Three-Dimensional Geological Model of Onshore Lebanon

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ABSTRACT

A three-dimensional (3-D) geological model was constructed for onshore Lebanon. The model main purpose was to enhance the understanding of the onshore geology which when linked to the offshore geology might reveal new findings that could support oil & gas exploration. Given the limitations of acquiring seismic surveys onshore and which is mainly attributed to the rough mountainous nature of the Lebanese terrain and dense urbanism, this model is believed to serve as a good reference and tool for quick identification of onshore structures and estimation of horizons depth and formation thicknesses. The model includes all outcropping stratigraphic formations (Quaternary till lower Jurassic) in addition to the Triassic which was extrapolated from neighboring countries and understanding of the regional geology. The formations were grouped in main units based on their major lithological components. Given the scarcity of deep well data and absence of onshore seismic data, the model relied primarily on the 1/50,000 scaled geological maps and cross-sections published by Dubertret. The model is being upgraded from knowledge of the local and regional geology gained through implementation of numerous mapping projects and field work. Around 30 to 40% of the surface area of the country is available at a scale of 1/20,000. This will allow areas with a potential prospectivity for oil & gas to be modeled in further details. Three zones of interest were identified in the south, north and inland. These are thought to be suitable in terms of structure and stratigraphy and shall be targeted in the detailed modeling.

The initial input data consisted of around 19,050 pseudo (virtual) wells and 1,171 faults which were derived from maps and cross-sections in addition to a digital elevation model. The inverse distance gridding method was used for interpolation whereby fault polylines were honored. The model allows for generation of various structural elevation maps and models, thickness (isopach) maps, plan geological maps at different depths, infinite number of multi-directional cross-sections and fence diagrams as well as volume calculations.

The model has limitations pertaining to uncertainties associated with formation boundaries at greater depths and difficulties in revealing potential subsurface faults. The model also assumes that the fault planes are vertical and extend from surface till bottom of the deepest modeled formation.

A number of tasks were set forth for enhancing and fine tuning the model. These include loading of hundreds of actual borehole data and geophysical logs, in addition to pseudo wells that will be generated from new cross-sections reaching bottom of the Triassic formation. Potential loading of the interpreted horizons from future onshore seismic surveys would be ideal for model calibration.