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PETROGENESIS OF THE PERMIAN INTERMEDIATE VOLCANIC SUITE OF THE NORTH-SUDETIC BASIN, SW POLAND: FRACTIONATION, REPLENISHMENT AND ASSIMILATION IN CRUSTAL MAGMA CHAMBERS

The Permian intermediate-composition volcanic rocks of the North-Sudetic Basin represent a high-K calc-alkaline suite that erupted in an extensional, intracontinental, post-collisional setting in the eastern part of the Variscan belt of Europe (Fig. 1). The volcanic rocks were emplaced as lava flows (and minor sub-volcanic intrusions) from, probably, fissure vents or small shield-type volcanoes. Several eruptive episodes separated by repose and sedimentation periods are marked by lava flow successions interbedded by clastic rocks.

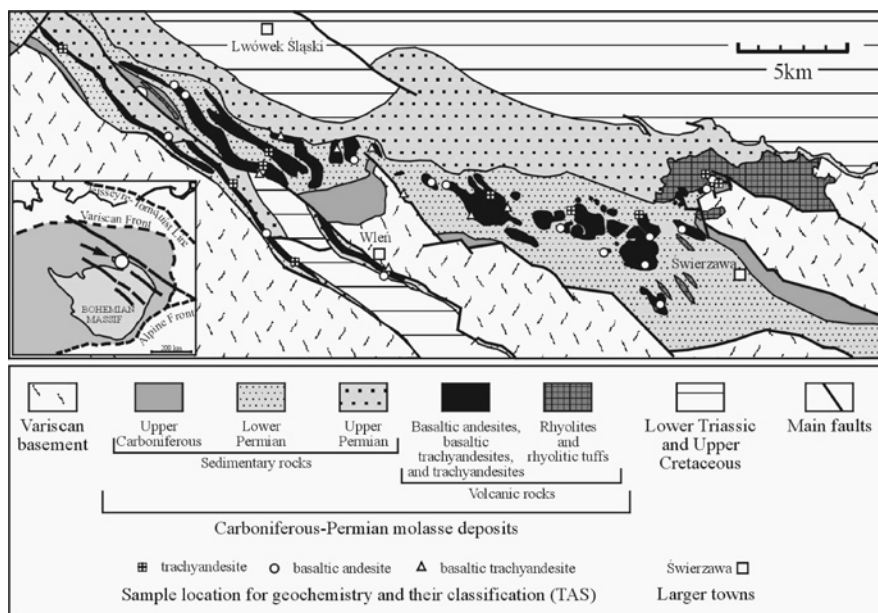


Fig. 1. Distribution of the Permian volcanic rocks in the North-Sudetic Basin (based on Milewicz, 1965 and Kozłowski, Parachoniak, 1967). Inset shows location of the area in the eastern part of the Variscan Belt of Europe.

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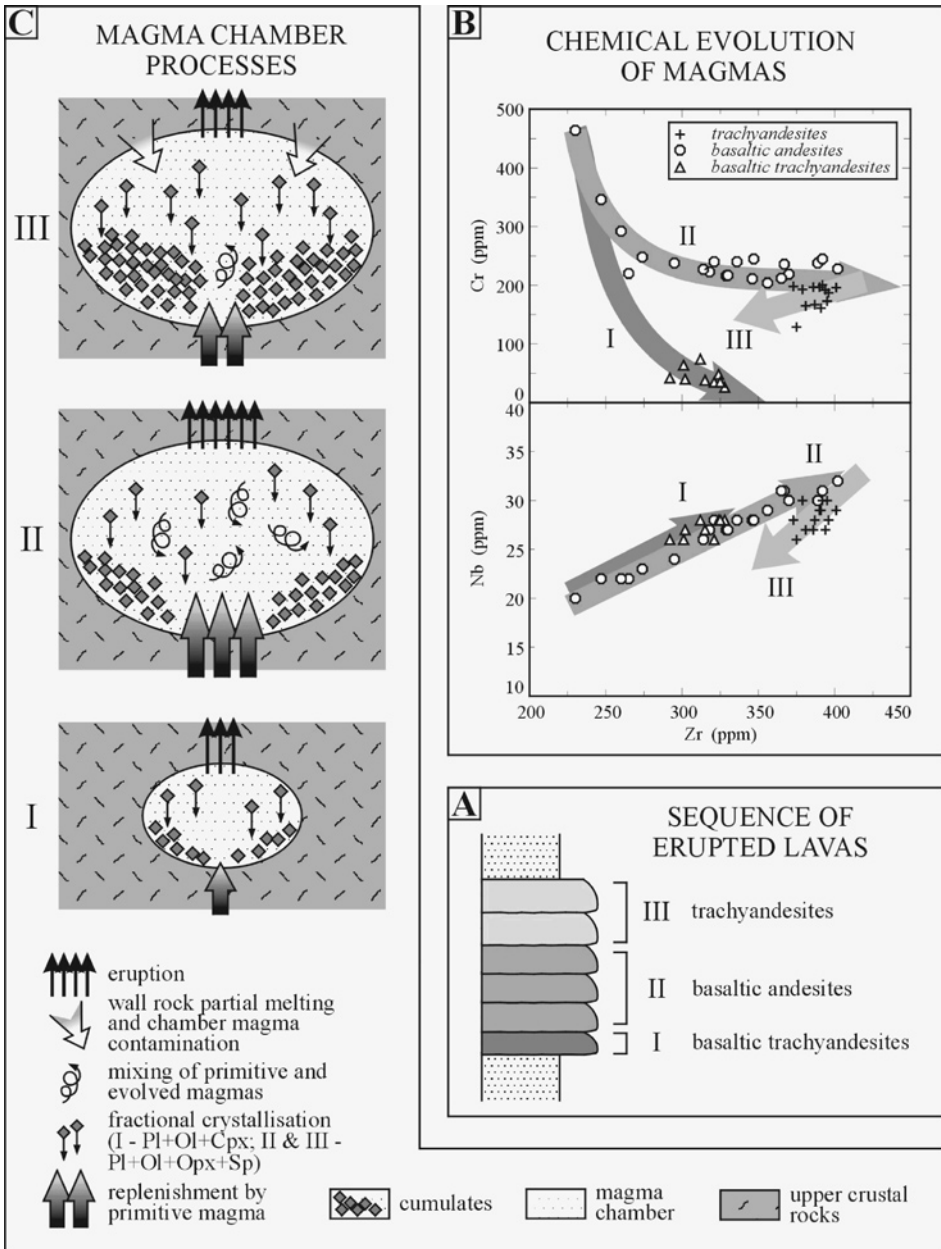


