AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

The major fault zones controlling the sedimentation, deformation and entrapment of hydrocarbon in the Zagros fold-thrust belt, Iran

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Abstract

The Zagros Mountain belt is one of the best-exposed fold-thrust belts in the world. However despite, this excellent exposure, little is known about the structural evolution of the belt. Data gleaned from the literature on the Zagros have been compiled and used in conjunction with new interpretations to provide a clearer picture of the structures, sedimentation history and deformation of this Mountain Belt. In this study the Kazerun, Izeh, Bala Rud and Mountain Front fault zones are defined as the master structural elements of the Zagros fold-thrust belt (Fig. 1). These fault zones controlled the stratigraphy of the region and thus divided the deformation belt into zones with different stratigraphical and therefore different rheological profiles.

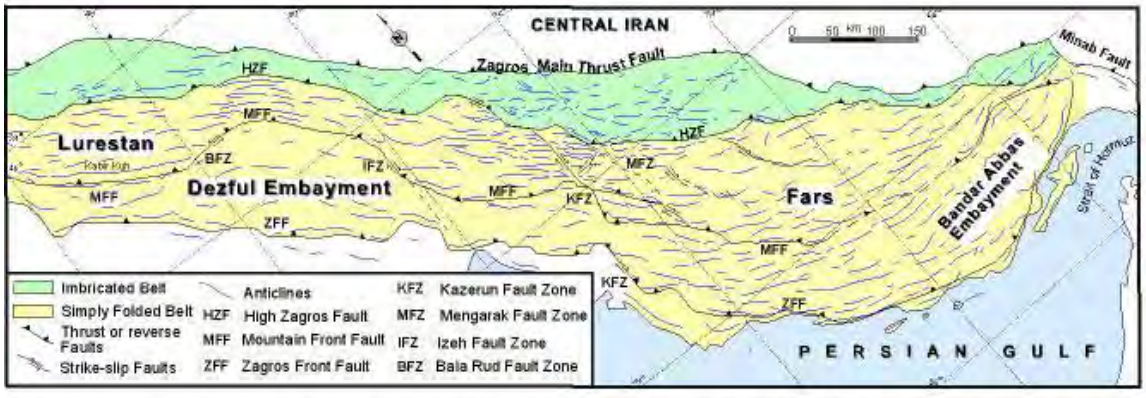

Fig. 1: Structural setting and tectonic sub-division of the Zagros fold-thrust belt (modified from Berberian 1995). The three major deformation fronts of the Zagros and their intersection with the strike-slip fault zones

It is suggested that during the Cambrian time the Kazerun fault zone acted as the basin bounding fault, which limited the distribution of the Hormuz salt to the east in the Fars region. The N-S trending Izeh and Kazerun fault zones (Fig. 1) later acted as the sedimentary transition zone between the Lurestan and Fars regions which experienced entirely different sedimentation histories during the Jurassic-Cretaceous time. The study of Cretaceous sedimentary isopachs and facies suggest that the Izeh and Kazerun fault zones were active at this time and their activity caused considerable thickness and facies variation along the zone and partly controlled the distribution of the Kazhdumi Formation (the major source rock in the Zagros)

By the end of Cretaceous i.e. after the initial collision between the Arabian and Iranian plates, the present NW-SE trend of the Zagros deformation belt had been initiated. During this time the NW-SE trending Mountain Front fault separated the present 'Simply Folded Belt' of the Zagros into a major foreland basin to the southwest and a piggyback basin to the northeast (Fig. 2). This fault zone which is still a topographical front (Fig. 3) coincides with the present zone of seismicity along the Zagros Mountain Belt. Activity along other major fault zones including the Izeh, Kazerun and Bala Rud Fault zones occurred at this time and controlled the sedimentation and subsidence of the Dezful Embayment one of the main target regions for hydrocarbon exploration. These fault zones controlled the thickness of the Asmari Formation (reservoir) and also the considerable thickness and facies changes of the Gachsaran Formation (seal). Portions of Kazerun, Izeh and Bala Rud fault zones act as transfer faults (lateral ramps) which link segments of the Mountain Front fault (Figs. 1 & 4).

