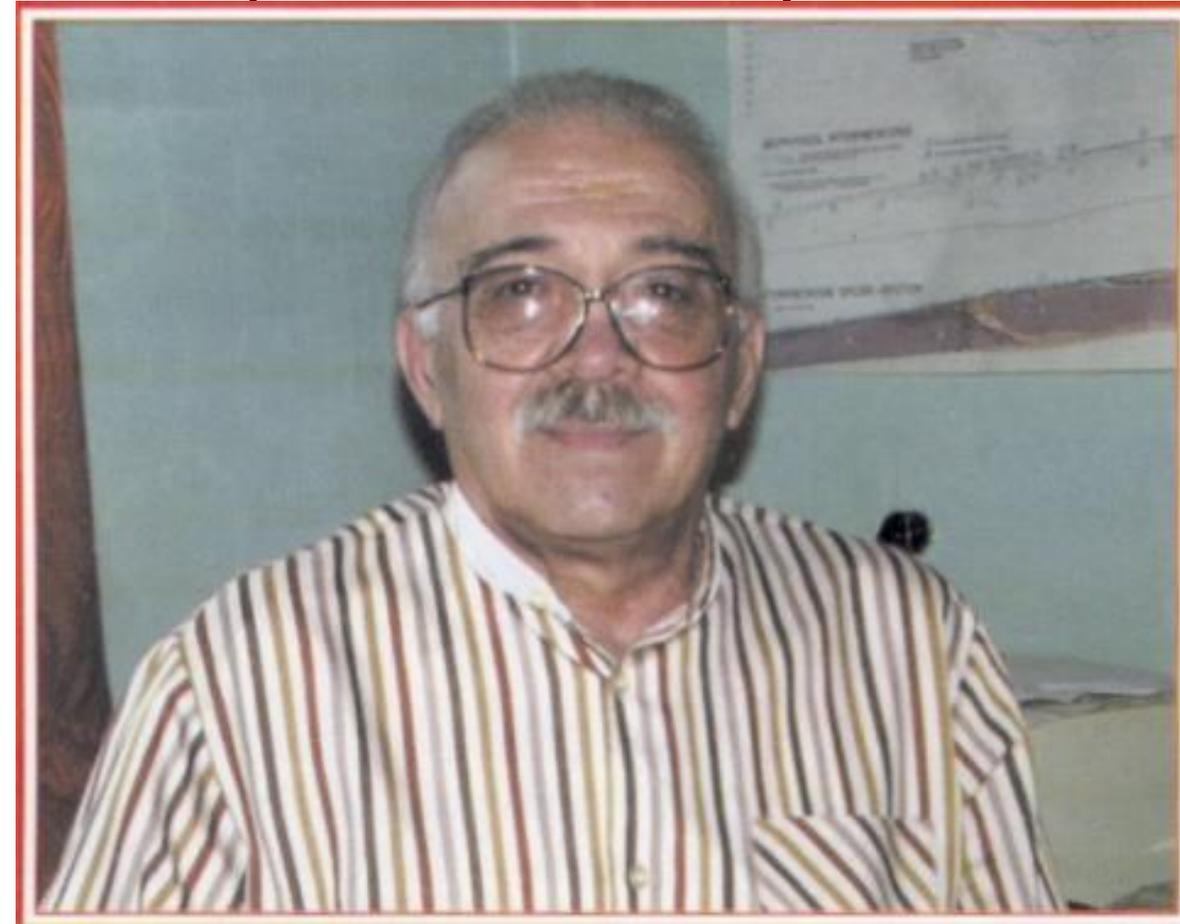


Выдающиеся ученые института земной коры:

Проф. Брандт
(1915-2010)



Проф. Зорин
(1933-2007)





1938 – Ленинградский электротехнический институт

1938-1955 – оборонный завод, защитил диссертацию к.т.н.

