Материалы
Всероссийской
конференции
с международным
участием

Петрология магматических и метаморфических комплексов

Выпуск 8

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ
РОССИЙСКОЙ ФЕДЕРАЦИИ
НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
ТОМСКИЙ ГОСУДАРСТВЕННЙ УНИВЕРСИТЕТ

Петрология магматических и метаморфических комплексов

Выпуск 8

Материалы Всероссийской конференции
с международным участием

29 ноября – 2 декабря 2016 года

Томск 2016

УДК 551.24
ББК 26.303

Петрология магматических и метаморфических формаций. Вып. 8. Материалы Всероссийской петрографической конференции с Международным участием. – Томск: Изд-во Томского ЦНТИ. 2016. – 412 с.

В сборнике представлены материалы 8-й научной конференции по проблемам генезиса, моделирования условий формирования, структурной организации и минерагении магматических и метаморфических комплексов. Рассмотрены вопросы их геохронологической корреляции и формационной типизации.

Для специалистов в области петрографии, геологической съемки и прогноза месторождений полезных ископаемых.

Кафедра петрографии Томского государственного университета

Petrology of magmatic and metamorphic complexes. Issue 8. Pceeding of science meeting. – Tomsk: Tomsk CSTI Publishing house. 2016. – 412 p.

The collection includes reports from the 8th science meeting according petrology of magmatic a metamorphic rocks and their metallogeny and structural construction. Questions of their correlation and formation type are discussed.

The book is interesting for specialists in the field of petrography and geological survey and proposal of ore deposits.

Petrography department of Tomsk State University

ISBN 978-5-89702-415-5

Издательство Томского ЦНТИ. Бумага офсетная № 1. Печать офсетная.
Подписано в печать 22.11.2016 г. Заказ № 944. Тираж 120 экз.
Отпечатано в Томском ЦНТИ.
Россия, 634021, г. Томск, пр.Фрунзе, 115/3. Тел. (8-3822) 26-31-69

Содержание

Frontiers in Large Igneous Province Research
Richard E. Ernst..8

Map of mafic dyke swarms and related units of Russia and adjacent regions,
and implications for continental reconstructions
Richard E. Ernst, Kenneth L. Buchan, Svetlana Botsyun 10

The magmatic history of the West European Variscan Belt. Pulsated vs. continuous magmatic events
Gabriel Gutiérrez-Alonso, Javier Fernández-Suárez and Alicia López-Carmona..........14

UHP metamorphism in the Polar Urals: evidences from the Marun-Keu Complex (Russia)
López-Carmona, A., Tishin, P.A., Chernyshov, Gutiérrez-Alonso, G., Gertner, I. F. 15

Origin of compositional diversity in the Chigu Tso intrusions in the remnant Comei large igneous province,
SE Tibet: implications for the Daly Gap
Ying Xia, Richard E. Ernst, Di-Cheng Zhua 20

Тектоно-магматическая эволюция территории северо-восточной части Ангаро-Витимского
гранитоидного батолита северного Забайкалья (U-Pb и ^{40}Ar-^{39}Ar возраст и состав пород
вулкано-плутонической ассоциации Баунтовского района)
Антонов А. Ю., Доронина Н. А., Травин А.В., В. Б. Хубанов В. Б., Посохов В. Ф., Буянтуев М. В. 21

К вопросу о возрасте различных типов гранитоидов Хилок-Витимского складчатого пояса Забайкалья
(на примере ^{40}Ar-^{39}Ar и Rb-Sr - изотопных датировок)
Антонов А.Ю., Посохов В.И. 28

Моделирование сульфидно-силикатной несмесимости и микроэлементного состава
сульфидной фазы в базальтовых магмах
А.А. Арискин, К.А. Бычков, Г.С. Николаев, Г.С. Бармина 32

Барит-полиметаллическое оруденение Змеиногорского рудного района и его генетические аспекты
Бестемьянова К.В., Гринев О.М. 36

Петрологические особенности Сыдыгского перидотит-габбрового массива (Западный Саян)
Е.В. Бородина, А.А. Монгуш...45

