999). (b) North–south cross section of Al Kufra Basin (after Roohi, 1996; Al Faitouri, 2013).

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