Reconstruction of a "Discrete Fracture Network" in the geothermal reservoir of Rosario de La Frontera (La Candelaria Ridge, Salta province, NW Argentina)

R. Maffucci, S. Bigi, S. Corrado, G. Giordano, A. Chiodi, L. Di Paolo
Dipartimento di Scienze Geologiche, Università degli studi "Roma Tre", 00146 Roma
Tel. +39 3490697960 – Email: roberta.maffucci@uniroma3.it

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Abstract:
Discrete fracture network (DFN) models are three-dimensional stochastic or combined stochastic/deterministic representations of fractures network that characterizes natural fracture systems. They represent an important tool to investigate pathways for fluid flow in geothermal reservoirs in order to predict their behavior in prospect evaluation and reservoir management.
In this project a DFN model is applied to the geothermal system of *Rosario de La Frontera*, in the Salta province, with the aim to assess the effective permeability of its reservoir and to obtain input parameters for dynamic reservoir modeling.
This active geothermal system is marked by several hot springs, with surface temperatures ranging between 50°C and 99°C, in the surroundings of the town of *Rosario de la Frontera*, to the north of *La Candelaria Ridge* (Fig. 1a). Fractured sandstones strata belonging to the syn-rift deposits of the Salta Group (Pirgua subgroup) provide the reservoir rocks of this geothermal fluids (Moreno Espelta et alii, 1975).
With the aid of dedicated software, a 3-D geological model of the *La Candelaria* anticline was built in order to extract a 3-D geocellular volume of the deep reservoir to constrain the fracture network model (Fig. 1).

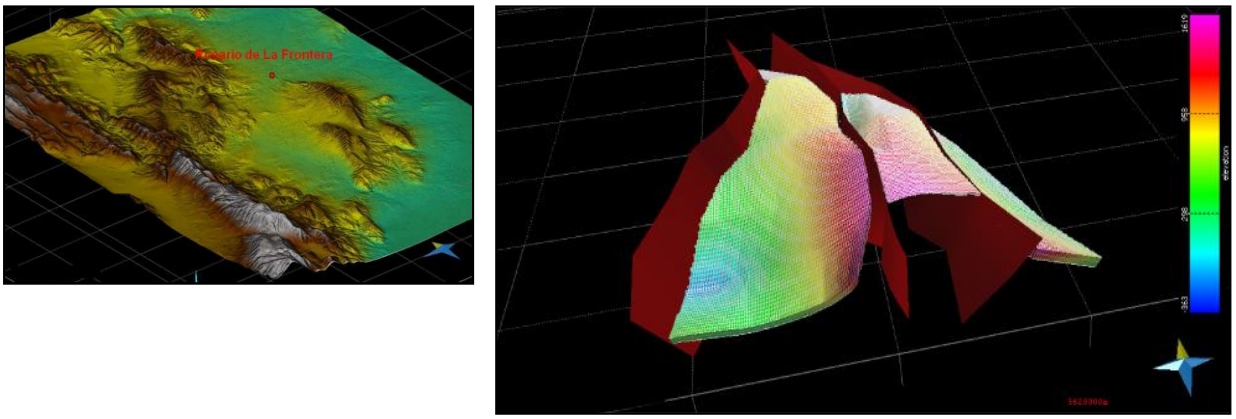

Fig.1 – a. DEM of the sub-Andean fold&thrust belt and foreland for the location of the study area. b. 3D Model of the deep geothermal reservoir (*Pirgua* subgroup) of *Rosario de La Frontera* geothermal system. The reconstruction of the structure model of the *La Candelaria* Ridge shows a broad N-S east-verging anticline uplifted by high-angle thrust faults.

Stuctural study on outcrops of the reservoir rocks allowed us to elaborate a deterministic fractures network model and to calculate the input parameters for the generation of the DFN. Field work was dedicated to a quantitative and qualitative analysis of the fractures and faults defining diagnostic parameters such as orientation, dimension, spatial distributions, surface texture, and to calculate their density distribution within the regional fold. The acquisition of these parameters was performed along scan-lines and on scan-areas of the outcropping reservoir rocks.
According to orientation, the observed discontinuities were classified as longitudinal, transverse and oblique with respect to the fold axis trend (e.g. Stearns, 1968; Hancock, 1985; Cooper, 1992), and in turn grouped into six sets. They show different frequency values across the anticline. In particular NNW-SSE and NE-SW trending fractures are predominant along the eastern and western limbs of the anticline, respectively.
In conclusion, DFN models were generated for each fractures set in order to evaluate their influence on the permeability anisotropy in different portions of the studied anticline.