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Research paper

Salt tectonics and tear faulting in the central part of the Zagros Fold-Thrust Belt, Iran

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ABSTRACT

The central part of the Zagros Fold-Thrust Belt is characterized by a series of right-lateral and left-lateral transverse tear fault systems, some of them being ornamented by salt diapirs of the Late Precambrian–Early Cambrian Hormuz evaporitic series. Many deep-seated extensional faults, mainly along N–S and few along NW–SE and NE–SW, were formed or reactivated during the Late Precambrian–Early Cambrian and generated horsts and grabens. The extensional faults controlled deposition, distribution and thickness of the Hormuz series. Salt walls and diapirs initiated by the Early Paleozoic especially along the extensional faults. Long-term halokinesis gave rise to thin sedimentary cover above the salt diapirs and aggregated considerable volume of salt into the salt stocks. They created weak zones in the sedimentary cover, located approximately above the former and inactive deep-seated extensional faults. The N–S to NNE–SSW direction of tectonic shortening during the Neogene Zagros folding was sub-parallel with the strikes of the salt walls and rows of diapirs. Variations in thickness of the Hormuz series prepared differences in the basal friction on both sides of the Precambrian–Cambrian extensional faults, which facilitated the Zagros deformation front to advance faster wherever the salt layer was thicker. Consequently, a series of tear fault systems developed along the rows of salt diapirs approximately above the Precambrian–Cambrian extensional faults. Therefore, the present surface expressions of the tear fault systems developed within the sedimentary cover during the Zagros orogeny. Although the direction of the Zagros shortening could also potentially reactivate the basement faults as strike-slip structures, subsurface data and majority of the moderate-large earthquakes do not support basement involvement. This suggests that the tear fault systems are detached on top of the Hormuz series from the deep-seated Precambrian–Cambrian extensional faults in the basement.

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1. Introduction

As part of the Alpine–Himalayan orogenic belt, the Zagros Fold-Thrust Belt (ZFTB) lies on the northeastern margin of the Arabian plate (Fig. 1), and resulted from the opening and closing of the Neo-Tethys oceanic realm and the still ongoing convergence between the Arabian and Iranian plates (Takin, 1972; Haynes and McQuillan, 1974; Stöcklin, 1974; Ricou et al., 1977; Berberian and King, 1981; Alavi, 1994; Agard et al., 2005; Frizon de Lamotte et al., 2011; Mouthereau et al., 2012). The Zagros is one of the most active collisional belts in the world. The majority of moderate-large

Used abbreviations: ZFTB, Zagros Fold-Thrust Belt; HZF, High Zagros Fault; MFF, Mountain Front Fault; KFS, Kazerun Fault System; KBFS, Karebas Fault System; SPFS, Sabzpushan Fault System; SFS, Sarvestan Fault System; BF, Bahar Fault; NFS, Nezamabad Fault System; RL, Razak Lineament; MZRF, Main Zagros Reverse Fault; DF, Dashti Fault; Hs, Hormuz salt; Kz, Kazhdumi Formation; Il-Sv, Sarvak and Ilam formations; Pd-Gu, Gurpi and Pabdeh formations; As, Asmari Formation; Gs, Gachsaran Formation; Grm, Guri member of Mishan Formation; Mn, Mishan Formation; Bk, Bakhtiari Formation.

