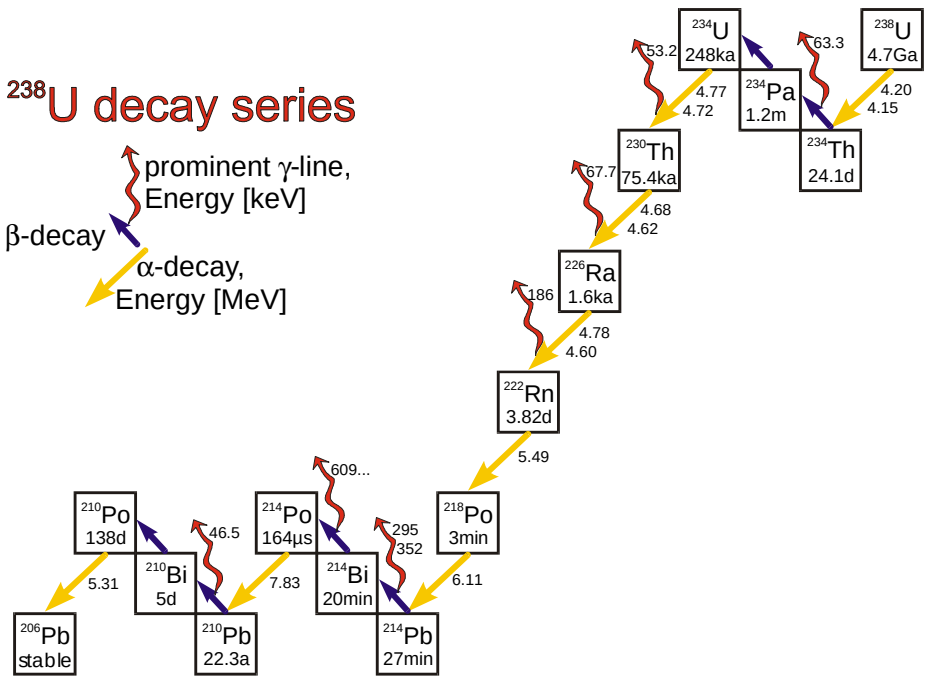
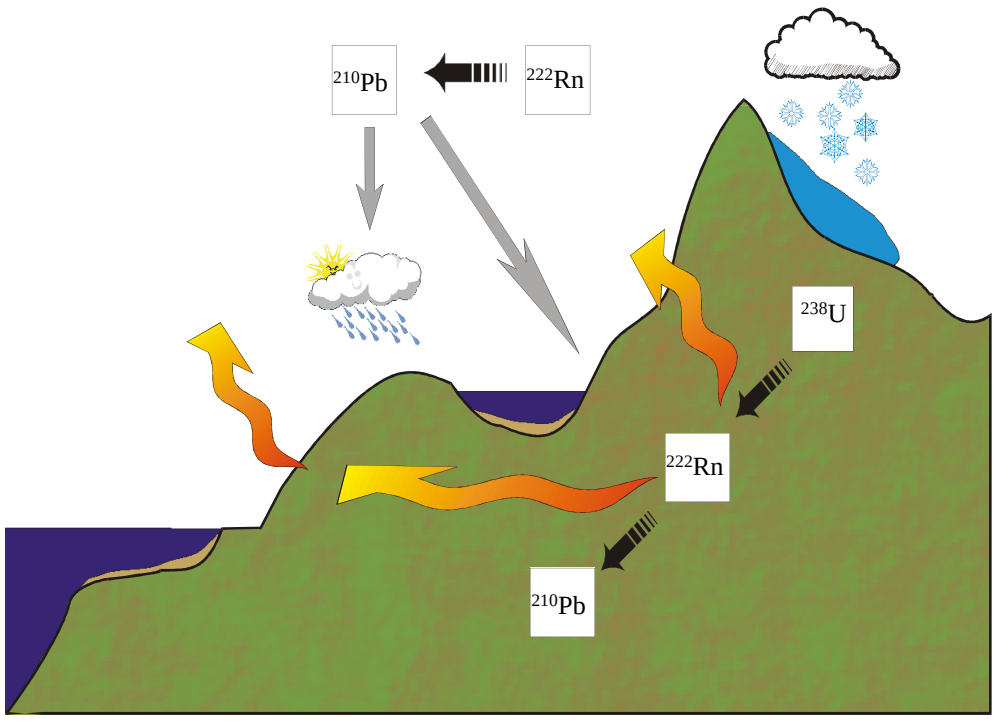
^{210}Pb Dating of Sediments

