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Origin and evolution of Suru Valley ophiolite peridotite slice along Indus suture zone, Ladakh Himalaya, India: Implications on melt-rock interaction in a subduction-zone environment

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ABSTRACT

In this paper, we present whole-rock and mineral geochemistry of serpentinized peridotites from the Suru Valley ophiolite slice Ladakh Himalaya, in an attempt to put constraints on their petrogenesis and tectonic evolution in the context of Mesozoic Neo-Tethys Ocean. On the basis of petrographic study, Suru Valley serpentinized peridotites can be identified as serpentinized harzburgites. Relative to primitive mantle these rocks have depleted major and rare earth element (REE) geochemical characteristics comparable to ocean floor mantle rocks reflecting their mantle residual nature. However, higher abundance of highly incompatible large ion lithophile elements (e.g., Rb, Ba, Th, U, Pb and Sr), reflect metasomatism in a subduction zone environment. The presence of silicate assemblage includes Mg-rich olivine (Fo_{90-92}) and orthopyroxene (En_{91-93} $Fs_{6.4-8.7}$) of supra-subduction zone affinity. Evaluation of mineral and whole-rock geochemistry suggests that the Suru Valley ophiolitic peridotites represent residues left after moderate degrees of partial melting thereby underwent metasomatism in a supra-subduction zone environment related to north dipping intra-oceanic island arc during Cretaceous in the context of Mesozoic Neo-Tethys ocean.

1. Introduction

Ophiolites are the obducted fragments of fossil oceanic lithosphere generally found along orogenic belts (Cann, 1970; Dewey and Bird, 1971; Coleman, 1977; Nicolas, 1989), formed by seafloor spreading in ancient ocean basins, and are of significance to our understanding of plate reconstruction and orogeny (Dilek and Flower, 2003; Dilek and Furnes, 2011). In north-western Ladakh Himalaya mafic and ultramafic rocks with well-preserved oceanic features occur along the Indus Suture Zone (ISZ) and represent the remnants of Mesozoic Neo-Tethys Ocean (Gansser, 1964, 1980; Frank et al., 1977; Srikantia and Razdan, 1980; Honegger et al., 1982; Searle et al., 1987; Radhakrishna et al., 1987; Sinha and Mishra, 1992; Mahéo et al., 2004; Ahmad et al., 2008).

In Ladakh Himalaya, ophiolitic rocks are reported as isolated tectonic slabs all along the ISZ from west to east for about 400 km length (Frank et al., 1977; Gansser, 1980; Srikantia and Razdan, 1980; Prasad et al., 1982; Honegger et al., 1982; Deitrich et al., 1983; Robertson, 2000; Mahéo et al., 2004; Ahmad et al., 2008). In Kargil district of Ladakh, the ophiolitic peridotites are best exposed towards west of Dras area at Thasgam and Khiber on opposite banks of Dras river along Srinagar-Leh National highway, in Suru valley south of Kargil and at Shergol village, east of Kargil. In Suru valley, ophiolitic slice is outcropped at Trespone village, 30 km south of Kargil, predominantly consists of serpentinized ultramafic rocks and are stratigraphically overlain by Dras-1 subunit (older and metamorphosed lower unit of Reuber, 1989) belonging to Suru unit of Late Cretaceous Dras arc complex (Robertson and Degnan, 1994; Robertson, 2000). Earlier Radhakrishna et al. (1987) studied the geochemistry of Dras ophiolitic plutonic rocks i.e., ultramafics and gabbros exposed near Dras and Thasgam areas and suggested a mid ocean ridge tectonic setting. Robertson (2000) described these dismembered serpentinized peridotite sheets cut by subduction influenced diabase dykes as detached oceanic basement related to the oceanic Dras arc complex based on detailed tectonostratigraphic and petrological study. Recently Bhat et al. (2017a, 2017b, 2018) studied the geochemistry of Shergol serpentinized ophiolitic peridotites and inferred mid ocean ridge tectonic origin influenced by subduction metasomatism.

In this contribution, we present whole rock major, trace and silicate

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