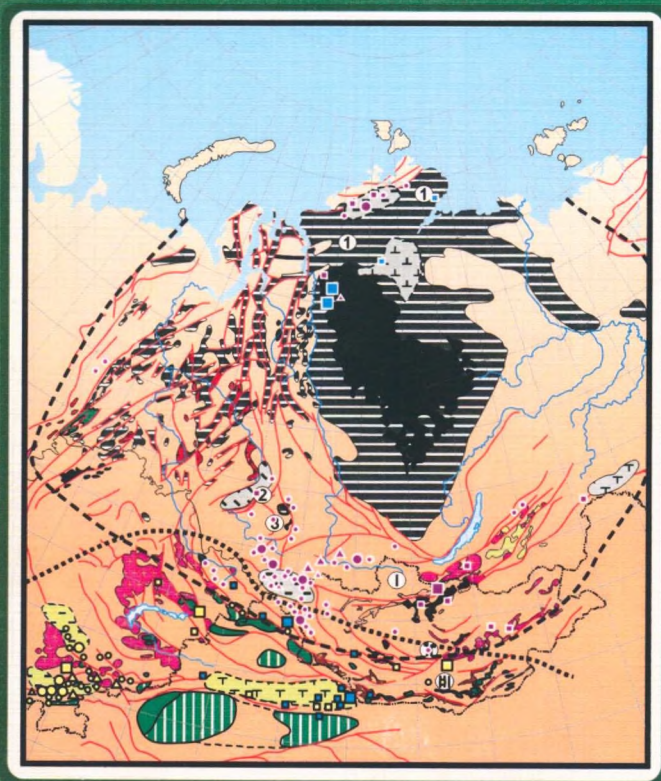


International Symposium

LARGE IGNEOUS PROVINCES OF ASIA, MANTLE PLUMES AND METALLOGENY



Organized by
Institute of Geology and Mineralogy, Siberian Branch
of Russian Academy of Sciences

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**INSTITUTE OF GEOLOGY AND MINERALOGY
SIBERIAN BRANCH OF RUSSIAN ACADEMY OF SCIENCES**

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
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⁴⁰AR/³⁹AR ISOTOPE DATING OF THE EDEL'VEIS CARBONATITE-BEARING COMPLEX, GORNII ALTAI: A CASE OF ALKALINE MAGMATISM IN THE EARLY PALEOZOIC LARGE IGNEOUS PROVINCE OF THE CENTRAL ASIAN MOBILE BELT

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In the geological history of the Gornyi Altai, middle and higher alkaline magmatism was volumetrically minor. Its typical products have a Mesozoic age. For example, the age of dike-like mica-bearing lamprophyres and lamproites of the Chuya Complex ranges from 240 to 246 Ma (Vrublevskii et al., 2004a). Small intrusions of alkaline rare metal-bearing granites in the Kalguta depression are characterized by a late Triassic age of about 201-216 Ma (Annikova et al., 2006). K-Ar isotope data show that the Jurassic time of formation (~ 160-200 Ma) is also proposed for the Edel'veis Complex, which includes alkaline pyroxenites, gabbroic and syenitic rocks and carbonatites (Obolenskaya, 1983). These rocks form small stocks and dikes confined to the southern slopes of the Northern Chuya Range. Moreover, the Sm-Nd isochron regression line calculated for whole rock compositions indicates an Early Ordovician age of 474 ± 37 Ma (Vrublevskii et al., 2004a). This isotopic dating is clearly correlated with one of the peaks of Ordovician magmatism ($T = 470 \pm 5$ Ma) in the central and eastern sectors of Altai Sayan Fold Belt. This event is temporally coincident with the main phase of mantle plume activity, which was probably responsible for the Early and Middle Paleozoic magmatism in the the Central Asian Mobile Belt or CAMB (Yarmolyuk and Kovalenko, 2003). Our new Ar-Ar isotopic data for rocks of the Edel'veis Complex confirm that timing of this rock association was the Cambrian - Ordovician boundary.

The geological structure of the Northern Chuya ridge is characterized by the presence of an ancient thrust-fold basement, comprising Vendian and Early Cambrian marbles and volcanic rocks and a Devonian cover of terrigenous, carbonate and volcanic sediments. The Edel'veis Complex was intruded into the lower formations and outcrops in erosional windows of the Devonian allochthon. The magmatic suite of the Edel'veis Complex is characterized by a sequence of alkaline pyroxenites → gabbroic rocks → alkaline syenites → calcic-carbonatites. These are present in a massif (~ 1.2 km²) located in the basin of the Chagan-Uzun river (Vrublevskii et al., 2004a). Late intrusion phases of leucocratic alkaline syenites and apatite-phlogopite-bearing carbonatites form small dike- and vein-like bodies, among the dominant mafic rocks. They correspond to high or mid-alkaline rocks on the basis of alkaline and silica levels in whole rock compositions (K₂O/Na₂O ~ 1-14; Na₂O + K₂O ~ до 14 wt %; SiO₂ ~ 34-58 wt %). Variations of contents and ratios of LIL- and HFS-elements established in the mafic units, allow to propose that the formation of these rocks occurred in a geodynamic setting of active continental margin with the mixing of sources, between basaltic magmas of the OIB and SZB types. The Nd-Sr isotopic systematics ($\epsilon_{Nd}(T) \sim +6.2...+6.4$; $^{87}Sr/^{86}Sr_T \sim 0.7033-0.7039$) show the possibility of a PREMA source for the primary magma.

