The Lower Vltava River Pluton: a semi-hidden intrusive complex in Neoproterozoic at the northern outskirts of Prague, Central Bohemia

Dolnovltavský pluton: poloskrytý intruzívní komplex v neoproterozoiku severního předpolí Prahy, střední Čechy

(6 figs, 2 tabs)

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Abundant dykes penetrate the Neoproterozoic volcanosedimetary sequences between the northern periphery of Prague and the towns of Kralupy n. Vlt. and Neratovice. Their petrographic character ranges from granite porphyries up to diabases. They are associated with small bodies of abyssal rocks of granite, granodiorite, tonalite, diorite and gabbro compositions. All these lithologies form a large composite plutonic complex termed Lower Vltava River Pluton, most of which is covered by sediments. Scattered outcrops represent only an apical part exposed at the present denudation level. The whole rock major-element geochemistry shows following characteristics: acid to basic (however not ultrabasic) span, medium to high-K calc-alkaline affinity for most of the rocks, medium- to high potassic and metaluminous to peraluminous compositions and probably post-orogenic tectonomagmatic setting. Field relations indicate a Cambrian age of the magmatic activity.

Key words: Bohemian Massif; plutonites; petrography; geochemistry; geological setting

Introduction

Remarkable magmatic dykes cutting the volcanosedimentary Neoproterozoic sequences between Prague and Kralupy n. Vlt. and perfectly exposed in cliffs of the Vltava River valley, have been known to geologists already since 19th century (Bořický 1880, Klvaňa 1893). Their abundance led several authors (first Kettner 1912) to an idea that their swarm radiates from a shallow plutonic body hidden mostly under Cretaceous, Tertiary and Quaternary sediments.

Woldřich (1917) was the first who desribed also intermediate abyssal plutonites from the area of Neratovice. The discovery of thermally metamorphosed schists containing chiastolite (and in places sillimanite and cordierite) at Čenkov and Veliká Ves (Matějka 1923) lended support to the idea of the presence of a larger hidden plutonic body at small depth. Direct evidence was provided by the find of granitoids cropping out on the surface at Hoštice and Odolena Voda (Röhlich 1960) and of a granitic stock in the Vltava-valley at Klecany (Fediuk 1996).

Indications of polymetallic ore mineralization were found in the nearby greywackes of the Klecany quarry (Láznička – Tichopádová 1959) and in the Tiché údolí valley at Roztoky (Velebil 1995), in metabasaltic volcanics south of Netřeba W of Neratovice (Ciniburk 1966, Fediuk – Chalupný 1998) as well as in lydites at Kojetice (Klein – Paděra 1953). New geological mapping at the scale of 1:25 000 (Volšan et al. 1983, Straka at al. 1988, 1994) determined the extent of contact metamorphic effects and the limit of the biotite zone. The erroneously for Proterozoic volcanics taken two bodies at Dolní Chabry in northern outskirts of Prague were reinterpreted as an alkali feldspar quartz syenite to gabbro intrusion (Fediuk 1994), a plutonic association belonging to the semi-hidden intrusive complex termed newly *Lower Vltava River Pluton* (Fediuk 1996a). Now, it is clear that this plutonic complex reaches from Prague to Neratovice as shown by dispersed outcrops scatterd over a territory of c. 10×15 km. Even in absence of

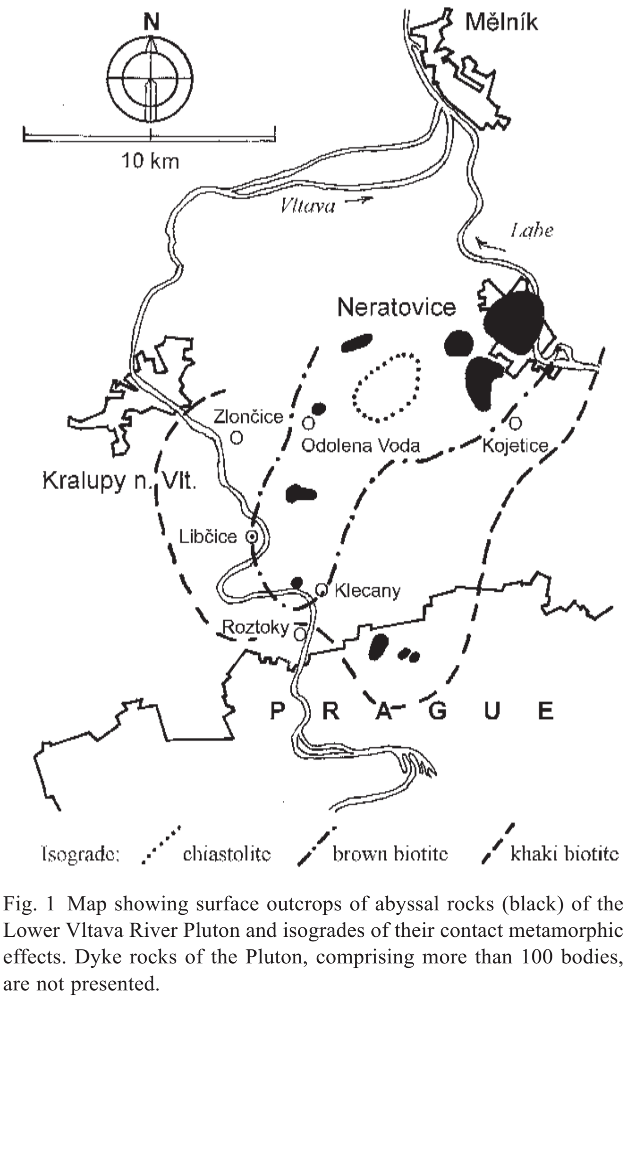


Fig. 1 Map showing surface outcrops of abyssal rocks (black) of the Lower Vltava River Pluton and isogrades of their contact metamorphic effects. Dyke rocks of the Pluton, comprising more than 100 bodies, are not presented.

sufficiently deep boreholes and of detailed geophysical data, a rough outline of this plutonic body can be drawn (Fig. 1).

Petrography

Dykes

They span a large spectrum of compositions: basic (~ 7 %), intermediate (~ 43 %) and acid (~ 48 %). Lamprophyres (~ 2 %) represent an additional specific rock type.

