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Activation analysis in studies of tektites and impact glasses

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Impact glasses and tektites are formed during fall of large meteorites on the Earth surface (impact) by melting and ejection of surface materials, mainly unconsolidated sediments and sedimentary rocks. In the Nuclear Physics Institute ASCR, methods of neutron and photon activation analyses have been utilized for detailed geochemical characterization of a collection of various tektites and impact glasses: Central European tektites - moldavites, Australasian tektites, impact glasses from the Zhamanshin crater in Kazakhstan - irghizites, and the Libyan Desert Glass.

Geochemical analysis of a large representative set of moldavites indicates that a substantial part of their parent materials must have been, besides the surface molasse sediments, also soil layer and plant biomass which are indicated in modavite composition by enrichment in the plant nutrient/essential elements (K, Ca, Mg) and depletion of nonessential elements (Na, Rb, Sr, Ba), similarly to their redistribution during the transfer from soil to plants. The hypothesis has been supported also by analysis of carbon isotope composition of moldavites which is similar to that characteristic of land vegetation.

In irghizites, determined contents of Ni, Cr, Mn, Fe and Co, after subtraction of their background contents from terrestrial source materials, allowed to assign the most probable impactor type as an ordinary L5 or L6 chondrite, and assess a range of the meteoritic fraction in the irghizite parent materials to 4 - 21 wt.%. An explanation has been suggested for lower Ir content in irghizites than matching a chondritic component which is based on significantly lower volatility of Ir compared to other meteoritic constituents as Ni, Cr, Mn, Fe and Co.

Unambiguous assigning parent materials and finding a parent crater for the Australasian tektites (AAT) still remains an open issue. After critical evaluation and comparison with literature data, the geochemical data acquired in a representative set of AAT point to a "fingerprint" similarity between AAT and Chinese loess which was discussed in literature as a probable AAT precursor much earlier but later was doubted and abandoned due to generally accepted hypothetical location of the impact to Indochina. The data have been coupled with data available in literature for both AAT and their potential precursors on their isotopic composition (Sr, Nd, Li, B, cosmogenic Be-10). The results, together with considering geographical, ballistic and paleoclimatic aspects, put in serious doubt the location of the AAT parent crater in Indochina and bring extensive evidence for possible location of the crater in the deserts in north-central China which are the source area of the Chinese loess.

Elemental composition of he Libyan Desert Glass (LDG) points to quartz sand as a main component of the parent materials, with admixture of elements implying an aluminosilicate component (clay minerals cementing quartz grains). A depletion of volatile elements (alkalis, Zn, As, Br, Sb, etc.) may reflect their evaporation loss during the impact. Higher Zr contents coupled with elevated contents of heavy rare earth elements may reflect melting of refractory zircon. LDG has recently been associated with the Kebira Crater on the Libya-Egypt border. The impact area was flooded with seawater during Cenomanian/Turonian stage and the assumed origin of LDG parent materials - compact sandstone with accessory minerals - in marine environment has been supported also by previous Li isotope investigation. No contamination of LDG by meteoritic material has been evidenced.

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