Tectonophysics 671 (2016) 235–248

Contents lists available at ScienceDirect

Tectonophysics

journal homepage: www.elsevier.com/locate/tecto

Not so simple "simply-folded Zagros": The role of pre-collisional extensional faulting, salt tectonics and multi-stage thrusting in the Sarvestan transfer zone (Fars, Iran)

Eugenio Carminati [a,*], Luca Aldega [a], Sabina Bigi [a], Giorgio Minelli [b], Ali Shaban [c]

[a] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Rome, Italy
[b] Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, Perugia, Italy
[c] National Iranian Oil Company, Tehran, Iran

A R T I C L E I N F O

Article history:
Received 12 May 2015
Received in revised form 12 January 2016
Accepted 13 January 2016
Available online 4 February 2016

Keywords:
Zagros
Salt tectonics
Thrusting
Transfer zone
Sarvestan

A B S T R A C T

The Sarvestan plain is bounded by highly elevated anticlines associated with thrusts or transpressional faults and hosts the NNW–SSE Sarvestan transfer zone. Surface and subsurface geological data, and 22 seismic lines allowed us to reconstruct the 3D geometry of the area. Mixed layer illite–smectite and 1D burial and thermal modelling were used to constrain the complex geological evolution of the Sarvestan plain where inherited structures strongly controlled the geometry of syn- to post-collisional contractional structures. Paleozoic–Mesozoic rifting related extension generated E–W and NNW–SSE normal fault systems. Such faults were associated with changes in the thickness of the sedimentary cover. Lateral facies changes were later induced by the Cretaceous obduction of ophiolites, cropping out some tens of km north of the study area. During the Miocene the footwall and the hanging wall of the Sarvestan Fault had different thermal evolution. This is tentatively explained by flow of Cambrian salt from the plain area towards the hanging wall of the Sarvestan Fault, associated with salt diapirism during Lower–Middle Miocene time. Salt tectonics is invoked also to explain, at least in part, the development of the overturned anticline in the hanging wall of the Sarvestan Fault. An early phase of contractional deformation occurred in the Middle Miocene (since 15 My, i.e., after the deposition of the Agha Jari Fm) generating the E–W oriented folds buried below the plain, likely inverting inherited normal faults. The erosion of these structures was followed by the deposition of the Bakhtiari Fm conglomerates in Middle–Late Miocene times. A later phase of contractional tectonics generated the thrust faults and the anticlines bounding the Sarvestan plain some 6–5 My ago. The Sarvestan dextral transpressional fault, that likely acted as a strongly oblique ramp of the Maharlu thrust, mainly structured in this period, although its activity may have continued until present.

1. Introduction

The geometry of contractional structures in the Zagros fold-and-thrust belt (Fig. 1) was influenced by facies and thickness changes in the stratigraphy (e.g., James and Wynd, 1965; Alavi, 2004). Such changes were induced mainly by Paleozoic to Mesozoic thick-skinned extensional tectonics and by shallow-rooted Tertiary extensional faults (Navabpour et al., 2010).

The most important stratigraphic change occurs between the Dezful Embayment and the Fars region, respectively characterized by the absence and presence of Cambrian evaporites (Hormuz Fm) at the bottom of the deformed succession. The front of the belt is characterized by a salient (i.e., by larger advancement of the compressional front) in the Fars region (Fig. 1), and a recess in the Dezful Embayment, (Allen and Talebian, 2011), as predicted by sand-box models. Cambrian salt also controls strain distribution in the belt (Carminati et al., 2013). The larger advancement of the thrust fronts in the SE part (Fig. 1) is accommodated by a major N–S transfer zone (Kazerun fault; Sepehr and Cosgrove, 2005; Carminati et al., 2014), where dextral strike-slip and/or transpressional earthquakes take place. Other regional transfer zones developed along N–S Paleozoic–Mesozoic normal faults, such as the Sabz Pushan dextral strike-slip fault (Lacombe et al., 2006), and the Izeh Fault (Sherkati and Letouzey, 2004; Lacombe et al., 2006; Ahmadhadi et al., 2007).

