

Anatomy of the Cretaceous Shaku-dake High-Mg diorite (HMD) intrusion, north Kyushu, SW Japan: Sheet on sheet model, and its genesis

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The formation of plutons has fundamental implications for the geological linkage between volcanism and plutonism (e.g., Lipman, 2007; Macdonald et al., 2014), and ultimately for our understanding of the growth and evolution of the Earth's crust (e.g., Bachl et al., 2001; Annen, 2011; Menand et al., 2011). Much of the research on magmatic intrusions has focused on the mechanics and dynamics of dikes, which are the main agent for the vertical transport of magma through the crust (e.g., Lister and Kerr, 1991; Rubin, 1995; Menand and Tait, 2002). In comparison, that on sills has been discussed mainly on the mechanical and dynamical aspects of the propagation of sills, and on the deformation induced by sill intrusions (Pollard, 1973; Pollard and Holzhausen, 1979; Fialko et al., 2001; Malthe-Sørenssen et al., 2004). In recent years, however, the supply and emplacement mechanism of sills have been clarified from both of the detailed field research and experimental works using gelatin as natural analogs (Kavanagh, 2006; Menand, 2008, 2011). They stressed that such an emplacement mechanism gives an important role in the crustal evolution. Therefore, we performed the geological and petrological investigations and clarified a petrological character of magmatic processes, plumbing system, and growth process of the Shaku-dake high-Mg diorite (HMD) intrusion from the Cretaceous northern Kyushu batholith, Southwest Japan. It can contribute to the elucidation of large-scale igneous activity in northern Kyushu during the Cretaceous.

The granodiorites, the main constituent rock type of the Cretaceous batholiths from northern Kyushu, show the zircon U–Pb ages of 104–102 Ma, and are accompanied coevally by fine-grained gabbro to diorite (e.g., Adachi et al., 2012; Tiepolo et al., 2012). Recently, the gabbro to diorite with the high-Mg andesite (HMA) compositions, referring to high-Mg diorite (HMD), has been reported (e.g., Kamei et al., 2004; Yuhara and Uto, 2007; Eshima and Owada, 2018; Eshima et al., 2019). The mantle-derived mafic magma is strongly involved in the origin of granitic magma as a parent magma and/or a heat source of crustal melting. The geology of Mt. Shaku-dake is composed of two-pyroxene diorite (TPD) and various dikes that intrude the Wakino sub-group as the host rock. The dikes are divided into five types; dolerite (Do), porphyritic fine-grained tonalite (PFT), clinopyroxene granodiorite (CG), hornblende-biotite granodiorite (HBG), and fine-grained biotite granite (FBG). In addition, the TPD intrudes into the host rock (Wakino sub-group) as the sheet converted from the vertical dike; thereby, suggesting the feeder dike. The TPD shows lithological variations on the metric and centimeter scales with different mineral mode and grain size. These field occurrences suggest that there were multiple injections of magma through the feeder dike before the TPD intrusion was fully consolidated. That is to say, the TPD intrusion is considered to be grown by the loading of sills and to bring to various compositional changes.

Keywords: sheet on sheet model, 3D model, high-Mg diorite (HMD), magma process

