^{241}Am supporting ^{210}Pb and ^{137}Cs dating

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^{210}Pb dating is usually supported by radioactive ^{137}Cs to verify age models. Atmospheric nuclear bomb testing in the 50th and 60th as well as the Chernobyl accident in 1986 has introduced not only measurable amounts of radioactive Cs but also Pu nuclides into the environment. Due to the relatively short half-life of ^{241}Pu (14.35 a) measureable activities of the daughter ^{241}Am are now present and can directly be analysed by modern gamma-ray detectors (Appleby *et al*. 1991). The advantages of using ^{241}Am over ^{137}Cs are a) its high particle reactivity causing rapid sedimentary burial and b) its immobile behaviour after deposition minimizing redistribution. While the 1963 peak in ^{137}Cs is prone for a large dispersion in the sedimentary environment, ^{241}Am forms sharp peaks in undisturbed sediments. Even the frequency of atmospheric nuclear bomb testing can be identified by high-resolution sampling of geological archives resulting in more trustful age determinations. In sediments where both ^{210}Pb and ^{137}Cs fail to give reliable ages, ^{241}Am can be used for a rough age estimation of sediment intervals. In such cases the following ^{241}Am time markers can be used: increased activities due to the frequency of atmospheric bomb testing in 1951, first maximum in 1958, second maximum in 1962 and a narrow peak in 1986 (Chernobyl) and possibly in the future 2011 (Fukushima). Between these markers, sediment velocities or sedimention rates (if dry bulk density is known) can be calculated spanning at least a half century back in time. The sharp peaks originating from accidents can easily be missed by low-resolution sampling. Due to the much longer half-life of ^{241}Am (432a) compared to ^{137}Cs (30.17a) this tracer can be used when ^{137}Cs cannot be detected in the environment any more. For instance, ^{137}Cs in 1962 sediment layers will be decayed after app. eight half-lifes in 2075. In addition, sediment data from the euxinic Landsort and Gotland Deeps (Baltic Sea) indicate a significant influence on ^{137}Cs and ^{210}Pb burial over time due to the Mn-pump within the redoxkline.

[1] Appleby P.G., Richardson N., & Nolan P.J. (1991): ^{241}Am dating of lake sediments. Hydrobiologia 214, 35-42.

Cr isotopic variations in Neoarchean to Paleoproterozoic near-surface chemical sediments

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Recent studies explored the potential of stable Cr isotopic variations in oceanic sedimentary archives as tracer for atmospheric oxygen levels through Earth's history [1,2]. Thereby, the stable Cr isotopic variations in up to 2.75 Ga old BIFs were interpreted to indicate oxidative chromium weathering on the continents initiated by an accumulation of small levels of free atmospheric oxygen some 350 Ma before the ca. 2.4 to 2.32 Ga great oxidation event (GOE) [1]. This interpretation, however, was challenged by others [3], who propose that the Cr isotopic variations in these predominantly Algoma type BIFs are due to non-redox isotopic effects caused by rapid precipitation from their deep-water hydrothermal source.

In order to shed light on the applicability of stable Cr isotopes as paleo-redox tracer we investigated carbonates from well-defined supra-, intra- and subtidal depositional environments from the ca. 2.55-2.48 Ga old Malmani Subgroup of the Transvaal Basin in South Africa and 2.06 Ga old lacustrine carbonates, marine stromatolites and near-shore jaspilites from the Pechenga Greenstone Belt, as well as 2.0 Ga organic-rich, siliceous deposits from the Onega Basin, both situated in the NW Fennoscandian Shield. The relatively large variations (ca. +1.4‰ to -1.2‰ in $\delta^{53/52}$Cr) found in post-GOE sedimentary archives from the Fennoscandian Shield support chromium redox-cycling associated with oxidative chromium weathering on the continental surface. Compared to the large Cr isotope variations of these post-GOE deposits, the range in $\delta^{53/52}$Cr values of late Archean sedimentary archives appears to be much smaller. Possible scenarios to explain the observed Cr isotopic variations in these sedimentary archives and their implications to the presence of free atmospheric oxygen will be discussed.

[1] Frei *et al*. (2009) *Nature* **461**, 250-253. [2] Frei *et al*. (2011) *EPSL* **312**, 114-125. [3] Konhauser *et al*. (2011) *Nature* **478**, 369-373.

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