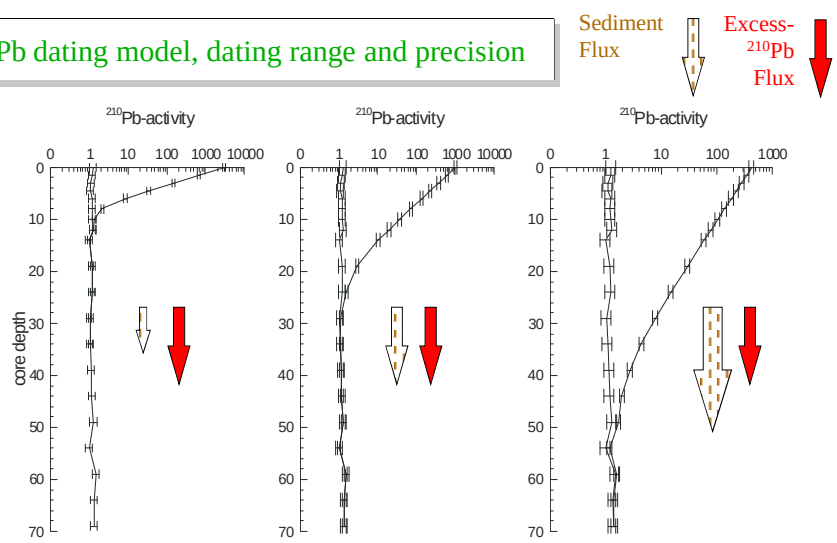
^{210}Pb dating is a U/Th series disequilibrium method. It uses the fact that the noble gas ^{222}Rn escapes from sediments to the atmosphere and here decays to ^{210}Pb. The particle-reactive ^{210}Pb attaches to aerosols, is deposited, and can be used to date sediments in the anthropogenic time scale. Atmospheric natural fallout of ^{210}Pb is not the only source of ^{210}Pb in sediment. Since most sediments contain U and ^{226}Ra also, ^{210}Pb is also naturally produced in situ („supported“ ^{210}Pb). Using γ-spectrometry, this part can be determined from ^{214}Pb.The difference between total ^{210}Pb and ^{214}Pb is „unsupported“ ^{210}Pb ($^{210}Pb_{exc.}$) and used for dating.





The flux of usupported $^{210}Pb_{exc.}$ to the sediment varies globally, but much less than sediment fluxes in different systems. Consequently, the signal of unsupported $^{210}Pb_{exc.}$ varies considerably as function of the sedimentation rate. If the sedimentation rate is small, $^{210}Pb_{exc.}$ will be high and vice versa. This means that the dating range is higher if the sedimentation rate is low, but then high sample resolution is required and sample size is small. Dating range in natural systems can vary from less than 50 years up to 150 years. If one assumes that either the flux of $^{210}Pb_{exc.}$ was constant with time (cf model) or that the initial value of $^{210}Pb_{exc.}$ was constant with time (cic model), ages can also be computed for varying sedimentation rates.

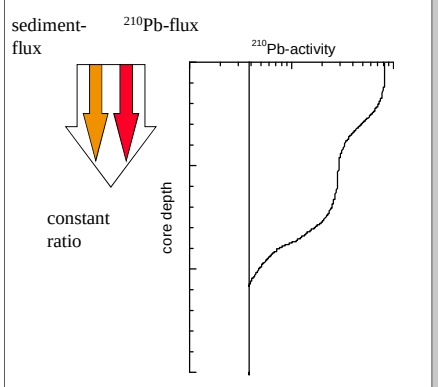
^{210}Pb dating model, dating range and precision



The smaller the sedimentation rate, the higher is precision and dating range

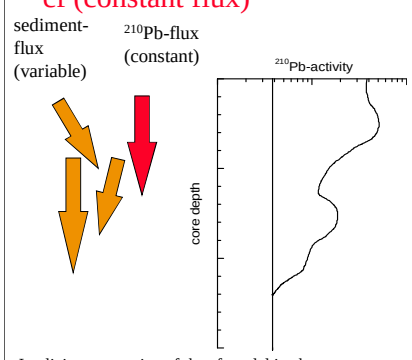
Models for ^{210}Pb-dating with variable sedimentation rates

cic (constant initial concentration)



