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Natural fractures of Garau Shaly formation in Zagros fold and thrust belt of Iran and prediction of drilling direction

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Shale-gas production depends on natural and hydraulic fractures to flow it to well. A major part of source rocks in the Zagros Fold Belt were deposited during Neocomian time; the lowermost part of the Garau Formation has charged the Early Cretaceous Petroleum System of the Lurestan subzone which has a potential of being as a shale-gas resource. These source rocks are widely distributed in the Lurestan Depression and in the NW part of the Dezful Embayment. Knowing factors which controls fracture intensity and fractures length in each area are important in drilling into shale-gas resources. In this regard, a very dense and accurate field data acquisition on fracture sets, orientation, length, as well as bedding thickness, texture and lithology, was carried out in Early Cretaceous Garau Formation and basal Sarvak Formation within two anticlines with different structural setting (Kabir-Kuh and Khoram-Abad). According to our analyses, we have identified 2 fracture systems: 1) An orthogonal fracture system: set A in Khoram-Abad anticline and sets A and B in the Kabir-Kuh anticline and a longitudinal fracture set: set B in Khoram-Abad anticline and sets C and D in the Kabir-Kuh anticline, 2) An oblique fracture system: sets C and D in Khoram-Abad anticline and set E in the Kabir-Kuh anticline. The normal faults and stylolites (prior to stylolitization) in the study area of Kabir-Kuh anticline had formed in response to extension stress regime and the transverse fractures in the study area of Khoram-Abad anticline, are Early Cretaceous to Late Oligocene in age, then the transverse fractures and their orthogonal stylolites in Kabir-Kuh anticline and longitudinal and oblique fracture systems in the Khoram-Abad anticline have formed from Early Miocene to Middle Late Miocene, while longitudinal and oblique fracture sets in the Kabir-Kuh anticline have formed since Middle Late Miocene. We suggest that there have been two phases of counterclockwise rotations in orientation of the stress fields that had produced these fractures. The rotations in the stress field have probably occurred due to rotation of the Arabian plate during its convergence to the Eurasian plate which had been changed the orientation of fractures. These rotations forming some range of fractures with different attitude, that now with recent direction of impression apply by the Arabian plate those fractures which generate in the past would have shown different reaction. In our study area in addition to transverse fracture sets which originated near parallel to maximum horizontal stress, one set of oblique fractures is the second normal fracture set which are reactivated in response to fluid pressures, prior to originate new hydraulic fractures. In the Lurestan structural province deformation intensity is increased from the Kabir-Kuh anticline in the southern part of the Lurestan structural province to the Khoram-Abad anticline in northeastern part of the province. In the Kabir-Kuh anticline, lithology has played the most important role in fracture intensity, so that in some places even with increasing bedding thickness, we observe an increase in fracture intensity instead of expected decreasing fracture intensity. While in Khoram-Abad anticline bedding thickness has the most important effect on fracture intensity, and lithology has a minor role. In both investigated areas, fracture length is increased with changing texture from mudstone to wackstone, and also from wackstone to packstone.

Biography

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