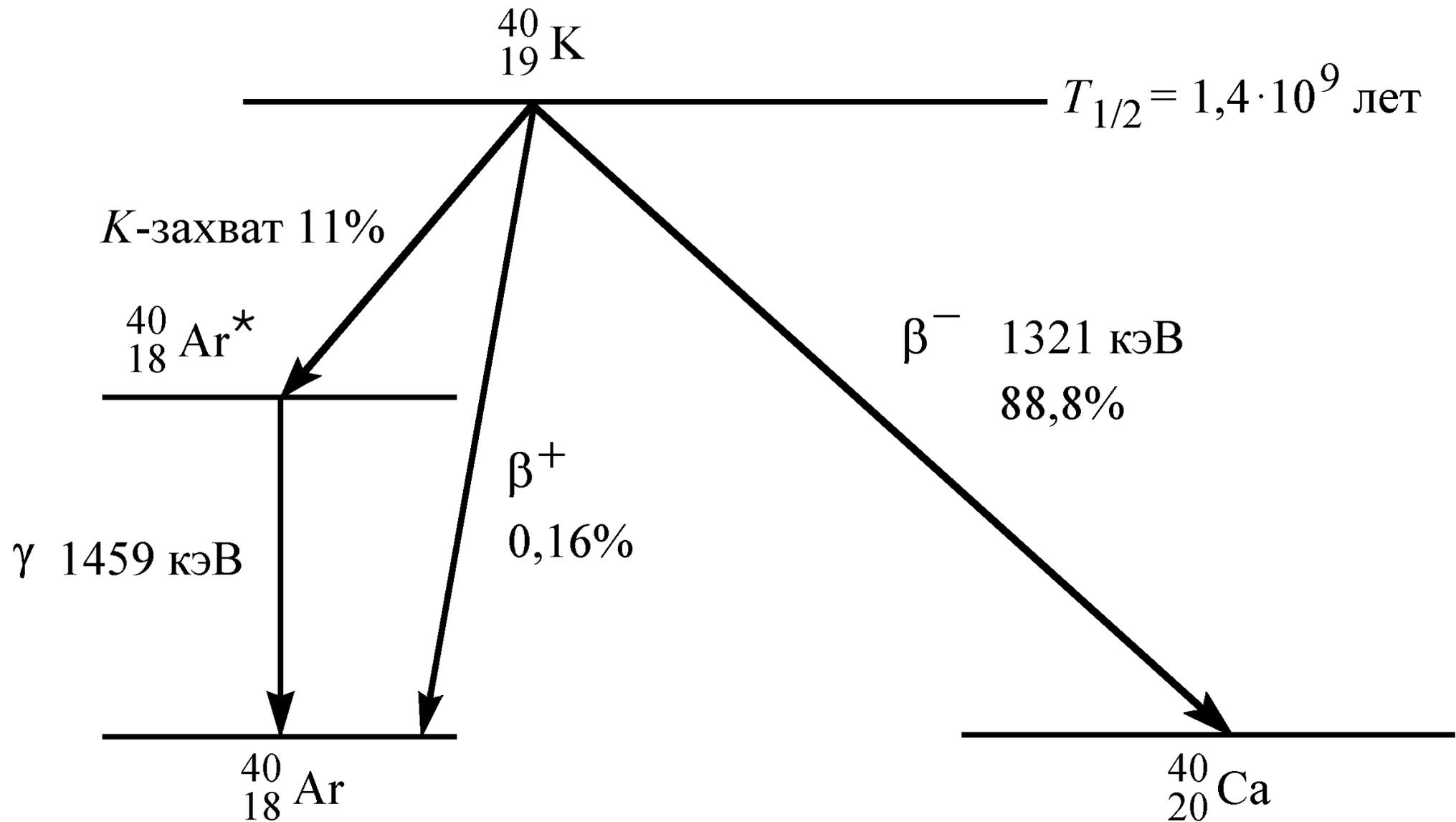
1955-1964 – Институт физики Дагестанского филиала АН СССР

1965-1972 – Институт геохимии СО АН СССР,
защитил диссертацию д.г.-м.н.

1972-2010 – Институт земной коры СО АН СССР (СО РАН)



В монографии исследуются позднекайнозойская геодинамика юго-восточной части Евразийской плиты в свете пространственно-временного распределения вулканизма. Основная роль в датировании вулканических пород отводится калий-аргоновому методу в различных модификациях...



1. Законы Фика (Диффузия)

Описывают перенос вещества из области высокой концентрации в область низкой.

- **Первый закон Фика** (стационарная диффузия, концентрация не меняется со временем):

$$J = -D \frac{dC}{dx}$$

где J — плотность потока, D — коэффициент диффузии, $\frac{dC}{dx}$ — градиент концентрации.

- **Второй закон Фика** (нестационарная диффузия, концентрация меняется со временем):

$$\frac{\partial C}{\partial t} = D \frac{\partial^2 C}{\partial x^2}$$

описывает изменение концентрации со временем t . 

2. Закон Аррениуса (Температурная зависимость)

Коэффициент диффузии D сильно зависит от температуры, подчиняясь уравнению Аррениуса:

$$D = D_0 \exp\left(-\frac{Q}{RT}\right)$$

где:

- D_0 — предэкспоненциальный множитель (не зависящая от температуры константа);
- Q — энергия активации диффузии;
- R — универсальная газовая постоянная;
- T — абсолютная температура (в Кельвинах). 

Итог: При повышении температуры (T) энергия активации (Q) преодолевается легче, D растёт (уравнение Аррениуса), что приводит к увеличению потока вещества (J) (первый закон Фика).

**Radiogenic argon distribution within a mineral grain:
implications for dating of hydrothermal mineral-forming
event in Sludyanka complex, Siberia, Russia**

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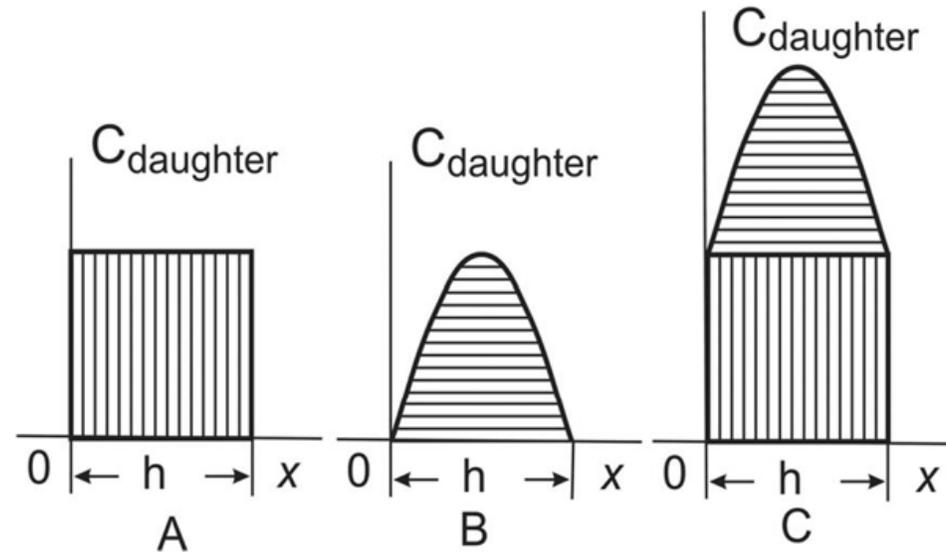


Figure 1. Distribution of daughter concentration within a mineral grain: (A) without losses of daughter; (B) with partly loss of daughter by diffusion; (C) summary distribution in a grain which suffered losses in some geological past and then remained closed.

