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$^{226}Ra/^{234}U$ and $^{230}Th/^{234}U$ Dating of Holocene Corals and Speleothem

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Young Holocene Young quaternary corals from Mauritius Island (Indian Ocean) and freshwater travertine from Northern Switzerland were investigated by two chronometer dating using the ^{238}U-series couples $^{226}Ra_{ex}/^{226}Ra(0)$ (excess decay) and $^{230}Th/^{234}U$ (ingrowth). Analyses of recently formed material showed for both types of samples that $^{230}Th/^{234}U$ started with insignificant inherited ^{230}Th, (i.e. $^{230}Th(0)=0$). Additional analyses of the chemically to Ra similar behaving Ba suggested furthermore that the initially incorporated $^{226}Ra_{ex}$ remained constant over the formation history of both systems (i.e. $^{226}Ra_{ex}(0)$ = const). Mathematical analytical solutions of the coupled $^{234}U/^{230}Th/^{226}Ra$ radionuclide system predicted that the $^{226}Ra_{ex}/^{226}Ra(0)$ chronometer is independent of the actual ^{230}Th activity build up from decay of ^{234}U, if the systems starts with zero inherited $^{230}Th(0)$. The radiochemical analyses confirmed this hypothesis because the values for $^{226}Ra_{ex}/^{226}Ra(0)$ plot on or close to the $^{226}Ra_{ex}/^{226}Ra(0)$ decay curve if the $^{230}Th/^{234}U$ ages are inserted for the time elapsed since formation. While $^{226}Ra_{ex}/^{226}Ra(0)$ dating of travertine is possible up to about 6000 years b.p., this chronometer is limited to about 3000-4000 years for corals because of the very low initial $^{226}Ra(0)/^{234}U(0)$ activity ratio of about 0.05. The ^{226}Ra data of older samples were, however, useful to demonstrate closed system behaviour between ^{230}Th and ^{234}U. Closed system status in the ^{238}U-series was furthermore suggested for the limestone samples by measured secular equilibria between the progeny of ^{226}Ra, i.e. ^{210}Pb which is considerably more short lived (i.e. 22 years vs. 1600 years). For corals, however, this tool is not always applicable, because recent ^{210}Pb may sorb on the surface of the highly porous corals, if these are permanently exposed to percolating sea water. In conclusion, it is suggested that $^{226}Ra_{ex}/^{226}Ra(0)$ applied on young Holocene corals may be suitable to explain discrepancies between $^{230}Th/^{234}U$ and ^{14}C which is of importance in the discussion on the terrestrial climate evolution.