MOLDAVITES IN THE VIENNA, STYRIA AND TRANSCARPATHIAN BASINS (AUSTRIA, SLOVAKIA, UKRAINE) AND THE ORIGINAL EXTENT OF THEIR STREWN FIELD M. Trnka[1], [1]Lithos Co., Ltd., Durdakova 41, 613 00 Brno, Czech Republic (trnka@lithos.cz).

Introduction: It is generally assumed that the moldavites were ejected to east and northeast of the Ries crater during the impact, and they fell in several separate areas, referred to as partial strewn fields [1]. The richest area is in southern Bohemia, where over 99.5% of all moldavites were found so far. Less than 0.5% of moldavites were collected in southwestern Moravia. The numbers of moldavites in the remaining areas (Lusatia in Germany, Cheb Basin in northwestern Bohemia, Lower Silesia in Poland and Waldviertel in Austria) range from about twenty to a few thousand, which in total corresponds to only tenths of a per mille of all finds [2].

Next to major areas whose extent is confirmed by repeated moldavite finds, there are other places from which only solitary pieces are known. In such cases, it can be difficult to decide whether these represent real natural occurrences or human transported pieces (archaeological or recent), misinformation or mere fabrications. However, if we have detailed information about such findings, they can help us to answer this question. In this abstract, I will focus on moldavites with detailed finding information, which testifies to their authenticity and at the same time significantly expands the strewn field to the east and south.

Vienna Basin (Czechia, Austria and Slovakia): Until recently, the easternmost reliably verified locality of moldavites was Hlohovec near Valtice at the western margin of the Vienna Basin. New solitary moldavites close to this locality were found along the right banks of the rivers Dyje and Morava in a strip stretching to the SSE to Austrian territory up to the vicinity of Bratislava. The finding places (Rabensburg, Dürnkrut - 2 pieces, Marchegg an der March and probably Zwerndorf) are located not far from the current watercourses, approximately on a single line about 50 km long.

Another moldavite was found in gravel near the village of Láb (48.369° N, 16.976° E) on the left bank of the Morava River in Slovakia. However, it cannot be ruled out that it was transported here from the gravel pit near village Vysoká pri Morave. The gravel pit is located about 3 km from the site where moldavite was found in Marchegg.

The moldavites from the Vienna Basin represent, without exception, well-rounded pebbles with a newly formed fine sculpture covering the entire surface. This sculpture is caused by the corrosive widening of small surface cracks formed during transport. In terms of appearance, these moldavites are similar to those from the area east of Znojmo.

Moldavites were found by several collectors in places where Pannonian or younger gravel sands crop out on the surface. They must have been incorporated into them by redeposition from sediments formed shortly after the fall of the moldavites. Possible original sources seem to be sediments of the Middle Badenian, cropping out on the surface on the slopes of the Little Carpathians (Devinska Nova Ves Formation - [3]), or sediments of the Hrušky Formation in Moravia.

Styrian Basin (Austria): The first moldavite find from Austria, which is described in detail and geographically localized (46.924° N, 15.206° E) come from the western margin of the Styrian Basin from Stainz, about 20 km southeast of Graz [4]. It was found during the construction of a road at a depth of about 20 cm below the surface in rusty brown sediment, the adhering remains of which are still preserved on it. The moldavite has a deeply sculptured surface and is without any damage. All the circumstances of the find, including the absence of traces of prehistoric settlement in the close area, show that it was a finding in the natural environment.

By comparing the chemistry of the moldavite from Stainz with the moldavite from southern Bohemia and Moravia, especially based on the high CaO/TiO2 ratio, Koeberl [5] found its similarity to the South Bohemian moldavites. Following his observations, he claimed that the moldavite was brought to Stainz by man. Shortly afterwards, however, the moldavites were newly described from Waldviertel [6], and it turned out that the chemistry of some of them was very close to the moldavite from Stainz. Consequently, the similarity of chemical composition of moldavite from Stainz with the geographically closest moldavites from Waldviertel logically suggests that it was excavated from its original natural position.