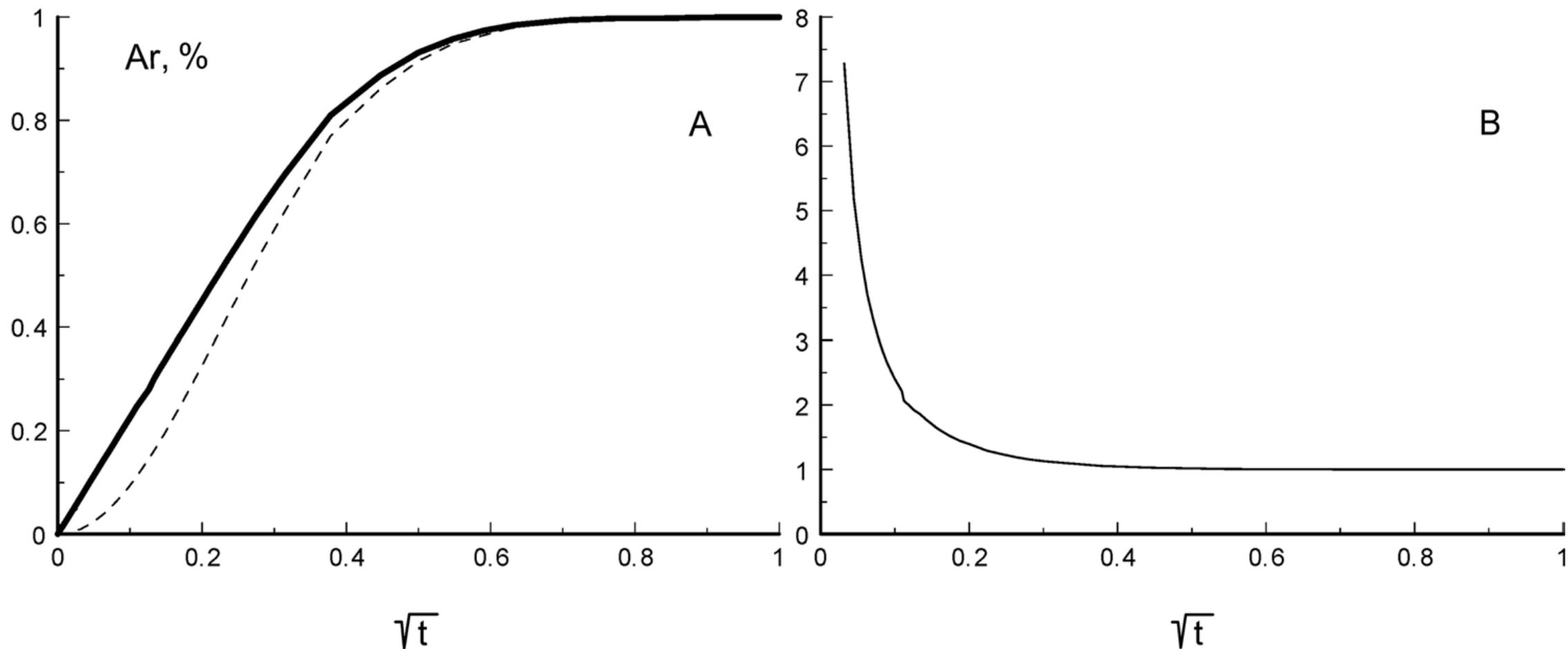


Figure 2. Radiogenic argon release plots versus square root of time. (A) A system with a rectangular distribution of concentrations without losses (bold curve) and a system which previously lost 80 % of radiogenic argon (dashed curve); (B) Ratio of concentrations corresponding to the bold and dashed curves.

Table 1. Sequence of rock-forming events following the granulite-facies metamorphism in the Sludyanka area.

| Rock-forming event (from old to young according to their geological relations) | Temperature of mineral crystallisation (°C) | Age (Ma) | Dating method | Reference |
|--|---|-------------|---|-----------|
| Peak of the granulite-facies metamorphism | 800–830 | 477.6 ± 2 | U–Pb for zircons | [19] |
| | | 471.1 ± 1.2 | | [19] |
| Emplacement of syenites and monzonites | | 471.1 ± 1.5 | U–Pb for zircons | [21] |
| Emplacement of alaskite- granites | 650–700 | | | |
| Formation of the phlogopite- bearing veins | 500–550 | 459.6 ± 6.6 | R–Sr for phlogopite– calcite–apatite assemblage | [20] |
| Emplacement of ‘post- phlogopitic’ pegmatites | 600–650 | 447.3 ± 2.4 | U–Pb for zircons | [21] |
| Formation of calcite-sulfide veins | 250–300 | 274 | Probably corresponds to K–Ar isotopic system closure in the phlogopite and hyalophane | [22] |
| Formation of the low- temperature calcite and quartz–carbonate veins. | 50–150 | 271 ± 2 | | This work |

Note: Stated errors are analytical and do not include uncertainty in used decay constants.



