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Investigation of activity of Quaternary Khazar fault branches in Khalilshahr area using GPR and electrical resistivity methods

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Extended Abstract

Basic approach for investigation of Khazar fault, due to covered areas by quaternary deposits and absence of the fault outcrop in some of areas in the region, is to use the subsurface exploration methods, and especially, high resolution geophysical methods. In this study, we calculated the subsurface geometric parameters of Khazar fault, geological model, and especially, the Khazar fault borders in Khalilshahr region by comparison of GPR and resistivity profiles, and combining the results with geological results, and then, we made forward and inverse modeling of the resistivity and GPR data.

Introduction

Iran is currently deforming as a result of the northward collision of Arabia with Eurasia. Despite a relatively good understanding of how the broad-scale deformation is currently accommodated throughout this wide (>1000 km) region the detailed tectonics of many earthquake-prone regions throughout the country still remain poorly understood. The Khazar fault is the boundary between the Caspian plain and Alborz Mountain. As a major tectonic feature, this fault may be considered as the northern mountain front fault of the Alborz Range. Subsidence of the Caspian Sea in north, uplift of the Alborz Mountain, and its over thrusting on southern part of South Caspian basin has occurred along the Caspian fault. In this paper, a segment of the fault, which is located between longitudes 53.60 and 53.68 and latitudes 36.65 and 36.70- in the southern part of geological map of Behshahr is investigated. This segment of the fault does not outcrop on the ground surface. This paper introduces the general structural and morphotectonic characteristics of this zone and morphotectonic effects in this zone.

Methodology and Approaches

In this study, we managed to detect the fault boundaries below the ground surface using the electrical resistivity and GPR methods. Then, forward and inverse modeling of the resistivity and GPR data was made. For this purpose, we initially designed the resistivity and GPR survey lines perpendicular to the imaginary fault strike, and then, the obtained resistivity data were modeled and inverted using the nonlinear least squares optimization method with the help of RES2DINV software The obtained GPR data were also modeled using ReflexW software. Furthermore, synthetic resistivity model of the Khazar fault was built in Res2dmod software using forward modeling method. The synthetic GPR model of the fault was also built using ReflexW software.

There is generally a large range of models that can give rise to the same calculated apparent resistivity values. The RES2DINV software uses a range of user-selectable starting models, and then, iteratively refines the model until a user-selected value for convergence is achieved that is defined as a small change between successive models. A percent error between the observed apparent resistivity and calculated apparent resistivity is then reported. Root mean square (RMS) error gives a measure of the difference between iterations. It is essential to our interpretation of the data to find the model for which the difference between the calculated and measured values is minimized. The purpose of RES2DINV software is to determine the resistivity of the discrete regions within the model that will best reproduce the measured apparent resistivity values. To do this, RES2DINV program implements a smoothness-constrained least-squares

inversion method. The least-squares method is useful as a measure of misfit since it leads to simple analytical forms for the equations in the minimization problem. It will tend to give the right answer if the misfit is caused by stochastic Gaussian noise in the observed data.

Results and Conclusions

The geological model, and especially, the Khazar fault borders in Khalilshahr region have been determined from comparison of GPR and resistivity profiles, and combining the results with geological information, and also, interpretation of the resistivity cross-sections obtained from the inversion process.