ATTENTION: FULGURITE! G.G.Kochemasov,NationsUnies,Projet "Recherches Minières - CMR/81/005",Republique Unie du Cameroun,Yaoundé, B.P. 836. *

In searching for impact structures on surface of the Earth scientists often give decisive word to mineralogical arguments not considering geological,structural and tectonic criteria as very important. This approach is sometimes dangerous as the mineral forms like to those characteristic for supervelocity impacts of meteoroids can be developed under pure earth's conditions without cosmic factors. We have in view the fulgurites -rocks developing on the surface or near to the earth's surface in the depth of few meters as result of lightning impact.

The conditions of lightning discharges,their energies and targets are badly known,but it was however remarked in some places that they are attracted by certain ground electric anomalies. The natural electric anomalies often form at contacts of basic and ultrabasic rocks with their country rocks of different compositions,in fault zones with water circulation,in zones of oxidation of sulphide mineralization (gossan),at outcroppings of ferruginous quartzites.

High probability of finding of fulgurites exists naturally in places where storms are common like in the equtorial western Africa. In this area tropical storms during the rain season are characterized by high intensities and high frequencies of electric discharges. Some authors call, for example,the cameroonian downpours "the lightning rains". The isolated mountain Nabeba in the northern Congo,for example,composed of ferruginous quartzites attracts lightnings that fall there very frequently giving in the course of certain storms almost continuous light.

It is practically impossible to find traces of lightning impact in soil heavily covered with vegetation,but fragments of resistant melted rock-fulgurite during erosion can be concentrated like common quartz gravel in stream gravel beds. We have found indeed in few streams of the NW part of the Congo craton (the SE of Cameroon) confined to geologically particular areas (contacts of serpentinites and dolerites with schists and quartzites,complicated by faults with traces of sulphide mineralization) fragments of fulgurites. Usually they are rare,but sometimes form upto 20-30 % of gravel fragments.

The fulgurite is presented by branch-like,sprig-like,icicle-like, cylinder-like or irregular fragments of 1 cm to 10 cm long and 2-3 mm to 2-3 cm in width. Colour is light-grey,grey,yellow-grey,reddish,dark brown-red. Sometimes in the middle of a cylinder-like body passes an "axial" cavity -trace of a burned plant root which was probably used by ramifying lightning for penetration in soil. Confusion of the fulgurite fragment with central cavity with possible cementation of soil around some roots is completely excluded by presence of traces of quartz melting.

Composition and structure of the fulgurites is variable reflecting variable composition of "target" (from lateritic soil at different levels to almost pure quartz alluvial) and different quantities of energy dispersed at different depths of lightning penetration. A transverse section of the fulgurites sometimes is roughly concentrically zonal.

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Two components are easily distinguished in the fulgurite composition : fragments and cement. Amount of fragments in different sections of the fulgurites varies between weak traces and approximately 50%, their size varies between few tens of microns and 2-3 mm. They are usually angular and composed of quartz and quartz partly isotropic and vitrainized. Sometimes one observe in quartz linear structures of extinction and very complex extinction (result of high pressures?, an analogy to the planar structures?). Zones of quartz melting usually appear from one side of a fragment, but can also follow fractures. The zones of melting normally are characterized by conchoidal structures and sometimes are bordered by curved microfractures in still anisotropic quartz. The fragments sometimes consist of aggregates of quartz grains.

One observe usually three types of cement : devitrified quartz - lechateliérite, siderite and red-brown iron oxides. Sometimes all three or two of them can be present in one thin section. Siderite is normally microgranular and often gives crown structures around quartz fragments. Very typical is presence in the cement of muscovite microflakes. The cement sometimes contains opaque microspherules (0,02 - 0,2 mm in diameter). Part of them is composed of iron oxides. There is also one type of spherules with relatively high hardness (their composition is still unknown), they easily go away from the lechateliérite cement under polishing.

The lightning impact - instantaneous penetration of a powerful electric charge in soil - is poorly studied. It is certainly accompanied by burning and evaporation of a part of the substance (vegetation roots- CO_2, moisture - H_2O, iron oxides - Fe_2O_3, for example, with precipitation of the fine grained siderite - $FeCO_3$), or its melting (lechateliérite, opaque spherules), or its deformation in solid state under very local high pressures (deformation of quartz structure). Some of these results are usually considered as proofs of the impact of cosmic origin. One has to note that it is quite possible that the opaque spherules in the fulgurites formed in the ultrabasic environment would be enriched in Ni (the background in serpentinite soil is about 0,3 % of Ni) and this is usually considered as one of the signs of cosmic origin of spherules.

Some of the products of lightning impacts, as we have seen, can be found in streams and could be taken for "proofs" of a meteorite impact in the area where one strongly wants to find these "proofs". It is thought that systematic geological and structural study of an area that could be an astroblem is not less important than findings of dispersed mineralogical evidences which sometimes are ambiguous. It has to be noted that old gigantic astroblems of shields cannot have these evidences even theoretically as their rocks (primarily impact melts) underwent the influence of complex processes of the crystal differentiation, liquation, metamorphism and metasomatism.

In conclusion one can pass a remark that the fulgurite formation is in sense a natural model of an impact process.

It is interesting to note that the numerous spherules found in the place of the Tunguska event of 1908 (1,2) could be partly related to fulgurite formation that could have accompanied this event.

REFERENCES: (1) Nazarov M.A. et al (1983) LPS XIV, p.548-549; (2) Zbik M. (1983) LPS XIV, p.877-878.