Докторская диссертация, 1971

- Изостазия и новейшая структура Байкальской рифтовой зоны и сопредельных территорий

Evidence and causes of the two-stage development of the Baikal rift

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(Received August 14, 1985; accepted October 2, 1986)

Abstract

Logatchev, N.A. and Zorin, Y.A., 1987. Evidence and causes of the two-stage development of the Baikal Rift. In: I.B. Ramberg, E.E. Milanovsky and G. Qvale (Editors). *Continental Rifts—Principal and Regional Characteristics*. *Tectonophysics*, 143: 225–234.

The data on the geological and deep-seated structures of the Baikal rift zone are briefly summarized. Based on the analysis of the composition of the sedimentary infill in rift basins, two stages of the zone development have been recognized: (1) “slow rifting” and (2) “fast rifting”. As a consequence of the study of the deep-seated structure and construction of the thermal model of the lithosphere, it was assumed that the first stage is associated with a slow uprise of the surface of the asthenospheric upwelling, and the second stage connected with sideways flows of the substance involved in this upwelling after the crustal base was reached.

THE NATURE OF CENOZOIC UPPER MANTLE PLUMES IN EAST SIBERIA (*Russia*) AND CENTRAL MONGOLIA

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We discuss the space relationship between upper mantle plumes revealed earlier from analysis of long-wavelength isostatic gravity anomalies and the subducting Pacific slab. According to global seismic tomography, the oceanic slab in its segments corresponding to the Japan and Izu–Bonin island arcs flattens out at the bottom of the mantle transition zone, extends horizontally far beneath Eurasia, and then resumes sinking into the lower mantle. The upper mantle plumes are located beyond the western endpoint of the slab sector that advances the farthest beneath the continent.

A considerable part in the plume material may belong to fertilized (enriched with incompatible elements) peridotite. A layer of fertilized peridotite forms at depths between 200 and 600 km under the effect the melts produced by partial melting of the slab oceanic crust cause on the overlying depleted mantle. The peridotite layer integrates into the slab and heats up by friction along the slab top during the horizontal motion of the latter in the transition zone where the mantle material is of relatively high strength. Portions of hot fertilized peridotite detach from the slab as it sinks into the lower mantle, rise by buoyancy through the upper part of the transition zone, and become entrained into an elongate asthenospheric convection cell which arises beneath the continent behind the subduction zone. The ascending convection flow splits into separate streams which are the upper mantle plumes.

Upper mantle plumes, subducting slab, mantle transition zone, fertilized peridotite, asthenospheric convection

