

A STUDY OF FRACTURE MORPHOLOGY FROM BOREHOLE IMAGE DATA IN KARAKUS, CENDERE AND OZAN SUNGURLU FIELDS - TURKEY

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Electrical and acoustic images were recorded in several wells in the Karakus, Cendere and Ozan Sungurlu Fields of Southeastern Turkey, over the past several years. These images which include both electrical (FMS) and acoustic (BHTV) data give an excellent indications of the degree of fracturing and orientation of the natural fracture systems present within the reservoir units. Several fracture orientations can be observed in each well studied and the orientations can be related to local structural events. Typically, the fractures are observed in certain lithologic units in association with faults and unconformity events within the reservoir. Orientation changes in fractures can be observed across faults and plots of calculated fracture porosity indicate and increase in porosity associated with fracture density as well as the proximity to unconformity surfaces. In general, most fractures observed, show a tensional morphology and suggest the rocks failed, probably during uplift or as the result of deformation near faults.

Drilling induced fractures are also observed, and orientation changes in these fractures associated with the principal far-field stress of the rock sequence often occur near fault structures.

The studies performed to date indicate a significant contribution by the fracture systems to productivity. Successful off-setting of producing wells will benefit from an understanding of the orientation and density of fracturing in a formation. In addition, the orientation of natural fractures in a wellbore will aid in the understanding of fault orientations for better mapping of the reservoir from well and seismic data.

UTILISATION OF THE NORMAL GEOTHERMAL ENERGY IN GREECE

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The normal geothermal energy can be used profitably in Greece by applying two types of exploitation systems:

1. With 1000-2500m deep bore holes, which can yield warm water with temperatures ranging from 50^o-100^oC. This type has the disadvantage of high initial research and

bore hole expenses connected with a great risk of failure. In case of success the heating energy of the deep ground water can be used for district heating and production of domestic warm water.

2. With 50-200 m deep bore holes, in which we can obtain normal geothermal energy contained in the ground waters and/or in the rocks. The temperatures in these media and depth range in Greece between 15°-20°C and are very suitable to heat and cool buildings and produce domestic warm water by means of heat pumps. In case of a bore hole with a sufficient ground water yield a water pump is needed to feed the heat pump. In case of a bore hole with no ground water exploitable for its heat content, a vertical earth heat exchanger is used. This is a closed water circuit which absorbs the geothermal energy from the first tens or hundreds of meters of the rock strata and feeds the heat (geothermal) pump.

The earth coupled heat pump systems of type 2 are very suitable for the climatic and shallow geothermal conditions of Greece and can be used for individual dwellings and buildings of any kind. Their high initial installation costs are compensated by their low functional and maintenance costs. But the additional profits of these systems are: — the energy saving, as their Coefficient of Performance (COP - ratio of produced heat energy to consumed electrical energy) is expected to be greater than 3:1 in Greece. — the use of a renewable energy source, which is environmentally pure and everywhere - everything steadily flowing and therefore available also in regions requiring urgently substitutes for the pollutant mineral fuels.

The systems of type 2 are also very interesting from the point of view of energy saving and environmental suitability. A research for the application of these systems, as well as of those of type 1 in Attica is in progress.

PROBABILITIES OF OCCURRENCE OF LARGE EARTHQUAKES IN VERY ACTIVE ZONES OF THE EARTH

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Analysis of the seismicity in 24 active zones of the world is attempted in terms of repeat times of strong earthquakes. A recently compiled homogeneous catalogue of large earthquakes ($M_a \geq 7.0$), which covers the time span 1898-1985, was used in this analysis. A probabilistic approach is used to forecast the likelihood of large future shallow earthquakes in certain seismic zones of the world. The time dependent seismicity model and the Poisson one were used and the probability that a seismic zone