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Development of a conceptual model and identification of a karst spring source using integrated geophysical and hydrogeological data - A case study: Ravansar karst spring

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Extended Abstract

Summary

Karst formations, as key groundwater resources, play an important role in determination of both the quantity and quality of water. The Ravansar karst spring, located in Kermanshah Province, is one of these valuable resources. It originates from Cretaceous carbonate rocks and is influenced by tectonic activities and faults. Tectonic investigations indicate that the main trends of the faults in this area are in directions of N60W and N30E, with dips greater than 45 degrees toward the northeast. This study employs geophysical methods, including gravity and electrical resistivity surveys, to identify the extent of karst development within the limestone formations. In the interpretation of gravity data, all positive and negative potential field anomalies were examined through field investigations. Additionally, two electrical survey lines were designed at key locations, and data were collected using the pole–dipole and dipole–dipole electrode arrays. The resistivity data were modeled using a two-dimensional inversion algorithm based on the least-squares technique. The results reveal the presence of large cavities and karstic structures within the carbonate rocks, which act as conduits for water flow feeding the Ravansar spring. Moreover, a conceptual model of the karst system and groundwater flow pathways was developed based on the collected data, illustrating the relationship between cavities, karst features, and tectonic structures such as faults. These findings can contribute to the effective management of water resources and the protection of groundwater quality. This study focuses on the identification and modeling of a karst spring source in the Ravansar region. By integrating geophysical and hydrogeological data, the research aims to develop a conceptual model of the karst aquifer system and to reveal the subsurface structures influencing groundwater movement and spring discharge

Introduction

Karst aquifers are among the most important water resources having relatively high permeability and storage capacity. The study emphasizes the significance of understanding karst systems for sustainable water management in semi-arid regions like western Iran. It highlights how geological, tectonic, and climatic factors contribute to karst development and spring formation, referencing prior global research in karst hydrogeology and geophysics.

Methodology and Approaches

The research employed a combination of gravity surveys, electrical resistivity tomography (ERT), and geological mapping to investigate subsurface features. Field data were collected along two main survey lines, processed and modelled using Grav3D and RES2DINV inverse modeling software packages. Structural and hydrogeological data were integrated to interpret the karst system, identify faults, and construct a three-dimensional (3D) conceptual model of the subsurface.

Results and Conclusions

The results reveal several fault-related zones and cavities responsible for the karstic water flow toward the Ravansar spring. Low-gravity anomalies and reduced electrical resistivity values correspond to water-filled or empty karstic voids. The integrated model confirms that tectonic activity plays a major role in karst evolution and groundwater transport. The conceptual model provides a reliable framework for understanding subsurface hydrology and supports

future water resource management and protection strategies in karst regions.