



Integrated provenance analysis of Zakeen (Devonian) and Faraghan (early Permian) sandstones in the Zagros belt, SW Iran



Yousef Zoleikhaei^{a,*}, Abdolhossein Amini^a, S. Mohammad Zamanzadeh^b

^a Geology Department, College of Science, University of Tehran, Tehran, Iran

^b Faculty of Geography, University of Tehran, Tehran, Iran

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ABSTRACT

Successions of a controversial period of time in the Zagros and Arabian Plate stratigraphic column, including Zakeen (Devonian) and Faraghan (early Permian) formations are investigated for their provenance characteristics. Nearly similar depositional environments of the formations, regardless of 70–80 My hiatus between them, is the main motivation for this study. Evidence from various methods are put together to reconstruct a comprehensive image of their provenance. Results from petrographic and detrital mode analysis indicate a continental block provenance for of the sandstones of both formations. In addition, evidence of recycling is evident from some rock fragments in the conglomeratic facies.

Heavy mineral diversities are limited to the ultra-stable species which represent consistent morphological characteristics in both formations. However, the values of rutile: zircon index (RZi) showed intermittent changes from low RZi to high RZi intervals in both formations. Detrital zircon age data in previous studies represented the same source for these two formations, which also remained unchanged from Neo-Proterozoic to late Paleozoic successions. Zircon grains' morphology, however, showed remarkable difference between the Zakeen and Faraghan formations on the one hand and successions deposited in the basin prior to the tectonic movements of mid-Paleozoic time on the other.

Outcomes of this study show that, although each single technique may shed light on a particular aspect of the greater provenance problem, by integration of all the data, important evidence of recycled nature of these successions could be confirmed. Changes in the thickness of the Paleozoic units, the nature of their stratal surfaces, along with the information from magmatic events in the area provide a tectono-stratigraphic framework for northern margin of Gondwana in which the recycled nature of these successions is justifiable. The recycled nature of the studied formations on the one hand, and their identical provenance on the other, raise a challenge for the timing proposed for two tectonic activities of middle Paleozoic and mid-Carboniferous.

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1. Introduction

The Zagros Fold-Thrust Belt extends from SE Turkey through north Syria and Iraq to W/SW Iran, with ~2000 km length and ~250 km width (Fig. 1). It is the most hydrocarbon prone fold-thrust belt in the world. This belt comprises deposits from late Precambrian to Neogene with different lithological and environmental characteristics and enormous stratigraphic and tectonic events (Alavi, 2004; Ghavidel-Syooki, 1997b, 2003; Motiei, 1993; Setudehnia, 1975; Szabo and Kheradpir, 1978). Due to the dynamic tectonics and major faults activities, the thickness of sediments in this part of the Arabian Plate reaches up to 14 km (Bahroudi and Talbot, 2003; Motiei, 1993; Stern and Johnson, 2010).

* Corresponding author. Tel.: +98 919 0136698.

E-mail address: yousef.zoleikhaei@yahoo.com (Y. Zoleikhaei).

The Devonian-early Permian deposits of this belt in SW Iran are dominated by siliciclastic successions which are known as Zakeen (Devonian) and Faraghan (early Permian) formations (Ghavidel-Syooki, 1997b). The formations were considered as a single lithostratigraphic unit of early Permian age (Faraghan Formation) (Szabo and Kheradpir, 1978). In 1997 a distinct hiatus (70–80 My long) was reported in this unit based on palynological studies (Ghavidel-Syooki, 1988, 1997a, 1977b). The new findings resulted in separating the unit into the Zakeen (deposits below the unconformity with Devonian age) and the Faraghan (deposits above the unconformity with early Permian age) formations. This 70–80 My long hiatus is interpreted as a result of mid-Carboniferous tectonism (Ghavidel-Syooki, 1997b). Despite the long-lasting hiatus in between, sedimentological and stratigraphical characteristics of the formations and their depositional environments are found to be very similar (Zamanzadeh, 2008). Considering the

