GEOCHEMISTRY AND GEOCHRONOLOGY OF THE IKH NART GRANITE MASSIVE, EASTERN MONGOLIA: IMPLICATIONS FOR ITS ORIGIN MAGMA

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Abstract: We present new geochemical, geochronological data of the late Mesozoic Ikh Nart massive in the eastern Mongolia. The Ikh Nart massive was intruded to metasedimentary rocks which was emplaced within low grade regional and contact metamorphism along its boundary. The massive are mainly consisted coarse grained porphyritic granite (PCG) and medium grained biotite granite (BMG). In generally, granites were composed by K-feldspar, plagioclase, quartz, biotite, minor amount muscovite and accessory minerals.

The geochemical patterns shown calc-alkaline, I and S-type characteristics which was emplaced in syn to post-collision of tectonic settings. The Eu and Sr anomalies and unfractionated HREE suggest the presence of plagioclase and absent garnet in the source or extensive melting which has resulted in garnet being exhausted from the source. Perhaps the Ikh Nart massive could be described of juvenile material added to the crust from the enriched mantle during Cretaceous extension. The late Mesozoic syn-extensional granites are mainly occurred in the southern and eastern Mongolia. Our U-Pb zircon geochronological data indicates that the Ikh Nart pluton was emplaced in early Cretaceous age 134,5±1.6 Ma.

Keywords: Ikh Nart granite, I and S-type granite, Extension, Crustal material.

I. INTRODUCTION

Late Mesozoic (Jurassic-Cretaceous, J-K) is an important period for global geological evolution and prominent crustal movements, and strong geological events occurred in NE Asia [11]. The study area situated in southeastern, Mongolia which is located nearby to western the North Gobi belt. The belt is one of several Permian–Early Cretaceous rift zones superimposed on the central part of the CAOB bordered to the west Kharkhorin rift zone surrounding Khangai-Khentey belts [12], [13], [4], [3]. Specially, the end of late Jurassic to Early Cretaceous periods are generated basaltic, these related to extensional environments of the rift grabens.

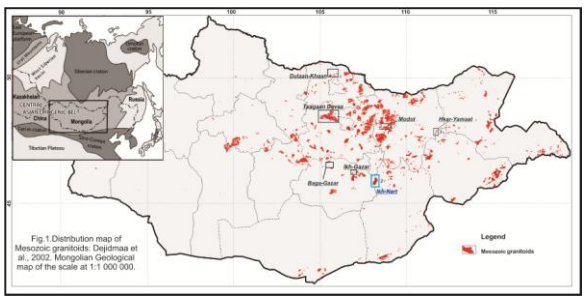


Fig.1. Distribution map of Mesozoic granitoids: Modified Dejidmaa et al., 2002. Mongolian Geological map of the scale at 1:1 000 000.

As well as, typical within-plate basalts, reflecting the final closure of the Mongol-Okhotsk Ocean [4], [10]. Here, we represent new LA-ICPMS zircon U-Pb age, and geochemical data for Early Cretaceous plutonic rock form the Ikh-Nart (INC) pluton in the south eastern Gobi, Mongolia (Fig.1.). Currently our study was focused the purpose of this research aimed to clarify the geological significance and petrogenesis of granitoid to constrain their tectonic setting as well as their significant for the Late Mesozoic tectonic evolution of eastern Mongolia.

II. GEOLOGICAL SETTING AND PETROGRAPHY

The Ikh Nart massive located in the eastern Mongolia, extends over 300 km from Ulaanbaatar. The massive is roughly halt oval shaped which is bounded to the northwest by the NE-SW trending Choyr Basin. That is a part of a large basin domain in the central part of eastern Mongolia, the Choyr-Nyalga Basin [6]. As mentioned above these host rocks are mainly met sediments (Fig.2) comprising dark blue quartzite, slate and grayish laminated marble containing archeocyathes and stromatolities, considered as Neoproterozoic to Cambrian age [1].

