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The age of microbial build-ups growing at methane seeps of the Black Sea abyssal basin

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Following the first hydroacoustic detection of gas seeps in the Black Sea in April 1989, numerous seeps have been found by echosounding down to a water depth of 2070 m. Most of the seeps are located along the shelf edge and on the upper slope, particularly at the paleo-deltas and canyons of the largest Black Sea rivers: the Danube, Dnepr, Dnestr and Don. The deepest seeps have been discovered recently in association with faults and mud volcanoes in the central Black Sea basin. Direct observations and sampling carried out in 1990 and 1993 with submersibles Benthos-300 and Sever-2, respectively, revealed fields of chimney-like structures growing at gas seeps in permanently anoxic waters at depths ranging from 230 m to 1738 m in the NW Black Sea. During the earlier trawling in the latter area a carbonate chimney was recovered from 1555 m water depth. Besides, the extensive dredging carried out during the 2^{nd} CRIMEA cruise in May-June 2004 in the Dnepr paleo-delta area (NW Black Sea) yielded the chimney-shaped carbonate microbial build-ups, which occur at methane seeps close to upper boundary of the gas-hydrate stability zone (approx 700 m). All these structures represent carbonate build-ups, the upper part of which is covered by massive microbial mats consisting of methanotrophic bacteria. The ^{14}C-dating has shown a gradual increase with depth of the age of carbonates of these build-ups. Comparing the radiocarbon age of the base and middle parts of the microbial structures gives an approximate time of origin of the deepest and shallowest microbial build-ups as about 5300 and 2900 years before present, respectively. These dates correspond to the first appearance of hydrogen sulphide in the deepest Black Sea waters and to the stabilization of the upper boundary of the anoxic zone around the present day level.