The Ar-Ar isotopic composition of the magmatic phlogopite suite (MgO ~ 20.4; Al₂O₃ ~ 12.3; TiO₂ ~ 0.7 wt %) obtained from a sample of mica-bearing pyroxenite was studied to verify the rock age. Measurements were performed with the mass spectrometer «Noble gas 5400» and the using of the MCA-11 biotite standard. The studied sample has a ⁴⁰Ar/³⁹Ar spectrum with a plateau age of 506.8 ± 3.5 Ma, which is defined by 55 % of total ³⁹Ar released for five high-temperature (950-1150°C) steps at 1σ level of uncertainty. The integrated age defined by 95 % of total ³⁹Ar is 495.3 ± 3.5 Ma. These data assume that the initial formation of the Edel'veis Complex took place somewhere between the Middle Cambrian (maximum age) to (minimum age) Early Ordovician.

The established Ar-Ar isotopic data (~507 Ma) closely correspond to the formation time of the Verkhnepetropavlovsk Complex, composed of alkaline mafic rocks and carbonatites (509 ± 10 Ma, Sm-Nd-isochron, $\epsilon_{Nd}(T) = 5.1$) in the Kuznetsk Alatau, a region close to the studied area (Vrublevskii et al., 2003). Similar ϵ_{Nd} -parameters in isotopic composition of these two complexes assume a relationship of primary magmas

with mantle sources. The geodynamic model for Caledonides of the CAMB (Yarmolyuk et al., 2003), suggests that it was formed by the amalgamation of terranes, including fragments of the Rodinia paleocontinent, Vendian-Cambrian island arcs and back arc basins and oceanic islands, followed by accretion onto the margins of the Siberian Craton. Perhaps, the Kuznetsk-Altai segment of this superterrane was associated with hotspots draining a PREMA reservoir. This may have caused intraplate magmatic activity and the wide development of the Paleozoic associations of alkaline rocks and carbonatites in the western part of CAMB (Vrublevskii et al., 2004b). Moreover, the Caledonian epoch of the CAMB magmatic history is characterized by a development of picritic and alkaline basalts and different ultramafic or mafic intrusions and rock associations of the gabbro-diorite-granite type, associated with widespread granitic batholiths. The narrow temporal interval (about 510-470 Ma) for this magmatism within a regional framework, and the large scale of different magmatic products and their geodynamical setting suggest the possibility of an Early Paleozoic Large Igneous Province (LIP) within CAMB (Izokh et al., 2007). The Cambrian age and Nd-Sr isotope systematic established by us for the alkaline and carbonatites-bearing rocks of the Edel'veis Complex in the Gornyi Altai, allow to include this magmatic association as a plume-related member of the Central Asian LIP.

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References

1. Annikova I.Yu., Vladimirov A. G., Vystavnoi S. A., et al. U-Pb and $^{39}\text{Ar}/^{40}\text{Ar}$ Dating and Sm-Nd and Pb-Pb Isotopic Study of the Kalguty Molybdenum-Tungsten Ore-Magmatic System, Southern Altai, Russia // *Petrology*. 2006. V. 14, No. 1. P. 81-97.
2. Izokh A.E., Polyakov G.V., Shelepaev R.A., et al. Early Paleozoic Large Igneous Province of the Central Asia Mobile Belt // In: *Abstracts of the International Symposium «Large Igneous Provinces of Asia, Mantle Plumes and Metallogeny»*. Novosibirsk: Publishing House of SB RAS, 2007. P. 30-32.
3. Obolenskaya R. V. *Mesozoic Magmatism of the Altai-Sayan Fold System*. Novosibirsk: Inst. Geol. Geofiz. Sib. Otd. Akad. Nauk SSSR, 1983. 47 p. (in Russian).

4. Vrublevskii V. A., Gertner I. F., Zhuravlev D. Z., and Makarenko N. A. The Sm-Nd Isotopic Age and Source of Comagmatic Alkaline Mafic Rocks and Carbonatites of Kuznetsk Alatau // *Doklady Earth Sciences*. 2003. V. 391A, No. 6. P. 832-835.
5. Vrublevskii V. V., Zhuravlev D. Z., Gertner I. F., et al. Sr-Nd Isotopic Systematics of Alkaline Rocks and Carbonatites from the Edel'veis Complex, Northern Chuya Range, Gornyi Altai // *Doklady Earth Sciences*. 2004b. V. 397A, No. 6. P. 870-874.
6. Vrublevskii V.V., Gertner I.F., Polyakov G.V., et al. Ar-Ar Isotopic Age of Lamproite Dikes of the Chua Complex, Gornyi Altai // *Doklady Earth Sciences*. 2004a. V. 399A, No. 9. P. 1252-1255.
7. Yarmolyuk V. V. and Kovalenko V. I. Deep Geodynamics and Mantle Plumes: Their Role in the Formation of the Central Asian Fold Belt // *Petrology*. 2003. V. 11, No. 6. P. 504-531.
8. Yarmolyuk V. V., Kovalenko V. I., Kovach V. P., et al. Geodynamics of Caledonides in the Central Asian Fold Belt // *Doklady Earth Sciences*. 2003. V. 389A, No. 3. P. 311-316.