As well as, the country rocks have experienced both low grade regional and contact metamorphism. The granite is associated with aplitic dyke, quartzite veins, pegmatites, greisen zones, hematite veins, breccia and low angle normal shear zones. Alluvial gold, fluorite, wolframite beryl and Ta-Nb mineralization associated with the Ikh Nart granite. The Ikh Nart granite occurs in a number of texturally and compositionally different subtypes: (a) a pink and very coarse grained and porphyritic granite (PCG); (b) a pinkish gray medium grained biotite granite (BMG); (c) a pegmatite; (d) a pinkish fine/ aplitic muscovite granite (FG).

The PCG forms the phenocrysts often show magmatic flow alignment and occurs in few places. The MBG granite forms the mainly parts of the Ikh Nart granite and have fewer phenocrysts compared to the PCG. The BMG is richer in biotite, calcic plagioclase and zircon but K-feldspar and quartz. The BMG occurs most of the granite margin but is often found central part of main body itself.

Pegmatite bodies were mainly occurred by formed miarolitic cavity in PCG. On the other hand, BMG was cut by pegmatite and aplitic dykes. BMG was mainly cut by mafic dyke at south eastern margin.

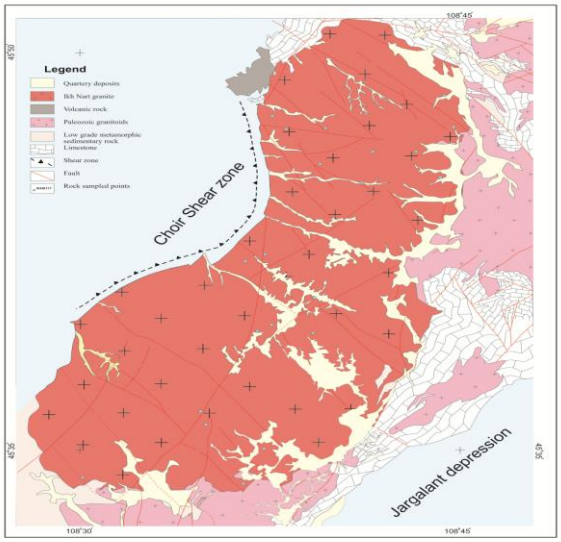


Fig.2. Geological map of Ikh-Nart massif, southeastern Mongolia (modified by Amantov. 1966, Daoudene. 2009, Erdenetsogt. 2009, This study 2018) [5], [6], [1].

The Ikh Nart granite gradually shows zonation in texture, color and mineral composition. Most samples of The Ikh Nart granite consist to granite and a minor amount are leucogranite. The mineralogy is occasionally contained: K-feldspar, plagioclase, quartz, biotite, a minor amount muscovite and other opaque minerals. K-feldspar, plagioclase and quartz constitute both the phenocrysts and the groundmass. Few phases include zircon, apatite, sphene, monazite, xenotime and thorite most of which are inclusions in biotite. Chlorite, epidote, sericite and fluorite are secondary minerals.

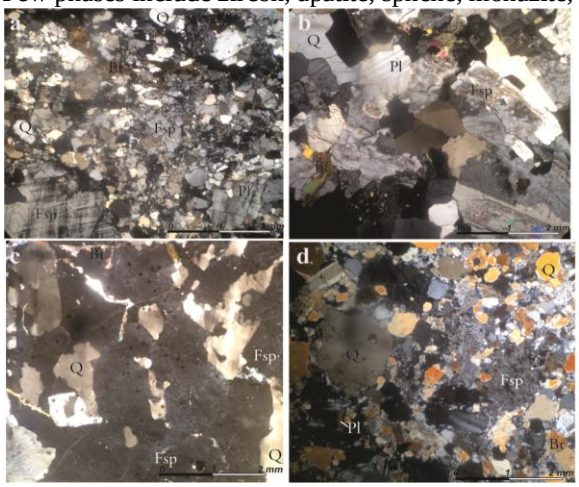


Fig.3. a) Medium grained biotite granite, b) Coarse grained granite, c) Pegmatite, d) Aplitic/fine grained granite

