Search for Fullerenes in Rocks from Ries Impact Crater

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Fullerenes have been so far identified in a few rock types with unique geological history. One group of these finds is related to impacts of extraterrestrial bodies on Earth surface, strictly speaking the impact structure of Sudbury (Becker et al., 1994) and to events recorded from Permian/Triassic (Becker et al., 2001) and Cretaceous/Tertiary boundaries (Heymann et al., 1994). Generally two basic hypotheses have been proposed for the origin of fullerenes at these sites. The first one considers formation of fullerenes during the impact, the latter supposes their extraterrestrial origin. To elucidate this problem, we searched for fullerenes in the Ries impact structure, Germany, where the target rocks are carbon-rich and thus could have been the source of carbon in the fullerenes, if they are to be formed during the impact.

The Ries impact crater lies in southeastern Germany. It is approximately a circular structure with the inner diameter of 25 km, 15 Ma in age. Impact breccias from the Ries crater, the suevites, can be differentiated to various classes depending on the grade of shock metamorphism, where the highest ranked classes comprise mainly glass. Considering our previous works on fullerenes in rocks, one of the most important factors of fullerene survival till the present is the matrix of rock in which fullerenes could be preserved from weathering, especially from the influence of molecular oxygen and ozone and ultraviolet radiation. Suevites of lower metamorphic class are affected predominantly mechanically, with weak thermal transformation, and show low stability against weathering. On the contrary, impact glasses from the Ries crater are far less weathered, thus they represent almost ideal medium for fullerene conservation. In addition, moldavite tektites, which can be interpreted as condensates of vaporized, surficial sediments (Vonengelhardt et al., 1995), have been chosen as another possible carrier of fullerenes that could originate during the Ries impact event. And as for suevite glasses, moldavites are very stable under air conditions.

In the first step, suevites containing larger amounts of glass from Otting (Ries crater, Germany) were sampled and – together with moldavite samples from Habří (Czech Republic) – subjected to demineralization in a mixture of HF and HCl acids (2:1), the residuum in HF only, then repeatedly washed in distilled water. This was followed by a 2-hour ultrasound toluene extraction of the remaining material and HPLC analysis us-