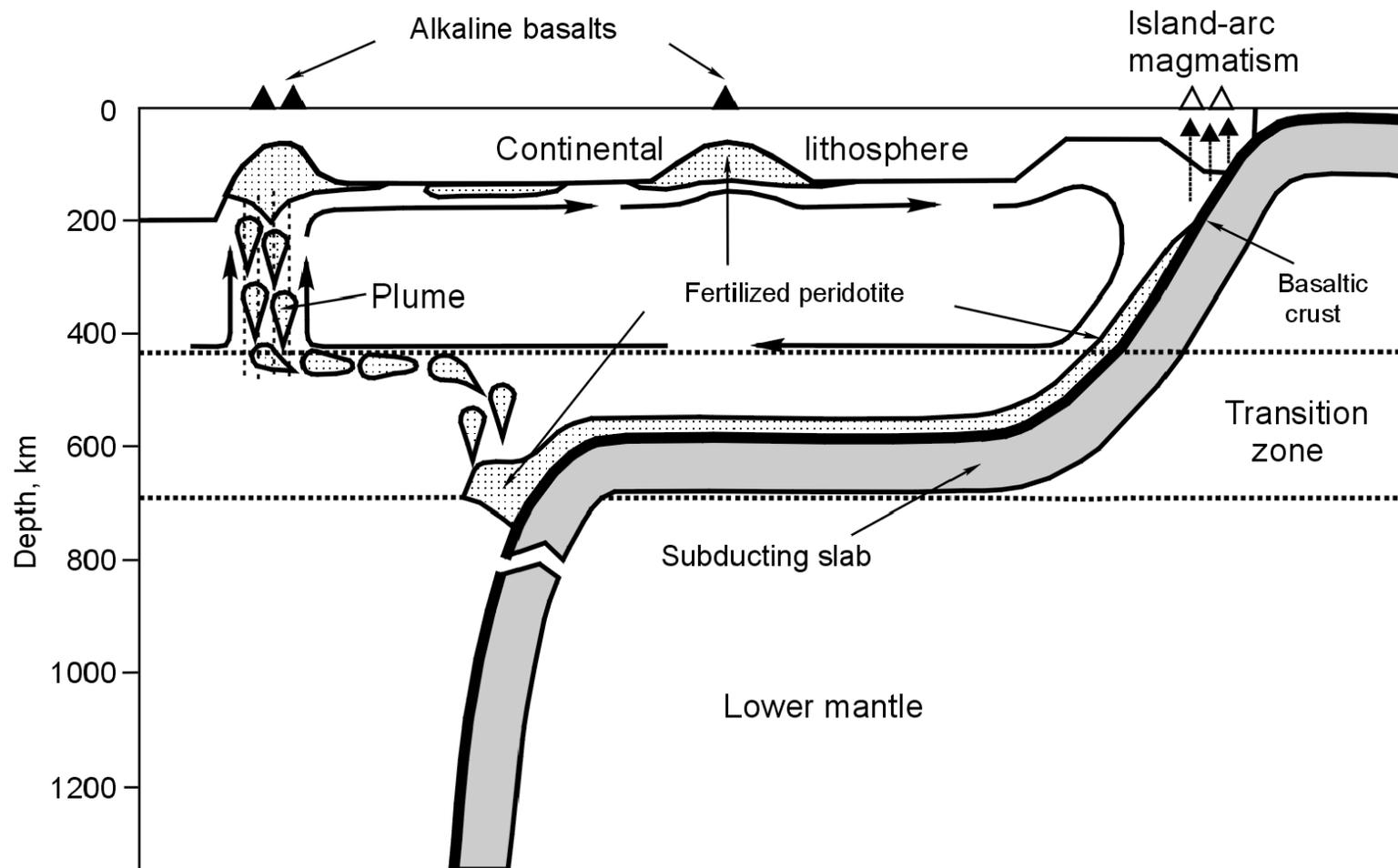


Fig. 6. Suggested formation model of upper mantle plumes. Batches of hot fertilized peridotite detach from depth-stagnant slab during its sinking into lower mantle, rise by buoyancy through the upper part of the mantle transition zone, and become entrained into an elongate asthenospheric convection cell which arises in the asthenosphere cooled by the inclined subducting slab part. Ascending convection flow splits into separate streams which are the upper mantle plumes.

The South Siberia–Central Mongolia transect

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(Received August 4, 1992; revised version accepted March 12, 1993)

ABSTRACT

Studies of geological and geophysical data on the South Siberia– Central Mongolia geoscience transect which runs approximately along 100°E, show that the Asian continent was formed in the Phanerozoic by accretion of terranes most of which were microcontinents with Precambrian basement. Suture zones separating the terranes are deformed and deeply eroded magmatic arcs of different widths likewise classified as specific terranes. In these sutures, magmatic-arc rocks are locally associated with fore- and back-arc basin series. Most of the oceanic crust has been subducted. The observed ophiolite belts are as a rule attributed to the base of oceanic island arcs. The fragment of the Asian continent traversed by the transect was formed through early, middle and late Paleozoic stages of accretion.



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Tectonophysics 359 (2002) 307–327

TECTONOPHYSICS

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Low seismic velocity layers in the Earth's crust beneath Eastern Siberia (Russia) and Central Mongolia: receiver function data and their possible geological implication

