GEOCHEMICAL CHARACTERISTIC OF INFILLINGS OF PALEOALPINE KARSTIC TRAP (MALÉ KARPATY MTS.)

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Abstract : The Paleoalpine infillings of karstic traps were analysed in regard of grain-size distribution, clay minerals, trace and major elements. They represent a weathering crust of non-carbonate rocks which was transported during the dry season by wind, or washed onto the carbonate karst surface by areal waterflows during the wet season of the year and caught in the karstic traps.

Keywords: weathering crust, allochthony, karstic traps

1. Introduction

The recent terra rossa is a reddish-brown residual soil found as a mantle over limestone bedrock, typically in the Mediterranean area. The aim of our work is above all to characterize the Paleoalpine terra rossa of the Malé Karpaty Mts. and answer the following open paleogeographical questions: 1. autochthony or allochthony of the terra rossa fillings of the karstic traps, 2. characteristics of source areas, 3. contribute to the age of the fillings.

Various data of terra rossa occuring above carbonate complexes, especially Middle/Upper Triassic limestones and dolomites, appear in Western Carpathian geological literature since more decades. There are two different opinions on their origin.

The first opinion considers terra rossa to be redeposited products of weathering, especially of crystalline schists, granitoids and volcanites (Andrusov et al., 1958, Borza & Martiny, 1964, Borza et al., 1969, Činčura, 1973, 1997).

The second opinion considers terra rossa to be formed from insoluble residues of underlying carbonate rocks (Smolíková & Ložek, 1962, Smolíková, 1963, Bronger & Smolíková, 1981).

2. Analytical results

The fillings of karstic traps were analysed in regard of grain-size distribution, clay minerals, trace and major elements. The methods are described in Činčura & Puškelová (2000).

Occurrences of Paleoalpine terra rossa have been found on several locations in the Malé Karpaty Mts. The most abundant occurrences found so far are located in the central and northern part of the mountains, built of carbonate complexes of Middle/Upper Triassic age of the Hronicum. The analysed terra rossa was collected from the locations 2.1. Sološnica quarry and 2.2. Brezová road cuts.

2. 1. Sološnica quarry

Location: Abandoned quarry left side of the Sološnica Valley in the foot of the Mt. Veľká Vápenná.

The right side of the quarry is formed by dark grey thick-bedded Annaberg Limestone of Middle Triassic age. The limestone is strongly cracked and penetrated by fissures widened by karst dissolution. In a part of the quarry wall, the limestones have even megabreccia character. Terra rossa penetrates across the 46 m thick Annaberg Limestone into fissures of underlying dolomite in the MKP-1 (Omlaď) drillhole of approximately 500 m west of the quarry.

From the viewpoint of grain-size, terra rossa occurring in fissures of Annaberg Limestone represents a two or three component system in which the clay fraction is predominant (75-80%). The content of silt particles is relatively constant (15-18%). As a rule, the content of sand particles varies between 5-7%. In contrast to the clayey character of insoluble residue of underlying limestones, the overlying terra rossa contains also abundant admixture of silt as well as sandy grains.

Clay material of the limestone insoluble residue consists of illite and a small quantity of chlorite (Lintnerová et al., 1988). This mineral assemblage is different from terra rossa. Illite is the predominant mineral of the Sološnica terra rossa (34-47%), accompanied by kaolinite (15-19%) and smectite (6-15%). The content of chlorite varies from 1 to 3%. With the exception of the strontium, the content of trace elements in the Annaberg Limestone is very low, unlike to overlying terra rossa.

The terra rossa and the Annaberg Limestone are covered by the Borové Formation consisting of thick bedded sandy limestones with rich organic debris including nummulites. The foraminiferal association indicates Lower Eocene age of transgressive rocks (Činčura &

Köhler, 1995).

2. 2. Brezová road cuts

Location: Road cuts on the left side of the Brezovský potok Valley in the foot of the Mt. Zúbková.

The road cuts are situated in the northernmost part of the Brezovské Karpaty Mts. on the slopes of the Zúbková paleokarst plateau. The escarpment of the road exposes the upper part of the Hauptdolomite complex of Upper Triassic age. Shallow, only several metres deep and 2 to 3 m wide doline-like depressions and deeper depressions most probably of canyon-like shape in Hauptdolomite and Wetterstein Dolomite are exposed in road cuts. Such depressions and different kinds of fissures developed in dolomites and limestones are often filled with red terra rossa. In the bottom of a deeper canyon-like depression occurrs also a probably lens-shaped boehmite-kaolinite bauxite. The bauxite is surrounded by terra rossa. The paleokarst forms and sediments are unconformably overlain by the poorly sorted, coarse- and medium grained Valchov Conglomerate of Upper Cretaceous age. Terra rossa sometimes composes also the matrix of the Valchov Conglomerate.