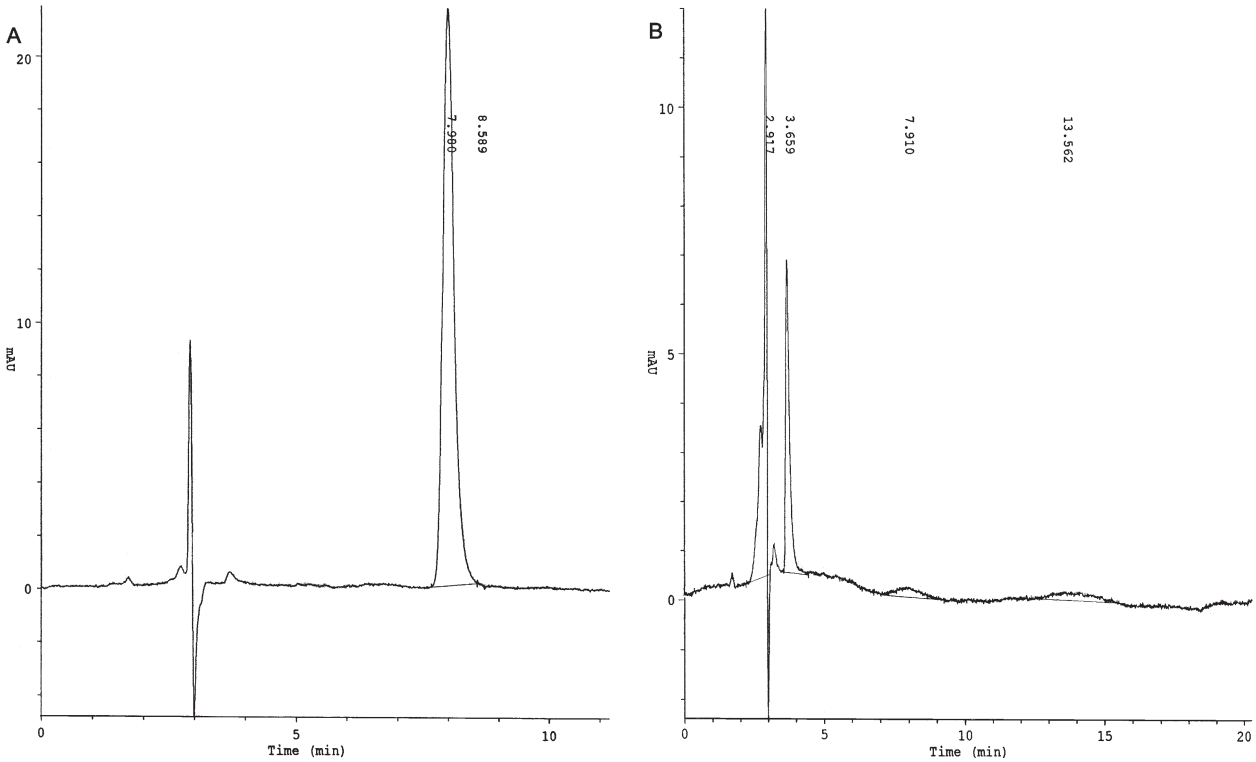

Fig. 1. Retention spectra of C_{60} standard (A) and toluene extract of suevite from Otting (B).

ing Buckyprep analytical column 4.6mmI.D.x250mm (method tested and confirmed by Jehlička et al., 2000).

Retention spectra of toluene extracts of the natural samples were compared to spectra of C_{60} standard (Fig. 1a) with a clear peak at 7.980 minutes. No such fullerene C_{60} peak has been observed in moldavite samples in concentration higher than 0.01 ppm. Signs of peaks with retention times 7.910 and 13.562 (approximately C_{70}) can be observed in retention spectrum of the Otting suevite (Fig. 1b), nevertheless, with such a weak signal it is impossible to confirm the presence of fullerenes from these results.

Fullerene C_{60} has not been identified in the toluene extract of moldavite from Habří, Czech Republic. The presence of fullerenes C_{60} and C_{70} in the extract of suevite from Otting locality in the Ries impact crater, Germany, could not be confirmed or disproved. Further analyses of suevites sampled in the Ries crater will be carried out with higher amounts of material used for demineralization and extraction. The absence of fullerenes in toluene extracts of moldavites reflects small amount of insoluble residuum after demineralization.

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Some Aspects of the Barrandian Tectonics – Preliminary Results

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The Prague Basin (Ordovician to Devonian of the Barrandian area) is a large post-sedimentary syncline, well-known due to numerous localities of fossil finds and precisely documented stratigraphy (i.e., Chlupáč et al., 1998, etc.). This very good state of paleontological, stratigraphic and sedimentological knowledge of the area contrasts with a scarcity of exact tectonic data. The new systematic tectonic study is supported by grant project FRVŠ 0599/2003.

In the first stage of the investigation, attention is paid both to major tectonic faults in the central part of the Prague Basin, e.g. Tachlovice, Koda and Očkov Faults, and to tectonic blocks/slices of Silurian rocks incorporated in Ordovician sediments (so-called "Barrande's colonies"). Detailed structural observations are carried out in close conjunction with precise stratigraphic assignment.

Based on the new field data and previous documentation, the Tachlovice Fault and other faults limiting the "Barrande's colonies" were identified as significant bedding-parallel faults. They can be therefore interpreted as major, partly reorientated thrusts. These large-scale detachments are documented by:

- facies differences in rocks of the same age occurring on both sides of the bedding-parallel faults (compare Beroun – Lištice cross-section in Horný 1965),
- stratigraphic gaps or stratigraphic twinnings associated with bedding-parallel faults and
- stable "stratigraphic level" of the regional bedding-parallel faults (compare stratigraphic ranges of "Barrande's colonies" in Přibyl, 1940, for instance).

The detachments preferably follow a specific stratigraphic horizon on regional scale (e.g., the Bohdalec, Želkovice and Motol Fms) as well as in detail (e.g., *convolutus*, *crispus*, *spiralis* zones).

In the close surroundings of these large-scale detachments, small-scale detachments are abundant. These are well visible in the outcrops, being marked by:

- small-scale duplexes,
- small-scale ramps (upper or lower; see Fig. 1),

Fig. 1. A small ramp indicating south-vergent tectonic movement in the Silurian rocks, footwall of the Tachlovice Fault, Lištice village near Beroun.