Petrology and geochemistry of the dykes from the Muslim Bagh Ophiolite Balochistan, Pakistan

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Abstract

Two different categories of dykes are found in Muslim Bagh Ophiolite; sheeted dyke complex; and the mafic dyke swarm. The sheeted dyke complex comprises of metadolerites, plagiogranites and diorites and has a poorly-developed nature with a comparatively well-developed plutonic section underneath. This configuration of the Muslim Bagh crustal rocks implies that the sheeted dykes have formed in a oceanic setting with the low magma supply in pulses and in different times, that fractionated; possibly, a thick accumulation of cumulate rocks in the magma chamber, and resulted in a less well-developed sheeted dyke complex. Both the sheeted dykes and dyke swarms are hydrothermally metamorphosed to greenschist and amphibolite schist rocks. Except the upper level gabbros, the dyke swarms almost crosscut the whole ophiolite sequence including the metamorphic sole rocks but are truncated structurally at the contact with the underlying mélange and sediments. The relationship between the dykes and ophiolitic rocks indicate that dyke swarms' emplacement postdated formation of the Muslim Bagh Ophiolite and the formation of metamorphic sole rocks. However, the dyke's intrusion predates the accretion of mélange the final emplacement of ophiolite onto the Indian continent margin. Both the sheeted dykes and dyke swarms show geochemical composition of being tholeiitic in nature, and have the geochemical characteristics between the Mid-oceanic ridge basalt (MORB) and Island arc tholeiite (IAT). These geochemical characteristics are evidenced by the higher contents of large ion lithophile elements (LILEs) and flat pattern of the high field strength elements (HFSEs) and with no depletion in the light rare earth elements (LREEs) and almost straight pattern of heavy rare earth elements (HREEs). Generally oceanic rocks exhibiting such characteristics are thought to have involvement of subduction component in the source region by fluids along the subduction zone and are formed in a supra-subduction zone tectonic setting. The Muslim Bagh Ophiolite sheeted dykes originated in the late Cretaceous, in a supra-subduction zone tectonic setting related to the west or northwest dipping subduction of a narrow branch of Neo-Tethyan Ocean, followed by subduction rollback due to splitting of the nascent arc in the Neo-Tethyan Ocean. This intra-oceanic subduction led to the formation of a metamorphic sole, followed by the intrusion of mafic dykes into the ophiolite, off-axis, through a slab window. The Muslim Bagh Ophiolite accretes the Bagh Complex and finally obducted over the Indian Platform.