Кампанское игнимбритовое извержение (~39 тыс. л.н.): краткий обзор и новые данные
по дистальным фациям извержения
А.В. Вишневский, К.К. Павленок, М.Б. Козликин 55

Динамика внедрения базит-ультрабазитовых тел на глубинных уровнях
аккреционно-коллизионных систем (ольхонский регион, западное прибайкалье)
Владимиров А.Г., Мехоношин А.С., Давыденко Ю.А., Хлестов В.В.,
Волкова Н.И., Хромых С.В., Михеев Е.И. 60

Глаукофансланцевый метаморфизм подушечных базальтов чарской зоны (СВ Казахстан)
Н.И. Волкова, В.В. Хлестов, В.П. Сухоруков, А.В. Травин, Д.С. Юдин, М.В. Хлестов..........67

Геохимические и изотопные (o, sr, nd, pb) свидетельства фракционирования
и контаминации при формировании базальт-андезит-трахит-риолитовой серии
батеневского поднятия минусинского прогиба
А.А. Воронцов 76

Мантийные источники и условия генерации кембрийского oib–магматизма Горного Алтая
В.В. Врублевский, В.И. Крупчатников, И.Ф. Гертнер......................................82

Гибридные породы собского комплекса (Собский батолит, Полярный Урал)
Горбаченко К.В., Удоратина О.В. 90

Map of mafic dyke swarms and related units of Russia and adjacent regions, and implications for continental reconstructions

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Work is progressing to produce a map in ArcGISTM 10 of the mafic dyke swarms and related units (volcanics, sills and layered intrusions) of Russia and adjacent regions at a scale of 1:5,000,000. Over the past several years dykes have been traced from georeferenced source maps, including the 1:1,000,000 series of geological maps and numerous regional and local maps from journal publications. Dykes are being grouped into swarms based on their distribution, trend and geochronology. This work compliments broad-scale mapping of dyke swarms (and related units) in other regions such as Canada and adjacent areas, Finland and northern China. This Russian map is benefiting from new U-Pb ages that have been produced for Siberia, the Urals, Karelia, Kola, and elsewhere.

The new map of Russia and adjacent regions will be helpful in linking dykes of similar age in different local areas. In turn, this information can be used to determine the areal extent and overall geometry of giant dyke swarms. Giant radiating dyke swarms are of particular interest. Their foci locate probable mantle plume centres, which are often linked to continent or supercontinent breakup. Large dyke swarms are typically feeder systems for volcanic rocks, sills and layered intrusions associated with large magmatic events such as Large Igneous Provinces (LIPs).

The map will also be useful for testing global reconstructions, by facilitating comparison of giant dyke swarm trends and ages between cratonic blocks. Finally, it will be helpful in targeting dykes for precise U-Pb dating, paleomagnetism, geochemistry, and additional mapping.

Карта мафитовых дайковых «роев» и относящихся к ним элементов России и прилегающих регионах, применения в континентальных реконструкциях

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Продолжается работа по разработке карты в ArcGISTM 10 мафитовых дайковых «роев» и относящихся к ним элементов (вулканических пород, силлов и слоевых интрузий) России и прилегающих регионах в масштабе 1:5,000,000. На протяжении нескольких последних лет дайки отслеживались по географически привязанным картам источникам, включая 1:1,000,000 серии геологических карт и многочисленные региональные и местные карты, взятые из публикаций журналов. Дайки группируются в «рои» в зависимости от их распределения, направления/трендов и геохронологии. Данная работа дополнит широко-масштабное картирование дайковых «роев» (и относящихся к ним элементам) в других регионах, таких как Канада и прилегающих областях, Финляндия и Северный Китай. Данная Российская карта обновлена за счет новых U-Pb возрастов, определенных для Сибири, Урала, Карелии, Кола и др.