Dykes of basic composition are present in two forms: a) diabases, characterized by ophitic texture and b) gabbroporphyries (microgabbros) with a granular and often also porphyritic texture (Photo 1). The largest diabase dyke, 40 m thick and 3 km long, is composed of *calcic plagioclase > clinopyroxene > hornblende > ilmenite > apatite (± quartz).* It crops out in the cliff at the railway 300 m NNE of the former Podbaba station continuing to the SW into the Suchdol valley. Substantially smaller diabase dykes were found in the Tiché údolí valley at Maxmiliánka hotel W of Roztoky, in the Čimice gully at Zámky in the N of Prague, on the western end of Vodochody village east of Libčice, near Dolánky north of Libčice, and south of Netřeba between Neratovice and Kralupy n. Vlt. A thin dyke in the Tiché údolí valley west of Roztoky opposite to the Spálený mill was, with regard to its conspicuous green colour, taken also for diabase (Kratochvíl 1965, Ciniburk et al. 1965). However it is neither ophitic nor of basic composition and corresponds to epidotized quartz diorite (Fediuk 1996b). Dykes of microgabbro occur rarely: north of the Drahany valley in the norther outskirts of Prague and, strongly chloritized, at railway km 427.5 southwest of Letky south of Libčice.

Intermediate dykes are much more common than the preceeding ones. They are mostly porphyritic with *oligoclase* or *andesine* and sometimes also with mafic phenocrysts (mainly *hornblende*) and with microgranular groundmass. Their colour is grey or greenish due to chloritization of mafic minerals, of which mainly *hornblende* and less frequently also *biotite* remain preserved. The majority of these rocks, mostly described by previous authors (Kratochvíl 1965, Ciniburk et al. 1965, Čemusová 1983) as porphyrites, are microdiorites, less frequently quartz microdiorites and one micromonzodiorite (in the Klecany – quarry). A prominent dyke with large feldspar phenocrysts, quarried once in the Zlončice gully and classified by Kettner (1912) as monzonite porphyry, belongs to this group, too.

Acid dykes are light (whitish, yellowish or pale rose) in colour. They mostly contain small *feldspar* (*sodic plagioclase* + *orthoclase*) and *quartz* phenocrysts in a fine-grained felsitic groundmass. Graphic and spherolitic intergrowths occur often. *Biotite* is their sole mafic constituent and some types are almost without mafic minerals. These rocks can be classified as (leuco)micrograntes or granite porphyries (Photo 2). A typical example of this rock type can be seen at the Libčice cliff above the railway 0.75 km NNW of the station. In the Sedliny gully 1.25 km west of Máslovice, a 35 m thick microgranite dyke was quarried for the Vltava river wharf. Aplites and pegmatites are extremely rare (Ciniburk 1966). Vrána (1998) found in them *feruvite*, a rare member of the *tourmaline* group). Thin veinlets consisting of quartz and albite of cleavelandite type, occurring in the Tiché údolí valley at Roztoky (Fediuk 1996b), may belong to this leucocratic association, too.

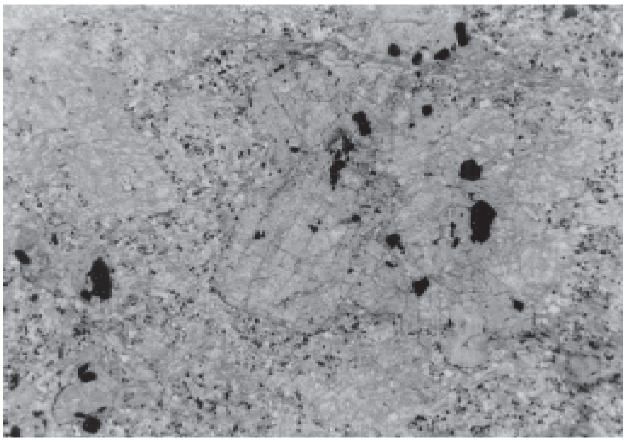
Lamprophyres are the rarest rock type, found in three dykes only: in the Libčice cliff where it cuts a Proterozoic metabasalt as well as a thick microgranite dyke (see above), on the western periphery of Chvatěruby NNW of Zlončice and in the Větrušice gully northwest of Klecany. The first dyke is kersantite (Bořický 1880, Kratochvíl 1965, Čemusová 1983) with *biotite* > *plagioclase* > *clinopyroxene* > *olivine* (pseudomorphosed) > *magnetite* > *apatite* (Photo 3). The other two dykes are less basic with *orthoclase ~ plagioclase.* One of them (at Chvatěruby, the northernmost lamprophyre of Central Bohemia) is a minette, the other one (at Větrušice gully) is of spessartite composition. Some melanocratic microdiorites approach the lamprophyre composition.

Abyssal rocks

Even though dykes are several times more frequent in the studied area than their abyssal equivalents, the latter are most important for the understanding of the plutonic structure of the region. Forming irregular stocks on the actual surface, they represent the main plutonic mass in its apical part. They are known in six occurrences: 1) around Neratovice, 2) S of Netřeba 5 km W of Neratovice, 3) on NE periphery of Odolena Voda, 4) between Hoštice – Vodochody – Drasty 3 km NE of Libčice, 5) on the right bank of the Vltava River at Klecany and 6) in

