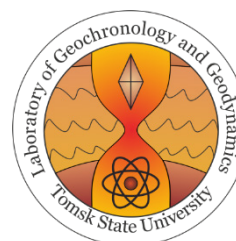


МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ
НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
ТОМСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ



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METALLOGENY AND OIL-GAS, PLANETARY ANALOGUES
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PARAMETERS AND CLASSIFICATION OF THE DEVON RIFTOGENOUS ALTAI-SAYANSKY LIP

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Introduction

In the course of long-term studies of the Devonian magmatism of the Altai-Sayan folded region (ASFR) and the adjacent regions of Western Siberia and Western Mongolia in 80-90, a large transregional rift-continental system was installed and restored (Grinev, 1990; 1999; 2007; Vorontsov, 1994; Yarmolyuk, Vorontsov, 1993; Devonian ..., 1996, etc.). In the course of further study of rift magmatism, it was established that it has a plume nature and corresponds in scale to LIP. In the light of already established concepts, LIP is characterized by a number of manifestation parameters, allowing them to be classified into types and subtypes. This paper presents the main parameters of the manifestation of the Devonian rift-continental system (RCS), which allow not only to consider it as a paleotype LIP, but also to expand the existing ideas about these unique geological objects.

Results

Structural and tectonic position of the Devonian RCS

The structure under study was laid at the turn of the end of the Silurian-Early Devonian within the west-south-west border (in modern coordinates) of the Siberian Craton. For heterogeneous fold-block structures of this AR-PR-PZ₁ frame is characterized by a roughly zonal structure. In the direction from the craton to the west, the zone of metamorphic archaean-proterozoic is replaced by a zone of Riphean-Cambrian folded structures and further Caledonian (O-S) structures. At the end of the Ordovician-Silurian, between the craton structures of the Russian, Siberian platforms and Kazakhstan, the Ural-Mongolian folded belt was laid and developed, and the Paleozoic Ocean corresponding to its beginning. In this context, the Devonian RCS occupied a marginal continental position. Using the inherited Precambrian structural seams separating uneven-age zones, she dissected the structures of the fold-block framing of the Siberian craton along almost its entire length.

The main morphostructures of the arch-rift system

In the structure of the RCS, two main types of morphostructures are distinguished: fragmentary developed depressive zones and the hand-like uplifts of the pre-rift base separating them. The structural framework of the system is formed by long-lived, activated in the Devonian, longitudinal transregional East-Sayan-Yenisei (eastern) and Kuznetsk-Alatau-Kobdinsky (Western) lineaments, cut into approximately equal portions by transverse (transform) regional faults. Along the eastern and western lineaments in the early Devonian, depressive zones were laid, and between them a long arched uplift was formed, of which ASFR became the nuclear part. During the growth and split of the vault, the

axial depressive zone of the RCS (Tuvinsko-Minusinsky) formed in its axial part. Further collapse of the arch led to the formation of the eastern and western hand-like uplifts, separating the axial depression zone from the adjacent marginal depression zones. Inside the zone, a series of transverse uplifts, dividing the deflections and depressions from each other along the strike, appeared.

Magmatism RCS, its composition and stages of formation

The morphostructure formation of paleorift was accompanied by active volcanism. The main arena of volcanic manifestations was depression zones, transverse elevations and nodes of their articulations. The framing horst-shaped uplifts were to a much lesser extent covered by volcanism. Within their limits, small and medium intrusive massifs, comagmatic to volcanics of adjacent structures, were mainly formed. It should be noted that the composition of volcanics is significantly influenced by their structural and tectonic position: the composition of volcanics and the set of their differentiates in the depressed zones and in the framing uplifts differ, as well as depending on the composition and structure of the pre-Devon rocks. So the eastern framing of the Minusinsky trough and its periphery are characterized by a wider development of lavas of acidic composition, and the western one, on the contrary, by the main one.

