Ra-excess dating: hopes and limitations

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Among U-series isotopes, radium 226 has attracted much attention as it potentially permits i) to confront ^{14}C-dates spanning the interval 0-8 kyr BP (^{226}Ra-excess dating), ii) the precise dating of the 0-100 yr interval (^{210}Pb-excess), and iii) also provides useful information on geochemical processes (^{226}Ra-Ba-Ca) and about ^{226}Ra-^{230}Th concordias in the 10-50 ka range. Applications for the study of speleothems, corals, mollusks, volcanic rocks, ground waters, soils have been explored. The ^{226}Ra-excess method is usually based on the assumption of a constant initial excess and/or ^{226}Ra/Ba ratio. Here, we discuss ^{210}Pb-^{226}Ra-^{230}Th-U systematics and Ra-Ba geochemistry in aragonitic Scleractinian deep corals, calcitic and organic Gorgonian corals and sea water from North Atlantic sites. One gram (Ra,Pb) to 0.1g (U, Ba, Ca) of carbonate samples, and from 1 ml (U, Ca, Ba) to 250-500 mL (Ra) of water, are usually needed to perform TIMS measurements (Ra, U), isotope dilution ICP-MS analyses (Ba), and ^{210}Po alpha-counting (^{210}Pb analysis). Ra/Ba ratios in water samples show distinct entry functions for these two elements, besides radioactive decay of ^{226}Ra, particularly in marginal marine settings and near deep hydrothermal sites. By combining ^{230}Th-^{234}U-^{238}U and ^{226}Ra measurements, initial ^{226}Ra-excesses in carbonate minerals are examined. They indicate specific Ra/Ba fractionation, variable and possibly thermodependent Ra-uptake rates, thus raise concern about the reliability of ^{226}Ra-excess ages. Applications for the validation of ^{230}Th-ages of recent deep-sea corals are presented. Finally, ^{210}Pb-^{226}Ra ratios in biogenic carbonate minerals as well as initial ^{210}Pb-excesses in organics corals are shown to provide good age estimates for the calculation of recent growth rates.