Explanation of Photos 1–8 ⇨

1 – Diabase porphyrite. Railroad in Sedlec, northern Prague. Crossed polars, enlarged 10.5×.
2 – Granite porphyry. Working quarry at Klecany. Crossed polars, enlarged 10.5×.
3 – Kersantite. Cliff at the railroad north of Libčice. Plane-polarised light, enlarged 10.5×.
4 – Gabbrodiorite. Abandoned small quarry, western end of Dolní Chabry, northern Prague. Crossed polars, enlarged 10.5×.
5 – Tonalite. Abandoned small quarry at Drasty south of Odolena Voda. Crossed polars, enlarged 10.5×.
6 – Tonalite. Outcrop at the road, western end of Vodochody NE of Libčice. Crossed polars, enlarged 10.5×.
7 – Alaskite. Abandoned quarry at Klecany. Crossed polars, enlarged 10.5×.
8 – Alkali feldspar (quartz) syenite. Outcrop in Dolní Chabry, northern Prague. Crossed polars, enlarged 10.5×.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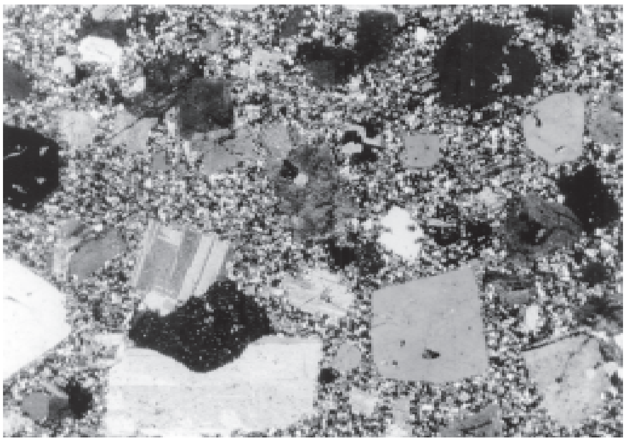
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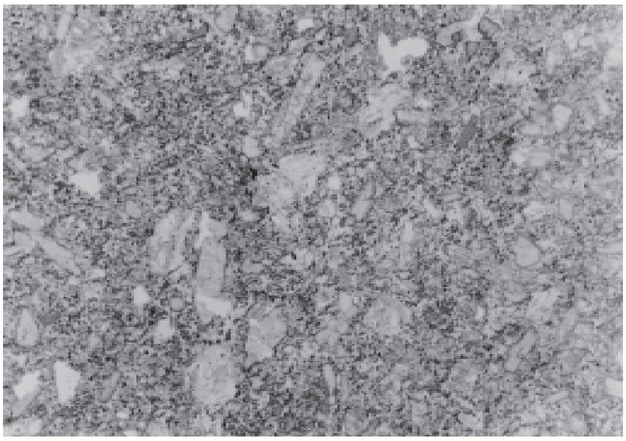
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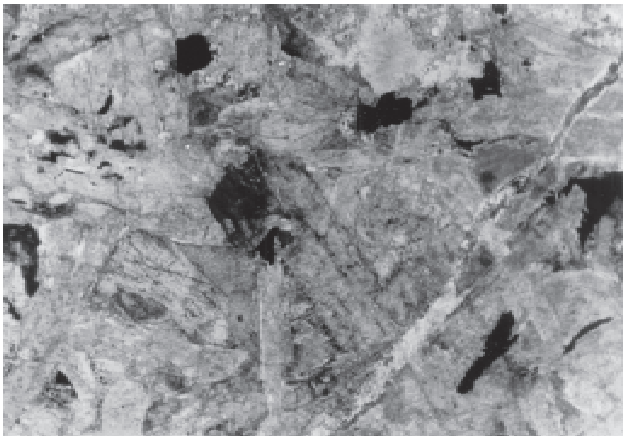
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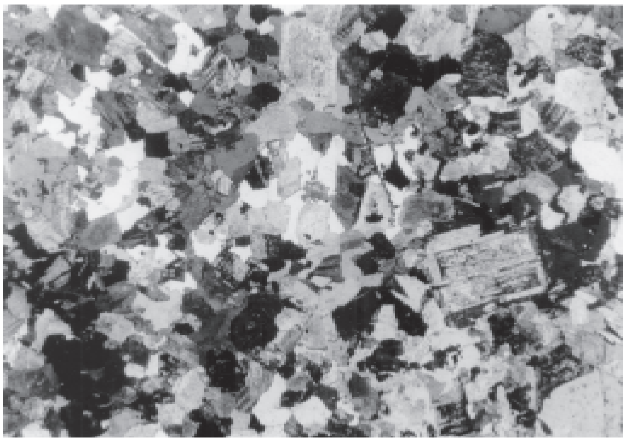
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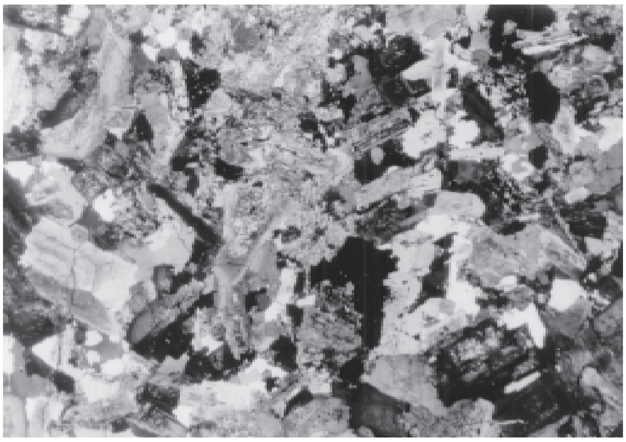
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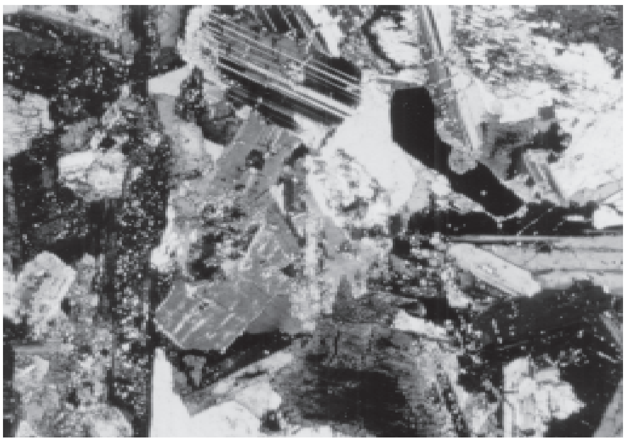
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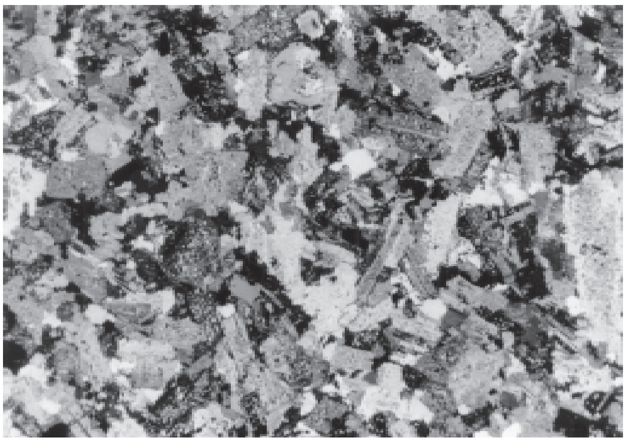
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the northern Prague district of Dolní Chabry (Fig. 1). The first occurrence, a cluster of several almost continuous bodies at Neratovice and Byškovice, is not only the largest one but also the longest known (Woldřich 1917). Bodies at Odolena Voda and nearby at Hoštice – Vodochody – Drasty were discovered much later (Röhlich 1960) and the stocks at Dolní Chabry and Klecany were recognized only in 1990's (Fediuk 1993 and 1994). The following rock types can be distinguished:

Gabbros and gabbrodiorites were found near Byškovice and Netřeba west of Neratovice. According to Ciniburk (1965) they are composed of *plagioclase* (often albitized), *hornblende* (up to 10 cm long columns) and sporadic relics of *clinopyroxene*. *Apatite* and *opaque minerals* are common accesories, *sphene, chlorite* and *epidote* are of secondary origin. The southernmost part of the Neratovice body in Dolní Chabry (Fediuk 1994) contains also a *clinopyroxene-hornblende* gabbroic facies (Photo 4).

