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Synoptic perception of environmental geohazards in hail region, Saudi Arabia

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Hail region in Saudi Arabia is exposed to some different geohazards related to the inherent physiographic nature of this inland desert. Geohazards include sand drift; flash flooding; rock fall and mass wasting; problem soils; and potential hazards from intra-plate volcanic activities. Satellite data and field verification were used to diagnose and quantify the severity of these geohazards. The City of Hail and its vicinity are vulnerable to most of the aforementioned geohazards. The northern part of Hail region suffers from dune encroachment upon settlements and roads. The southern and eastern sides are prone to lava flowing from current-day dormant volcanoes. Hail region is witnessing an accelerated urban development, however, some infrastructure have been constructed in highly vulnerable locations. Development plans should consider potential geohazards when implementing urbanization and extension of public services.

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Experimental and numerical 2D analysis of hydraulic fracturing using high power electric discharge

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Hydraulic fracturing operation is one of the well-known and casual operations after perforation in oil and gas wells. Classical two wing hydraulic fracture is not feasible most of the time in these formations because of the presence of natural fractures or active faults. The result of these methods is a complex fracture network with almost no control on fracture propagation especially in unconventional reservoirs. One solution for this problem might be high injection pressure to create a simple two wing hydraulic fracture; however, it results in the consumption of a considerable amount of fluid and increases the risk of propagating into underground water sources. Another solution for this problem is to apply extra pressure inside the fracture in order to help crossing these discontinuities. The impact of those disadvantages made engineers and researchers to bring up novel methods to do the hydraulic fracturing operation by jointing new sciences in solid mechanics and fluid dynamics. One of the most important and novel methods in this area is hydro-pulse pressure fracturing which is a dynamic fracture propagation method in which of the excessive pressure is produced using an electrical discharge. In fact, unlike the traditional quasi static fracture propagation, this method has the advantage of creating a two wing planar hydraulic fracture because of its dynamic fracture propagation essence and is applicable even in the system of naturally fractured reservoirs. Creating multiple fractures is also possible in this method based on the power that is being used. In this paper a numerical and experimental pulse power fracturing study in which the fracture propagation can be controlled in unconventional reservoirs is presented. The experimental setup of our project produces 1KJ energy during electric discharge and the excessive pressure rose up to more than 100 Kpsi, enough for crossing faults and natural fractures. Furthermore, this research group already runs several tests which were performed on cylindrical 15 cm length and 5 cm diameter Shale and Dolomite specimens. Results showed that it was observed that the measured fracture propagation rate in this method was increased in the case of comparison with the conventional quasi static fracture propagation methods. Further field scale tests of this method are required to determine maximum fracture length.

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