

# Trace element and isotopic constraints on the genesis of the cumulitic xenoliths from the alkaline basalts in the eastern Rhodope metamorphic core complexes

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Oligocene within-plate alkaline basalts, intruded in the Eastern Rhodope metamorphic core complexes Kesebir and Biala Reka, carry ultramafic and mafic xenoliths, consisting of clinopyroxenites, websterites, orthopyroxenites, 2-pyroxene- and clinopyroxene gabbros. The xenoliths are interpreted as samples of layered intrusions formed at upper mantle-lower crustal depths as the results of mafic magma underplating. This process might be an attractive potential source for the heat required for thermal modification and extension of the lower and middle crust in the metamorphic core complexes.

We present LA ICP-MS trace element analyses of minerals from the xenoliths, along with limited whole rock ICP and Sr and Nd isotope analyses. All ultramafic clinopyroxenites, except high-Fe varieties, exhibit convex-upwards C-normalized REE patterns, similar to those of clinopyroxene mega/phenocrysts of the host alkaline basalts. Calculated parental liquids from the trace element analyses of clinopyroxene indicate that clinopyroxenites may have formed from melts with clear Nb and Ta positive anomalies, similar to composition of the host alkaline basalts. The clinopyroxene REE profiles of the orthopyroxenite and olivine websterite suggest that they also might have crystallized from an alkali-basaltic melt, but the slight Eu anomalies suggest either plagioclase fractionation or contamination by a crustal component. The most Mg-poor websterites, which have flat to “W”-shape REE profiles, are the result of strong differentiation, producing depletion in the MREE, flat negative slope and slight positive Eu anomaly. Gabbros and high-Fe clinopyroxenites and their melt inclusions indicate that these rocks appear to be the most differentiated product of the same parent. Their calculated parental liquids are more enriched in REE, with pronounced negative Eu, Nb-Ta and Ti anomalies and positive Pb anomaly on their Primitive-mantle normalized diagrams, as commonly observed for typical subduction-related rocks. This transition from within-plate to subduction-related signature can be related to fractionation of amphibole and other Ti-bearing phases. In addition, evolved websterites and gabbros have slightly higher Sr and almost identical Nd isotopic ratios compared to those of the host basanites. The most reasonable explanation for the isotopic offset of the cumulates is interaction of alkaline basaltic magma with lower/middle crustal wall-rocks.

In the light of our new data, the most mafic xenoliths are interpreted as cumulates originated from melts of alkaline magma, whereas the progressive change of the mineral and isotopic compositions in more evolved lithologies is consistent with extensive transformation through fractionation and a small percentage of assimilation of lower crustal material.

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## Application of regionalized variable theory in analysis of morphological phenomena of the Herzegovina karst

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This paper presents an interpretation of results of a long-lasting scientific investigation of the Herzegovina karst using the methods of Regionalized Variable Theory, i.e.

Geostatistics. Throughout the geological history of karst, its morphological phenomena (doline, polja, sinkholes, obodine) were filled by sedimentation processes and hence conserved only to some extent in their particular development phases, subsequently being subjected to further morphological development in such conditions. Data on these phenomena were carefully collected for twenty years. As the number of studied elements exceeded 100000, the collected database is very large and these data are all the more significant because these morphological elements were accessible for observation and measurement only for a short time before being filled again. A geostatistical model of soil was developed using the variographic analysis on soil samples taken in three characteristic glacial areas. Scientifically established relations between the geomechanical model and parameters of geological origin were defined.

## **Shallow ground waters and the formation of carbonate soils in southeast Bulgaria – a study in progress**

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Carbonate soils and indurate calcrete horizons are common in southeast Bulgaria. The carbonate accumulations are of variety of micro-structural and textural types. The calcrete usually forms lens or disk-like bodies on flat hills. The carbonate soils are observed on top of porous sediments but not on crystalline rocks. In the study area, where calcrete is common, the pH value of the agricultural land is usually above 7.5 and the surface, shallow ground and deep ground water is saturated with respect to calcium carbonate. Chemical analyses of indurate calcrete horizons, carbonate soils, rain water and ground water from southeast Bulgaria are commented in the text. It appears that competing processes of leaching and re-precipitation from waters oversaturated with respect to CaCO<sub>3</sub> are responsible for formation of transitional compounds - calcrete precursors, which further are transformed to calcrete. Because the rain water's acidity and ground water's degree of over-saturation, with respect to CaCO<sub>3</sub>, vary with the season, it appears that seasonal variations in the water composition and the temperature control the net balance of soil carbonates.

## **Geochemical characteristics of organic matter from overcoal sediments and dump materials (Maritza-East Coal Basin, Bulgaria)**

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The aims of the study were to characterize the geochemistry of organic matter from dump materials and overcoal sediments (Maritza-East Coal Basin, Bulgaria) as well as to try to find some differences among them from a chemical point of view. Three samples were studied: Sm. 1 – dump materials from “Iztok” Dump composed of a mixture of black clays and coals; Sm. 2 – gray schist-like clayey dump materials from “Staroseletz” Dump; Sm. 3 – overcoal massive black clayey sediments from “Trojanovo-3 mine”.

The samples were subsequently extracted by chloroform and ethanol-benzene (1:1, v/v). After asphaltene precipitation by *n*-hexane (1:50, v/v), the extracts were concentrated and subjected to Silicagel column chromatography separation. Solvents with increasing polarity were used for fractions preparation: *n*-hexane, for elution of alkanes/cycloalkanes (F. I); benzene for aromatic components (F. II); acetone for polar resins (F. III). Sulphur was removed from the first fraction by Cu grit treatment and thus cleaned F. I was studied by