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The upper Palaeozoic Godar-e-Siah Complex of Jandaq: Evidence and significance of a North Palaeotethyan succession in Central Iran

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ABSTRACT

The Upper Palaeozoic Godar-e-Siah Complex of Jandaq, Central Iran, comprises three isolated, fault-bounded outcrops exposing Palaeozoic fossiliferous carbonates, volcanics and siliciclastics, which are markedly distinct from the surrounding sedimentary successions. The three outcrops, that emerge below Cretaceous and younger sediments, are the Chah Rizab outcrop, the Godar-e-Siah northern outcrop, and the Godar-e-Siah central outcrop. Their sedimentary successions strongly differ from the typical passive margin successions of Gondwanan affinity that characterize the Yazd, Lut and Tabas blocks of Central Iran and the Alborz in North Iran. To understand the origin of these profound differences, we first calibrated the age of the Jandaq successions: U-Pb radiometric zircons ages, obtained from granitoid boulders in the conglomerates at Chah Rizab and in the Godar-e-Siah northern outcrop, gave a Late Devonian to Mississippian age. Biostratigraphic data from brachiopods and fusulinids from the Godar-e-Siah northern and central outcrops indicate a Pennsylvanian age. The age of the successions is thus post-Visean to Pennsylvanian. The petrographic composition of the siliciclastic deposits indicates the erosion of a magmatic arc. To understand where the Jandaq complex could have been located at that time, we have assessed the palaeobiogeographic affinity of the faunas. The collected brachiopods and fusulinids assemblages are mostly similar to coeval faunas from Spain, Donbass, Urals, and Yukon Territory (Canada) and have a North-Palaeotethyan affinity. The Godar-e-Siah Complex of Jandaq likely represents part of the southern active margin of Eurasia (northern margin of the Palaeotethys), in contrast to the surrounding Central and North Iran blocks, which were at that time located along the southern margin of the Neotethys.

Our investigations confirm a complex palaeogeographic evolution for the studied outcrops, suggesting that they represent fragments of the southern Eurasian active margin - today preserved in NE Iran - displaced by crustal-scale wrench motions related to the opening and closure of the Sabzear Ocean and to the Cenozoic activity of the Great Kavir-Doruneh Fault and its possible precursors.

1. Introduction

Palaeogeographic reconstructions are nowadays available for most of the Phanerozoic time intervals and for different areas. General scenarios are well-defined thanks to constraints from different datasets (e.g. stratigraphy, palaeomagnetic studies, geochronology, structural geology, palaeobiogeography). Nevertheless, additional data are continuously required to improve our knowledge of timing and areal occurrence of specific events. Palaeogeographic reconstructions are extremely complicate in the case of polyphase orogenic belts, especially when they result from the progressive accretion of different terranes, and were affected by intense post-collisional tectonics. One of this case is the Late Triassic Cimmerian orogenic event, which was preceded by a long-lasting subduction of the Palaeotethys Ocean below the Eurasian margin. The evolution of the complex jigsaw of the Cimmerian terranes, that detached from Gondwana during the Permian and later accreted to the southern margin of Eurasia, is still under debate. A key area

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for the understanding of the Cimmerian event is Iran, where remnants of subduction, collisional and post-collisional systems are preserved along the Palaeotethys suture. According to recent publications (Zanchi et al., 2009a, 2009b, 2015, 2016; Zanchetta et al., 2013), the suture zone approximately runs along the northern side of the present-day Alborz Mountains and their lateral equivalent, from the Talesh Mountains to Mashhad and Fariman in the SE part of the Kopeh Dag.

However, the occurrence of remnants of a late Palaeozoic to Triassic active margin has been recently documented also in Central Iran, otherwise considered part of the northern passive margin of Gondwana for most of the Palaeozoic (Wendt et al., 2002, 2005; Gaetani et al., 2009). These remnants occur south of the Great Kavir-Doruneh Fault, between Jandaq and Anarak (Fig. 1). The Triassic successions of the Nakhlak forearc basin, a few tens of kilometres just north of the town of Anarak (Alavi et al., 1997; Balini et al., 2009; Zanchi et al., 2009b) and the Anarak accretionary prism (Sharkovsky et al., 1984; Bagheri and Stampfli, 2008; Zanchi et al., 2015) document subduction from the late Palaeozoic to the Triassic. Moreover, Bagheri and Stampfli (2008) described upper Palaeozoic successions, possibly related to the Palaeotethys active margin, to the north of this area just south of Jandaq (Fig. 1). This emphasises the importance of carrying out additional geological studies to reconstruct the complex jigsaw puzzle of blocks and terranes that characterizes Central Iran.Despite the preliminary report of Aistov et al. (1984) and the recent advances in the geological knowledge of Jandaq (Bagheri and Stampfli, 2008), the area was still deserving additional investigations. In particular, the three isolated outcrops (Fig. 2) forming the Godar-e-Siah Complex SW of Jandaq (Aistov et al., 1984) represent key-exposures for the reconstruction of the Palaeozoic evolution of the Palaeotethys realm. The aim of this paper is to present new detailed stratigraphic, structural, petrographic, palaeontological and geochronological investigations performed on these enigmatic successions, and to discuss the obtained results in the frame of the geodynamic evolution of Central Iran during the late Palaeozoic.

