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Carbynes and DLC in naturally occurring carbon matter from the Alpine Foreland, South-East Germany: Evidence of a probable new impactite

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Unusual carbonaceous matter (UCM) in the form of mostly centimeter-sized lumps and cobbles has been sampled in the southeast Bavarian Alpine Foreland. It is a highly porous blackish material with a glassy luster on freshly crushed surfaces. In some cases aerodynamically shaped cobbles like volcanic bombs were sampled. The material is unknown from any industrial or other anthropogenic processes and thus appears to have a natural origin, which is underlined by findings on a small island in the large Lake Chiemsee and at some altitude in the pre-Alps mountains. Here we report a detailed analysis of this strange matter by a complex of high resolu-tion Raman spectroscopy, X-Ray diffraction, electron scanning and atomic force microscopy, transmission electron microscopy and differential thermal analysis.

We have found that the carbon matter is presented by the association of different carbon phases. The matrix is consisting of fully amorphous black glass-like carbon with a porous struc-ture and almost pure carbon content with traces of O, S, Si, Al. Inside of the matter monocrystal-line carbyne and amorphous diamond-like carbon (DLC) inclusions are found. The first is pre-sented by flattened particles of a-carbyne (predominantly) and in a single case by cooriented in-tergrowths of a- and b-carbyne modifications (Shumilova et al., 2012). The DLC is characterized by optically transparent particles of generally flattened irregular shape and rare bulk particles sometimes of trigonal form and octahedrons.

The typical DLC Raman spectrum is decomposed into three general wide bands – around 1400-1500, 1325-1370 and 1580-1600 cm-1 and two bands at down-shoulder side – around 1070-1090 and 1200-1250 cm-1. Among known carbon substances there are no exactly equal spectra. However, the listed Raman features could be interpreted as sp2-3 glass-like carbon containing some quantity of DLC, while the wide bands 1325-1370 and 1580-1600 cm-1 are rather expected to correspond to D and G Raman bands of carbon materials. The other features should be attributed to the presence of amorphous carbon with high content of tetrahedral carbon bonds (Ferrari & Robertson, 2004; Wei & Sankar, 2000; Robertson, 2002; Osswald et al., 2009). Following Xu-Li et al. (2009), the analyzed optically transparent amorphous inclusions are pre-sented by DLC formed under high temperature.

The observed carbon phases association and carbon state diagram are pointing to a process of very high pressures and temperatures to produce the UCM. We suggest the material to be a new impactite that was probably formed in the shock event of the proposed Chiemgau impact (Ernstson et al., 2010) with the formation of a large crater strewn field only a few thousand years ago.