The Sarvestan area, a flat triangular area bounded by high-elevation anticlines (Fig. 2), hosts another major transfer zone: the Sarvestan Fault. The High Zagros Fault, delimiting to the north the Sarvestan Plain, is displaced to SE along the Sarvestan Fault, which bounds the plain to the east. In this work we develop a geological model for the Sarvestan area, constrained by surface (geological mapping) and subsurface (well stratigraphies) geological data, by a network of 22 seismic

* Corresponding author at: Dipartimento di Scienze della Terra, Universita' degli Studi, di Roma "La Sapienza", P.le Aldo Moro 5, I-00185 Rome, Italy. Tel.: +39 06 49914950; fax: +39 06 4454729.
E-mail address: eugenio.carminati@uniroma1.it (E. Carminati).

http://dx.doi.org/10.1016/j.tecto.2016.01.033
0040-1951/

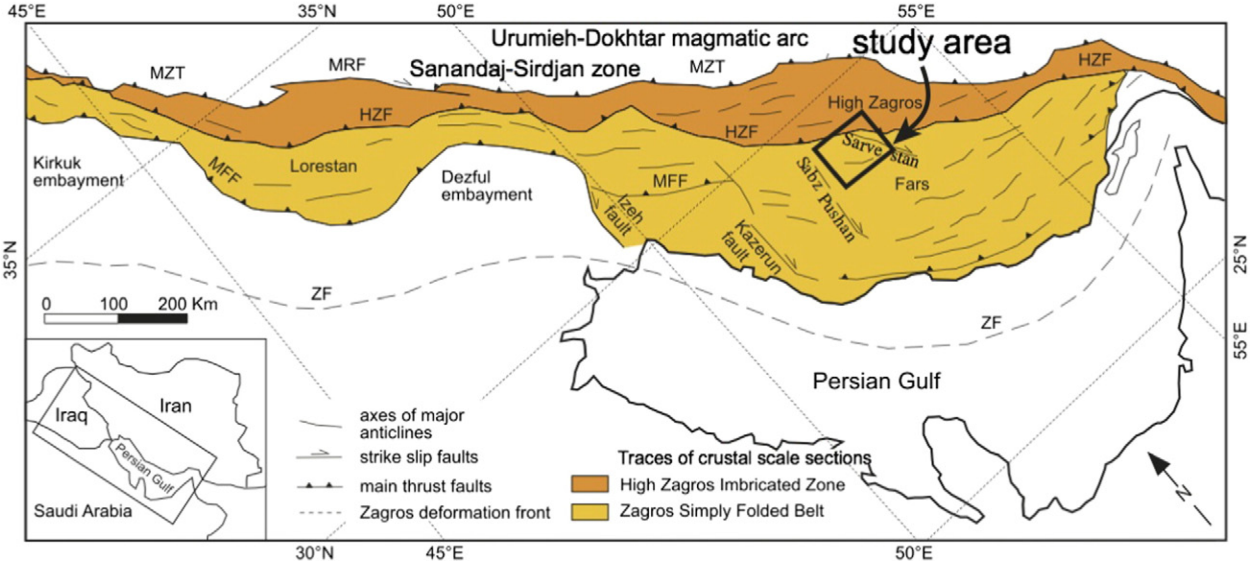

Fig. 1. Structural map of the Zagros fold-and-thrust belt showing the major fault zones, the geological provinces and the study area in Fig. 2 (modified after Pirouz et al., 2011). HZF: High Zagros Fault, MFF: Zagros Mountain Frontal Fault, ZF: Zagros Front.

lines, thermal maturity data and thermal modelling. This multidisciplinary set of data allowed us to define a geological evolution controlled by Paleozoic–Mesozoic rift-related extensional faulting, Cretaceous obduction of ophiolites, Tertiary normal faulting, salt tectonics, early syn-collisional basin inversion and multi-stage contractional tectonics. It is concluded that, although located in the so-called Zagros simply folded belt, the Sarvestan area is actually complex in terms of geometry, stratigraphy and tectonics.

