Microfabrics and mineral composition of calcretes and dolocretes from Southeast Bulgaria

Микростроеж и минерален състав на калкрети и долокрети от Югоизточна България

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Introduction

The present work is a continuation of complex investigation of calcretes from Southeast Bulgaria (Dimitrov et al., 2010; Koleva-Rekalova et al., 2010; etc.). The studied region is located in the eastern part of the Thrace Depression. The area between the towns of Yambol and Elhovo (Fig. 1) is part of a Neogene basin filled with Pliocene and Quaternary sediments.

Fig. 1. Location of the studied area

The calcrete profiles occur in many localities within the Pliocene sediments. Object of this study are some calcrete sections in the vicinity of the villages of Skalitsa, General Inzovo, Boyanovo, Duganovo and Miladinovtsi. Petrographic observations and SEM photomicrographs of the sediments were performed to reveal their microfabrics. The main carbonate minerals were distinguished by means of SEM analysis. Both methods helped to classify calcretes which in turn led to specifying of their conditions of formation.

The microfabrics of the examined sections was studied under polarized light microscope and by means of SEM photomicrographs. Quantitative analyses of the Ca and Mg contents were accomplished by scanning electron microscope and electron microprobe “SUPPER PROBE 733” equipped with “ORTEC-5000” energy dispersion and program “SPRINT III”.

Results and discussion

The following varieties are determined by observations of thin sections: indistinct nodular microspar calcrete, massive clayey-sandy calcrete, massive intraclast-peloidal clayey calcrete, massive calcrete, massive gravely-sandy-clayey dolocrete and massive clayey dolocrete. Most of the samples are composed mainly of micritic groundmass (matrix) and the calcite or dolomite content is evidenced by SEM analyses (Fig. 2). Only one sample consists of calcite micro-

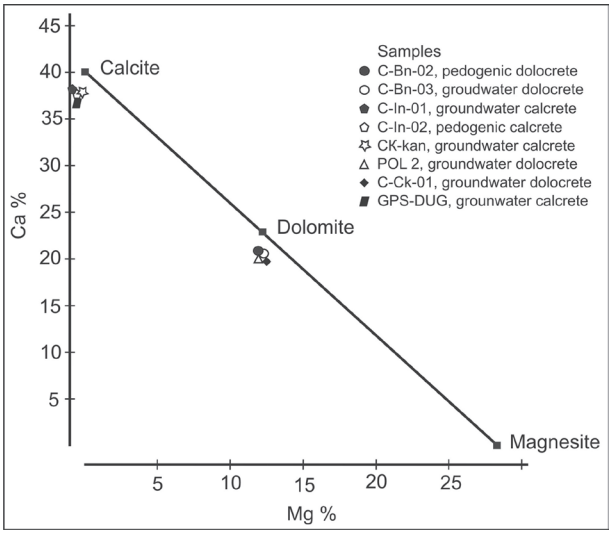

Fig. 2. Bivariate plot of Ca vs Mg (wt.%) (after McQuee, 2006) according to data from SEM analyses

spar mosaics. Commonly, the matrix contains clay minerals but their amount is difficult to define in thin sections. The desiccation and shrinkage cracks (complex and circumgranular) are a typical feature of the studied calcretes and dolocretes but they are locally filled with microspar and spar mosaics. The presence of circumgranular cracks is responsible for the formation of indistinct nodules. Intraclasts and peloids are rare constituents. The amount of detrital components (with variable sizes) ranges between single grains and about 35% and it is highest in the lower parts of the profiles near host rocks (clayey sands) where the process of calcretization is insignificant. Some quartz and feldspar grains are corroded to various degree and replaced by microspar calcite mosaic. Other grains show development of spar corona. The rock porosity reaches 25% in some cases.

In most of the studied samples biogenic features are not observed and they are generally structureless. According to Wright (1990) such soils possess alpha fabric, which is very characteristic of groundwater calcretes and dolocretes (so-called basal calcretes by Dimitrov et al., 2010) formed in the phreatic zone. Spherulites with radial fabric (sample C-Bn-02, maximum size 0.07 × 0.07 mm), indistinct alveolar-septal structures (C-Bn-02), and micro-rods (Fig. 3) having

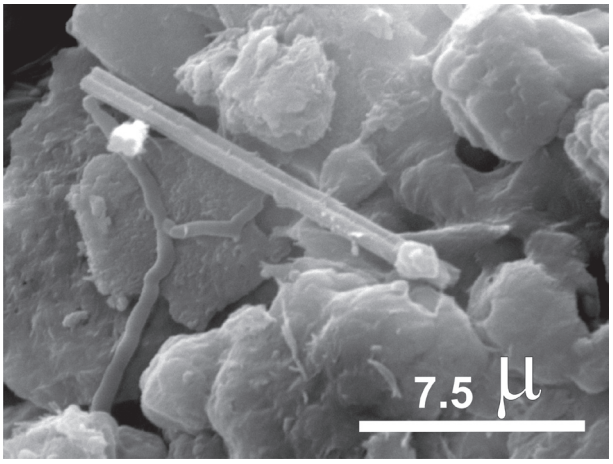

Fig. 3. SEM image of calcite micro-rod (sample C-In-02, X 6600)

width of 0.5–2 μm and length up to 70 μm (C-Bn-02, C-In-02) are of biogenic origin and their identification reveals beta fabric (Wright, 1990), which is typical for pedogenic calcretes that originate in the vadose zone. Modern microorganisms (Fig. 4, rod-shaped bacteria?) are observed in several SEM photomicrographs (samples C-In-02, C-Ck-01). Bacteria in the soils and

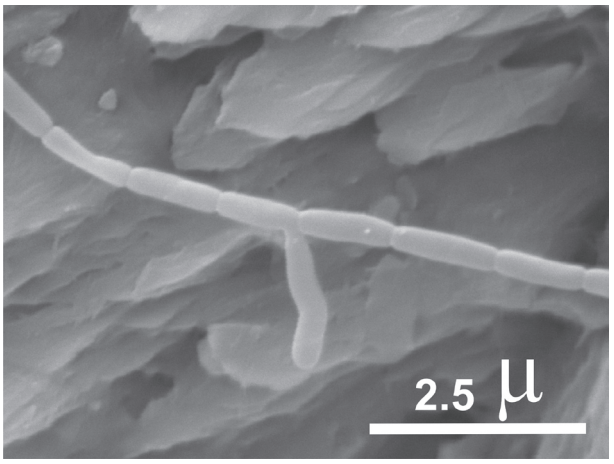

Fig. 4. SEM image of modern rod-shaped bacteria(?) (sample C-In-02, X 10 000)

other geological environments induce the precipitation of calcite directly or indirectly through their metabolic activity (Zhou, Chafetz, 2009).

In conclusion it can be noted that both calcretes and dolocretes with predominantly massive texture and alpha fabric were recognized in the studied sections. They represent groundwater varieties and dominate over pedogenic calcretes with beta fabric displaying some biogenic components – spherulites, alveolar-septal structures and micro-rods.

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