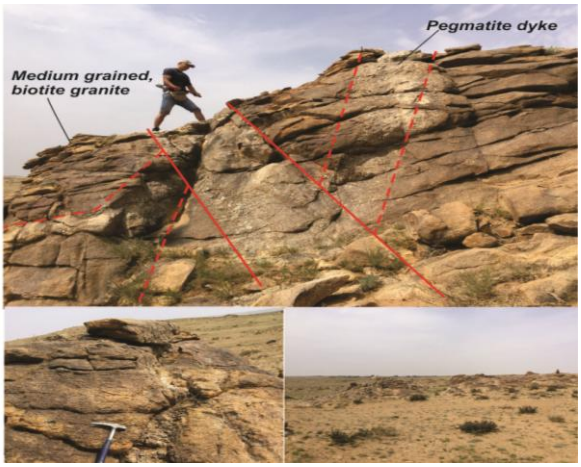


Fig.4. Field photographs illustrating field relationships of the Ikh Nart granite massive.

III. DETAILS METHODOLOGY

1.1. Sampling

In 2016 and 2017, the geological mapping, the sampling of main biggest granite body for geochemistry and U-Pb zircon geochronology were carried out. Petrographic thin sections were prepared at Institute of Paleontology and Geology, Mongolian Academy of Sciences (MAS).

1.2. Major and Trace Element Geochemical Analyses

Whole rock major and trace elements were determined using lithium tetraborate fusion at the SGS IMME Mongolia LLC. Major elements and some trace elements (As, Ba, Cr, Cu, V, Zn, Ba, Mo, Nb, Sn, Ta and W) were determined in 28 samples by XRF76V, whereas other trace elements (REE, Th, U, Sr, Rb and Hf) were analyzed in 10 of these samples using a IC90A and IC90M inductively coupled plasma mass spectrometer.

1.3. Zircon U-Pb geochronology

Sample of peralkaline granite from the Ikh-Nart pluton was collected for U-Pb zircon dating by laser ablation and sector-field mass spectrometry with inductively coupled (LA–SF-ICP-MS) in the Laboratory of Physical Methods of Analysis of the Geological Institute of SB RAS, Ulan-Ude. Zircon were separated by conventional magnetic and heavy liquid technique and subsequently mounted to perform Scanning Electron Microscope (SEM) and backscatter imaging (BSE) (Fig.8).

IV. RESULTS AND DUSCUSSIONS

1.4. Whole rock geochemistry

The rock samples were collected from The Ikh Nart pluton for geochemistry analyzes. The Ikh Nart granite has a variable composition, with SiO2 contents of (77.1–76.52 wt.%), total alkali content

(Na2O+K2O) ranging from 7.46 to 9.84 wt.% and K2O>Na2O. On Harker variation diagrams, the AF (Fine grained/aplitic dykes) samples plot at one end, whereas the PCG (Porphyritic course gained) one plot at the other end of an evolution line populated by the rest of the samples (Fig.3).

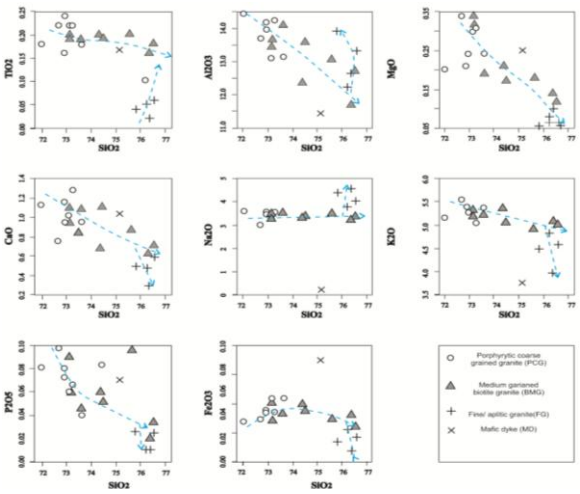


Fig. 5. Harker variation diagrams for the Ikh Nart granite. All the diagrams show general fractional crystallization trends in which the granite evolved from Coarse grained porphyritic granite through Medium grained biotite granite to the fine/ aplitic granite (see(a) and (b))

The PCG samples represent a relatively old and less felsic unit and the BMG (Medium grained biotite granite) and FG are younger and more felsic. The PCG also have relatively high total alkalis (Na2O+K2O) =8.3-9.25% and REE contents, and higher TiO2, Al2O3, MgO, CaO, Ba and Sr a minor wide variation than the BMG. In general, the contents of MgO, CaO, Fe2O3t, Al2O3, TiO2, P2O5, Ba, Sr, Eu, Zr, and V decrease with increasing SiO2 contents defining nearly linear trends (Fig. 5).