Новая карта России и смежных регионов будет полезной в установлении связей между дайками схожих возрастов из разных местностей. В свою очередь эта информация может быть использована для определения протяженности области и общей геометрии гигантских дайковых «роев». Гигантские радиальные дайковые «рои» вызывают особый интерес. Их очаги локализуют возможные ценры мантийных плюмов, которые часто связаны с континентальным или суперконтинентальным распадом. Крупные «рои» даек обычно являются системами снабжения вулканических пород, силлов и слоистых интрузий, связанных с крупными магматическими событиями, такими как Крупные Изверженные Провинции (КИП).

Данная карта также станет полезной для тестирования глобальных реконструкций засчет сравнения трендов гигантских дайковых «роев» и возрастов в разных блоках кратона. В заключении она будет полезной в выборе даек для прецензионного U-Pb датирования, палеомагнетизма, геохимии, и дополнительного картирования.

Mafic dyke swarm map

Work is progressing to produce a map in ArcGISTM 10 of the mafic dyke swarms and related units (volcanics, sills and layered intrusions) of Russia and adjacent regions at a scale of 1:5,000,000. Over the past several years dykes have been traced from georeferenced source maps, including the 1:1,000,000 series of geological maps and numerous regional and local maps from journal publications. Dykes are being grouped into swarms based on their distribution, trend and geochronology. This work compliments broad-scale mapping of dyke swarms (and related units) in other regions such as Canada and adjacent areas (Buchan and Ernst 2004; Buchan and Ernst 2013), Finland (Vuollo and Huhma 2005) and northern China (Peng 2015). This Russian map is benefiting from new U-Pb ages that have been produced for Siberia (e.g. Ernst et al. 2016a,b), the Urals (e.g. Puchkov et al. 2016), Karelia (e.g. Stepanova et al. 2015), Kola (e.g. Fedotov et al. 2012) and elsewhere.

The new map of Russia and adjacent regions will be helpful in linking dykes of similar age in different local areas. In turn, this information can be used to determine the areal extent and overall geometry of giant dyke swarms. Giant radiating dyke swarms are of particular interest. Their foci locate probable mantle plume centres, which are often linked to continent or supercontinent breakup. Large dyke swarms are typically feeder systems for volcanic rocks, sills and layered intrusions associated with large magmatic events such as Large Igneous Provinces (LIPs) (Ernst 2014).

The map will also be useful for testing global reconstructions, by facilitating comparison of giant dyke swarm trends and ages between cratonic blocks (e.g. Bleeker and Ernst 2006; Ernst 2014). Finally, it will be helpful in targeting dykes for precise U-Pb dating, paleomagnetism, geochemistry, and additional mapping.

Giant mafic dyke swarms of Russia

Approximately 100 relatively large swarms have been identified to date in Russia with lengths up to 1200 km. Of particular note are several giant radiating swarms. For example, the giant radiating swarm associated with the 250 Ma Siberian Trap LIP has subswarms which can be traced for >750 km over an arc of 100o (Ernst and Buchan 2001). It is also noted that a giant circumferential swarm is associated with this LIP (Ernst and Buchan 2001). Taken together with related volcanic rocks and sills, including those beneath the West Siberian Basin, the overall Siberian Trap LIP extends over ~6 Mkm2. The 370 Ma Yakutsk-Vilyui LIP of Siberia is dominated by a giant radiating dyke swarm, with subswarms that can be traced up to 900 km over an arc of 140o (Kiselev et al. 2012). These subswarms and associated volcanic rocks are located along arms of a prominent radiating rift system. The 1750 Ma Timpton giant radiating dyke swarm of Siberia exhibits three subswarms that extend out to a distance of 1200 km from the focal point over an arc of 200o (Gladkochub et al. 2010; Ernst et al. 2016a).

Several giant linear swarms have been catalogued. For example, the 400 km long 1870 Ma Kalaro-Nimnyrsky swarm of the Aldan Shield is approximately coeval and co-linear with the major 150 m wide Malozadoisky dyke in basement rocks exposed in the western Irkutsk promontory (Ernst et al. 2016a). Together they may represent a giant linear swarm that is 1500 km in length. Large linear swarms are also commonly observed intruding Phanerozoic rocks. For instance, a N-S trending Devonian swarm extends >1200 km along the Ural Mountains (Puchkov et al. 2016). A dense 600 km long NE-trending Jurassic/Cretaceous swarm cuts the Verkhoyansk belt and the Kolyma-Omolon block.

