TEKTITES OCCURRING IN SITU AND IMPACT CLASTIC SEDIMENTS ON THE INDOCHINA PENINSULA. M. Trnka¹, V. Tilsar¹, ¹Lithos Co., Ltd., Durdakova 41, 613 00 Brno, Czech Republic (trnka@lithos.cz).

Introduction: In study of tektites and microtektites, the authors sometimes misuse the term in-situ to describe localities where they consider that the tektites occur close to the places of their original fall and experience no significant transport. In addition, these authors also assume that the tektite morphology has not changed significantly. Sensu stricto, however, the use of the term in situ should be restricted to the situation where the tektites are deposited directly at the boundary between the pre-impact surface and the younger deposits, meaning that the thickness of this boundary omitting the tektites themselves is zero. However, the processes at the lithosphere--atmosphere or lithosphere--hydrosphere interfaces seem to effectively limit the possibility of ideal preservation of the original surface covered with tektites.

In the continental environment, an unconsolidated material forming a thin zone close to the surface is constantly reworked and displaced due to the interplay of climatic, biological, geomorphological and geological factors. Consequently, also tektites were transported to secondary sites immediately after their fall. The most common type of the oldest tektite-bearing subaerial sediments are colluvial deposits, which are concentrated near base of hillslopes or fill local erosive depressions close to the tektite fall sites. These sediments are poorly sorted, up to several meters thick, and only slightly younger than the tektites themselves. The length of tektite transport in these sediments did not exceed a few tens or hundreds of meters. Deeper parts of tektite-bearing sediments were already protected from the most aggressive environment prevailing on the surface and could be preserved until today.

Likewise, the microtektites and tektites on the ocean floor in abyssal zone did not remain in situ sensu stricto, although they were after their fall very gently covered by fine-grained sediments formed by a slow settling of particles from above. However, the impact ejecta including (micro)tektites have been continuously dispersed by bioturbations and other local mechanisms. As a result of this reprocessing, the current vertical extent of the zone containing microtektites and tektites ranges from tens of centimeters to meters and, as a consequence, the content of microtektites in the richest sections of this zone does not exceed 1% of sediment volume [1-4].

Therefore, at least the short redeposition of tektites associated with their mixing with the surrounding clastic material and the formation of a layer of tektite-bearing sediment should be a widespread phenomenon on the entire Earth’s surface and in all tektite strewn fields. Indeed, this assumption has been repeatedly confirmed during numerous field observations. However, there is a single exception: Indochina. Here, the tektites, despite the above facts, quite commonly occur directly at the boundary of two obviously different rock types. The surface along the boundary can be considered the original surface on which the tektites fell. Already the first description of the finding of Muong Nong-type tektites directly on a lateritized surface implied this interpretation [5]. Other places where the tektites are deposited in Indochina in situ are mentioned by many authors [6-13]. Obviously, the regional situation in Indochina is highly specific promoting the preservation of tektites in situ despite any theoretical assumptions implying the opposite.

Occurrences of tektites in situ in Indochina and their geology: The tektites were found in Indochina in situ on a large area of over 5 \times 10^5 km². They are widely distributed in all partial basins of the Khorat plateau in Thailand and Laos (the Khorat, Sakon Nakhon and Savannakhet basins), in the lowlands around the rivers flowing into the South China Sea (Red, Ca, Thu Bon, Tam Ky, Da Rang, Phan Rang or Saigon Rivers etc.), on the plateaus of the Central Highlands of Vietnam (Dalat, Kontum, Pleiki, Darlac plateaus) and elsewhere. The altitude of these in situ occurrences ranges from a few meters to more than 1500 m above sea level.

The rock types immediately underlying the surface covered with tektites are very diverse reflecting the large area extent of the entire region. Regardless of the original nature of the rocks, however, the topmost part of a sedimentary pile just below tektites is usually lateritized. On the contrary, the strata overlying the surface covered with tektites is formed by sandy sediments of yellowish, ocher brown to reddish-brown color, which are free of any marked structure and have only a slightly variable character over the whole area. The thickness of these sediments most often varies from tens of centimeters to several meters.

Since there are numerous extensive outcrops in the area, the horizon with tektites sandwiched between underlying lateritized pre-impact surfaces and overlying sandy sediments is observable in sections hundreds of meters long or along the entire perimeter of horizon walls. The boundary is usually subhorizontal or slightly inclined, but sometimes clearly wavy. However,
even in these wavy sections, the tektites with the surrounding sediments were not flushed into a distinctive layer of measurable thickness.

**Formation of overlying sandy strata:** The preservation of the original surface covered with tektites in Indochina and the invariant character of the sediments overlying the horizon with tektites in a large, geologically and geomorphologically diverse area unequivocally identifies these overlying sediments as impact clastics formed simultaneously with tektites. These clastic sediments buried the surface covered with tektites immediately after their fall and protected it from denudation. Without this burial the surface covered with the tektites would face the same history as in other parts of the world, i.e., intense denudation.

The formation of these sandy sediments has been explained by various mechanisms in the past. Most often, they were considered as loess in geological literature [14, 15] etc., and also the authors studying tektites adhered to this interpretation (e.g. [8, 16]). However, in the area of the Indochina Peninsula between 10 and 22° N, the conditions for loess formation have never occurred and therefore not such a sediment may have formed there (cf. e.g. [17]).

Such a conclusion is consistent with results of several recent studies of geological settings of the Khorat Basin. Songtham and co-workers [18-20] studied the vertical profiles of sediments deposited atop of the lateritized surface covered by tektites and found trend of decreasing of grain size upwards. Based on these observations, the rocks are interpreted as impact sediments, formed by a single-stage downward settling of clastic material. In addition, the presence of shocked quartz has been found in these sediments as well [21, 22].

In summary, it appears that extensive relics of unmelted allochthonous impact rocks coeval with Australasian tektites remain preserved on the Indochina Peninsula. Their original total volume of these sediments can be estimated based on their thickness at studied localities to about 200 km³. The extent of these impactites represents further evidence that tektites are the products of a single impact located in Indochina.

**References:**