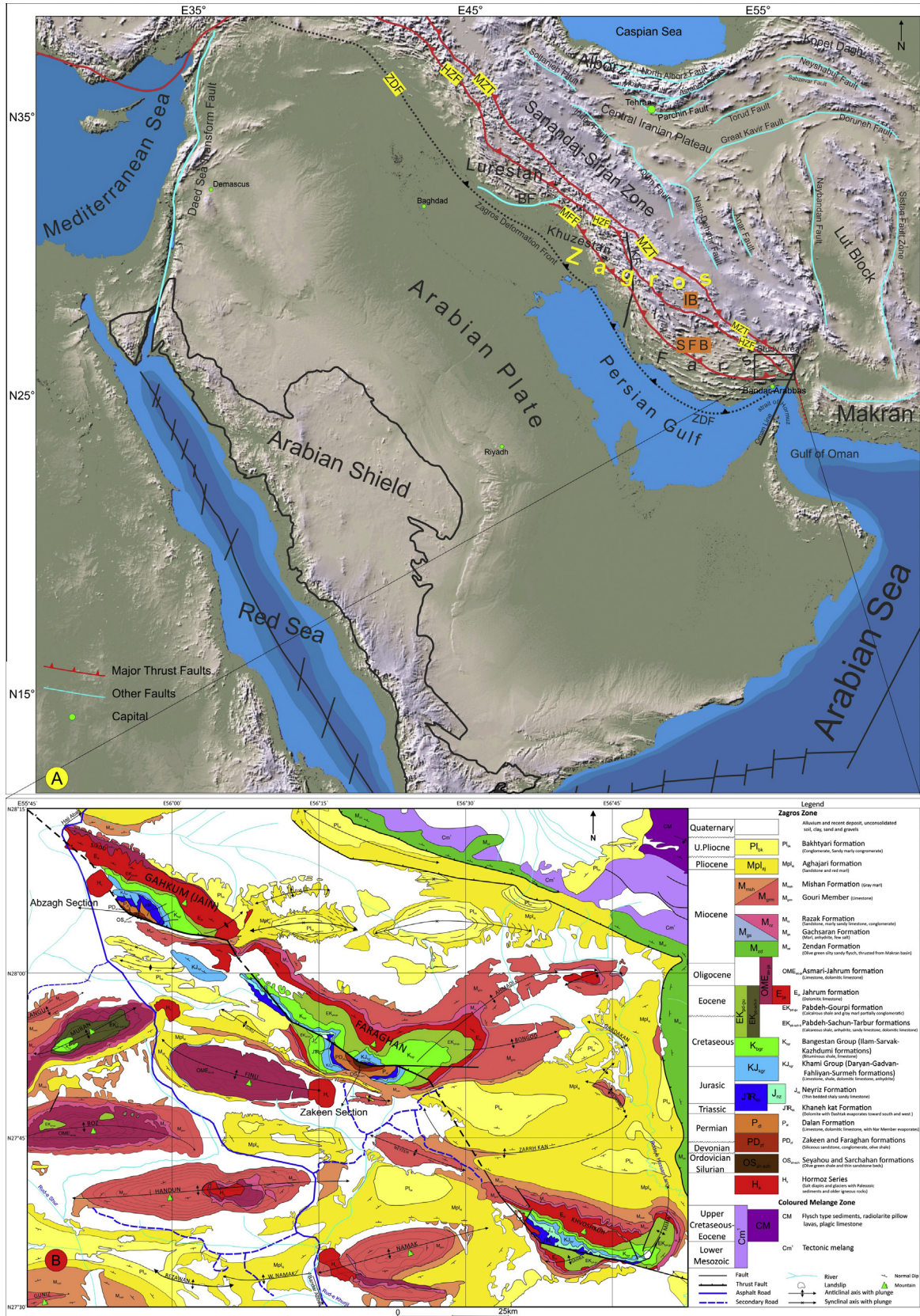


Fig. 1. (A) Regional map depicting mountain ranges, topography and major tectonic features of the Arabian Plate and Iranian Micro continents, emphasizing the position of the Zagros Fold-Thrust Belt. MZT: Main Zagros Thrust, HZF: High Zagros Fault, MFF: Mountain Frontal Fault, ZDF: Zagros Deformation Front, IB: Imbricated Belt, SFB: Simply Folded Belt, BF: Balarud Fault, KF: Kazerun Fault (base topographic map source from SRTM data). (B) Geological map of the study area (modified from Fakhari, 1994; Ghomashi, 1993).

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