While the basic lithologies occur in independent and probably slightly younger stocks, substantially more widespread diorites, quartz diorites, tonalites and granodiorites form a lithologically variable complex with gradual transitions between individual rock types. These rocks vary in grain size from fine- to medium-grained, and are mostly equigranular. *Quartz* is absent in most basic members, *plagioclase* (mainly of *andesine* composition, but often *albitised*) is the main mineral while *orthoclase* occurs only in places and in subordinate amount. Of the mafic constituents, *amphibole* and *biotite* are always present. *Amphibole* is of *hornblende* type with some transitions into *actinolite*; in the tonalite of Drasty S of Odolena Voda, accessoric *cummingtonite,* mentioned also from Netřeba west of Neratovice (Vrána 1998) was confirmed by electron microprobe. *Biotite* is often chloritized. *Pyroxene* occurs scarcely and almost in relictic cores transformed to *uralite* (Ciniburk 1966). *Apatite, epidote (± allanite), calcite, magnetite* and ± *sphene* are the main accessories. Modal analyses can be found in Ciniburk (1966). Granodiorite and tonalite (Photo 5 and 6), as stressed also in most previous papers (Ciniburk 1965, Zoubek in Straka et al. 1994, Fediuk, Chalupný 1998 etc.), are the most representative rock types.

Granites and quartz-bearing syenites represent the most acid members of the plutonic suite, occurring in two rare facies: the alkali feldspar leucogranite (alaskite, Photo 7) on the right bank of the Vltava-river at Klecany (Fediuk 1993) and the alkali feldspar syenite, quartz-bearing, (Photo 8) at Dolní Chabry (Fediuk 1994). Both of them contain minor *biotite.*

The size, form and interrelations of the main minerals in individual rock types can be derived from microphotographs 1 to 8.

Table 1 Major-element compositions of selected Lower Vltava River Pluton rocks, unpublished analyses (wt. %).

	1	2	3	4	5	6	7	8	9	10	11	12
SiO_2	76.46	75.35	75.14	74.36	74.04	71.76	64.64	64.24	62.92	60.23	54.18	52.28
TiO_2	0.06	0.03	0.03	0.05	0.05	0.25	0.73	0.47	0.82	0.96	1.22	1.18
Al_2O_3	13.16	13.26	13.47	13.32	14.16	13.76	16.55	14.57	16.34	16.79	11.77	16.99
Fe_2O_3	0.73	0.61	1.13	0.41	2.94	1.11	0.39	1.06	0.56	0.78	2.26	1.47
FeO	0.18	0.25	0.25	0.74	0.14	0.85	4.81	2.87	4.91	4.68	2.75	5.18
MnO	0.01	0.03	0.02	0.03	0.03	0.03	0.02	0.07	0.06	0.08	0.01	0.05
MgO	0.21	0.29	0.29	0.15	0.25	0.35	1.42	1.76	1.76	2.25	4.69	7.05
CaO	0.50	0.56	0.41	0.92	0.35	2.59	3.85	2.10	4.31	4.42	6.83	7.61
Na_2O	4.16	4.15	4.10	4.75	4.06	4.19	4.27	9.04	4.42	3.82	1.03	2.49
K_2O	3.17	4.61	4.31	3.41	3.23	2.59	1.40	0.58	1.20	2.20	6.55	1.69
P_2O_5	0.03	0.03	0.09	0.03	0.19	0.06	0.32	0.05	0.28	0.23	0.92	0.18
H_2O^+	0.64	0.46	0.48	0.81	0.41	1.31	0.90	2.76	1.86	2.72	2.63	2.94
H_2O^-	0.16	0.12	0.12	0.14	0.06	0.06	0.17	0.20	0.29	0.14	0.67	0.55
CO_2	0.37	0.22	0.32	0.51	0.20	0.95	0.37	n.d.	0.52	0.93	4.07	0.20
total	99.84	99.97	100.16	99.63	100.11	99.86	99.84	99.77	100.25	100.23	99.58	99.86

1 – felsic granite porphyry, working quarry at Klecany
2 – felsic granite porphyry, northern Prague, Šárka valley 0.5 km from the Vltava River
3 – felsic granite porphyry, abandoned quarry at Klecany
4 – granite porphyry, abandoned quarry in the Sedliny gully at Máslovice northeast of Libčice
5 – alaskite, abandoned quarry at Klecany
6 – granite porphyry, working quarry at Klecany
7 – tonalite, abandoned quarry at Drasty, south of Odolena Voda
8 – alkali feldspar syenite, rock outcrop in the centre of Dolní Chabry, northern Prague
9 – tonalite, dug well, northeastern end of Odolena Voda
10 – monzonite porphyry, working quarry at Klecany
11 – minette, test pit, western end of Chvatěruby SE of Kralupy n. Vlt.
12 – gabbrodiorite, rock outcrop, western end of Dolní Chabry, northern Prague
Laboratories: Czech Geol. Survey Prague (1, 7, 9, 10), Faculty of Science, Masaryk University Brno (8, 12), Faculty of Science, Charles University Prague (2 to 6, 11).