Even clearer argument in favor of original natural position of Stainz moldavite, however, is that at the site of the described finding at an altitude of about 500 m above sea level, there are relicts of sandy and gravelly sediments of the Lower Badenian (Stallhofer Beds - [7]). These sediments are dated to ~15 Ma, an approximate age of moldavites. Regions which have such a favorable geological and geomorphological situation in terms of the possible occurrence of moldavites occupy only a small area in Austria. Thus, long human transport of the moldavite to such a place is unlikely..

Transcarpathian Basin (Ukraine): An interesting piece of information about the finding of a sculptured moldavite in the salt mines near Solotvyno in Ukraine (47.957° N, 23.861° E) is the unpublished report of Academician Jaromír Koutek, a man very familiar with moldavites, from 1941. Moldavite was found by a miner while digging salt by hand at a depth of 180 m below the surface. The moldavite came from the boundary between Miocene salt clay (pallag) and a layer of salt [8].

At the time when Koutek acquired moldavites, it was not possible to comment on the finding from a geological point of view, because the age of moldavites was not known. Today, however, it is possible. To be deposited at the boundary between the salt and clay layers, the moldavite had to fall directly into the sedimentary environment. Therefore, it was in an *in situ* position. The age of the surrounding sediment had to correspond to the time of moldavite formation. If this were not the case, it could not be a moldavite. But if so, the probability that it was a moldavite would be very high. And, the salt deposit in Solotvyno is formed by the Terebla and Solotvyno Formations, whose stratigraphic position [9, 10] corresponds to the time of moldavite formation.

Discussion: In the past, researchers came to the opinion that moldavites were ejected to a distance of 200 to 500 km from the Ries crater at a scattering angle of 60 to 75° [11]. However, the above findings suggest that the original moldavite strewn field was larger and extended to a distance of 1000 km east of the Ries at a scattering angle of 90° or more.

The formation of moldavites before ~15 Ma stratigraphically corresponds to the boundary of the Lower and Middle Badenian in the Central Paratethys area (15.023 Ma - [12]). With the exception of the above-mentioned case in Solotvyno, the known places of moldavite occurrences in Europe have so far only been found in non-marine sediments. All these occurrences are distributed in areas, where an accumulation activity proceeded and clastic sediments formed at the time of Ries impact. Such areas were especially the lowlands along the sea shores with river deltas or inland basins and valleys. In areas, where denudation dominated and sedimentary cover did not form at that time, moldavites are missing.

This shows that the preservation of moldavites on the continent was only possible if, shortly after the impact, they became part of the newly deposited sediments and thus were protected from the destructive effects of exogenic factors. Therefore, the areas where the moldavites occur do not represent any partial strewn fields formed during the impact, but slight denudation relicts of an originally much larger and more continuous field [2]. The close relationship between the distribution of the recent moldavite areas and sedimentary areas existing before 15 Ma is evident from paleogeographic reconstructions [e.g., 13].

The moldavites obviously had to fall into the Central Paratethys sea area as well. However, its bottom subsidence resulted in burial of moldavites by younger marine sediments and their preservation in almost *in situ* position. The thickness of these sediments sometimes exceeds 2000 m, so the theoretical chance to find moldavites is limited to only a narrow zone along its oscillating Badenian coast.

The original non-marine moldavite-bearing sediments from the period shortly after the fall of the moldavites have been partially preserved to present days, partly they were lost due to erosion. During redeposition, the preserved moldavites were incorporated into younger sediments of various origin. Number of moldavites in these sediments dropped rapidly with length of redeposition. The possibility of finding moldavites in places located tens and hundreds of kilometers from the places of their fall [e.g., 14, 15] author excludes.

The possibility of moldavite preservation in the large ragged areas of the Alps, the Carpathians or in the peripheral mountains of the Bohemian Massif was negligible. This and the burial of moldavites in the Central Paratethys area represent also the main reasons why are the moldavites missing in the regions between today's areas of their occurrence.

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