Reconstruction implications

Some mafic dyke swarms are thought to be components of giant radiating or linear swarms and associated LIPs that extend outside the current map area or are located on other continental blocks as a result of continental break up and drift. In fact, the matching of LIP events between crustal blocks has been an important tool in establishing continental reconstructions, using the LIP barcode matching – piercing point method (Bleeker and Ernst 2006).

For example, the 2330-2310 Ma Kuito-Taivalkoski (Stepanova et al. 2015; Salminen et al. 2014; Ernst, 2014) and 1970 Ma Pechenga-Onega (Lubnina et al. 2016) dyke swarms extend outside of Russia into Finland. Furthermore, the ca. 2100 Ma Karelian -Tohmajärvi dyke swarm can be traced into Finland, and in a continental reconstruction has been linked to the coeval Marathon dyke swarm of the Superior craton of North America (Bleeker and Ernst 2006).

The dykes of Franz Josef Land are part of a giant radiating swarm that extends acros across Svalbard, northern Greenland and the Arctic islands of northern Canada and is associated with the 130-80 Ma High Arctic Large Igneous Province (HALIP) (Buchan and Ernst 2006).

Nine LIP events of southern Siberia can be traced into northern Laurentia on the basis of a recent 1.9-0.7 Ga Siberia-Laurentia reconstruction that featured nine new U-Pb ages and six new Ar-Ar ages (Ernst et al. 2016a). Four particularly robust age matches are at 1870, 1750, 1350 and 720 Ma (Figure 1). The 1870 Ma Ghost-Mara River-Morel event of the Slave craton, Laurentia, (Buchan et al. 2016) lies along trend from the above mentioned 1870 Ma Kalaro-Nimnyrsky-Malozadoisky swarm of southern Siberia (Ernst et al. 2016a). The 1750 Ma Kivalliq magmatism and related dykes in northern Laurentia (Peterson et al. 2015) are coeval with the above mentioned 1750 Ma Timpton radiating dyke swarm of Siberia. The 1350 Ma Wellington Inlier sill and related units of northern Canada, are matched with the Listvyanka swarm of the Irkutsk area of Siberia. Finally, the widespread 725-715 Ma Franklin LIP of northern Canada (e.g. Ernst and Bleeker 2010) shares the same mantle plume centre with the 720 Ma Irkutsk event of southern Siberia (Ernst et al. 2016a). The latter includes Nersa area sills, Baikal dykes, and layered intrusions (including the Dovyren and Upper Kingash intrusions) (Ariskan et al. 2013; Polyakov et al. 2013; Ernst et al. 2016a). The giant 1270 Ma Mackenzie swarm of Laurentia may continue into Siberia, with the recognition of the 200 m wide 1260 Ma Srednecheremshanskii dyke (Ernst et al. 2016a)

On the northern side of the Siberian craton the 1385 Ma Chieress dykes and widespread 1501 Ma Kuonamka LIP (Ernst et al. 2000; Ernst et al. 2016b) extend into the formerly attached Sao Francisco and Congo cratons (Ernst et al. 2013).

