Lithos 168–169 (2013) 33–47

Contents lists available at SciVerse ScienceDirect

Lithos

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

Geochemistry and tectonic evolution of the Late Cretaceous Gogher–Baft ophiolite, central Iran

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ARTICLE INFO

Article history:
Received 16 October 2012
Accepted 21 January 2013
Available online 10 February 2013

Keywords:
Gogher–Baft ophiolite
Geochemistry
Subduction initiation
Supra-subduction zone
Neo-Tethys
Iran

ABSTRACT

The Late Cretaceous Gogher–Baft ophiolite is one of the best preserved remnants of Neo-Tethyan oceanic lithospheric within the inner Zagros ophiolite belt. The ophiolite comprises from bottom to top, harzburgites, pegmatite and isotropic gabbroic lenses within the mantle sequence, pillowed to massive basalts to dacites and pyroclastic rocks associated with blocks of pelagic limestone and radiolarite. Basaltic to dacitic sills crosscut the pyroclastic rocks. The ophiolite sequence is overlain by Turonian–Maastrichtian pelagic limestones (93.5–65.5 Ma). Mineral compositions of harzburgites are similar to those of fore-arc peridotites and overlap with abyssal peridotites. Most Gogher–Baft ophiolite magmatic rocks show supra-subduction zone affinities, except for some E-MORB type lavas. The geochemical characteristics suggest that Gogher–Baft ophiolite magmatic rocks were generated during subduction initiation. These show progressive source depletion leading to the formation of MORB to boninitic magmas. Early E-MORB-type pillow lavas may have originated by melting mantle that was not affected by subduction components as the Tethyan oceanic plate began to sink beneath Eurasia as subduction began in the Late Cretaceous. Initial εNd (t) values range from +2.6 to +9 for Gogher–Baft magmatic rocks. Samples with radiogenic Nd overlap with least radiogenic MORBs and with Oman and other Late Cretaceous Tethyan ophiolitic rocks. The initial $^{87}Sr/^{86}Sr$ ratios range from 0.7048 to 0.7057, indicating modification due to seafloor alteration. Radiogenic $^{207}Pb/^{204}Pb$ isotopic compositions (systematically above the NHRL) and less radiogenic Nd isotopic compositions suggest the involvement of sediments in the mantle source in some magmatic rocks. Our results for Gogher–Baft ophiolite and the similarity of these to other Iranian Zagros ophiolites suggest a subduction initiation setting for the generation of these magmatic rocks.

1. Introduction

Ophiolites are relicts of oceanic lithosphere that commonly delineate suture zones between continental terranes. They are important markers of convergent margin processes and preserve the records of tectonic and magmatic events from rift-drift through subduction, accretion and collision stages of continental margin evolution (Dilek and Furnes, 2011). Ophiolites are interpreted to form in a wide variety of plate tectonic settings including oceanic spreading centers, back arc basins, fore arcs, as well as arc and other extensional settings including hotspots (Dilek et al., 2007; Kusky, 2004; Pearce and Robinson, 2010; Santosh et al., 2009; among others). Among the various categories of ophiolites, the mid-ocean ridge (MOR) and suprasubduction zone (SSZ) types constitute the major categories (Pearce et al., 1984).

The origin and tectonic evolution of ophiolites provide important constraints on the evolution of orogenic belts. Understanding ophiolites in a region such as Iran, the geologic history of which is dominated by accretionary tectonics where tectonostratigraphic terranes of different origin are now juxtaposed (Ghazi et al., 2003), is particularly important. The Zagros Orogenic Belt which formed by the most recent and ongoing accretion, reflects the Oligo-Miocene closure of Tethys. The growth of Zagros Orogenic Belt accompanies the continuing subduction of Arabia beneath Iran, with continental contact commencing at 10–20 Ma (McQuarrie et al., 2003). The abundant Zagros Orogenic Belt ophiolites thus define the evolving suture between Arabia and Eurasia.

The Zagros ophiolitic belt, of central interest to this study, lies along the NE flank of the Zagros fold-thrust belt and marks a Late Cretaceous episode of subduction initiation on the northern side of Neotethys (Shafaii Moghadam et al., 2010). Zagros ophiolites constitute the central parts of the Late Cretaceous Tethyan ophiolite belt, which extends ~3000 km from Cyprus to Oman (e.g., Alabaster et al., 1982; Dilek and Furnes, 2009; Dilek et al., 2007; Floyd et al., 1998; Garfunkel, 2006; Godard et al., 2003, 2006; Robertson and Mountrakis, 2006; Robertson, 1998, 2002; Sengor, 1990; among others). Although Zagros ophiolites make up almost half of the length of the Tethyan ophiolite belt, their

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0024-4937/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.lithos.2013.01.013

tectonic evolution is relatively poorly constrained due to limited field, geochemical and geochronological data. Zagros ophiolites can be subdivided into an “inner belt” and an “outer belt” south of the Main Zagros Thrust Fault and along the SW periphery of the Central Iranian block (Stocklin, 1977). Hereafter, we use “Outer Zagros Ophiolite Belt” and “Inner Zagros Ophiolitie Belt” for describing the two NW–SE belts containing the Neyriz-Haji-Abad and Nain -Gogher–Baft ophiolites, respectively (Fig. 1).