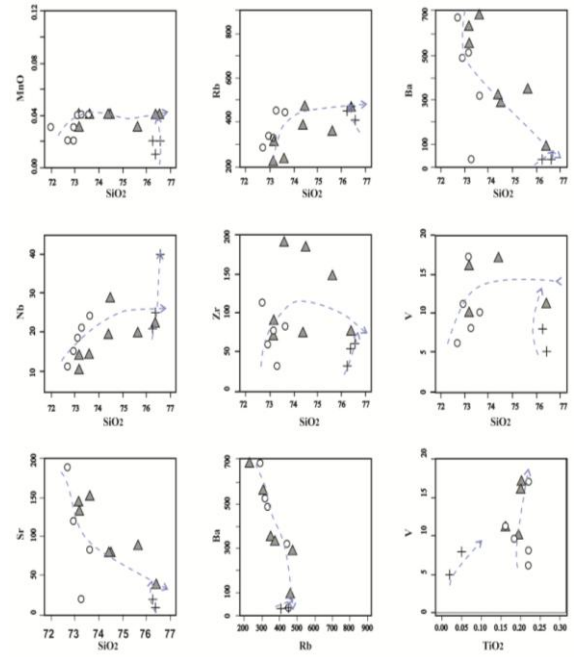


Fig.5. continue

Harker variation diagrams for the Ikh Nart granite. All the diagrams show general fractional crystallization trends in which the granite evolved from Coarse grained porphyritic granite through Medium grained biotite granite to the fine/ aplitic granite (see(a) and (b)).

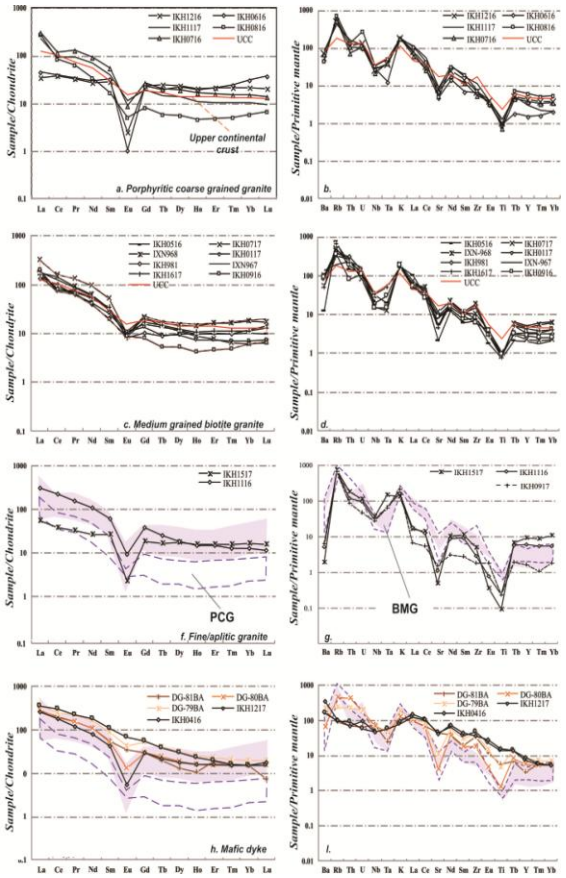


Fig.6. Spider trace and rare earth element diagrams for the IGC pluton [9].

Chondrite-normalized [9] REE patterns show that the PCG are enriched in light REEs (LREEs) relative to heavy REEs (HREEs), have a weak negative Eu anomaly (Eu/Eu*≥0.4-0.82), a flat HREE pattern, and are less fractionated ((La/Yb)cn=1.5-24.5).

BMG show a weak variable negative Eu in general, the Ikh Nart granites (both BMG and PCG) show weak fractionated HREE patterns (Fig. 6).