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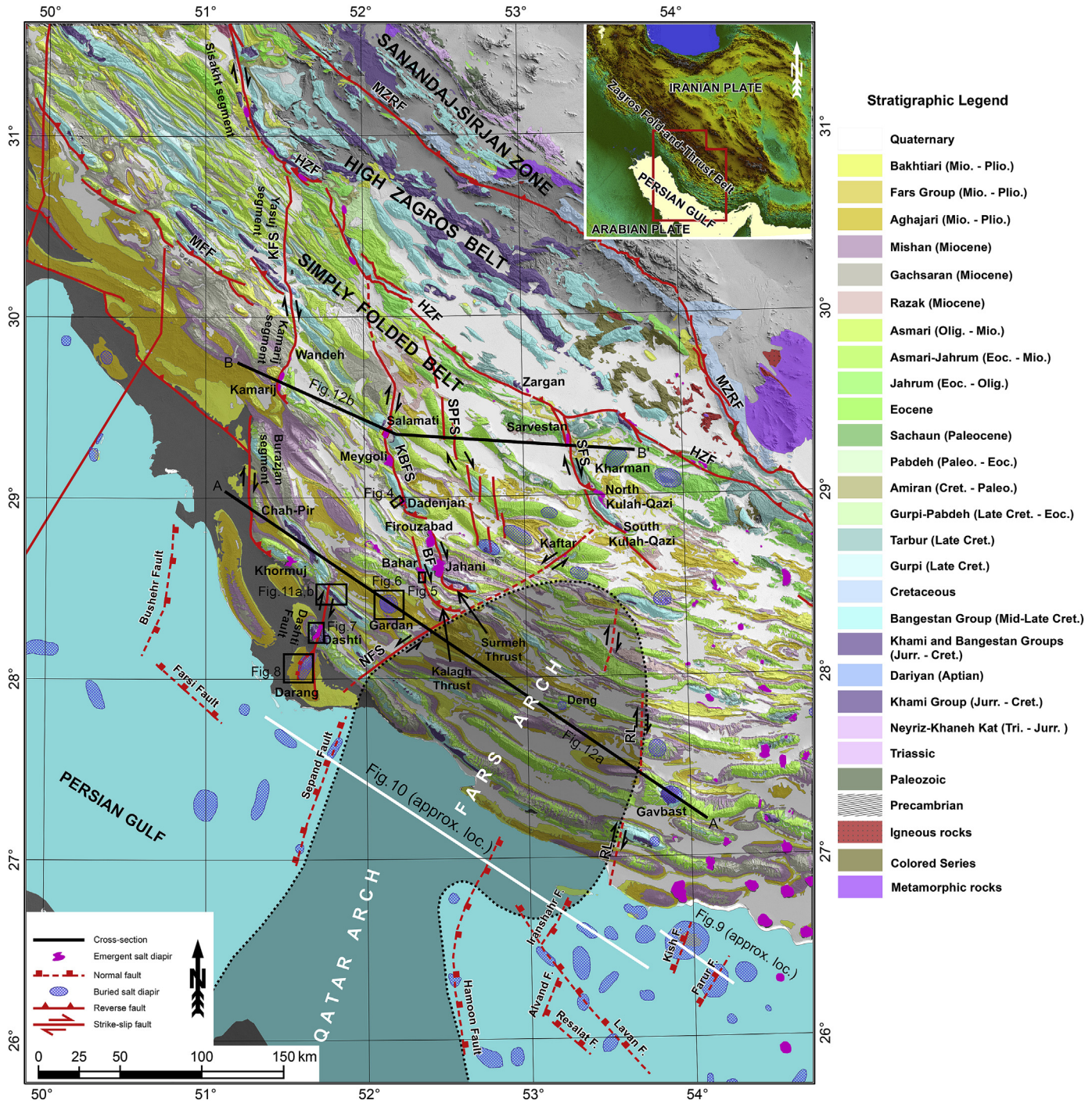

Fig. 1. Geological map on DEM representing the main structural features of the central part of the ZFTB including transverse tear fault systems, salt diapirs, major thrust faults, and the Qatar and Fars Arches. Cross-sections A–A′ and B–B′ are presented in Fig. 12. Abbreviations; MZRF (Main Zagros Reverse Fault), HZF (High Zagros Fault), MFF (Mountain Front Fault), KFS (Kazerun Fault System), DF (Dashti Fault), KBFS (Karebas Fault System), BF (Bahar Fault), SPFS (Sabzpushan Fault System), SFS (Sarvestan Fault System), NFS (Nezamabad Fault System) and RL (Razak Lineament).

earthquakes of the Zagros Folded Belt occur within the middle and lower parts of the sedimentary cover and the Zagros basement contains only rare moderate-large earthquakes (Nissen et al., 2014; Elliott et al., 2015). Large earthquakes in the ZFTB occur mainly along and around major NW–SE trending thrust faults (e.g., High Zagros Fault, HZF; Mountain Front Fault, MFF) and transverse strike-slip fault systems (Ni and Barazangi, 1986; Berberian, 1995; Talebian and Jackson, 2004). GPS measurements indicate that the present active convergence and shortening between the Arabian and Eurasian plates is about 20–30 mm/yr, where 6.5 ± 2 mm/yr is accommodated across the Zagros Mountains (Hessami et al., 2001a; Vernant et al., 2004) and is mainly concentrated within the Simply Folded Belt (Talebian and Jackson, 2004; Hessami et al., 2006; Walpersdorf et al., 2006) (Fig. 1). Some researchers used earthquake data (Talebian and Jackson, 2004), GPS studies (e.g., Authemayou et al., 2005; Tavakoli et al., 2008) and mechanical