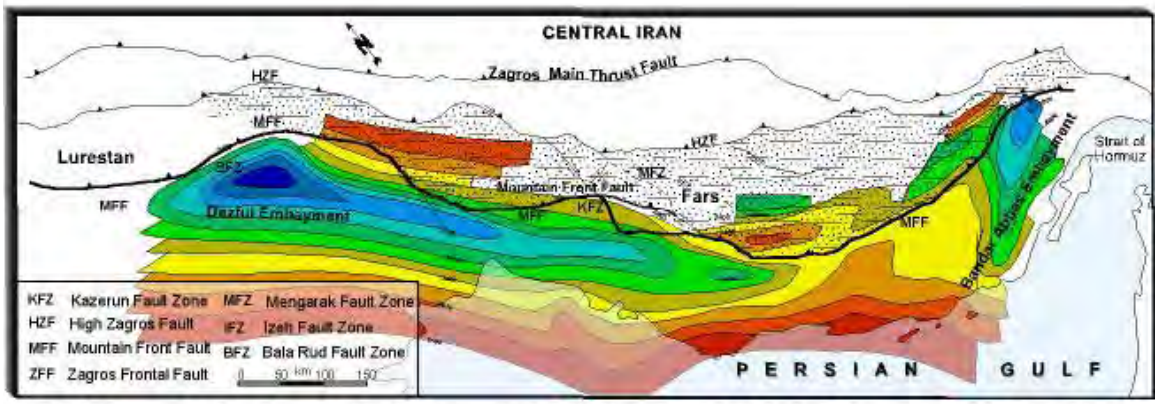

Fig.2: Post Oligocene isopach and facies map of the Zagros basin, (Sepehr 2001). The fault separates the foreland to the southwest and the piggyback basins to the northeast. The maximum thickness occurs to the northwest of the Dezful Embaymrnt and in the northeastern part of the Bandar Abbas Embayment.

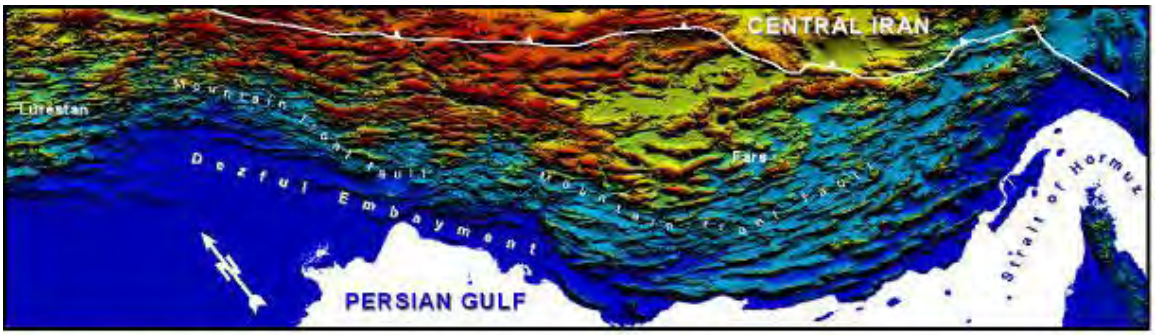

Fig. 3: Digital elevation model of the Zagros illustrating the major topographic front along the Mountain Front Fault.

The existence of the Hormuz salt in the Fars region decoupled the basement structures from the cover and lead to the present arcuate plan geometry, smaller taper angle and additional southwestward migration of the fold-thrust belt in the Fars region (Fig. 4). The variation in subsidence rate and the present morphology of the Mountain belt (Figs. 2 & 3) is interpreted as being mainly related to the pinning of the Mountain Front fault to the northwest of the Dezful Embayment and to the north of the Strait of Hormuz (Fig. 4). Because the Dezful Embayment, Lurestan and Fars regions have their own structural framework and history it is suggested that they should be consider individually. These regions display different fold and thrust geometries, partly in response to their different rheological profiles which reflect the movement history of the Zagros major fault zones.

Fig. 4: Sketch map showing the structural framework of the Zagros and the significant role of the Kazerun, Bala Rud, Izeh and Mengharak Fault zones as lateral ramps or transfer faults