Aplitic dyke enriched in the LREEs, But strongly and variable negative Eu (Eu/Eu*≥9-16). In generally, all phase granites are composed

Mafic dykes are shown by wide amount contents of TiO2, Fe2O3t and MgO with lower Rb Th, and High Sr, Ba, Zr, REEs compared to all granite samples. It patterns a near-parallel REE pattern to that of the BG and normal Eu anomaly.

In the Ikh Nart granite, with increasing SiO2 contents the contain of P2O5 decreases in a regular fashion (Fig.5.1). The regular pattern of decreasing P2O5 with increasing SiO2 is characteristic of low-temperature I-type granite [2].

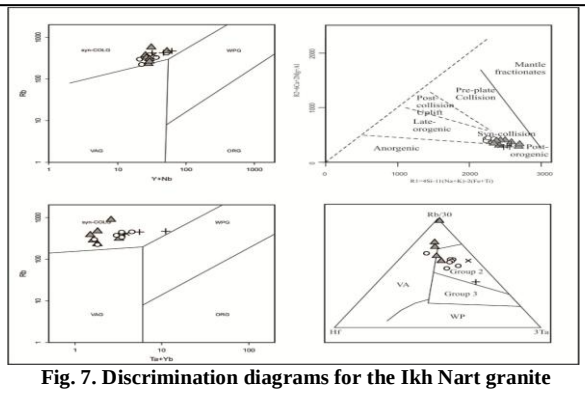


Fig. 7. Discrimination diagrams for the Ikh Nart granite pluton. Syn-COLG- syn collision, VAG-volcanic arc granite, WPG-within plate granite, ORG-Ocean ridge granite, IAG-island arc granitoids, CAG-continental arc granitoids, CCG-continental collision granitoids, RRG-rift related granitoids, CEUG-continental epeirogenic uplift granitoids, POG-post orogenic granite. a) Rb-(Y+Nb), b) Nb-Y and c) Rb-(Ta+Yb) plots, showing that most of the samples belong to Syn-COLG. Field boundaries after [7]. d) Al2O3 versus SiO2, showing that all the intermediate samples and the pink porphyritic granite plot in the diagrams.

Discrimination in the [7] diagram (Rb) (Y+ Nb)) shows that the Ikh Nart granites on the syn-collision granite field (Fig.7). On an Hf–Rb–Ta diagram, all the plot at the boundary between volcanic arc granite field. As mentioned above all suggestions support that magma course appear by crustal partial melting this region involved active tectonic events.

GEOCHRONOLOGY

A sample IKH0916 was selected for LA-ICPMS U-Pb zircon dating, and the analytical results are presented (Fig.4.5). Zircons separated from the sample IKH0916 is light brownish or colorless, and have subhedral, prismatic crystals, generally 100-300 um in length.

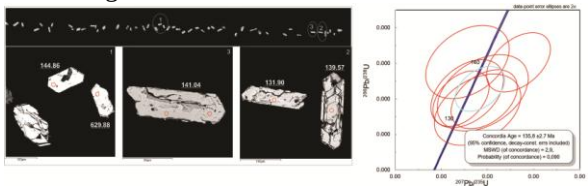


Fig.8. a. BSE images from relevant zircons in IKH0916 (number and red circles on zircons correspond to number of measurements in the marked sample) LA-ICPMS zircon U-Pb analyses for the granite in the Ikh Nart pluton. b. Concordia and weighted mean age diagrams for IKH0916, as well as weighted mean age 135,8 ±2.7 Ma (95% confidence) MSWD-2.9

CONCLUSION

The Ikh Nart granite geochronology, petrography, geochemical characteristics suggest that differentiation process and magma origin. Unfractionated and high HREE contents and low Sr and Eu contents suggest that melting and differentiation took place under low-P conditions or more extensive melting which has resulted in garnet being exhausted from the source.

U-Pb zircon geochronology indicates an Early Cretaceous age (135,8±2.7 Ma) for granitoid in Ikh-Nart massif. Geochemical and geochronology evidences are indicated during this time the tectonic setting was mainly related to the continental rift basins and tectonic setting formed on the Eastern Mongolia.

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