Information about the behavior of S and Cl during the formation of the Plana pluton

Информация за поведението на S и Cl при формирането на Планския плутон

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Резюме. Планският плутон има концентрично разпределение на изграждащите го скални разновидности, което се дължи вероятно на диференциация “in situ” в една относително голяма камера на внедряване. При еволюцията на магмата се установява нарастване на съдържанията на флуидите (H_2O, S, Cl) от габро-пироксенити до кварцовите монцодиорити и гранодиорити, след което тяхното съдържание намалява при формирането на гранитите.

Key words: Plana pluton, sulfur, chlorine, volatiles in magmatic evolution.

Geology

The Plana pluton is in the western part of the Srednogorie zone. The pluton is intruded in high grade metamorphic rocks and partly in rocks of the diabase-phyllitoid complex (Boyadjiev, 1971). The pluton outcrops at about 400 km^2 and is elongated in SE–NW direction. It is composed of gabbro-pyroxenites, gabbro, diorites, quartz diorites, quartz monzodiorites, quartz monzonites, granodiorites and granites, changing gradually respectively from the periphery (basic varieties) to the center of the plutonic body (Bidzhova, Nedialkov, 2006). The gabbro-pyrixenites and some of the gabbros show cumulative textures. Basic and intermediate in composition rocks predominate and cumulative rocks outcrop at the eastern part of the pluton. That allows us to presume that the bottom of the magmatic chamber of intrusion at eastern part is shallower and it is slopping slightly westward.

In different rock types are established rounded mafic microgranular magmatic enclaves with dimensions up to 1.5 m. Plutonic rocks are crosscut by dioritic, quartz dioritic and spessartitic porphyritic dykes and three morphological types of pegmatites (isometric, dyke-like bodies and metasomatic around cracks).

Magmatic rocks are composed by plagioclase, quartz, potassic feldspar, amphibole, biotite, clinopyroxene, rare orthopyroxene and accessory: magnetite, apatite, titanite, allanite, zircon and very rarely garnet (Bidzhova, Nedialkov, 2006). Among mafic minerals amphibole and biotite clearly predominate. Pyroxenes are present in gabbro-pyroxenites and gabbro rarely in quartz diorites, quartz monzodiorites and quartz monzonites. With magmatic evolution the percentage of water-containing minerals (amphibole and biotite) and apatite increases toward the quartz monzodiorites and granodiorite, then it decreases. The mineral composition of pegmatites is quartz, potassic feldspar, oligoclase, albite, biotite, magnetite, hematite, ilmenite, garnet, beryl, cyrtolite, allanite, titanite, tourmaline (schorl-dravite, dravite-schorl, dravite-feruvite, buergerite), epidote, adularia, muscovite, and stilbite (Arnaudov et al., 2002).

The crystallization temperature (700–790 °C) and pressure (2–4 kbars) estimations (Bidzhova, Nedialkov, 2006), show that magma has been emplaced at a depth between 6 and 12 km. Grains with higher Al contents amphibole corresponding to pressures of 8 kbars have been established only in gabbroids. Their crystallization has probably occurred at deeper parts of the crust during the ascent of the magma to the intrusive chamber. The pressure estimations (2–4 kbars) let us suppose that the vertical dimensions of the magmatic chamber of the Plana pluton were about 5–6 km and that it volume was approximately between 600 and 1000 m^3.

Volatile composition

Volatiles in the magma could be estimated indirectly through the composition of volatile bearing minerals. The contents of Cl and S are estimated through the apatite composition (Piccoli, Candela, 1994). The estimated contents of these volatiles for the magmas (rocks) of the Plana pluton are presented in Table 1.

Discussion

At the beginning of the magmatic differentiation fluid contents in the magma (H_2O, S, Cl) are relatively

Table 1. Apatite saturation temperature, oxygen fugacity, S (ppm) and Cl contents in rocks of the Plana pluton

Samples	102	45a	8	30-1	6	29	121x	41x
rock	GaD	MD	QMD	QMD	GD	G	micro D	micro D
T° C Hb-Pl	850	780	780	780	760	740	775	775
T°C Ap satur	706	953	921	771	655	836	837	791
fO_2	–12.06	–13.85	–13.92	–13.92	–14.48	–15.13	–13.85	–13.85
ΔNNO	+1	+1	+1	+1	+0.5	0	+1	+1
SO_3% Ap	0.14–0.31	0.44–1.35	0.93	0.24–0.33	0.34–0.44	0.18–0.35	0.41–1.2	0.21–0.24
S	30	600–>1000	1000	20–30	0	50–70	120–500	60
C_{Cl} %	0.08–0.16	0.06–0.1	0.08	0.02–0.03	0.02			0.03–0.05

GaD, gabbrodiorite; MD, monzodiorite; QMD, quartz monzodiorite; GD, granodiorite; G, granite; micro D, dikes of microdiorite
T °C Hb-Pl – after Blundy and Holland (1990); T °C Ap satur – after Piccolli and Candela (1994); fO_2 – after Wones (1989)

high and have incompatible behavior. From gabbro to quartz monzodiorites their contents increase. The further magmatic evolution is attended with fluid content decreasing. This decreasing is marked also by the diminution of the percentage of the fluid containing minerals (amphibole, biotite and apatite). Apparently the boron content increase during the magmatic evolution and it is fixed in pegmatites when tourmaline crystallizes. Probably its content in the magma is determined by the assimilation of host rocks. The decreasing of the oxygen fugacity toward the formation of the granites is probably due to the water content decreasing in the residual magma. The decreasing of the fluid content is probably du to a discrete, accidental opening of the magmatic chamber causing volatile discharge of the magma.

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