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Functionning of the Katari-Lago Menor Basin aquifer, Lake Titicaca-Bolivia, inferred from geophysical, hydrogeological and geochemical data

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The population of the semi-arid Bolivian Northern Altiplano depends greatly on groundwater resources, surface water being intermittent and often contaminated by human activities. The aim of this study is to provide a first insight into the hydrogeological structure and groundwater dynamics of the Katari-Lago Menor Basin aquifer located between the Eastern Cordillera and Lake Titicaca, Bolivia. Resistivity profiles combined with geology, borehole lithology, topography as well as additional groundwater level and geochemical measurements, were helpful in resolving the spatial limits of the aquifer, the vertical and lateral continuity of the Quaternary porous geologic media, the shape and position of the bottom of the aquifer (depth to the bedrock, i.e. Tertiary or Devonian Formations), and revealed a general overview of the natural dynamic behaviour of the aquifer at the scale of the Katari and Lago Menor Basin. The quaternary sediments are hydraulically connected and behave as a single regional basin-aquifer. The main groundwater flow system starts in the upper Piedmont (high mountain ranges of the Eastern Cordillera) and follows the topographic Piedmont gradient (NE to SW). Most groundwater recharge results from the infiltration of precipitation and runoff on the high mountain ranges. Indeed, groundwater circulating in the upper and lower Piedmont layers present primarily facies. In the regions of the lower Piedmont urbanized areas, groundwater presenting facies, show a noticeable enrichment of sulphate and chloride relating mainly anthropogenic contamination (mining and urban nature). A large portion of the aquifer presents an unconfined behaviour whereas it remains confined below the Ulloma Formation. The thickness of the unconfined portion varies from 50 to 150 meters and that of the confined from 100 to 150 meters. Values of hydraulic conductivity for the unconfined portion range from 1.1×10^{-4} m s^{-1} (alluvial fan deposit), 2.5×10^{-6} m s^{-1} (fluvioglacial deposits,) to 5.9×10^{-8} m s^{-1} (glacial deposits), while for the confined part transmissivity values range around 6.0×10^{-6} m^2 s^{-1} (paleo-lacustrine deposits).

This multidisciplinary approach proved to be an appropriate method to derive a consistent picture of the hydrogeological functioning of the Katari-Lago Menor Basin aquifer.