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The genesis of tektites

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Abstract

There is still no agreement on the formation of the tektites. We make arguments for the reological ignimbrite mechanism. It was shown by modeling [11] that the dense ignimbrite currents could be the source for deposits of the Ries crater. Moldavites are considered as distal deposits of the Ries crater. We assume both moldavites and other fields of tektites are connected with (reo)ignimbrite dense currents. Craters for separate zones of Australasian tektites can be different. Probably, one of them is the Toba volcano [6]. The source for the Muong Nong type tektites can be in Indochina and for south australites – volcanoes of the Cosgrove hotspot.

1. Introduction

In spite of the consensus, tektites did not originate during meteorite impacts due to their delicate shapes, sharp boundaries between different inclusions, and limits for the presence of round voids [10, 15]. The mechanism of 'vapour-condensation' can be excluded because of the presence of both rigid coesites and Fe-Ni particles in tektites [9, 10]. The theory asserts the melting of rigid bodies by impacts, but, probably, Muong Nong tektites did not melt [10]. Only four tektites fields were found on Earth. It contrasts to the random distribution of meteorites craters. Taking into account these apparent difficulties, we propose to consider tektites as result of the (reo)ignimbrite dense currents by not impacts, but by of the explosive volcanism from the Earth's depth as well.

2. Welded tuffs of tektites

The collapse of pyroclastic flows induces the welding of tuffs. Partly welded tuffs are called reoignimbrites. Orientations of elongated particles in dense ejecta indicate currents or the moving after welding [9]. Tektites have analogous manifestations. The scientific consensus asserts the Ries crater as the reason for distal (200-500 km) moldavites. It was proved that ejecta of the Ries crater are similar to classic ignimbrites [11]. The dense ignimbrite currents, by analogy with base surges, supple from a vertical basal cloud and move as solitary waves to a great distance [2]. Hence, we assume dense ignimbrite currents can be reasons not only for moldavites, but for other tektites fields.

3. The Australasian tektites

Australasian tektites occupy a 1500 km field without an identified source crater. It is claimed [8] that closer to eruption centers, deposit materials of base surge erode. Probably, hence tektites are not found in the craters themselves. Australasian tektites are subdivided into three types because of different configurations. Their splash forms are distributed in the middle of tektites field, the Muong Nong type – in the north, and light australites – in the south. Not dense layers move in the head of ignimbrite eruptions. At the beginning, they are turbulent. It corresponds to splash tektites. But then flows can be laminar as well [14, 15], which conforms to light australites. The part of splash and light australites can be aerodynamic sculpturing deposits from the vertical basal cloud (accompanying ignimbrites). At the end of ignimbrite eruptions the moving dense massive flow has a high viscosity because of cooling. It induces the gradation and, hence, bundle layers [7] such as in Muong Nong tektites. It has already been asserted [10] that the Muong Nong type is the welded tuffs of hot volcanic ash. Rims of Muong Nong tektites could be formed either via cooling of magma analogous to rims in kimberlite autolites [4] or later during the hot convection in ignimbrite currents.

There are several geographical groups of tektites with centers in Indochina, Philippines and S. Australia. Their dispersion has big gaps (N. Australia, New Guinea, Sumatra, Timor), which contradicts to only one deposit. The oldest eject tuffs of the Toba volcano were found in sediments in the South China Sea at least 2500 km from the caldera. It was accepted that there is a difference in the main elements between deposits of the Toba and tektites, e.g., in Mg, Na, K, silicates [13]. But some explosions of Toba with long time intervals are known, hence the chemical composition of the magma could change. By analogy as it was proposed to moldavites, the magma of the Toba volcano could also change in connection with redox environment, due to the isotopic fractionation, etc. Hence, we reset the Toba volcano as the cause for splash and light australites. Probably, Muong Nong tektites could not originate far from their place of finding since of being massive, without tracks of aerodynamic ablation, and must move at the end of ignimbrite eruptions. Therefore, the origin for Muong Nong type must be in Indochina. Additionally, the origin of australites zones can relate to other ignimbrite volcanoes in Asia or in Australia (e.g., Taupo, etc.).

In our opinion, the paradox of age between tektites and strata layers of their findings appears in connection with or since, analogous to kimberlites [4], young magma cements old magma, containing tektites, or due to recurrent explosions of ignimbrites when old tektites intrude into the younger surface strata. The impact hypothesis does not explain the age paradox of tektites. Australian tektites can be older than Asian ones for about of 150 ka [12]. In this case, their origin could be connected with the movement of mantle-fed plume hotspots (e. g., with volcanoes of the Cosgrove hotspot [5]).

4. The formation of tektites

Isotopes of tektites uniquely correspond to those of crustal rocks. But it was shown [1] that tektites properties are not compatible with mechanical mixing of sedimentary parent rocks and are analogous to a magmatic differentiation by partial melting (in analogy to ultrametamorphic glasses combustion). In zones of tectonic shears, the partial melting on the microscale takes place rapidly and in dry conditions [3]. Dryness is the dominant factor in tektite properties. High temperatures from the deep core-mantle boundary can possibly explain, e. g., the vapor of alkalies and the domination of FeO in tektites. Later, the mechanisms of mantle plums work, leading to partial melting and to ash pyroclastic tuffs. The final step of tektites formation is a dense (reo)ignimbrite current over the earth surface. By means of the degasation, dense currents remove possible water remains in tektites and add traces of sediments for schlieren inclusions, e.g., coesite/zircon, from the depth of the Earth.

5. Summary and Conclusions

We claim that tektites could not be formed in impact events and are the result of explosive deep volcanism by both a magmatic partial melting and dense (reo)ignimbrites currents.

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