DIAMOND FOSSILS AS AN IMPORTANT NEW KEY FOR ASTROBIOLOGY. T. G. Shumilova[1], [1]Institute of Geology FRC Komi SC UB RAS (Pervomayskaya st 54, Syktyvkar, 167982, Russia; shumilova@geo.komisc.ru; tg_shumilova@mail.ru).

Introduction: Astrobiology is one of the actively studied fields aimed to answer the question about the Earth life origin. The detail studies of the organic matter could give a key for understanding about possible conditions for preservation of the biological material at the extreme conditions of the giant impact events and meteorite fallings. In the context of the astrobiological problem the recent discovery of diamond fossils is very informative and impressive [1, 2]. Here we describe in short the features of the impact-preserved organic relicts in the diamond state having relict fragments of cellulose and lignin, pointing to possibility to save organics even under the conditions of diamond formation.

Impact Diamonds: Almost 50 years have passed since the discovery of impact diamonds. Currently, several varieties of impact diamonds are known in natural geological objects, determined by the type of carbon precursor, that define their formation mechanisms and structural features. Actually, after-graphite, after-coal and after-organic diamonds are known [1-5]. The latter usually present in the form of diamond fossils after plant fragments.

After-Graphitic Impact Diamonds: The after-graphitic diamonds were discovered in the 70s of the XX century in the largest Popigai astrobleme with a diameter of about 100 km, bearing giant reserves of valuable technical diamond raw materials [3, 4]. This type of impact diamonds is formed by solid-state transformation of the graphite precursor structure to diamond with a diffusion-free mechanism forming micropolycrystalline aggregates with submicrometer-sized crystals [1]. This variety is characterized by polyphase aggregates with possible substantial amount of hexagonal packaging defects (named "lonsdaleite") within the cubic diamond structure [6]. It may also include an admixture of relict graphite, amorphous and onion-like carbon [7, 8]. Currently, apographic diamonds have been discovered in several deposits, for example diamond-rich Popigai and Puchezh-Katunki in Russia, Ries (Germany), Sudbury (Canada).

After-Coal Impact Diamonds: After-coal impact diamonds were discovered a bit later, they were found in the giant Kara astrobleme in 80s of the XX century [3, 4]. This diamond type was formed by short-distance diffusion mechanism from coalificated carboniferous particles from the host sedimentary rocks, described in detail in [5]. The diamonds have crystallites size about 20-50 nm, differ from the after-graphitic variety by presence of ideal octahedral crystallite shapes and dislocation-free (lonsdaleite-free) structure [2]. By present the after-coal diamonds are known only at the Kara astrobleme and near-set Ust`-Kara impactites.

After-Organic Diamonds (Diamond Fossils)*:* The diamond fossils have been just discovered. The first find has been found out within melt fragment within suevitic breccia at the Kara astrobleme (Fig. 1). The diamonds are presented with well preserved relict cell micromorphology and have very specific structure, composition and spectroscopic features studied and described in detail in [1].

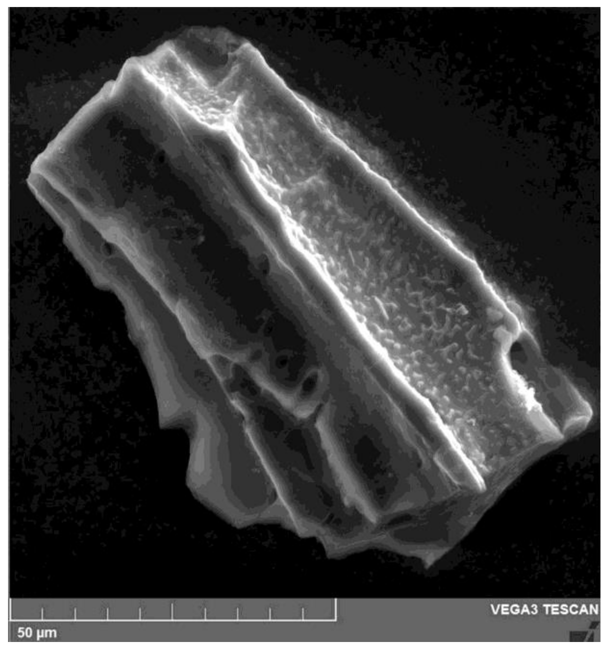

Fig.1. Diamond fossil enriched from a melt fragment of suevite in the Kara astrobleme [1].

The diamond fossils have ultrananocrystalline structure with diamond crystallites about 2-5 nm. The ultrananocrystalline structure specifies the characteristic Raman spectrum with large red shift of a T_{2g} diamond band (FWHM=38–66 cm^{-1}) up to 1318 cm^{-1}. Also, the band is characterized with an accompanied red-side shoulder at 1220–1240 cm^{-1} and a wide G-band (1620 cm^{-1}, FWHM=100–150 cm^{-1}). According to LA ICP-MS the essentially lower level of impurities compare to the co-existing after-coal Kara impact diamonds have been established, demonstrated absence of REE elements. The latter point to principle different source of carbon substance of the diamond fossils than for the coal particles of the Kara sedimentary target [2].

Concern to astrobiological problem the most important data have been measured with IR spectroscopy on the individual diamond fossils (Fig. 2). The detail discussion of the IR spectra is presented in [1], where it has been demonstrated the relict presence of structural fragments of lignin and cellulose being the structural components of wood or slightly restructured wood matter.

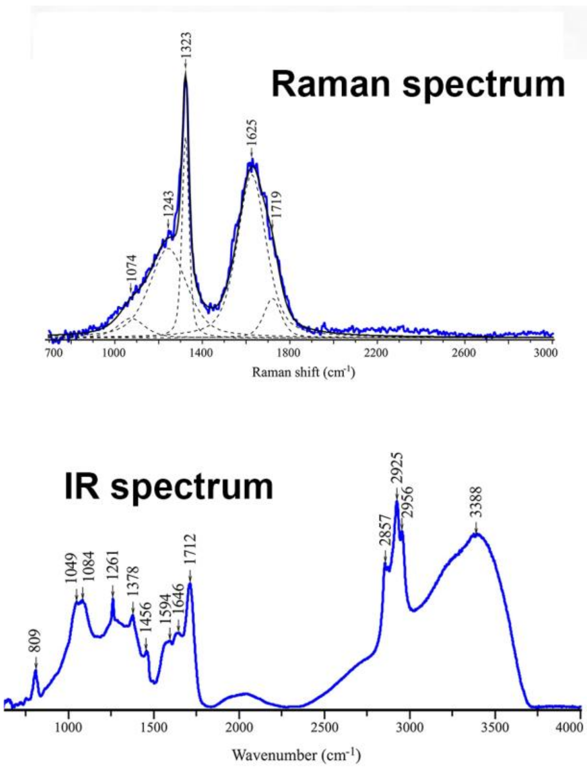

Fig. 2. Raman and IR and spectra of a diamond fossil with elements of relict radicals of lignin and cellulose [1].

The provided find of relict organics within the diamond fossils have a large value for astrobiological theory of the Earth life origin, pointing to possibility of organic preservation at huge impacts even at the conditions of diamond formation.

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