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Crystal differentiation trend of TTG rocks

Yoshiaki Kon[1*], Tsuyoshi Komiya[2]

[1]Geological survey of Japan, AIST, [2]University of Tokyo

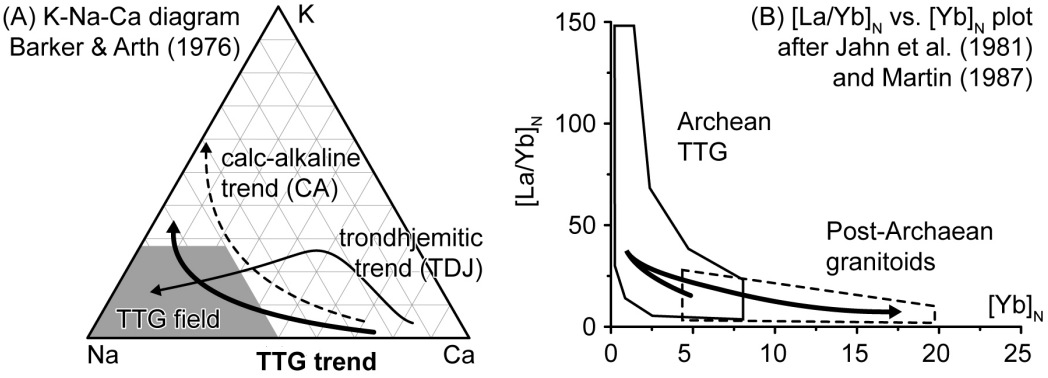
Continental crust is the key and unique system of the Earth, thus its formation and growth strongly affect not only dynamics and evolution of the solid Earth but also climate and biological evolution on the surface. TTG (tonalite, trondhjemite, granodiorite) has an important role for continental growth of early earth, and its origin has been investigated. It is essential to estimate chemical compositions of the primitive magma that to understand the compositional changing along fractional crystallization and crustal assimilation. In this presentation, chemical compositions of TTG are compiled, and we make a revisional study for its fractional crystallization trends.

Major element : Although TTG is a part of *sensu lato* calc-alkaline series, it is distinguished from *sensu strict* calc-alkaline series (Nockolds and Allen, 1953) by its high Na-content (Fig. A). Generally, *sensu lato* calc-alkaline series shows positive correlation between Ca content and K/Na ratio. This trend was determined using Ca-Na-K composition of andesitic to granitic rocks (Nockolds and Allen, 1953; Barker and Arth, 1976). On the other hand, a trondhjemite-trend has negative correlation between Ca content and K/Na ratio (TDJ trend: Barker and Arth, 1976). However, this trend was determined using Archean bimodal trondhjemite-basalt suite, and there was no typical correlation among granitic rocks. Therefore, Martin (1994) proposed a trondhjemite (TDH)-field which Na-rich granitoids were classified (Fig. A). However, TDJ trend was still used as a fractional crystallization trend of TTG rocks, to distinguish from *sensu lato* calc-alkaline trend.

However, each TTG suits have also positive correlation between Ca content and K/Na ratio (e.g. Kleinhanns et al., 2003). It suggests that TTG rocks has a fractional crystallization trend, and it changes along *sensu lato* calc-alkaline trend (Fig. A).

REE : Adakite are and/or Achaean TTG are well known as a HREE-depleted rocks, and its origins are considered as a partial-melting of hydrated basalts under garnet-stability field (e.g. Arth and Hanson, 1972). To discriminate these rocks, $[La/Yb]_N$-$[Yb]_N$ plot has been used (Fig. B: Jahn et al.,1981). Although, these rocks have high $[La/Yb]_N$ ratio (5-150) and low $[Yb]_N$ value ($<$8.5) (Martin, 1987), most samples have relatively low $[La/Yb]_N$ ratio ($<$50). For some adakite, $[La/Yb]_N$ has positive correlation to SiO_2 content while SiO_2 content was low, and it has negative correlation to SiO_2 content while SiO_2 content was high (e.g. Richards and Kerrich, 2007). It was well explained by fractional crystallization of hornblende and plagioclase. It means that HREE-depleted granitoids can also made by fractional crystallization.

References Arth and Hanson (1972) *Contrib. Min. Pet.*, **37**, 161-174., Barker and Arth (1976) *Geology*, **4**, 596-600., Jahn et al (1981) *Geochim. Cosmochim. Acta*, **45**, 1633-1652., Kleinhanns et al (2003) *Contrib. Min. Pet.*, **145**, 377-389., Martin (1987) *Precam. Res.*, **35**, 257-276., Martin (1994) *Archean Crustal Evolution*, 205-259., Nockolds and Allen (1953) *Geochim. Cosmochim. Acta*, **4**, 105-142. , Martin (1994) *Archean Crustal Evolution*, 205-259., Richards and Kerrich (2007) *Economic Geol.*, **102**, 537-576.



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