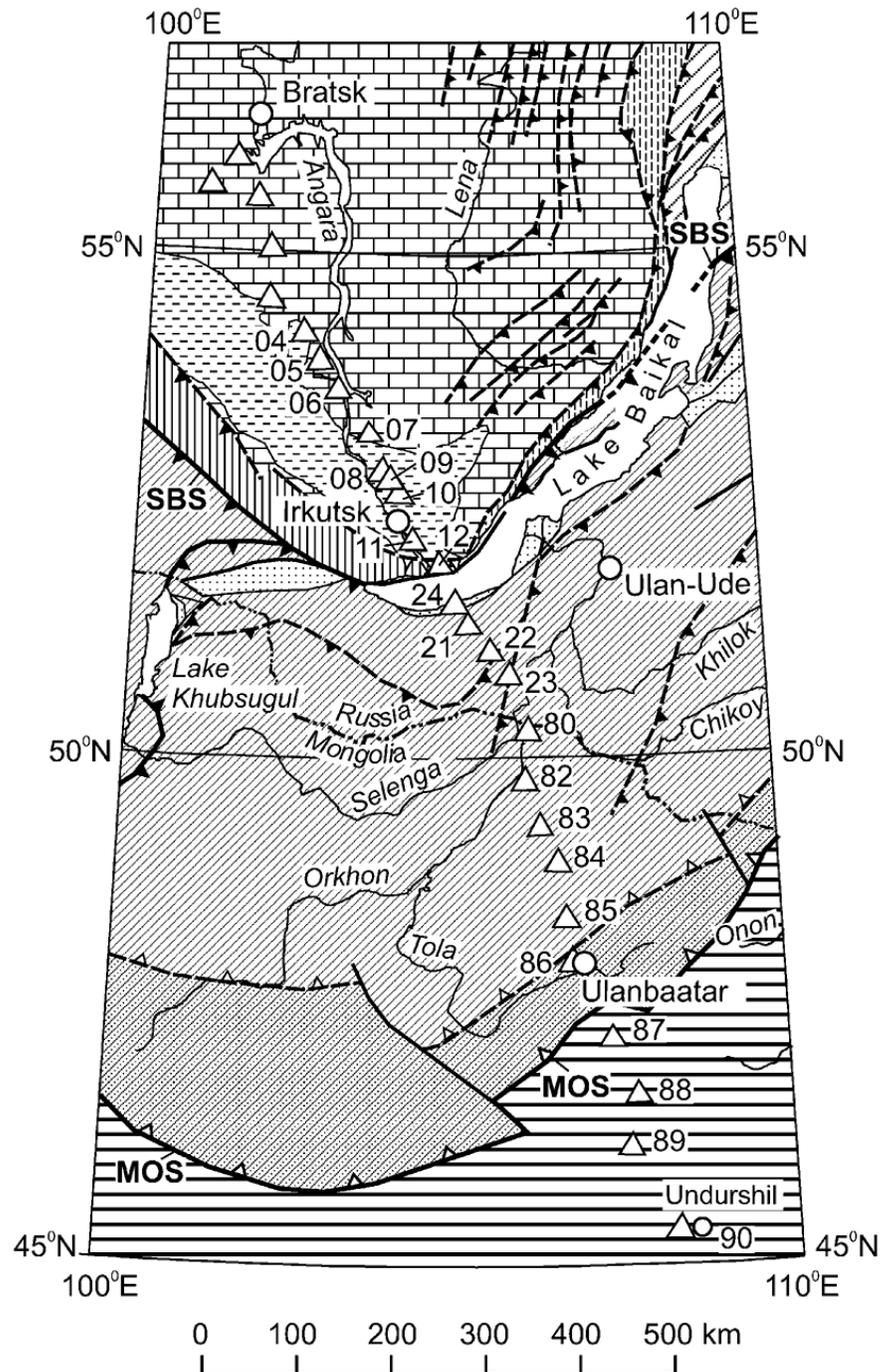
Yu.A. Zorin^{a,*}, V.V. Mordvinova^a, E.Kh. Turutanov^a, B.G. Belichenko^a,
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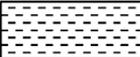
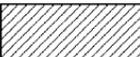
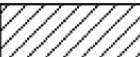
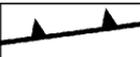
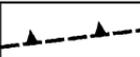
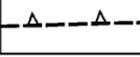
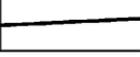
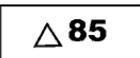
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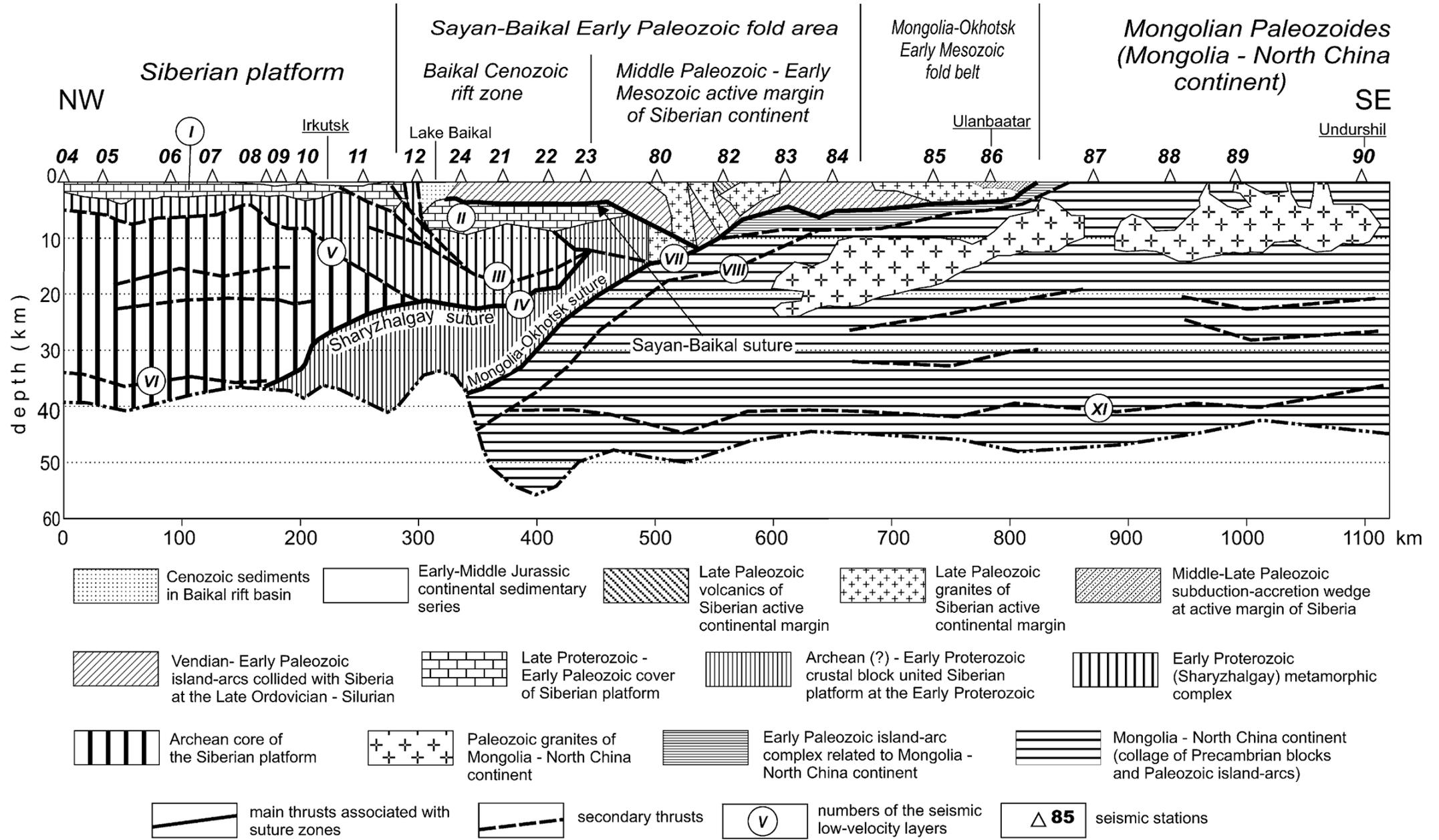
Received 2 August 2001; accepted 26 August 2002



LEGEND

-  Cenozoic continental rift basins
-  Early-Middle Jurassic continental basin
-  Middle-Late Paleozoic subduction-accretion wedge at active margin of Siberian continent
-  Vendian- Early Paleozoic island-arcs collided with Siberia at Late Ordovician - Silurian and then superposed by Middle Paleozoic - Early Mesozoic complexes of active continental margin
-  Late Proterozoic island arc collided with Siberia before Vendian and repetitively deformed in Late Ordovician-Silurian
-  Late Proterozoic - Early Paleozoic cover of Siberian platform
-  Early Proterozoic granites and volcanics
-  Early Proterozoic (Sharyzhalgay) metamorphic complex
-  Mongolia - North China continent (collage of Precambrian blocks and Paleozoic island-arcs)
-  Early Paleozoic first order thrusts (SBS = Sayan-Baikal suture)
-  Early Paleozoic second order thrusts
-  Early Mesozoic first order thrust (MOS = Mongolia-Okhotsk suture)
-  Early Mesozoic second order thrusts
-  other faults
-  digital seismic stations





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Fig. 11. Cross-section of the Earth's crust constructed on the basis of combined interpretation seismic, gravity, and geological data. Geological and gravity data are taken from Zorin et al. (1994) and Zorin (1999).



