Mineralogy, Geochemistry and Geochronology of pegmatites and associated alkaline granite rocks of the Khan Bogd complex, South Mongolia

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ABSTRACT

Pegmatites occur as zoned lenses or layered rocks in the cupola of the Khan Bogd alkaline granite, Mongolia. Their emplacement occurred during repeated ductile-to-brittle transitions, which resulted in sudden pressure drops, undercooling and consequent formation of unidirectional solidification textures. The geochemistry of the alkaline granites of the Khan Bogd complex is compatible with a post-orogenic or anorogenic environment. A high precision U-Pb zircon age on a granite sample of the western body has yielded a concordia age of 292±0.51 Ma, in agreement with previous geochronological data.

Key-words: *Khan Bogd, pegmatite, alkaline granite, zircon.*

INTRODUCTION

In this contribution we present new data on the mineralogy, geochemistry and geochronology of rare metal (REE, Nb, Zr, ± Ta, Hf, Th) pegmatites and their host rocks, the Khan Bogd alkaline granite complex, situated in the Gobi desert, south Mongolia.

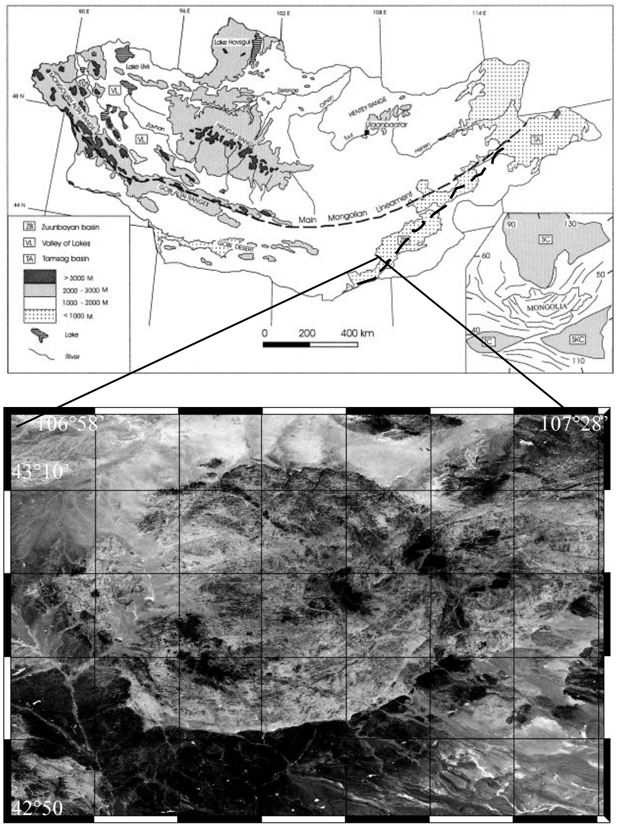

FIGURE 1. Top: Geological setting of the Khan Bogd complex (from Badarch et al., 2002). Bottom: Satellite Image (Landsat 7).

The Khan Bogd alkaline granite complex consists of two ring bodies (eastern and western) covering a surface area >1500 km^2 (Figure 1), and intruding sedimentary and volcanic rocks of the Ordovician-Devonian Gurvansayhan Island arc Terrane and its cover.

The Khan Bogd alkaline granite complex consists of different intrusive phases including, according to Kovalenko et al. (2006), (i) elpidite-bearing aegirine-arfvedsonite alkaline granite of the main intrusive phase, making up the majority of the western body, (ii) aegirine(-arfvedsonite) granite, sometimes with greisen-type alteration and fluorite, making up the majority of the eastern body, (iii) ekerite dikes, layered ekerite-pegmatite-aplite, and pegmatite bodies in the western body, (iv) pantellerite dikes, (v) dikes of alkali leucogranite porphyry, and (vi) red microgranosyenite and micromonzonite dikes in the western body.

The Khan Bogd alkaline granite complex contains many xenoliths, whose abundance increases approaching the contact of the complex with the roof consisting of either dark grey volcanic rocks of the island arc complex or a pink porphyritic granite.

The age of the alkaline Khan Bogd complex has been determined both by K-Ar on riebeckite (287± Ma) (Kovalenko and Yarmolyuk, 1995) and more recently by U-Pb on zircon (290±1 and 292±1) of different phases of the complex (Kovalenko et al., 2006).

MINERALOGY AND TEXTURES OF THE PEGMATITES

The Khan Bogd pegmatites occur with two different geometries: (i) as zoned lenses 5 to 100 meter long, and (ii) as layers in alternation with aplite and ekerite. In both cases pegmatites occur in the cupola of the western body, often near the contact with the host rock at the roof. In the zoned lenticular pegmatites, the core consists exclusively of quartz or quartz-K-feldspar, sometimes in large pluridecimetric crystals. The first outer zone after the quartz core, bears aegirine-K-feldspar as main minerals, and is followed outwards by a zone with elpidite ($Na_2Zr(Si_6O_{15})*3H_2O$), and an outermost zone with arfvedsonite as the main mineral.