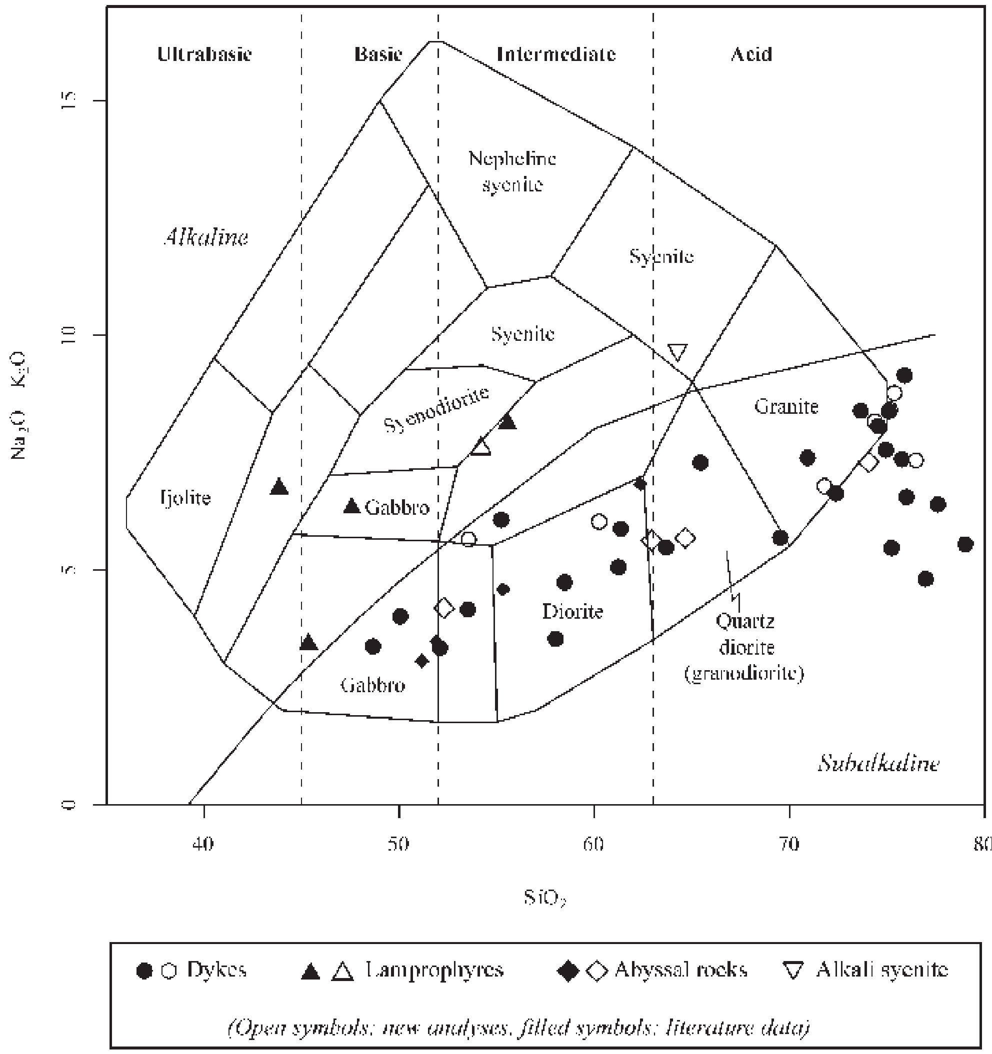

Fig. 2 SiO_2 vs. (Na_2O + K_2O) diagram (Cox et al. 1979) with 46 plots of Lower Vltava River Pluton rocks. The dividing line between alkaline vs. subalkaline rock according to Irvine – Baragar (1971).

Petrochemistry

A set of 46 major-element analyses of igneous rocks, constituting the Lower Vltava River Pluton, are available: 36 dykes (including lamprophyres) and 10 abyssal rocks. Twelve so far unpublished analyses are given in Table l: 7 dykes (one of which is a lamprophyre) and 5 abyssal rocks. The rest (34 analyses) have been taken from following sources: Čemusová 1983 (10 analyses), Kratochvíl 1965 (8), Ciniburk 1965 (5) and Fediuk et al. 1966 (1). Ten old analyses (6 of Bořický 1880 and 4 of Klvaňa 1893), the quality of which is despite of their age sufficient for the purpose of the present contribution, have been included, too. On the other hand, some relatively new but incomplete analyses without data for important oxides were omitted.

The above mentioned set was treated using the software GCDkit of Janoušek et al. (2003) and presented in five diagrams (Figs 2 to 6).

From the silica vs. total alkalis plot (Fig. 2), it follows that the set covers rocks from basic to very acid. Most dykes and abyssal rocks belong to a subalkaline suite and the lamprophyres represent an independent alkaline group.

The SiO_2 vs. K_2O plot (Fig. 3) demonstrates the medium to highly potassic character of the most rocks. Biotite lamprophyres (kersantite and minette) are ultrapotassic (shoshonitic), while hornblende lamprophyre (spessartite) is high-potasssic “only”. Low-K rocks occur exceptionally, one of them being represented by alkali feldspar (albite) syenite.

Ternary AFM diagram (Fig. 4) shows the absolutely dominating calc-alkaline character of the rock series. Shand’s diagram (Fig. 5) excludes the presence of peralkaline rocks and shows the almost equal proportion of metaaluminous and peraluminous rocks in the data set.

The multicationic B-A diagram (Fig. 6) discriminates the analyzed rocks into six categories according to their likely mineral associations. Most analyses fall into III, IV and V fields, which are characterised by the assemblages with *biotite, amphibole* and *pyroxene.* This is in line with the results of the microscopic study. On the other hand, a few analyses plot in the fields I and II, for which both micas should be present. In reality, however, *muscovite* is restricted to extremely rare pegmatites only.

Analyses with SiO_2 > 65 % were also plotted in tectonomagmatic discrimination diagrams for granitoids (Maniar – Piccoli 1989). The rocks belong clearly to a post-orogenic setting.

Field Relations

No zoned distribution of rock types, dykes and abyssal rocks as well, was found in the area. Nevertheless, the occurrence of coarsely porphyritic dykes of granodiorite to monzonite compositons (monzonite porphyry of Kettner 1912) and lamprophyres is limited only to the northern sector of the area around Libčice (see Fig. 1).

