A Balanced Cross Section across the Southern Kirkuk Embayment, Zagros Fold and Thrust Belt, Kurdistan

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The Zagros is one of the oldest and richest oil and gas provinces in the world. For a variety of geopolitical reasons the NW end of this mountain belt, the Kirkuk embayment, has been under-explored in recent years. It lies in Kurdistan, a province of Iraq. The focus of this talk will be this tectonic embayment and in particular the position of the Mountain Front Fault within it.

The Zagros fold and thrust belt lies on the boundary of the Arabian and the Eurasian Plates. It is orientated SE to NW and runs from the Arabian Sea in south-eastern Iran to the Taurus fold and thrust belt on the Iraq Turkish Border. It is made up of three zones of variable width that run sub parallel with the Main Zagros Suture. The most proximal zone to it is the High Zagros, which is followed by the Zagros Foreland and the Zagros Foredeep progressively as you progress towards the Mesopotamian block on the Arabian plate. Together they make up a zone of deformation about 300 km. wide and 2,000 km. long.

The High Zagros is bounded by the Main Zagros Suture and the High Zagros Fault. It is at an elevation of 3000 to 4000 meters. It has duplexed Palaeozoic metamorphic rocks at surface with a structural wavelength of 10 to 15 km. Outboard of this is the Zagros Foreland that is bounded to the SW by the Mountain Front Faults. This is lower, with an elevation of 2000 meters. The younger Paleogene, Asmari and Pila Spi carbonates are mapped at the surface with the structures being dominated by detachment folds with a wavelength of 3 to 4 km. Lastly the most distal zone is the Zagros Foredeep. It has an elevation of about 1000 meters. It has recent sediments at surface with Miocene rocks forming anticlines in the hanging wall of thrusts. This zone has a more variable wavelength of about 20 to 40 km.

The structural style of the area is the result of the Cainozoic continental collision between the two plates. This episode of shortening has affected a 10 to 12 km. thick sedimentary succession of Cambrian to Early Miocene platform sediments (mainly carbonates), the Gachsaran evaporites and the Mio-Pliocene foredeep clastic deposits. The direction of transport is NE to SW with the major anticlinal axis and faults orthogonal to this direction. This fold and thrust belt is complicated by the interaction of an old deep seated strike slip system that runs NE to SW. It originates in the autochthonous basement of the Mesopotamian block in front of the Zagros and is seen as major lateral discontinuities and minor fracture swarms through out the Zagros Foreland and Foredeep.

The width of the Foreland zone is variable. In map view there are two prominent re-entrants defined by the mountain front fault. These are the Dezfur and the Kirkuk embayments. Both of these structures play a prominent part in defining the potential for oil and gas exploration.

To provide a regional geological setting in which exploration can progress a deformation model was needed. This was determined by drawing a regional cross section across the

Mountain Front Fault that defines the boundary between the Foreland and Foredeep Zones in the Kirkuk Embayment. It was built incorporating remote sensing, geological field mapping and modern sesimic. The section drawing and balancing software Move 2010* was used. This allowed the incorporation of the surface data and the seismic, in both depth and time, into one usable model.

On a regional scale the cross section had to address the concerns of thick versus thin skinned tectonics. This modelling resulted in a complex deformation model. It provided some answers as to the large scale thick versus thin skinned discussion. At a more local level a variety of decollemont surfaces are found in the fold belt dominated by detachment folds. In addition we have examples of out of sequence thrusting with hinterland vergent thrust defining a triangle zone.

This information was then used to constrain the seismic interpretation at the surface. In addition it provided a geological cross section suitable for conversion to a velocity model for use in the time to depth conversion of the recently acquired high fold 2D seismic.

* Move 2010 is produced by Midland Valley Exploration, Glasgow, Scotland

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Andrew Newson has 35 years of experience in the geological and geophysical evaluations of structurally controlled plays. He is a Professional Geological Consultant registered in the province of Alberta and is currently living in Calgary. Andrew graduated in 1972 with a B.Sc. (Hon) in geology from London University, England. Since then he has worked as a structural geologist specializing in the exploration and exploitation of hydrocarbon prospects around the world.

As a consultant for nearly 20 years, Andrew has been involved with numerous projects for clients among the major, independent and junior oil and gas companies. To facilitate this he incorporated Moose Oils Ltd. in 1993. Through Moose Oils Ltd he teaches in-house workshops on structural play evaluation techniques and regularly leads field trips for industry. He is closely involved in developing computer software to assist in the interpretation of structural plays.