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Dating of coastal marine sediments: 210Pb versus 137Cs signal on the Danube-influenced Black Sea shelf

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Coastal marine sediments represent a natural archive of pelagic processes, coastal erosion and river discharge of suspended matter. Correct dating of those sediments is a prerequisite for chronological reconstruction of the flux of pollutants and organic matter from the water column to the sediments and hence, the reconstruction of the pollution and eutrophication events. In the reconstruction of the sedimentation history during the pre-industrial and industrial periods, which usually spans the past 100 years, the natural occurring radionuclide 210Pb and the artificial radionuclides 137Cs and 241Am are widely applied tracers. 137Cs is used as an independent time marker for end the atmospheric bomb test fallout in 1963 and the Chernobyl accident in 1986. As the 137Cs signal is often weakened due to its mobility in sediments, 241Am, less mobile than 137Cs and derived from decay the bomb fallout of 241Pu, is used as a second time marker of the 1963 event.

The northwestern shelf of the Black Sea has been seriously affected by eutrophication and pollution from the late 1960's to the mid-1990's, largely triggered by Danube River input of nutrients and pollutants. The aim of our study is ultimately to reconstruct the eutrophication history and recycling of nutrients following the deposition of organic matter. The 'memory effect' of sediment recycling plays a critical role in maintaining eutrophic conditions in enclosed seas such as the Black Sea. Here we present results from sediment cores taken within the Danube River plume on the shallow northwestern shelf of the Black Sea. The cores have been dated in two laboratories to rule out artifacts. The sediment record is repeatedly interrupted by so-called turbidites that consist of stiff clay. The clay horizons display a drop in unsupported 210Pb and 137Cs and a higher signal of supported 210Pb than the non-clay horizons. Below the turbidite, the unsupported 210Pb and 137Cs increase again to values above the turbidite. This points to a non-marine origin of the turbidite. In such sediment sequence, the classical application of the CRS model would provide false ages and sedimentation rates. We hypothesize that the turbidite represents terrestrial clay eroded from the Danube Delta that had been transported in pulse-like events during flash floods of the Danube River.