From the viewpoint of grain-size, terra rossa occurring in the shallow, only several metres deep and wide doline-like depressions and deeper canyon-like depressions in Hauptdolomite and Wetterstein Dolomite represents a three component system in which the clay fraction is predominant (>70%). The content of silt paricles is relatively constant (aprox. 15-20%). As a rule, the content of sand particles varies between 7-12%. In contrast to the clayey character of insoluble residue of the Hauptdolomite complex and Wetterstein Dolomite the overlying terra rossa contains also abundant admixture of silt as well as sandy grains. Clay material of the dolomite insoluble residue consists of illite and a small quantity of chlorite (Lintnerová et al., 1988). This monotonous mineral assemblage is different from terra rossa. The clay fraction of the terrra rossa consists of chlorite, kaolinite, illite and illite/smectite.

3. Discussion

3. 1. Autochthony versus allochthony of the terra rossa.

Limestones and dolomites of Middle/Upper Triassic age, underlying the terra rossa fillings of the karstic traps have low contents of insoluble residues, which is a characteristic feature of shelf carbonates where the supply of clastic material is minimal. Insoluble residues of the limestones and dolomites in Malé Karpaty Mts. consist exclusively of clay material

(Lintnerová et al., 1988). In contrast to the insoluble residue of underlying carbonates the terra rossa contains also abundant admixture of silt as well as sandy grains. The silt and sand particles of the terra rossa could not have originated from the insoluble residua of the carbonates.

Clay material of the insoluble residue of the different carbonates consists generally of a monotonous mineral assemblage of illite and a small quantity of chlorite (cf. Lintnerová et al., 1988). There is a much wider range of clay minerals present in the terra rossa, while the mineralogical composition varies relatively strongly from place to place (Činčura & Šucha, 1992, Činčura & Puškelová, 2000).

The average distribution of alumina and silica in the terra rossa is rather irregular and shows no correlation with the relief of the karstic traps. This finding also indicates, that the terra rossa does not represent a product of weathering in situ a dissolution residue of the bedrock. Trace elements of the fillings differ considerably from the insoluble residues of underlying limestones.

In assessing the problem of allochthony or autochthony we consider clastic sand grains and rapid changes in the mineralogical composition of clay minerals of individual samples to be significant factors of allochthony.

3. 2. The characteristics of source areas.

Extensive parts of the Slovak Western Carpathians were exposed to subaerial destruction before the transgression of the Upper Cretaceous (Činčura, 1990). The trace element content of the fillings of the traps corresponds to the mixture of different exposed parent rocks. The terra rossa occuring in the karstic traps is enriched in vanadium, nickel and chromium (in carbonate bedrock less than 10 ppm). Vanadium, nickel and chromium are ranked among trace elements whose distribution is mostly affected by the nature of parent rocks in the original source areas. Differences in the values of contents of trace elements characterizing the source rocks, may bear wittness to different materials, which give the source for the terra rossa. In relation to the geology of the Hronicum, above all the basalts of Ipoltica Group of Permian age should be taken into account This possibility also appears to be real, from a comparison of the trace element contents, directly with the basalts mentioned.

3. 3. The age of the terra rossa.

The origin of the karst was determined by the gradual emergence and termination of the marine deposition. The youngest marine sediments involved in the nappe system of the Hronicum are dated as Early Cretaceous (Hauterivian). The carbonate complex was in Mid–Cretaceous uplifted, exposed and karstified. The tectonic movements resulted also in the fracturation of the exposed carbonate complex. The tectonic fractured zones were particularly favourable for karstification.

Deep weathering probably operated in the source areas during the ?Early and Mid-Cretaceous. Weathering products have been eroded and washed into downfaulted blocks. The karst became covered first by the redeposited weathering crusts and then by marine Valchov conglomerates of Upper Cretaceous age. The variable matrix of these conglomerates is formed by terra rossa or fine clasts of limestone, dolomite and quartz.

The terra rossa fillings of karstic traps should be younger than the youngest marine sediments of the Hronicum (Early Cretaceous) and older than the overlying Valchov conglomerates/Borové Formation (Upper Cretaceous/Paleogene).

4. Conclusions

Grain-size distribution, clay minerals, trace and major elements of the terra rossa explicitly prove that the terra rossa fillings could not have originated from the underlying limestones. The results of the analyses speak for the allochthony of the terra rossa.

The terra rossa is a product of a warm, alternating wet and dry climate with monsoonal features which prevailed in the Paleoleoalpine period in the Western Carpathians.

The material of weathering crusts on non-carbonate rocks was transported during the dry season by wind, or washed onto the carbonate karst surface by areal waterflows during the wet season of the year and caught in the karstic traps. Burial protected the terra rossa from later erosion.

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