Geochemical characteristics of effusive rocks (greenstones) in the Hidaka Belt, Hokkaido, Japan

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Igneous rocks in a subduction complex typically occur as greenstones, and petrological and geochemical investigations of such greenstones can provide important insights into the oceanic magmatism, origin of the accretionary complex, and growth of the continental margin. The Hidaka Belt in Central Hokkaido, Japan consists of an early Paleogene subduction complex, referred to as the Hidaka Supergroup (HSG), dominated by clastic rocks. Locally, the terrigenous sediments of the HSG were intruded by the contemporary, normal-type mid-ocean ridge basalts (“*in situ*N-MORBs”) that were formed at an oceanic ridge near the Eurasian continent (Miyashita and Katsushima, 1986: GSJ). The southern area of the HSG has been referred to as the Nakanogawa Group (NKG), which gradually leads to the high-temperature Hidaka metamorphic belt (HMB) in the western part. The lower sequence of the HMB consists mainly of high-grade metabasites, which are assumed to be equivalent to the N-MORBs in the HSG, based on their geochemical features. Recently, Yamasaki and Nanayama (2018a: Lithos) reported about the unique Daimaruyama greenstones from the NKG, formed by an immature intra-oceanic arc-type volcanism. In addition, highly-alkaline basalts, presumably formed at the seamount, exist as exotic blocks in the NKG and are named as Tachiiwa blocks (Owada et al., 1992: JMPEG). In fact, the N-MORBs in the HSG and the Tachiiwa alkaline rocks are characterized by the whole-rock major and minor element geochemistry, but the trace element geochemistry, including the rare earth elements (REEs), has not been reported yet for these rocks. Therefore, we collected 18 samples of greenstones from the entire Hidaka Belt and examined their whole-rock major and trace element geochemistry.

Including those in our previous reports (Yamasaki and Nanayama, 2018a, b: JpGU Abs.), there are three distinct types of greenstones in the Hidaka Belt. The first type are the MORB-type greenstones which show relatively flat chondrite-normalized (CN) REE patterns and N-MORB-normalized (NMN) multi-element patterns with Ti/V = 26–53 and Zr/Nb = 21–117. Although Miyashita and Kiminami (1999: MemGSJ) showed the flat NMN minor element (Nb, P, Zr, Ti, and Y) patterns of basalts from the northern HSG, trace element patterns of the MORB-type rocks in this study show rather light REE (LREE)-rich NMN multi-element patterns. The second type are the ocean island basalt (OIB)-type greenstones. The NMN multi-element and CN REE patterns for this type of greenstones show a gentle slope up to the left, with Ti/V>62 and Zr/Nb<15. The third type are the Daimaruyama greenstones. This type of greenstones show similar NMN multi-element patterns and CN REE patterns to those in the OIB-type, but with a clear relative depletion of Nb, Ta, and Ti. In addition, their Ti-V relations are similar to those in the MORB-type greenstones.

MORB-type greenstones are distributed from the northernmost part of the HSG to the southern Rakko River area in the NKG. OIB-type greenstones occur in the Tachiiwa block and the Rakko River area. Daimaruyama greenstones occur only in the Daimaruyama megablock in the NKG. Since the Tachiiwa and Daimaruyama blocks are presumably derived from the neighboring Tokoro Belt, the absence of the OIB-type and Daimaruyama greenstones in the northern HSG implies a difference in provenance between the HSG and NKG. The MORB-type greenstones do not show the typical N-MORB-type (LREE-depleted) trace element patterns, whereas the metabasite in the HMB shows the typical N-MORB-type geochemical features. In addition, the distribution of the MORB-type greenstones is separated from the metabasites of

the HMB in the southern Hidaka Belt. These lines of evidence suggest that the protolith of the HMB is not an equivalent of the “*in-situ*MORB” in the HSG, and is probably an accreted fragment of the older oceanic plate.

Keywords: Hidaka Belt, greenstones, trace elements

