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TECTONIC SETTING OF UPPER PALEOZOIC IGNEOUS ROCKS FROM THE RADZIMOWICE Au-Cu-As DEPOSIT IN THE KACZAWA MTS

ABSTRACT

Discrimination diagrams applied for Radzimowice potassic igneous rocks divided them into subalkaline (dacite, rhyolite, andesite) and alkaline (trachyandesite, trachyte and tephrite-basanite) suites. Lamprophyres, spatially related to quartz-sulfide veins, are representing by calc-alkaline serie (spessartites, kersantites) with K_2O/Na_2O ratio 1.12-1.89, mg# 73-52 and high concentrations of mantle-compatible trace-elements. They have a high LILE, and low LREE content and low HFSE that implicate a subduction related postcollisional arc setting. Fractional crystallization in dacites resulted in low mg# (<63) and a very low concentrations of mantle-compatible trace elements, high LILE, moderate LREE, and low HFSE. On the Y+Nb vs Rb diagram the granitoids plot in the VAG field close to a triple boundary point what is characteristic for post-collisional granites.

TECTONIC SETTING OF UPPER PALEOZOIC IGNEOUS ROCKS

The Radzimowice Au-Cu-As deposit lies within the Central-European province of the Permo-Carboniferous volcanism of bimodal character (Dziedzic 1996; Awdankiewicz 1999). This part of the Kaczawa Mts. formed here a horst structure between the North-Sudetic Basin to the northwest and the Intra-Sudetic Basin to southeast.

Igneous rocks from the Żeleźniak massif that host Au mineralization have been first classified according to the total alkali-silica (TAS) diagram after Le Maitre (1989). Due to a widespread hydrothermal alteration present in volcanic rocks that show a different content of silica and alkali elements this classification is checked against the Zr/TiO_2-Nb/Y plot, based on immobile trace elements (Winchester and Floyd 1977). On the TAS diagram the projection points for the Żeleźniak volcanic rocks lie in the fields of dacite, rhyolite, andesite, trachyandesite, trachyte and tephrite-basanite (Fig. 1). Within the subalkaline serie most of the author's samples are within the dacite field. Older data have been taken from references (Manecki 1965; Pendias 1965; Skurzewski 1984; Majerowicz and Skurzewski 1987) indicate for higher silica contents that probably results of some silica enrichment

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on alteration. A few samples are located in andesite field. In the alkaline serie a two distinct groups appear. The first one represent by samples in the trachyte-trachyandesite fields which are located close to the dacite-andesite fields and second one with tephrite basanite, foidite and picrobasalt that are considering later as lamprophyres of calc-alkaline suite.

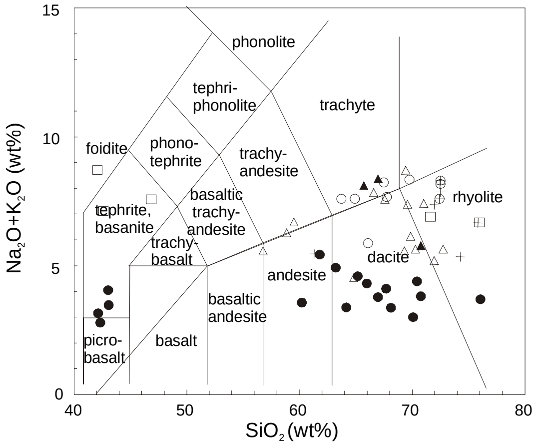

Fig. 1. Diagram of total alkali-silica (Le Maitre 1989) of Upper Paleozoic igneous rocks from the Radzimowice Au-Cu-As deposit. Symbol explanation: circles - data from present study; black circles - samples with As contents >0.02 wt%; circles with cross - granite samples; square - data after Manecki, 1965; cross - data after Pendias 1965; triangles - data after Skurzewski 1984, and Majerowicz and Skurzewski 1987.

