"Death in soil" or what can we learn from groundwater for the genesis of soil organic matter

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Soil microorganisms do not only catalyze the transformation of plant residues to soil organic matter, but also serve as considerable carbon source for the formation of refractory soil organic matter by providing cell fragments as structural interfacial surfaces in soil systems.

After incubation of ^{13}C-labeled Gram negative bacteria in soil for 224 days, we could show that 44% of the bulk carbon remained in soil [1] whereas only 10% were found in living biomass fatty acids (PLFA) [2]and ~15 % in amino acids [3] of the living microbial food web [4]. This shows that 30 – 35 % of the remaining bulk C from Gram negative microbial biomass was stabilized in non-living soil organic matter (SOM). Surprisingly, 95% of the added labeled biomass proteins remained in soil which clearly indicates the stabilization of proteins in cell aggregations being more resistant to biodegradation than free proteins and amino acids. Scanning electron micrographs of the soil showed very rarely intact cells but highly abundant patchy organic cover material of 20 to 50 nm^2 size on the mineral surfaces.

A possible mechanism for this stabilization and the observed material could be found by analyses of microbial communities and biofilms developing on Biosep© beads within *in situ* microcosms exposed to contaminated aquifers. Scanning electron micrographs of the developing biofilms on the beads showed the formation of such patchy material found in the soil by fragmentation of empty bacterial cell envelopes (cell walls) and all stages of decay. The fragmentation of these cell walls provided a mechanistic explanation for the observed stabilisation, the genesis of SOM derived from dead bacterial cells, and the enzyme activity always found associated to SOM.

[1] Kindler *et al*. (2006) *Soil Biol. Biochem.* **38**, 2860-2870. [2] Kindler *et al*. (2009) *Org. Geochem.* **40**, 29-37. [3] Kindler *et al*. (2009) *Org. Geochem.* in revision. [4] Lueders *et al*. (2006) *Appl. Environ. Microbiol.* **72**, 5342-5348.

Indications for the global character of the Early Toarcian Oceanic Anoxic Event: Evidence from the Pindos Zone, western Greece

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In this paper, we present the first carbonate-carbon isotope profiles in bulk rock from two different Lower Toarcian sections from the Pindos Zone of western Greece. These pelagic sediments, which record the geochemical signature of the Oceanic Anoxic Event (OAE), originate from an elongate remnant ocean basin that started to form in mid-Triassic times along the northeast passive margin of Apulia between the extensive Gavrovo–Tripolis carbonate platform in the west and the Pelagonian continental block in the east.

In both sections, the negative carbon-isotope excursion that characterizes the OAE is present. In the first section (Kastelli), the $\delta^{13}C_{carb}$ values are very stable within the lowest 8 m, with background values of ~2‰. At the top of this interval, values begin to fall, reaching a minimun of ~-5‰. The negative excursion extends over ~7 m, at the summit of which $\delta^{13}C_{carb}$ values return to background levels.

The second examined section is Livartzi. Here, $\delta^{13}C_{carb}$ values have the same background levels as in the Kastelli section; this value is retained for the first 6 m. The negative excursion that follows is divided in two smaller segments. The first (stratigraphically lower) excursion drops to ~ -0.5‰; the second to ~0‰. After this irregular excursion, values increase again, reaching ~ 3‰.

Examination of the two different sections provides definitive proof for the impact of the Toarcian Oceanic Anoxic Event in the Pindos Zone. This occurrence reinforces the intepretation of this event as global in character, because some of the deepest marine sediments of the Tethyan region accumulated in the Pindos Zone.