Petrophysical Properties of the Brno Massif and their Tectonic Implications

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The study of physical properties of rocks of the granitoid Brno massif started in the mid-sixties and culminated in the eighties. The investigations focused on solving various geological problems: regional, tectonic, and genetic. This contribution re-evaluates the data on grain density, bulk magnetic susceptibility and natural radioactivity (gamma activity, contents of Th, U and K) obtained by the present author during the last 30 years in the light of modern geological research.

The petrophysically most conspicuous unit is the Central Metabasite Zone (for the mean values see the enclosed table 1). All the rock types (metabasite, hornblendite, diorite, granodiorite) investigated in this Zone are characterized by alterations of variable intensity and extremely low contents of radioactive elements. Consequently, the rocks of the Zone, from the point of view of its radioactivity, originated under quite different tectonomagmatic conditions than the other parts of the massif. The low contents of the radioactive elements in rocks of the Metabasite Zone indicate that the Zone is a relic of an oceanic crust.

As obvious from the enclosed table, physical properties of granitoids of the Eastern Zone differ significantly from those of the Western Zone. Granitoids of the Eastern Zone, as indicated by relatively wide variation of grain density, display a relatively wide range of modal composition showing a predominance of tonalites to granodiorites, while the granitoids of the Western Zone are more acid (even though not represented by pure granites). The granitoids of the Eastern Zone show high magnetic susceptibility and their magnetic minerals are represented by pure, stoichiometric magnetite originated through low-temperature changes and by hematite mostly originated through magnetite martitization, while the granitoids of the Western Zone show very low magnetic susceptibility and ferromagnetic oxides mostly in very low amounts. Granitoids of the Eastern Zone have much lower radioactivity than the granitoids of the Western Zone. Higher contents of Th than those of U are characteristic of both granitoid Zones. The contents of K are significantly higher in the Western Zone than in the Eastern Zone.

The investigation of magnetic anisotropy has shown that the Eastern and Western Zones differ also structurally. Magnetic foliation poles in granodiorites of both Zones tend to create wide girdles. However, the girdle in the Eastern Zone is oriented NW-SE, while the girdle in the Western Zone is oriented NE-SW.

All the above observations argue against the older concept of the Brno massif as large magmatic batholith whose individual rock types originated through magmatic differentiation of the same source magma. Rather, the petrophysical data imply an idea that the Brno massif consists of at least three large units of different origins. All the units were tectonically juxtaposed, seemingly forming a single granitoid massif today.

Unit		*Dm*	*km*	*Q*	*Th*	*U*	*K*
Rock		*gcm^{-3}*	*10^{-6}*	*ppm Ue*	*ppm*	*ppm*	*%*
Western Zone	*m*	2.67	150	9.47	10.55	1.72	3.14
granodiorite	*l*	2.64	46	6.97	6.35	0.80	2.32
	r	2.70	15000	11.97	14.75	2.64	3.96
Metabasite Zone	*m*	2.69	200	2.0	1.3	0.3	1.08
granodiorite	*l*	2.67	95	1.7	0.8	0.2	0.93
	r	2.71	320	2.3	1.8	0.4	1.23
Eastern Zone	*m*	2.70	2600	4.78	5.54	0.87	2.03
granodiorite	*l*	2.67	1320	3.56	3.73	0.47	1.51
	r	2.73	10500	6.00	7.35	1.27	2.55
Western Zone	*m*	2.86	710	4.73	4.15	1.32	1.61
diorite	*l*	2.82	420	3.00	1.77	0.57	1.38
	r	2.90	1250	6.46	6.53	2.07	1.84
Metabasite Zone	*m*	2.90	1150	1.23	0.71	0.24	0.76
diorite	*l*	2.81	420	0.81	0.01	0.02	0.45
	r	2.99	8000	1.65	1.42	0.66	1.07
Eastern Zone	*m*	2.80	14000	487	4.15	1.25	1.72
diorite	*l*	2.75	5000	3.48	2.63	0.65	1.16
	r	2.85	32000	6.26	5.67	1.85	2.28

Table 1. Physical Properties of Granitoids of the Brno Massif
m - mean value (median in the case of susceptibility, arithmetical mean in other cases)
l - left limit of the variation interval (defined as the mean minus standard deviation)
r - right limit of the variation interval (defined as the mean plus standard deviation)