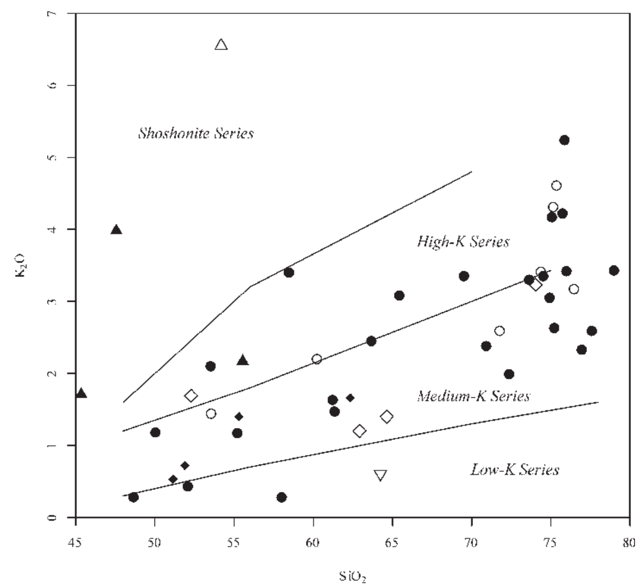

Fig. 3 SiO_2 vs. K_2O diagram (Peccerillo – Taylor 1976). Symbols as in Fig. 2.

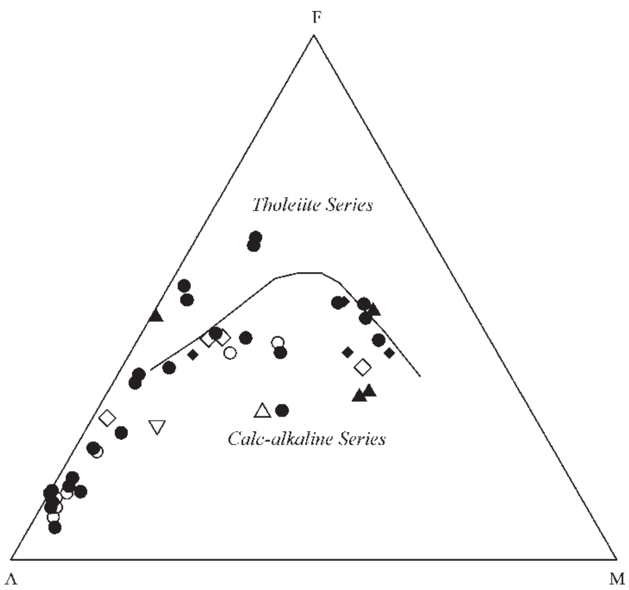

Fig. 4 *AFM* diagram (Irvine – Baragar 1971); *A*=(Na_2O+K_2O), *F*=($0.9Fe_2O_3$+FeO+MnO), *M*=MgO. Symbols as in Fig. 2.

Another important observation concerns the direction of magma movement. The dykes can be often observed in their whole thickness, from one contact to the opposite. More complicated situation is as to the length of the dykes. The cases, where the termination of the dyke can be directly observed, are very rare. Anyway, Čemusová (1983) mentioned two such cases from the southern part of the area. In both of them, the dyke of granite porphyry split and ended in several thin apophyses showing the magma movement towards the south. It indicates that the magmatic centre was situated in the northern part of the studied area.

Chilled margins can be seen only in thick dykes. In abyssal bodies, the endocontact changes are well developed in the abandoned quarry at Klecany (Fediuk 1993, 1996b): the even-grained alaskite (Photo 1) grades towards the margin into nevaditic granite porphyry and in a narrow contact zone even into a felsitic facies.

The thermal effects of the plutonic rocks are restricted to larger bodies, mostly of abyssal character. The Neoproterozoic volcanosedimentary country rocks, (metabasalt, greywacke, siltstone and subordinate shale and lydite), are mostly not very sensitive to contact metamorphism. Nevertheless, three zones of decreasing metamorphic intensity with a) chiastolite (± sillimanite and/or cordierite), b) clear brown biotite to c) dull khaki green-brown biotite were mapped in the area (see Fig. 1). On the other hand, Ordovician sediments are not affected by the contact metamorphism and moreover in their basal conglomerate were found pebbles of dyke rocks petrographically identical to dykes of the Lower Vltava River Pluton (Fediuk – Röhlich 1960).

All these observations lead to the conclusion the rocks are pre-Ordovician (Cambrian?) in age. Very limited surface area with dispersed plutonic outcrops between the northern periphery of Prague and the towns of Kralupy n. Vlt. and Neratovice would probably increase rapidly with the depth (see Table 2). The centre of the magmatic activity as well as the thinnest cover of its hidden part lies most probably in the northern part of the studied area around Odolena Voda.

Conclusions

The main conclusions are summarised in the form of Table 2.

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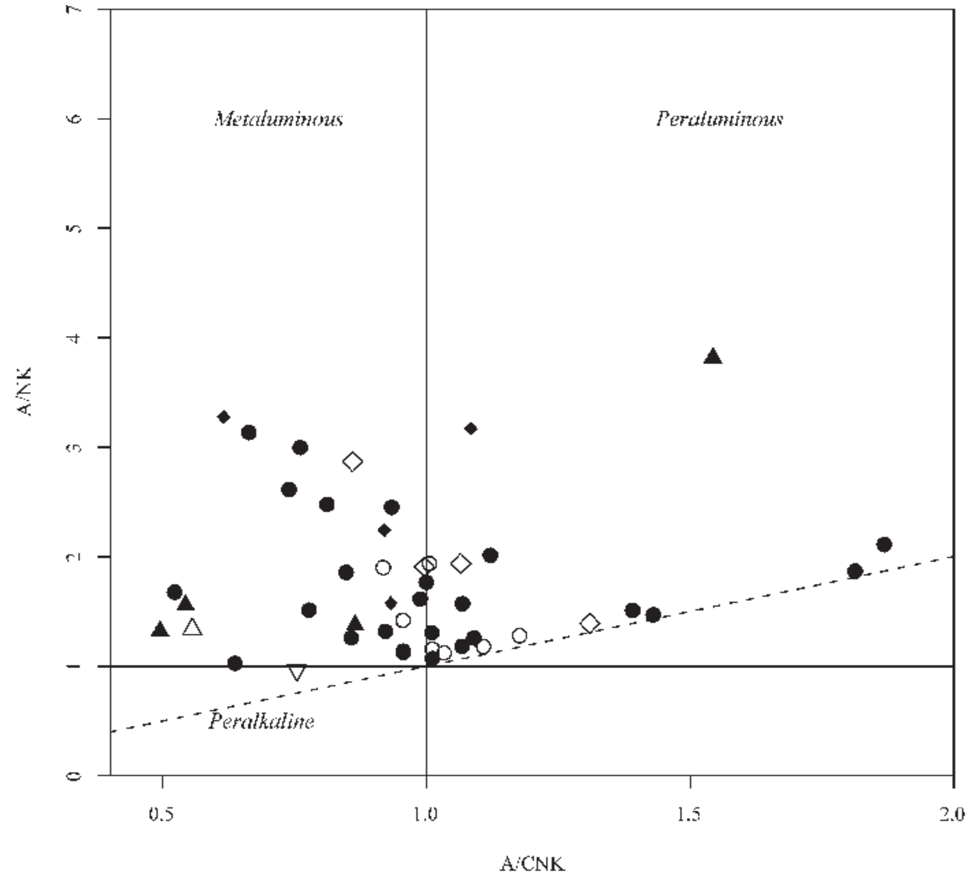

