Geophysical Research Abstracts
Vol. 13, EGU2011-2955, 2011
EGU General Assembly 2011

In-Situ Stress and Fault Reactivation Associate with LNG Injection in the Tienchanshan Gas Field, Fold-Thrust Belt of Western Taiwan

Jih-hao Hung (1) and Jong-chang Wu (2)

(1) Natinal Central University, Taiwan, Geophysics, Jhongli, Taiwan (jhhung@ncu.edu.tw), (2) Exploration and Production Research Institute, Chinese Petroleum Corporation, Taiwan

The Tiechanshan gas field located in the fold-thrust belt of western Taiwan was depleted and converted into underground storage of Liquid Natural Gas (LNG) decades ago. Recently, CO_2sequestration has been planned at shallower depths of the structure. In this study we intend to characterize the in-situ stresses from over 40 wells and assess the leakage potential through fault reactivation in response to pore-pressure increase as a result of LNG injection. Formation pore pressures (P_f), vertical stress (S_v), and minimum horizontal stress (S_{hmin}) were measured from repeated formation tests, density logs, and hydrofrac including leak-off tests and fluid injection, respectively. Formation pore pressures are hydrostatic above depths of 2 km, and increase with local gradients of 0.62 and 0.94 psi/ft above and below 3.2 km. Extremely high pore pressures (λp=0.8) are observed at depth below 3.8 km. Lower than normal pressures (average 0.42psi/ft) are observed in the gas-bearing reservoir of Talu A-sand. The gradient of S_{hmin} is $\sim$ 0.77 psi/ft or equivalent to 0.74 of S_v ($\sim$1.04 psi/ft). Combined the structure contour map of A-sand top with measured S_{hmin} and S_v,stress state in the Tiechanshan field is a predominantly strike-slip stress regime ($S_{Hmax} > S_V > S_{hmin}$). Without extended leak-off tests and images of borehole wall, the upper-bound values of maximum horizontal stress (S_{Hmax}) constrained by frictional limits and coefficient of friction (μ=0.6) is about 1.21 psi/ft. Caliper logs from two wells show that borehole breakouts is oriented $\sim$28^{o}N, or maximum horizontal stress being 118^{o}N, which is sub-parallel to far-filed plate-convergence direction. Geomechanical analyses on the reactivation of pre-existing faults at the depths of LNG reservoir sand indicate that all faults are relatively stable. Sensitivity analyses of affecting parameters indicate even the pessimistic risk scenario would require $\sim$5.9 Mpa excess pore pressure to cause the optimal oriented F1 fault to reactivate. This corresponds to LNG column height of $\sim$760 m (density= $\sim$790 kg/m^3), whereas the structure closure of the A-sand does not exceed 400 m. Therefore, LNG injection will unlikely to compromise the F1 fault stability.