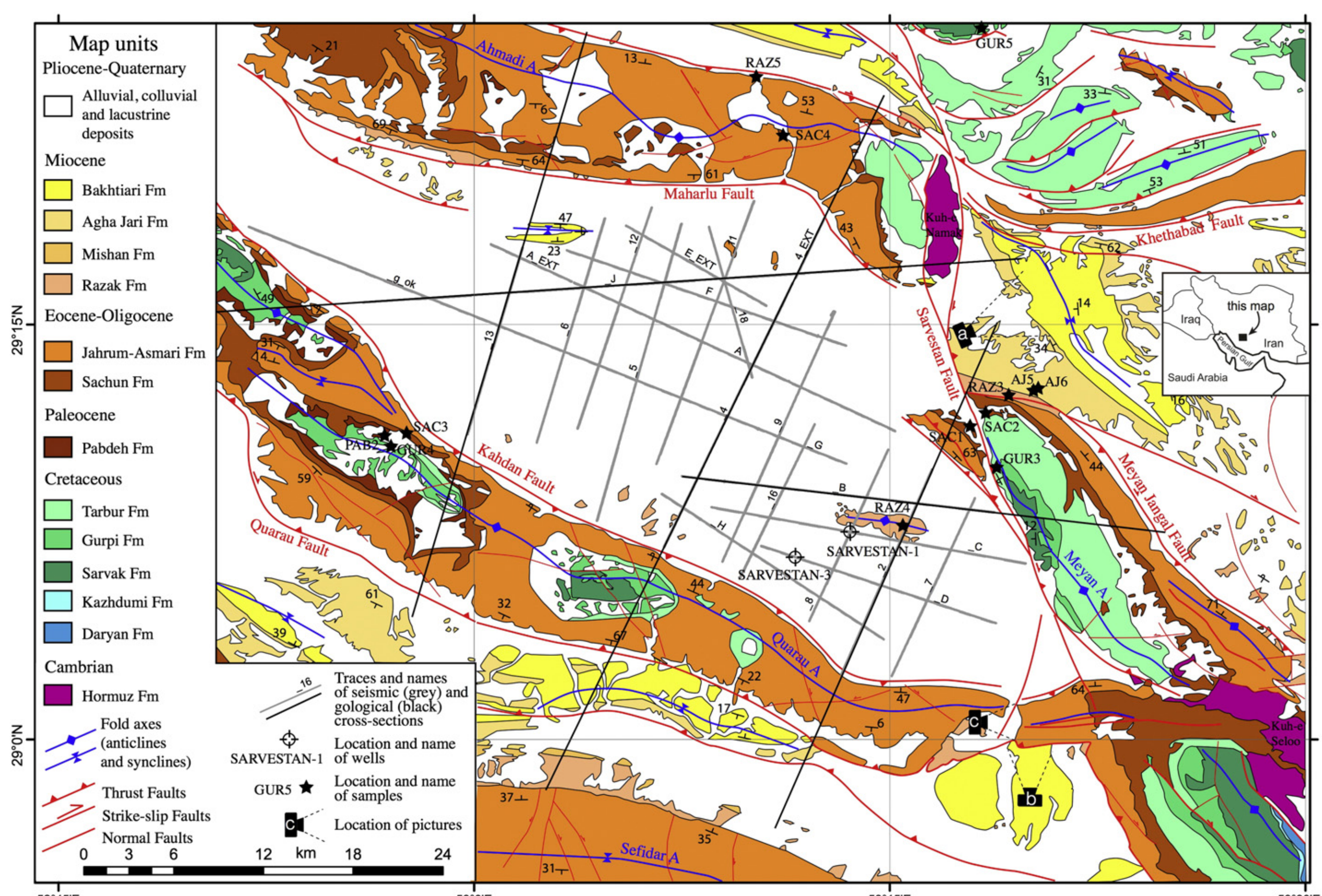

Fig. 2. Geological map of the Sarvestan area (redrawn and modified from the following 1:100,000 sheets of the geological map of Iran: Kangan no. 20867W, Kushk no. 6647, and Sarvestan no. 6648). The location of interpreted seismic lines, of the Sarvestan-1 and Sarvestan-3 wells, the traces of the cross sections and the sampling sites are also shown.