



Supra-subduction zone tectonic setting of the Muslim Bagh Ophiolite, northwestern Pakistan: Insights from geochemistry and petrology



Mohammad Ishaq Kakar^a, Andrew C. Kerr^{b,*}, Khalid Mahmood^c, Alan S. Collins^d, Mehrab Khan^e, Iain McDonald^b

^a Centre of Excellence in Mineralogy, University of Balochistan, Quetta, Pakistan

^b School of Earth and Ocean Sciences, Cardiff University, Main Building, Park Place, Cardiff, Wales CF10 3AT, UK

^c Department of Earth Sciences, University of Sargodha, Sargodha, Pakistan

^d Tectonics, Resources and Exploration (TRaX), School of Earth and Environmental Sciences, University of Adelaide, SA 5005, Australia

^e Department of Geology, University of Balochistan, Quetta, Pakistan

ARTICLE INFO

Article history:

Received 30 October 2013

Accepted 31 May 2014

Available online 6 June 2014

Keywords:

Ophiolite

Tethyan

Bagh Complex

Geochemistry

Cretaceous

ABSTRACT

The geology of the Muslim Bagh area comprises the Indian passive continental margin and suture zone, which is overlain by the Muslim Bagh Ophiolite, Bagh Complex and a Flysch Zone of marine–fluvial successions. The Muslim Bagh Ophiolite has a nearly-complete ophiolite stratigraphy. The mantle sequence of foliated peridotite is mainly harzburgite with minor dunite and contains podiform chromite deposits that grade upwards into transition zone dunite. The mantle rocks (harzburgite/dunite) resulted from large degrees of partial melting of lherzolite and have also been affected by melt–peridotite reaction. The Muslim Bagh crustal section has a cyclic succession of ultramafic–mafic cumulate with dunite at the base, that grades into wehrlite/pyroxenite with gabbros (olivine gabbro, norite and hornblende gabbro) at the top. The sheeted dykes are immature in nature and are rooted in crustal gabbros. The dykes are mainly metamorphosed dolerites, with minor intrusions of plagiogranites. The configuration of the crustal section indicates that the crustal rocks were formed over variable time periods, in pulses, by a low magma supply rate. The whole rock geochemistry of the gabbros, sheeted dykes and the mafic dyke swarm suggests that they formed in a supra-subduction zone tectonic setting in Neo-Tethys during the Late Cretaceous. The dykes of the mafic swarm crosscut both the ophiolite and the metamorphic sole rocks and have a less-marked subduction signature than the other mafic rocks. These dykes were possibly emplaced off-axis and can be interpreted to have been generated in the spinel peridotite stability zone i.e., <50–60 km, and to have risen through a slab window. The Bagh Complex is an assemblage of Triassic–Cretaceous igneous and sedimentary rocks, containing tholeiitic, N-MORB-like basalts and alkali basalts with OIB-type signatures. Nb–Ta depletion in both basalt types suggests possible contamination from continental fragments incorporated into the opening Tethyan oceanic basin during break-up of Gondwana. The lithologies and ages of the Bagh Complex imply that these rocks formed in an area extending from the continental margin over the Neo-Tethyan ocean floor. The Bagh Complex was then juxtaposed with the Muslim Bagh Ophiolite in the final stage of tectonic emplacement.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Ophiolites are fragments of oceanic lithosphere that have been emplaced tectonically along continental margins in accretionary prisms during orogenic processes. They either are intact; having almost a complete stratigraphy, or are preserved in a dismembered state i.e., an ophiolitic mélange (e.g., Robertson, 2002). The Muslim Bagh Ophiolite, in Balochistan, Pakistan is a relatively intact ophiolite consisting of thick mantle peridotites, with a mantle–crust transition zone which passes into layered ultramafic–mafic cumulates and a less well-

developed sheeted dyke complex with no basaltic extrusive cover (Figs. 1, 2).