Fig. 2. Cartoon showing the general sequence of erupted lavas (A) and their geochemical variation together with inferred differentiation paths and magma chamber processes (B and C; I – fractional crystallisation, II – fractional crystallisation and mafic replenishment, III – crustal assimilation and fractional crystallisation).

A complete, single eruptive episode comprised initial emplacement of basaltic trachyandesite lavas, basaltic andesites at the main stage of activity, and trachyandesites at the end of the eruptive period (Fig. 2 A). Such successions of lava flows, sometimes incomplete, were erupted several times, and the total volume of the lavas is possibly close to a hundred cubic km, with the basaltic andesites predominant.

The geochemical variation within the suite is characterised by well-defined trends for several trace elements (Fig. 2 B). The basaltic andesites show a systematic increase of incompatible trace element contents at constant ratios of these elements (e.g. Zr and Nb), and more complex, curved and segmented trends for such elements as Cr or Ti. Incompatible trace element ratios are slightly different in the other rock types compared to the basaltic andesites. In particular, the trachyandesites, the most evolved members of the suite, show a distinctive Nb depletion and LILE enrichment. Relatively high Cr and Ni contents are observed even in silica-rich rocks (up to 200 ppm Cr at 60-63% SiO₂). The geochemical data and modelling, as well as petrographic and mineralogical data, reflect a very similar parental magma for all members of the suite, but various differentiation processes involved in their petrogenesis (Fig. 2 B): (I) fractional crystallisation (plagioclase, olivine and clinopyroxene) for the basaltic trachyandesites, (II) fractional crystallisation (plagioclase, olivine and orthopyroxene) coupled with mafic replenishment and mixing of evolved and primitive melts for the basaltic andesites, and (III) assimilation of upper crustal rocks for the trachyandesites. Variation in the minor components of the fractionating assemblages (Cr-spinel, Fe-Ti oxides, apatite and other minerals) also influenced the trace element patterns of the volcanic rocks. Considering the emplacement sequence of the lavas and the petrogenetic processes involved it is suggested that the suite originated in magma chambers, in which the differentiation processes evolved with time (Fig. 2 C) from (I), through (II) to (III). In this context the general trace element characteristics of the volcanic rocks (enrichment in LILE, LREE and the more incompatible HFSE, relative depletion in Nb and Ta) seem to be unrelated to shallow level differentiation processes at crustal levels. It is more likely that the parental magmas of the suite originated from enriched lithospheric mantle sources carrying an upper crustal signature related to subduction processes during the earlier stages of the Variscan orogeny.

REFERENCES

- KOZŁOWSKI S., PARACHONIAK W., 1967: Wulkanizm permski w depresji północnosudeckiej. *Prace Muzeum Ziemi, Prace Petrograficzne i Geologiczne*, 11, 191-221.
- MILEWICZ J., 1965: Czerwony spągowiec okolicy Lwówka Śląskiego. *Biuletyn IG*, 185 (Z badań geologicznych na Dolnym Śląsku, t. XI), 195-228.