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Tectonophysics 306 (1999) 33–56

TECTONOPHYSICS

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Geodynamics of the western part of the Mongolia–Okhotsk collisional belt, Trans-Baikal region (Russia) and Mongolia

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Received 22 April 1998; accepted 2 February 1999

Abstract

After the western edge of the Mongolian microcontinent joined the Siberian continent in the region of Central Mongolia in the earliest Permian, these two continental blocks remained turned at an angle of about 120° with respect to each other and separated (on greater extent of their present-day boundary) by an enormous gulf of the Paleopacific called the Mongolia–Okhotsk ocean. Closure of this ocean at the Early/Middle Jurassic boundary led to the complete collision of Siberia and Mongolia, which by then had already become part of the Mongolia–North China continent. This main collisional episode, which lasted through the Middle and Late Jurassic, involved thrusting, folding and magmatism and produced the Mongolia–Okhotsk belt. The Onon island-arc, which was located in the Mongolia–Okhotsk ocean, was squeezed between the two major continents. Inasmuch as the third element (the island arc) was involved in the collision it is reasonable to distinguish two branches of the Mongolia–Okhotsk suture. These branches control the spatial distribution of gold mineralization in the Trans-Baikal region. On the southeastern periphery of Siberia the crust thickened considerably after the collision and a plateau-like uplift formed. In the Early Cretaceous, when compression ceased, the collisional uplift collapsed and the thrusts were transformed into low-angle normal faults, the motions on which were responsible for the formation of rift basins and exhumation of metamorphic core complexes. © 1999 Elsevier Science B.V. All rights reserved.

