Multi-Scale Fracture Characterization of a Carbonate Reservoir, Based on Remote Sensing, Outcrop Data and Thin Sections: a Case Study from the Neuquen Basin, Argentina

Jan Witte

ABSTRACT

Extensive field work was conducted to collect detailed data of more than 20.000 individual fractures across the N-S trending, ~50km long, thick-skinned Malargue Anticline, located in the northern Neuquen Basin of Argentina. New results are presented, extracted from the statistical data, regarding fracture orientations, densities and apertures.

The examined carbonate reservoir is the Valanginian Chachao Formation, a key reservoir in the region. More than 100 fracture measure stations were registered across the anticline. The majority of the stations are located on pavements, representing the top of the Chachao Formation. At each station, comprising a standard box (40m by 40m), reservoir-relevant parameters were collected for all visible fractures, including orientation, density, spacing, length, morphology, aperture, mineral fill, open or closed attitude of the fractures. Additionally, in the core of the anticline several hundred fracture orientation data points were collected from outcrops of the underlying Choyoi Group (intrusives, volcanoclastics), the economic basement in this area. At three stations at the southern plunge and backlimb, oriented thin sections were extracted from the limestone for fracture orientation assessment. Finally all fracture data was fed into an GIS database.

Air photos, satellite images, outcrop data and thin-sections independently reveal up to four consistent fracture sets in the Chachao limestone. These can be divided into one longitudinal, one transverse and two oblique systems. Locally, variations exist from this general pattern. The underlying Choyoi basement reveals very similar fracture orientations. For the Chachao Formation, the highest fracture densities are observed at the southern and northern plunge of the anticline. The largest average fracture apertures are found in the southern plunge and forelimb of the structure, while increased apertures are also observed locally on the backlimb and northern plunge.

Multi-scale data from the Chachao limestones strongly hint at fractal fracture orientations. Fracture densities and apertures seem to be controlled by cumulative strain. The statistical evaluation allows lateral mapping of reservoir-relevant fracture parameters. We encourage explorers and engineers to utilize all available outcrops in the vicinity of producing oil fields to improve the understanding of reservoir parameters at the inter-well scale.