In terms of scale and volume, volcanism sharply dominates over the intrusive component of rift magmatism. In general terms, there are three stages (impulses) of volcanism associated with tectonics and sedimentogenesis of the RCS. The most early and active magmatism manifested itself mainly in the axial depression zone and engulfed the early Devonian. Signs of lateral migration of volcanism from the axial zone to the eastern and western, where its maximum falls at the end of the early-middle Devonian, are established.

The early stage of volcanism in the axial zone is characterized as plateau-basalt, represented by sub-alkaline picrobasalts, trachybasalts, trachyleucobasalts and basalt trachyandesites.

The middle stage is represented by a series of trachybasalts, basaltic trachyandesites — trachyandesites, trachytes and trachyriodacytes. Along with it, alkaline series of tefrit-phonolites of sodium and potassium specificity of alkalinity (Martaiga, Sokol, Sopnyaya Sopka, etc.) appeared in local areas (subprovings) in parallel with it.

The final stage had trachybasal-trachyte, trachyryolite composition and a mild tephrite trend in the form of basanites.

A significant component of the volume of volcanics is a series of basalt sills and dikes.

The total time interval of the stages of manifestation of volcanism in the axial zone did not exceed 10-15 million

years. The duration of volcanism within the end of the early-middle Devonian of the eastern and western depression zones also corresponds to this interval.

The volcanites of the grabens and minor depressions of the framing uplifts and the periphery of the trough in the depressive zones are usually accompanied by a series of rod-like intrusions that are comagmatic in composition to the volcanites: gabbro-syenitic, alkaline-gabbroid, alkaline-syenite-granite.

RCS dimensions and approximate volume of volcanic rocks

The total length of the RCS from north to south is about 2.5 thousand km with a width of 1.0-0.4 thousand km, which is about 1.5 million km² of the total area of the RCS.

The volume of volcanic rocks (effusive, sills, dikes) of the largest structural-depressive sites of paleorift volcanism, reaching the level of erosion and not less than 500 km² (Agul'sky, Minusinsky, Delun-Yustytsky, Tuvinsky deflections, deflections and grabens of Gorny Altai, deflections and grabens framing Kuznetsk trough) is about 232 340 km³. Considering that the area of the troughs is a multiple of the area of the listed volcanic fields that reach the surface, and many hundreds of structures with an area of tens and first hundreds km², as well as those not covered by the calculation of the depression of the buried West-Siberian part of the RCS and the structure of the volcanic belts of Central Mongolia The Devonian system can be at least 1 million km³, even without taking into account the erosion cut of the paleorift and the plutonic component of magmatism.

Geochemical parameters of volcanism

The most important features of the volcanic rocks of the axial rift zone are their geochemical proximity OIB, with the presence of weakly pronounced Nb-Ta and Hf minima. They belong to intraplate basalts and partially to basalts of the destructive margins of continents. According to the Eu/Eu* index, rocks are mantle (0.78–1.07), and medium and acidic species (0.38–0.42) show a significant presence of crustal matter. The dominant source of source magmas was the plume component. Thus, in general, the studied volcanics formed with the dominant mantle-plume PREMA – a source “diluted” with the asthenospheric mantle substance, which retains the geochemical recycling characteristics of the Baikal-Salair stages of the region's development, and in the later stages, the differentiates were enriched in core material.

Paleorift development scheme

The active tectonic-magmatic stage of the development of the early, early-middle Devonian RCS was replaced by a lon-

ger slab-syneclite stage of the upper Devonian, Carboniferous and Permian. During this stage, the largest depressions of the RCS were largely covered by terrigenous-sedimentary strata, and the open parts were eroded.

Conclusions

According to modern ideas about LIP, as reflected in the works of R.E. Ernst, M.E. Coffin, S.E. Bryan, H.C. Sheth et al., The Devonian RCS should be defined as an intraplate sub-rift-continental and substantially mafic province with a dominant extrusive nature. The rift fields of India and Western Australia can be considered as supposed analogues of it.

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