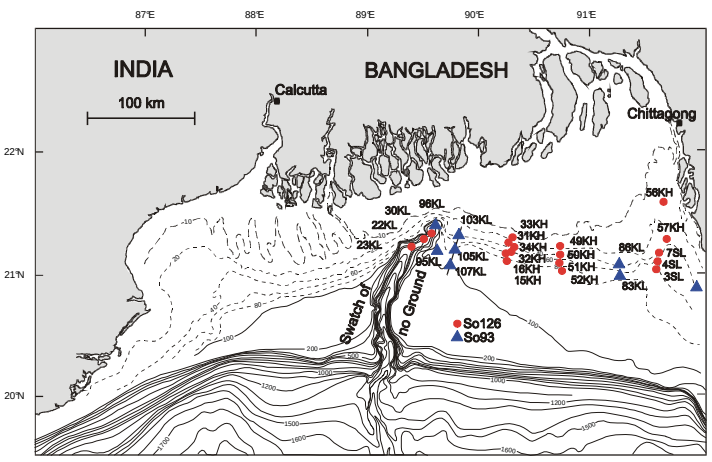
For application of the cic model excess ^{210}Pb has to be a monotonous function of depth

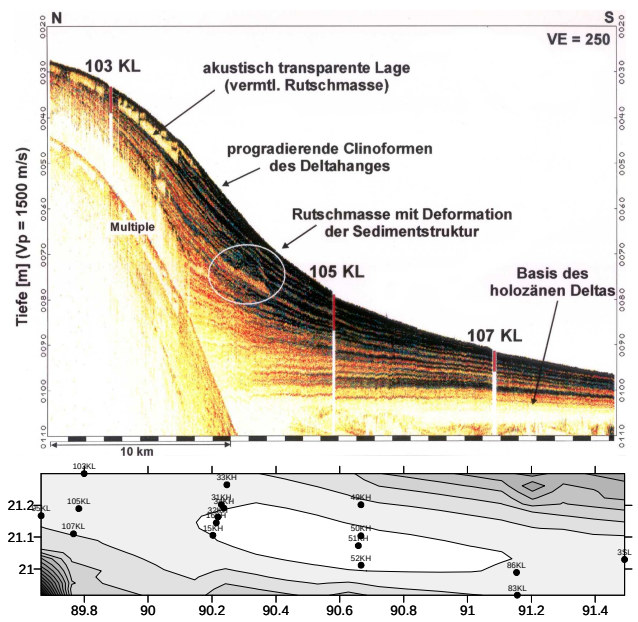
crs (constant rate of supply) cf (constant flux)



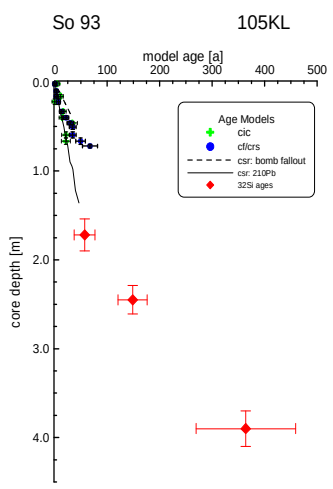
Implicite assumption of the cf-model is, that the atmospheric flux dominates excess ^{210}Pb. Therefore the total inventory of excess-^{210}Pb should be comparable with the 0.7-6kBq/m^2 resulting from natural fallout.

$^{210}Pb_{exc.}$ –dating was intensely and successfully applied to obtain a sediment balance for the Bengal Shelf off Bangladesh. The combination with marine seismic soundings turned out to be especially powerful to correlate age-dated reflectors and to derive sediment volumes deposited with time. Also dating comparisons with ^{32}Si and ^{14}C were done and showed different sedimentation processes being important on different time scales.

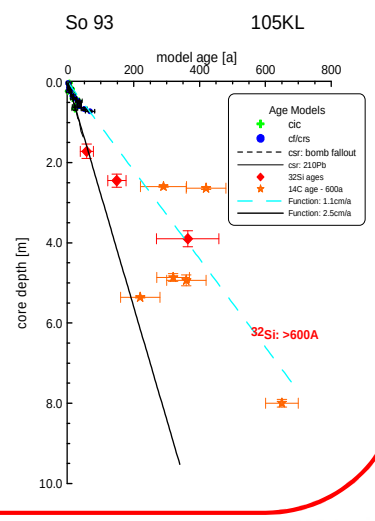




Dating Comparison: γ, ^{32}Si



and γ , ^{32}Si, reservoir-corrected^{14}C



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