2. Geological setting of Central Iran and its evolution

Central Iran forms the internal part of Iran and shows a very complex geological setting. Its most peculiar feature is the occurrence of an upper Mesozoic ophiolitic "ring", which delimits its internal part (Fig. 1). Central Iran is also affected by active strike-slip faults. The E-W trending left-lateral Great Kavir - Doruneh fault, which crosses the northern part of Central Iran, bounds at present the fault system to the north. Active deformation is accommodated within Central Iran by N-S to NNW-SSE trending dextral faults separating the Yazd, Tabas and Lut blocks (Fig. 1). These blocks, which show similar features, comprise a Precambrian metamorphic basement of Gondwanan affinity, intruded by Cadomian intrusives (Ramezani and Tucker, 2003; Rossetti et al., 2015) and locally covered by the Rizu Formation with metavolcanics, quartzites and dolostones followed by the late Ediacaran to lower Cambrian Soltanieh Formation including a thick dolomitic succession. A thick, poorly deformed Cambrian to Triassic succession, similar to the one exposed in the Alborz Mountains, is also discontinuously present in the three different blocks with local differences. This succession records the passive margin history of Central Iran from the Palaeozoic to the early Mesozoic, when it collided with Eurasia causing the formation of the Cimmerian orogen.

An extremely different evolution is instead recorded in the NW corner of Central Iran, where upper Palaeozoic to Triassic units directly related to the evolution of an active margin possibly connected to the Palaleotethys subduction have been recently documented south of the Great Kavir Fault between Anarak and Jandaq. Bagheri and Stampfli (2008) distinguished several units (Fig. 1), which mainly include the Anarak Metamorphic Complex (AMC; Zanchi et al., 2009b, 2015; Buchs et al., 2013), the Jandaq Metamorphic Complex (JMC), the Siah-e-Godar Complex and the Nakhlak arc-related succession (Alavi et al., 1997; Balini et al., 2009).

The AMC consists of a poly-metamorphic accretionary wedge characterized by a blue-schist facies metamorphic imprint. It con-

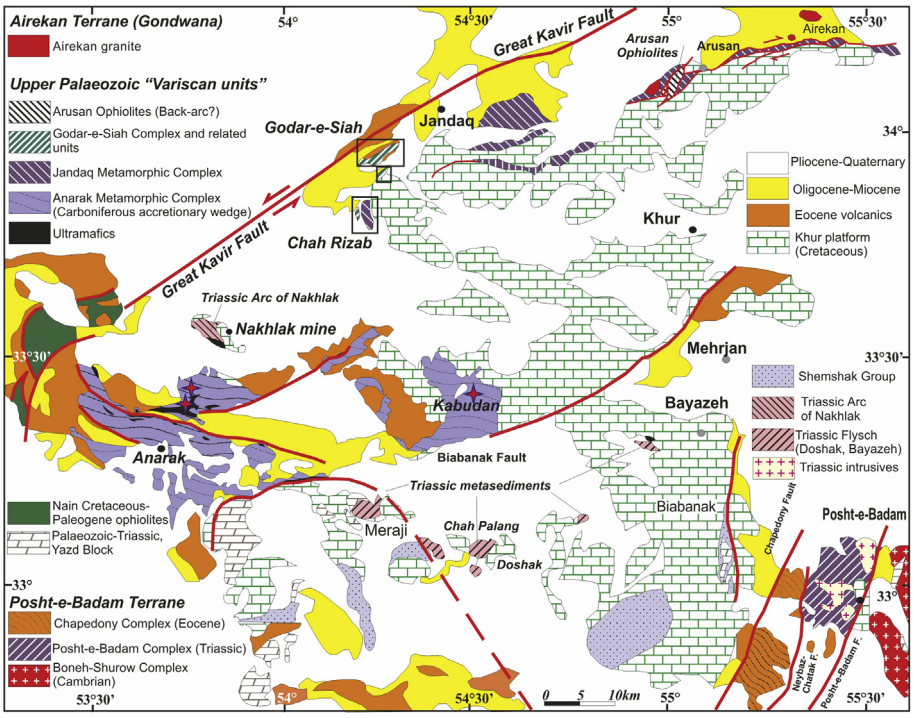

Fig. 1. Simplified geological map of Central Iran (modified from Zanchi et al., 2015). The boxes to the south-west of Jandaq indicate the position of the maps in Fig. 2.