Fig. 5 *A/CNK* vs. *A/NK* diagram (Shand 1927, Maniar – Piccoli 1989); *A*=Al_2O_3, C=CaO, *N*=Na_2O, *K*=K_2O (mol. %). Symbols as in Fig. 2.

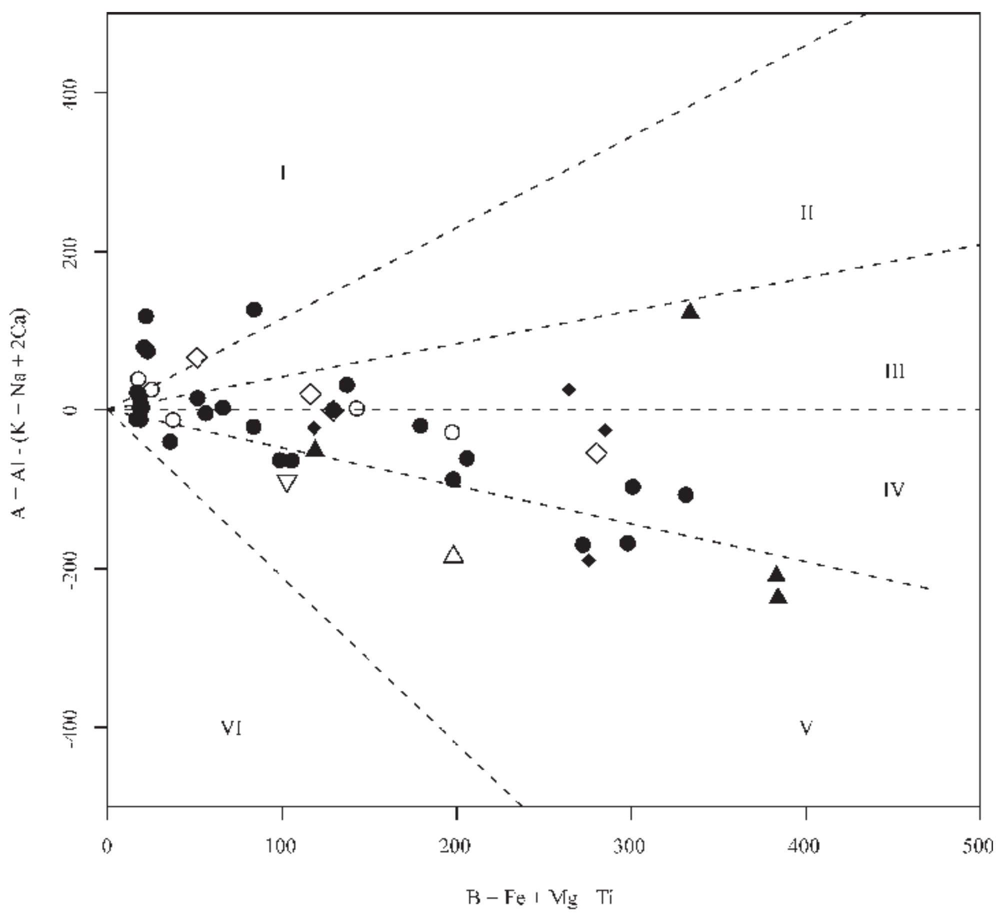

Fig. 6 *B* vs. *A* diagram (Debon – Le Fort 1983); *A*=Al-(K+Na+2Ca), *B* = Fe+Mg+Ti. I – muscovite or muscovite > biotite, II – biotite > muscovite, III – biotite, IV – hornblende + biotite (pyroxene), V – pyroxene, VI – exceptional igneous rocks. Symbols as in Fig. 2.

T a b l e 2 Characteristics of the Lower Vltava River Pluton.

aerial extent, current surface	1.8 km^2
supposed extent, – 500 m level	~ 70 km^2
supposed extent, – 1000 m level	~ 200 km^2
centre of magmatism	around Odolena Voda
dyke thickness	up to 40 m
virtual dyke length	up to 0.75 km
petrographical range	abyssal rocks: leucogranite up to gabbro dykes: leucomicrogranite up to diabase
contact metamorphism in country rocks	in sediments: *biotite, chiastolite*, scarcely *sillimanite, cordierite* in volcanics: *amphibole, epidote,* no *pyroxene*
special features of abyssal rocks	relics of *orthopyroxene* and *cummingtonite*
characteristics of the dyke suite	rare pegmatites and aplites, extremely high SiO_2 in microgranites (up to 79 %), no *muscovite* (except for pegmatites)
lamprophyres	rare, mostly biotite bearing, belonging to a younger magmatism?
geochemistry	calc-alkaline (except for lamprophyres), mainly medium-K to high-K, meta- as well as peraluminous
tectonomagmatic setting of granitic members	post-orogenic granites (*POG*)
age	Cambrian: older than Ordovician – absence of dykes, presence of pebbles of dykes in conglomerate; younger than Proterozoic sediments, volcanics, metamorphism and nappe structure
ore mineralization	polymetallic *(chalcopyrite*, *chalcocite*, *bornite*, *malachite, azurite, sphalerite, galena)*

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References

Bořický, E. (1880): Petrologická studia porfýrových hornin v Čechách, díl I: Porfýry a porfyrity křemenné. – Archiv přírodověd. Prozk. Čech, IV/3: 1–164.

Ciniburk, M. (1965): Nová intruzivní tělesa v severním Povltaví. – Čas. Mineral. Geol., 10/3: 327–330.

– (1966): Geochemie a petrografie západní části neratovického komplexu a přilehlého území. – Čas. Mineral. Geol., 11: 27–35.

