

A New Technology for the Characterization of Microfractured Reservoirs (Test Case: Unayzah Reservoir, Wudayhi Field, Saudi Arabia)

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This paper presents a test-case of a new technology using artificially-enhanced, magnetic susceptibility anisotropy (referred to here as EAMS) for the characterization of microfractured reservoirs. The study covers the Unayzah gas reservoir, in the Wudayhi Field, Saudi Arabia. Well tests indicate that fractures provide an important contribution to the productivity of the lower part of the Unayzah (Unayzah-B/C). The majority of the observed open fractures in this reservoir are small, in the order of microns to 10s of cm. Therefore an efficient and effective method is required to characterize these microfractures and to determine their contribution to porosity and permeability. A conventional geological characterization is costly, time consuming, and difficult to quantify in terms of assessing fracture impact on porosity and permeability. The EAMS technology, developed and tested here presents a rapid technology that “bridges” reservoir geology and engineering.

Verification of the EAMS method shows its superior accuracy in detecting fractures, compared to using thin sections of the same sample. The results show that EAMS-derived microfracture fabric strikes at ENE-WSW, consistent with that obtained by geological means. The effective-porosity profile obtained from EAMS tests is similar to that of the conventionally acquired porosity. Open microfractures in tested samples increase reservoir effective porosity by 30% to 48% in Unayzah B/C. The occurrence of connected microfractures is estimated to cause an increase in average permeability of 75% in Unayzah-B/C. Maximum permeability trend of NE-SW with total permeability anisotropy is detected. This will impact our operational and simulation effort directly.