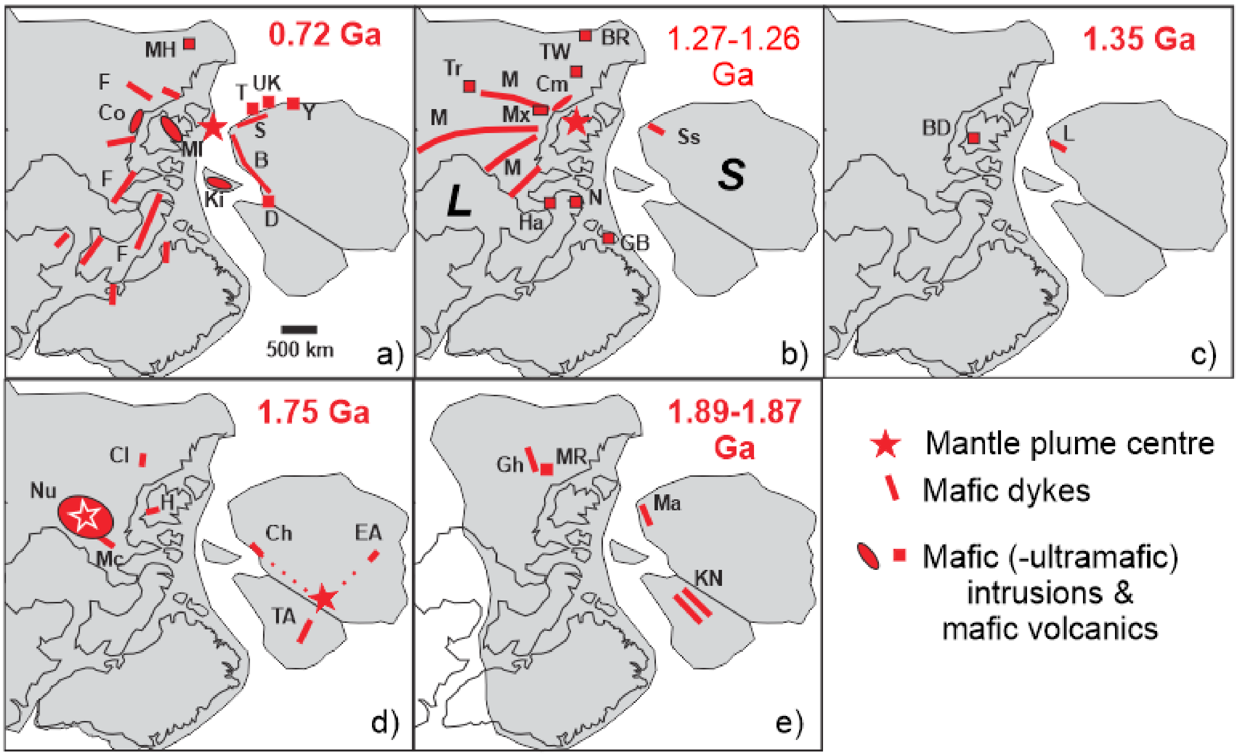

Figure 1: Matching LIP events of southern Siberia and northern Laurentia: S = Siberia, L = Laurentia. A) Siberia: Dovyren (D), Verkhnii (Upper) Kingash (UK) and Tartai (T) intrusive massifs, and Sayan (S) and Baikal (B) dyke swarms. Laurentia: Franklin dyke swarm (F), Coronation sills (Co), Minto Inlier basalts and sills (MI) and Mount Harper volcanics (MH). Note also the Kikiktat flood basalts (Ki) of the North Slope subterrane of Alaska. B) Siberia: Srednecheremshanskii (SS) dyke; Laurentia: Coppermine (Cm), Tweed Lake (TL), Nauyat (N) and Hansen (Ha) volcanics, Muskox (Mx) layered intrusion, Tremblay (Tr), Goding Bay (GB) sills, and rotated Bear River (BR) dykes and most markedly the giant radiating Mackenzie (M) dyke swarm. C) Siberia: Listvyanka (L) dykes; Laurentia: Barking Dog (BD) sill. D) Siberia: Timpton radiating dyke swarm consisting of Eastern Anabar (EA), Chaya (Ch) Timptano-Algamaisky (TA) subswarms. Laurentia: Kivalliq Igneous Suite which includes the Nueltin (Nu) granite intrusions, gabbro and anorthosite intrusions, basalt, rhyolite and pyroclastic rocks of the Pitz Formation, and related McRae (Mc), Hadley Bay (H) and Cleaver (Cl) dyke swarms. E) Siberia: Kalaro-Nimnyrsky (KN) and Malozadoisky (Ma) dyke swarms. Laurentia: Mara River (MR) sheets, Ghost (Gh) dykes. Diagram revised after Ernst et al. (2016a).

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