These rocks are clearly distinguishhed on the Zr/TiO_2-Nb/Y diagram. Most of them have rhyodacite-dacite, trachyandesite and andesite compositions with Nb/Y ratios characteristic of calc-alkaline rather than alkaline suites (Mikulski in press). The MORB-normalised patterns of the rhyodacites and trachyandesites are relatively smooth and similar but slightly different from the pattern of lamprophyres. Intermediate volcanic rocks, show especially a strong Cr depletion and weaker P and Ti depletion. Lamprohyres have relatively more smooth signatures with well pronounced Cr enrichment. Geochemically barren or slightly mineralized dacites from the Żeleźniak massif have different content of SiO_2 (57-76 wt%) and alkalies and rather high Al_2O_3 contents (up to 15.16 wt%). Na_2O and K_2O contents varies in a wide range from 0.1 up to 3.8 wt% and from 2.4 to 7 wt%, respectively. A two groups of different Na contents within dacites is recognized: of a high (1.66 up to 3.1 wt%) and low (0.07 up to1.41 wt%) Na contents. Petrographic difference is demonstrate by the porhyritic texture, presence of K-feldspar and Na-bearing plagioclase phenocrysts and absence of mineral pseudomorphs after primary feldspars what is a common feature in the low Na-bearing dacites. In both calcite and sericite formed pseudomorphs after biotite and in groundmass are calcite, muscovite, quartz and in high Na dacites more commonly occurs feldspar. Macroscopicaly, the high Na dacites have a characteristic pink colour and low contents (< 0.02 wt% As) of ore mineralization and K_2O/Na_2O ratio is from 1.45 up to 2.27. Na- poor dacites are of gray or light beige colour and rich of disseminated sulfides (mainly pyrite impregnation) and very high alkali ratio >25. In dacites K_2O/Al_2O_3 ratios is <0.35. Fractional crystallization resulted in low mg# (<63) and a very low concentrations of mantle-compatible trace elements (Cr, Ni).

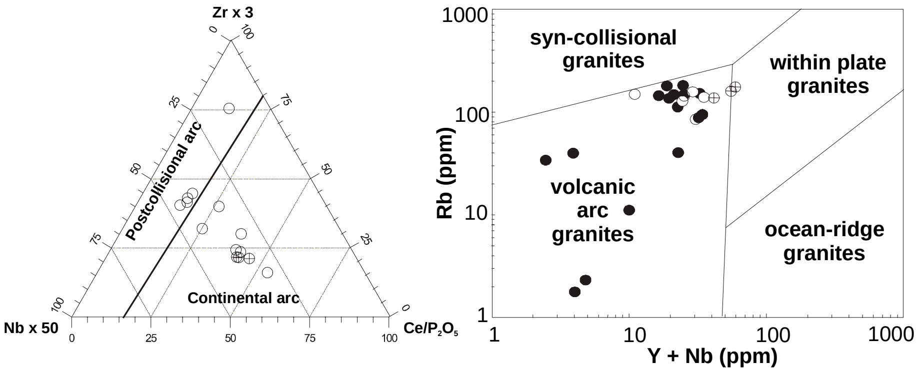

Fig. 2a-b. Discrimination diagrams after Müller and Groves (2000) on the left side and after Pearce et al., (1984) for the Upper Paleozoic igneous rocks from Radzimowice

These rocks are characterized by high concentrations of LILE (e.g. up to 4.95 wt% K_2O, up to 155 ppm Rb, 213 ppm Sr, 1058 ppm Ba) moderate LREE (e.g. up to 40 ppm La, 95 ppm Ce), and low HFSE (e.g. < 0.48 wt% TiO2, < 191 ppm Zr, < 14 ppm Nb). Higher contents of Th up to 19 ppm and U (up to 7 ppm) suggest some crustal contamination during magma uprise what is a characteristic for continental arc associations.

Discrimination diagram Zr-Nb-Ce/P_2O_5 proposed by Müller and Groves (2000), has been applied for Radzimowice igneous rocks. Samples from Radzimowice are plot in the field of continental and post-collisional types and clearly out of within-plate type (Fig 2a). The lamprophyres from Radzimowice are located within the tectonic setting of the post-collisional arc character and high Na contents dacites trachytes and granites in continental arc. This implies that the rocks were generated in subduction-related zone. The lamprophyres have been intruded into a postcollisional arc. On the Y+Nb vs Rb and Y vs Nb diagrams (Pearce et al., 1984) the granitoids from Radzimowice deposit plot in the volcanic arc granites close to a triple boundary point for syn-COLG, VAG and WPG (Fig. 2b). Two of granitoids lie on the boundary line between VAG and WPG. It is characteristic for post-collisional granites.

CONCLUSIONS

Geochemical signatures of volcanic sequences from the Radzimowice deposit are comparable to the environment of the post-collisional, extensional settings adjacent to former active continental margins.

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