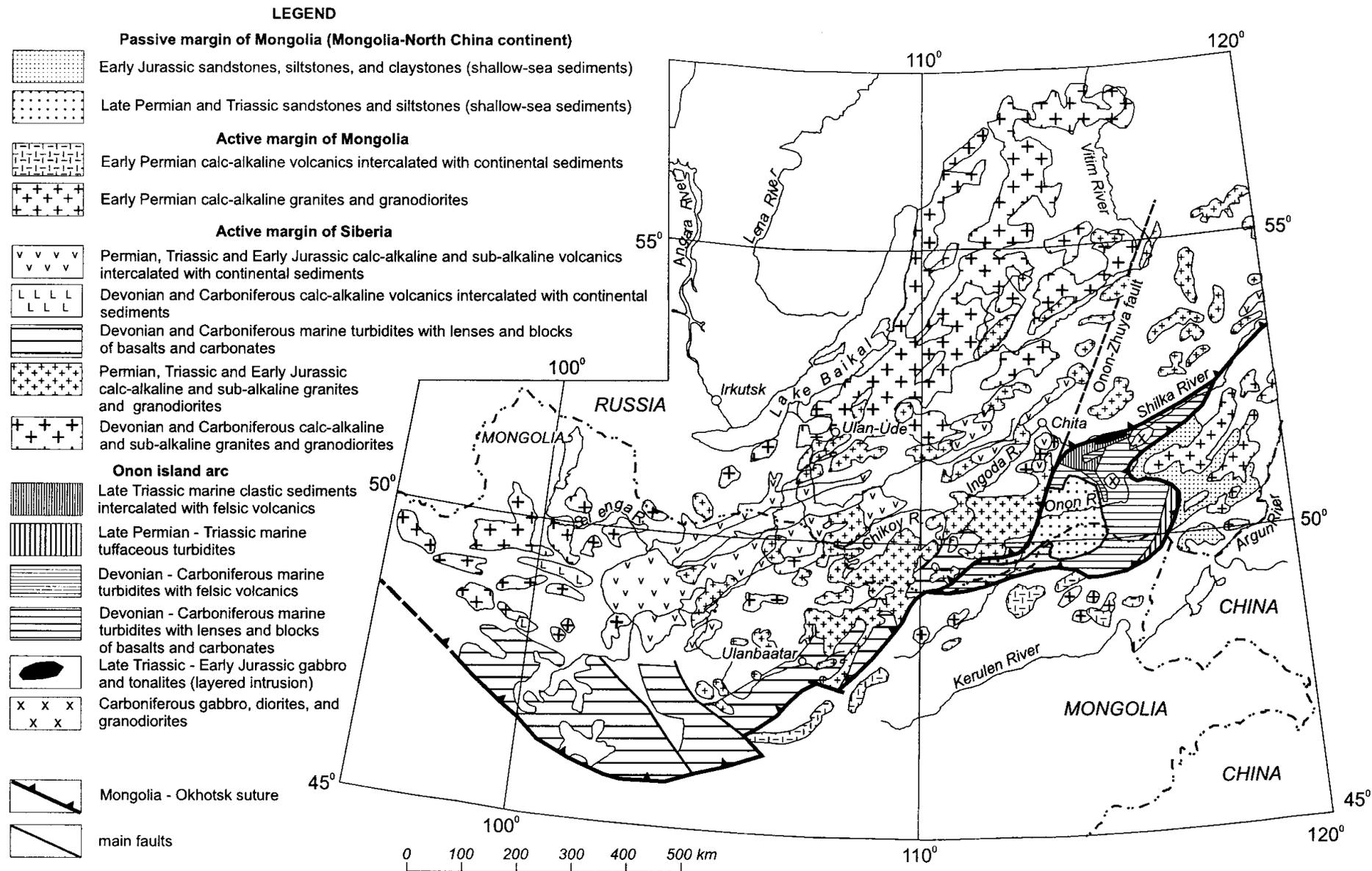


Fig. 2. Pre-collisional rock series. Compiled on the basis of published geological maps (Marinov, 1972; Shobogorov, 1977; Khrenov, 1988; Rutshtein, 1992) with regard to newly obtained data (Zorin et al., 1993, 1994, 1995, 1998a; Yarmoliuk et al., 1997). Only the middle-late Paleozoic and early Mesozoic (Devonian–Early Jurassic) rock series of the Mongolia–Okhotsk fold belt, produced by processes at the continental margins of Siberia and Mongolia and related to the evolution of the Mongolia–Okhotsk ocean, are shown. Rock series related to the evolution of the northern branch of the Paleotethys, that had ended with the collision of Mongolia with the North China continental block at the Early/Late Permian boundary, in the southern part of the study region are not shown.

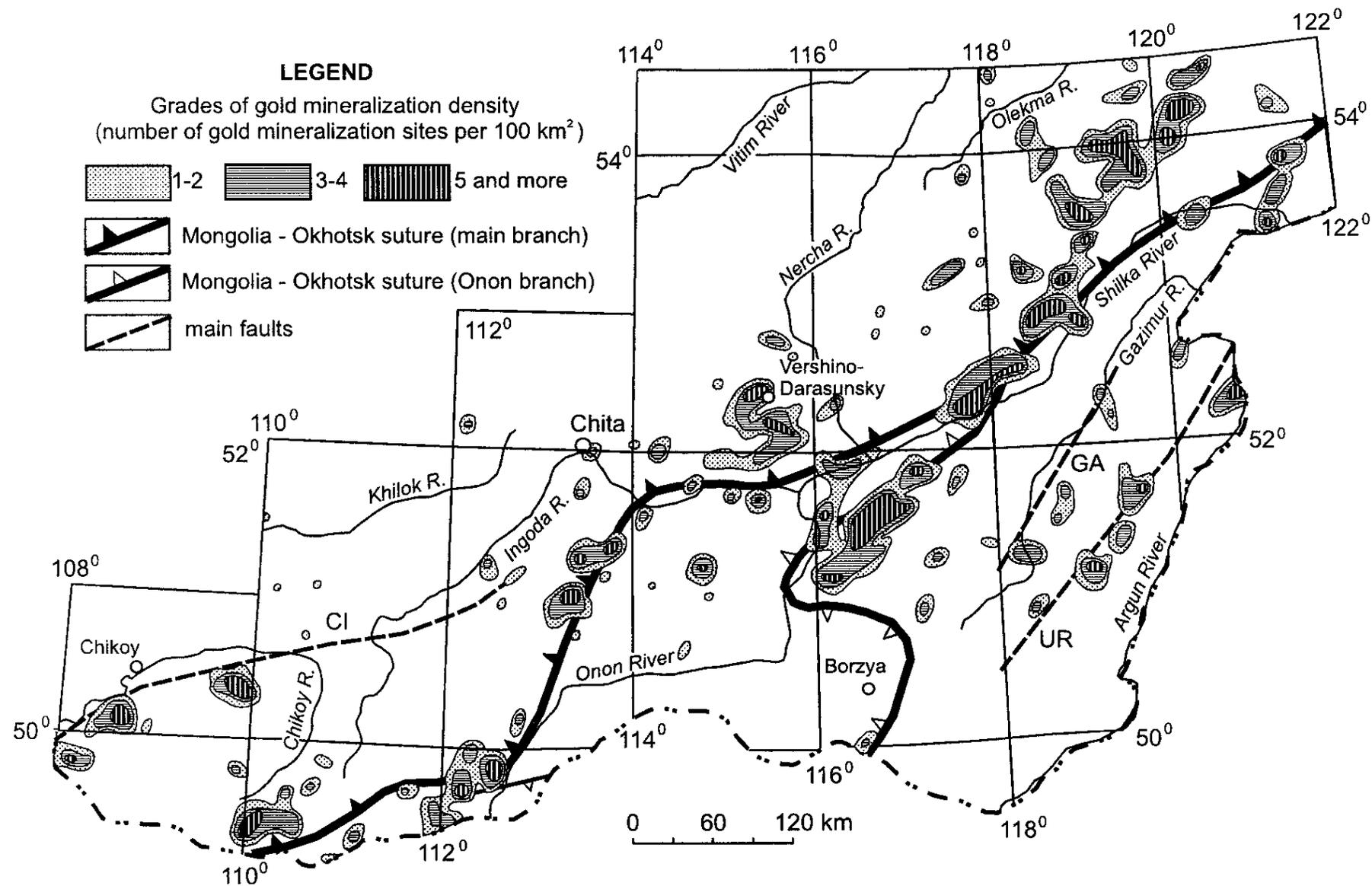


Fig. 9. Distribution of gold mineralization in the Trans-Baikal region. Density of gold sites is after Zorin et al. (1998a). Main faults are abbreviated as: *CI* = Chikoy–Ingoda; *GA* = Gazimur; *UR* = Urulunguy; their positions are after Khrenov (1988). For the position of the two branches of the Mongolia–Okhotsk suture see text and Fig. 6.