Ciniburk, M. – Kratochvíl, F. – Najdr, J. – Tomek, O. (1965): Přehled geologických poměrů v severním Povltaví mezi Prahou a Kralupy n. Vlt. – Oblast. Muz. Roztoky: 1–37.

Cox, K.G. – Bell, J.D. – Pankhurst, R. J. (1979): The interpretation of igneous rocks. – Allen – Unwin: 1–410.

Čemusová, P. (1983): Žilné horniny v proterozoiku vltavského údolí. – MS Přír. Fak. Univ. Karlovy: 1–64.

Debon, F. – Le Fort, P. (1988): A cationic classification of common plutonic rocks and their magmatic classification principles, methods, applications. – Bull. de Minéralogie 111: 493–510.

Fediuk, F. (1993): Žula v dolnovltavském údolí u Klecan. – Zprávy geol. Výzk. za r. 1992: 24–25.

– (1994): Pokračování neratovického komplexu do území Prahy. – Zpr. geol. Výzk. z r. 1993, 24–26.

– (1996a): Poloskrytý dolnovltavský pluton. – Uhlí, Rudy, Geol. Průzkum, 3/3: 91.

– (1996b): Geologický výlet do Tichého údolí u Prahy. – MŽP ČR, – ČGS and Geohelp: 1–12.

Fediuk, F. – Chalupný, V. (1998): Geologický a vlastivědný výlet do pravobřežního Dolního Povltaví. – Exkurze Čes. geol. Spol., 2: 1–28.

Fediuk, F. – Ichinkhorloo, B. – Ciniburk, M. (1966): The Neratovice complex – a product of metasomatic transformation of volcanites into rocks of plutonic appearance. – Paleovolcanites of the Bohemian Massif, Charles Univ.: 51–60.

Fediuk, F. – Röhlich, P. (1960): Basální vrstvy ordoviku v Praze – Troji. – Acta Univ. Carol. Geol., I: 75–93.

Irvine, T. N. – Baragar, W. R. A. (1971): A guide to chemical classification of the common volcanic rocks. – Can. Jour. of Earth Science, 8: 523–548.

Janoušek, V. – Farrow, C. M. – Erban, V. (2003): GCDkit: new PC software for interpretation of whole-rock geochemical data from igneous rocks. – Geochim. et Cosmochim. Acta 67: 186.

Kettner, R. (1912): O některých vyvřelinách povltavského algonkia. – Rozpr. Čes. Akad. Věd, 21/30: 8–37.

Klein, V. – Paděra, K. (1953): Výskyt měděných rud u Kojetic. – Věst. Ústř. Úst. geol., 28: 145–155.

Klvaňa, J. (1893): Údolí Vltavské mezi Prahou a Kralupy. Petrografická studie. – Archiv přírodověd. Prozk. Čech, IX: 1–94.

Kratochvíl, F. (1965): Žilné vyvřeliny v algonkiu mezi Prahou a Kralupy n. Vlt. a v širším okolí Prahy. – Zpr. geol. Výzk. za r. 1964: 101–104.

Láznička, P. – Tichopádová, Š. (1959): Nálezy nerostů v lomu Klecany na sever od Prahy. – Čas. Nár. Muz., Odd. přírodověd., 78: 90–91.

Maniar, P. D. – Piccoli, P. M. (1989): Tectonic discrimination of granitoids. – Geol. Soc. of Amer. Bull. 101: 635–643.

Matějka, A. (1923): O geologických poměrech severního Povltaví, část II. – Sbor. Geol. Úst. ČSR 3: 65–90.

Peccerillo, A. – Taylor, S. R. (1976): Geochemistry of Upper Cretaceous volcanic rocks from the Pontic Chain, Northern Turkey. – Bull. Volcanologique 39/4: 557–589.

Röhlich, P. (1960): Objev granodioritového pně v algonkiu severně od Prahy. – Věst. Ústř. Úst. geol., 35: 73–76.

Shand, S. J. (1927): Eruptive rocks. – Murby: 360 pp.

Straka, J. a kol. (1988): Vysvětlivky k základní geologické mapě ČSSR 1:25 000 12–241 Roztoky. – Ústř. Úst. geol.: 1–71.

Straka, J. et al. (1994): Vysvětlivky k základní geologické mapě ČSSR 1:25 000 12–233 Odolena Voda. – Ústř. Úst. geol.: 1–49.
Velebil, D. (1995): Azurit a malachit v proterozoiku na sever od Prahy. – Minerál, 3/6: 359.
Volšan, V. et al. (1983): Vysvětlivky k základní geologické mapě ČSSR 1:25 000 12–224 Neratovice. – Ústř. Úst. geol.: 1–55.
Vrána, S. (1998): Ferruvit v primitivním pegmatitu v hybridním diorit-granitoidním komplexu u Neratovic. – Bull. min.-petr. Odd. Nár. Muz. v Praze, 6: 257–258.
Woldřich, J. (1917): Příspěvek k paleontologii a stratigrafii českého útvaru křídového. – Rozpr. Čes. Akad. Věd a Um., 41: 1–40.

Dolnovltavský pluton: poloskrytý intruzívní komplex v neoproterozoiku severního předpolí Prahy, střední Čechy

Neoproterozoikum mezi s. okrajem Prahy až ke Kralupům n. Vlt. a Neratovicím protínají magmatické žíly sahající složením od granitporfyrů až po diabasy a gabrové porfyrity. Jejich mimořádná četnost vedla k názoru, že vyzařují z plutonu uloženého nehluboko pod povrchem. Takovou koncepci podepřely nálezy řady drobných těles hlubinných magmatitů zastoupených obdobně širokou škálou od gaber až po granity. Tuto silně diferencovanou suitu lze shrnout označením *Dolnovltavský pluton*, který jen svými apikálními členy proniká až do současné denudační úrovně, ale s přibývající hloubkou zjevně rychle nabývá na rozměrech. Jeho makrochemickými rysy jsou rozsah od ultrakyselých až po bazické (nikoliv však ultrabazické) členy, příslušnost k alkalicko-vápenaté sérii, převážně středně až vysokodraselný charakter a metaaluminické až peraluminické složení. Vyznačuje se postorogenní tektonomagmatickou pozicí a projevuje se i polymetalickou mineralizací a kontaktně metamorfními účinky ve svém proterozoickém plášti. Terénní kriteria řadí jeho stáří do kambria.