

The effect of vertical stress on fractures created by hydraulic fracturing with super critical carbon dioxide

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Abstract

Geological storage of carbon dioxide has been considered to be an effective method to mitigate global warming. To utilize low-permeable formation for the storage of carbon dioxide, hydraulic fracturing with super critical carbon dioxide that has a low viscosity has been proposed.

Tanaka (2011) conducted hydraulic fracturing tests with super critical carbon dioxide and water to create fracture system in low-permeability rocks by hydraulic fracturing. In that study, three confining pressures of 5, 3 and 1 MPa were applied to the specimen for the two horizontal and the vertical directions, respectively, and the effects of the viscosity and the flow rate of the fracturing fluid and the type of rock on fracture propagation behavior were experimentally investigated.

However, the vertical stress can be assumed to be larger than 1 MPa at actual geological conditions for the storage of carbon dioxide. Therefore, in this study, the vertical stress of 12 MPa was applied to clarify the effect of vertical stress on fractures created by hydraulic fracturing with super critical carbon dioxide.

Main results obtained in this study can be summarized as follows: Only vertical fractures that are perpendicular to the rift or bedding planes were created in the case of the vertical stress of 12 MPa, while horizontal fractures along the rift or bedding planes were also created in the specimen in the case of the vertical stress of 1 MPa. Total length and number of branches of the fractures obtained by the latter was greater than those obtained by the former. These results indicate that the large vertical stress constrains the fracture propagations along the rift or bedding planes.