Two tectonic models have been proposed for Muslim Bagh Ophiolite; a back-arc basin (BAB) setting (Siddiqui et al., 1996) and a composite tectonic setting (M. Khan et al., 2007). The latter has divided the ophiolite into two nappes; 1) an ophiolite sequence of island arc affinity and 2) the underlying Bagh Complex which was interpreted to have formed in a mid-ocean ridge setting. However, detailed mapping of the ophiolite (Kakar, 2011), the Bagh Complex (Mengal et al., 1994; Naka et al., 1996) and the metamorphic sole (Kakar et al., 2012) along with the new geochemical analysis reported in this paper, indicates that both previous interpretations are problematic. The objectives of this paper are therefore to test and evaluate the previous hypotheses

* Corresponding author.

E-mail address: kerra@cf.ac.uk (A.C. Kerr).

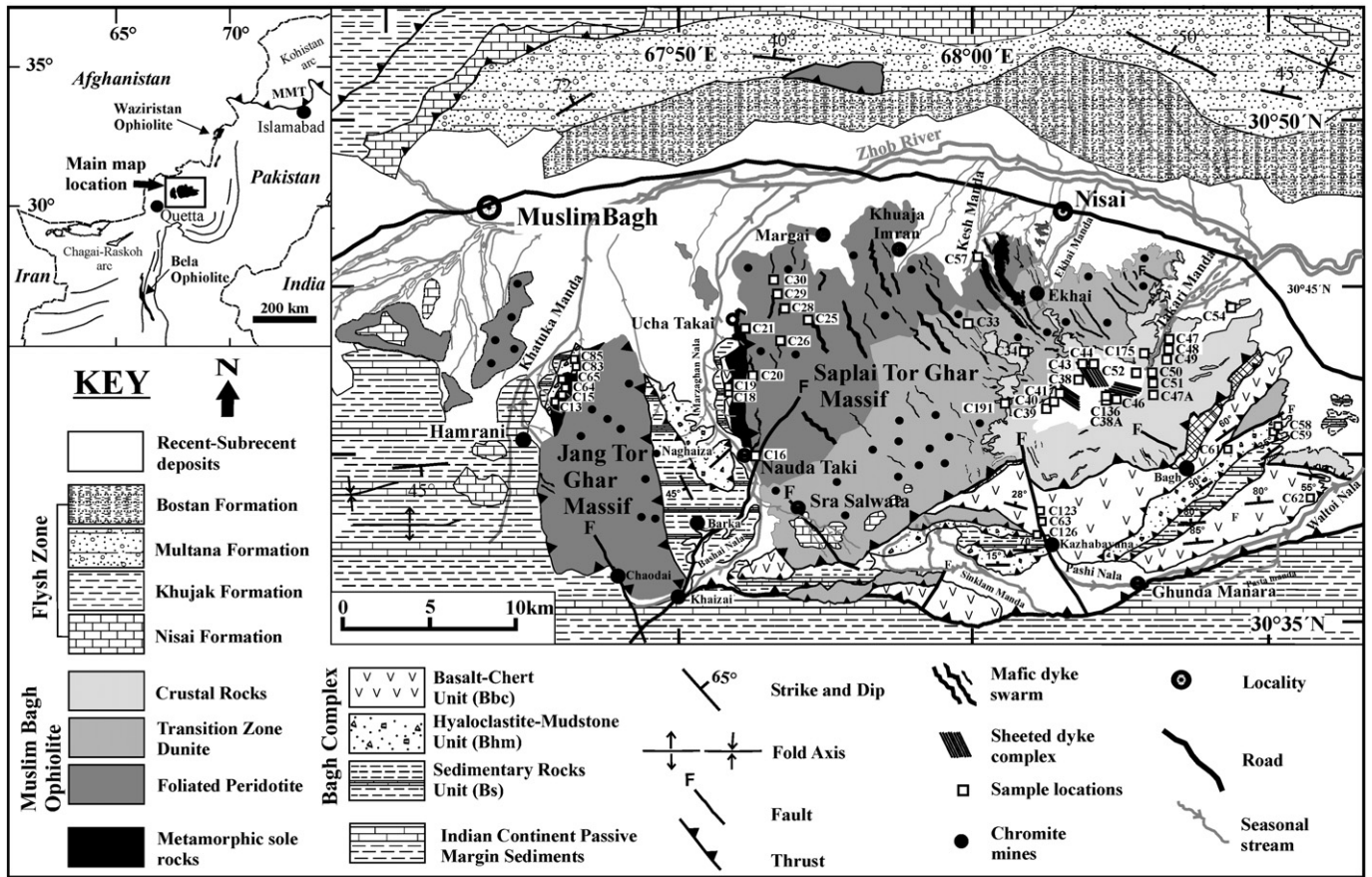


Fig. 1. Geological map of the Muslim Bagh area showing the Muslim Bagh Ophiolite, the Bagh Complex, the Flysch Zone and the Indian passive margin sediments (after Hunting Survey Corporation, 1960; Siddiqui et al., 1996; Van Vloten, 1967 and this study).

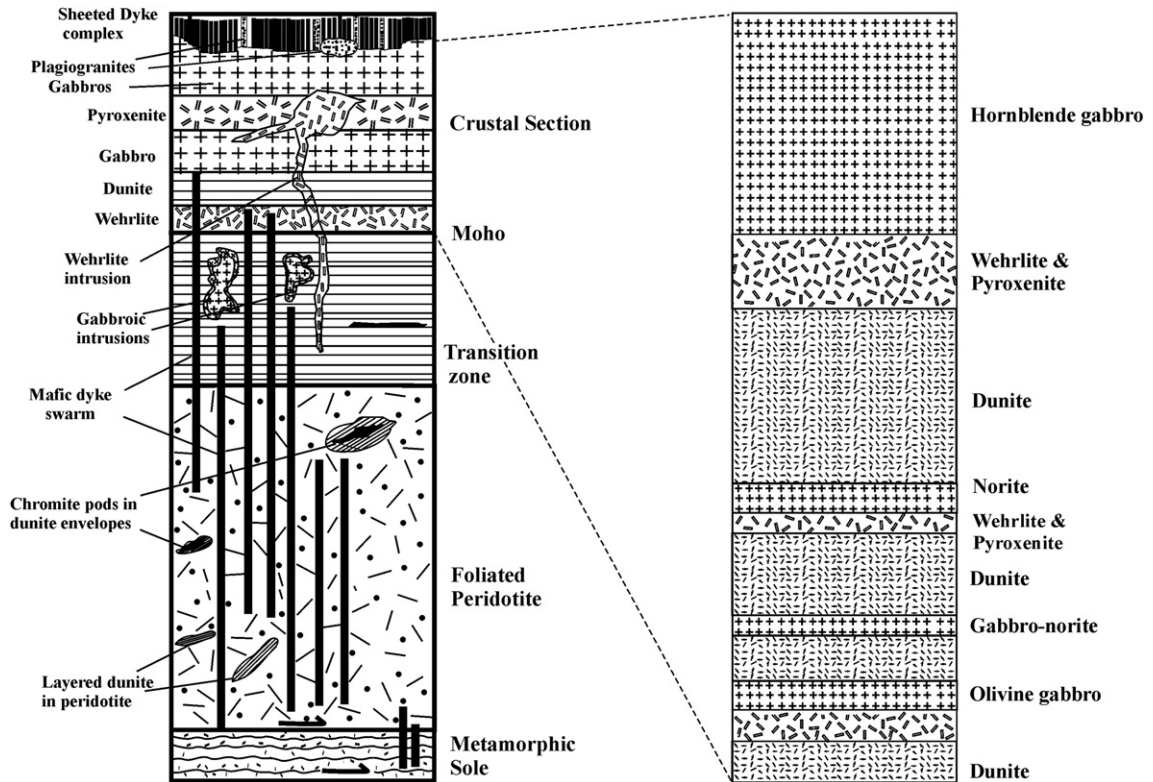


Fig. 2. Schematic log of the Muslim Bagh Ophiolite showing the ophiolite suite and the attached metamorphic sole rocks. Not to scale. The inset is log of the cumulate sequence of the crustal rocks from the Muslim Bagh Ophiolite (after Salam and Ahmed, 1986).

Download English Version:

<https://daneshyari.com/en/article/4715880>

Download Persian Version:

<https://daneshyari.com/article/4715880>

[Daneshyari.com](https://daneshyari.com)