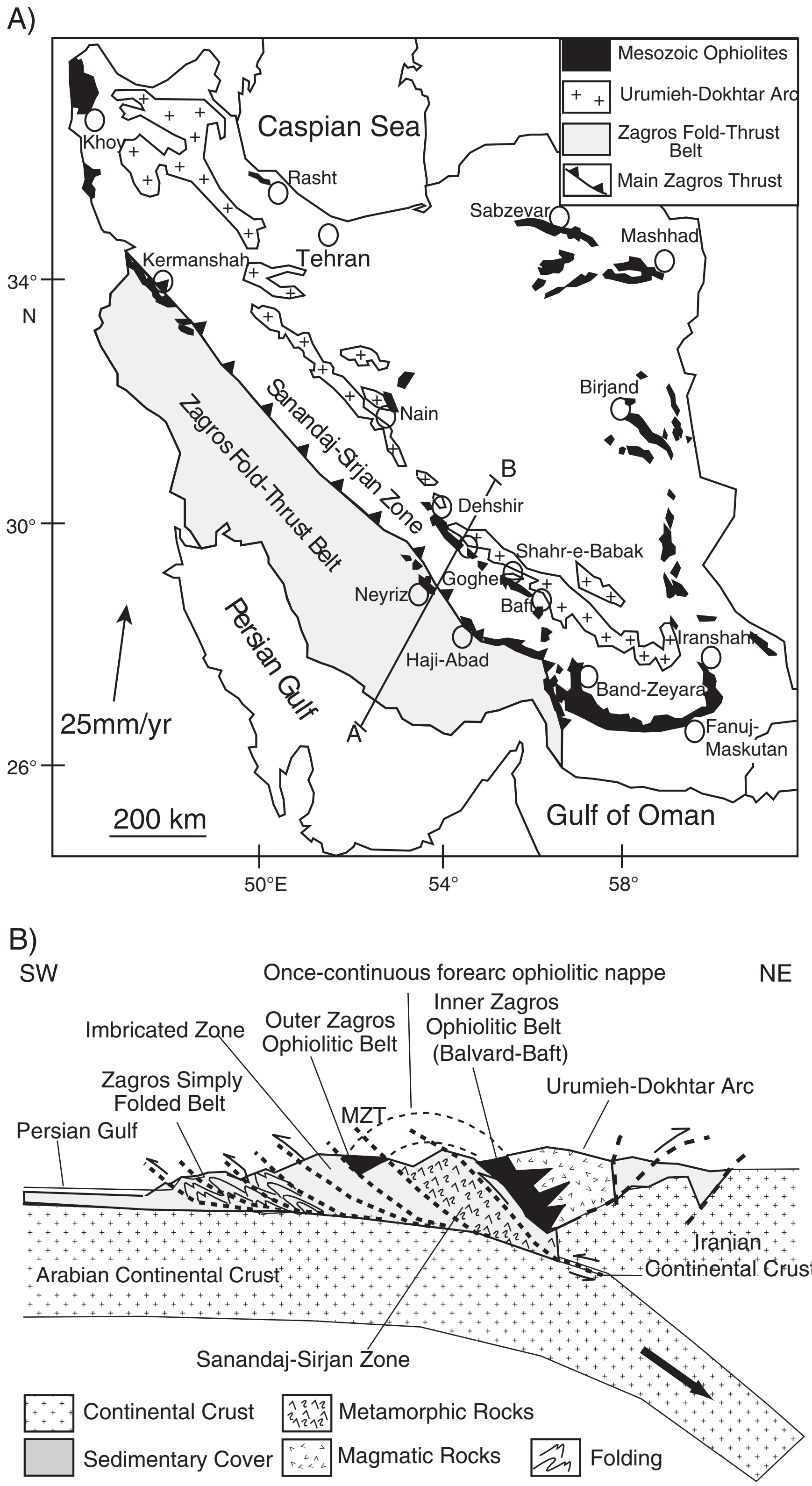

Fig. 1. (A) Map showing the distribution of the Nain-Baft (inner) Zagros ophiolitic belt, the Kermanshah-Neyriz-Haji-Abad (outer) Zagros ophiolitic belt, the location of the Urumieh–Dokhtar magmatic arc (Eocene-Quaternary), and the main Zagros thrust (MZT). (B) Schematic cross section showing the relations between the outer and the inner Zagros ophiolitic belts and the Zagros thrust-fold belt (after Shafaii Moghadam et al., 2010).