The rhythmically layered pegmatite-aplite-ekerite alternations present textures that indicate their formation at the brittle-ductile transition zone, such as plastic folding of the layers and intra-layer-faults. A sudden rupture of plastic rocks, either due to fluid pressure build-up or tectonic deformation, may result in an abrupt pressure decrease. In turn, the latter may be responsible for significant undercooling, resulting in the formation of line rocks or unidirectional solidification textures in the pegmatite-aplite environment (Webber et al., 1997), through repeated cycles of brittle-to-ductile transitions. The aplites associated with the pegmatites in the layered rocks are either fine-grained leucocratic, or have a spotty appearance, derived from the late crystallization of arfvedsonite in the interstices of quartz and K-feldspar crystals.

GEOCHEMISTRY AND GEOCHRONOLOGY

We have analyzed 57 samples of whole rocks from the Khan Bogd alkaline complex for major and trace element geochemistry, including samples from the western and eastern bodies, aplite and ekerite dikes, and three non-mineralized pegmatites.

Whole rock samples of both the western and eastern bodies fall in the A2 field of the classification of anorogenic granites (Eby, 1992), suggesting a possible origin from magmas derived from the continental crust or underplated crust that has undergone a continent-continent collision or island-arc magmatism. The geochemistry of the eastern and western bodies differs by the slightly higher content of incompatible elements (Rb, Y, Nb) and by the lower Fe_2O_3 content (1-2 wt.% versus 5-6 wt.%) in the eastern body granite, compared to the western body. Lead isotope analyses of K-feldspars from the western body of the Khan Bogd granite and from the associated pegmatite are in progress to better constrain the source of the magma.

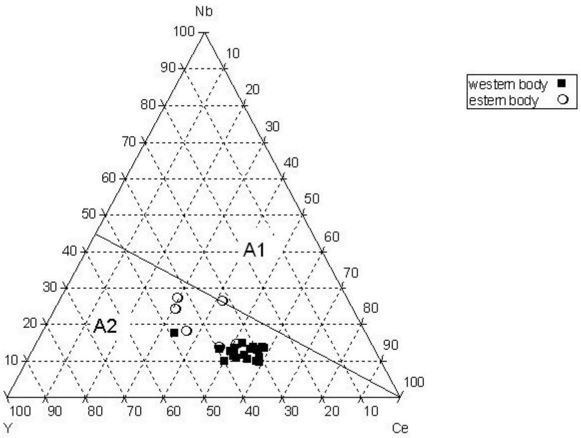

FIGURE 2. Representative triangular plot for distinguishing between A1 and A2. A1: granitoids from plume, rift and hotspot environment, A2: granitoids from postcollisional, postorogenic and anorogenic environment.

The geochemistry of ekerite, aplite and non-mineralized pegmatite shows a consistent evolution along trends characterized by lower incompatible element (Y, Nb, REE) concentrations for similar Zr concentration values, with respect to those of the western and eastern alkaline granite bodies.

We have also dated by the single zircon U-Pb method a sample of the main intrusive phase of the western body of the Khan Bogd complex. The three zircon grains dated give a concordant age of 292±0.51 Ma, which is in perfect agreement with the dates obtained by Kovalenko et al. (2006). Further dating of other phases of the Khan Bogd complex as well as of the aplite and ekerite dikes is currently in progress and will allow us to better reconstruct the magmatic evolution history of the complex and of the associated pegmatites.

CONCLUSION

The pegmatites of the alkaline granite complex of Khan Bogd, Mongolia occur as zoned lenses or layered rocks in alternation with ekerite-aplite in the cupola of the huge western body of the Khan Bogd alkaline granite. Field observations indicate that their emplacement occurred during repeated transitions from the ductile to the brittle regime, which resulted in sudden pressure drops, undercooling and consequent formation of line rock or unidirectional solidification textures. The geochemistry of the alkaline granites of the Khan Bogd complex is compatible with their origin from melting of continental or island-arc crust in a post-orogenic or anorogenic environment, in agreement with the emplacement of the Khan Bogd complex within the Gurvansayhan island arc terrane. A U-Pb zircon age on a granite sample of the western body has yielded a concordia age of 292±0.51 Ma, in agreement with previous geochronological data of Kovalenko et al. (2006).

ACKNOWLEDGEMENTS

We thank D. Crane and D. Sketchley (Ivanhoe Mines), as well as Prof. O. Gerel and U. Majigsuren (Mongolian University of Sciences and Technology, Ulaan Baatar, Mongolia) for logistic support and shipping of the samples. This study was supported by individual fellowships granted to DV and MC by SPHN and Schmidheiny Foundation respectively.

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