R-Process Chronometers - II

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We have examined in great detail problems and constraints associated with the Th/"third peak" and Th/U cosmochronometric pairs, such as uncertainties in the underlying atomic and nuclear physics (for references see, e.g. [2]). In part I of this report, we have examined the reproduction of the observed Pb and Bi r-abundances as a consistency check for our calculations of the "initial" isotopic or elemental abundances of the actinide chronometers Th and U [3].
Table 1 summarizes our recent results of Th/X ratios from r-abundance calculations assuming two different seed compositions, a) the classical Fe-seed and b) a Zr-seed [3]. Combined with recent Th/REE and Th/U observations in several ultra-metal-poor Halo stars, chronometric ages of about (14±3) Gyr have been determined, which are in good agreement with other, independent age determinations of the Universe.
Further progress in r-chronometric age determinations are expected from a combination of improved astrophysical calculations [4] and high-resolution optical spectroscopy of **isotopic** abundance ratios [5,6]. Such data would also allow to determine r/s-mixtures and with this the onset of s-process nucleosynthesis in the early galaxis.

References:
[1] J.J. Cowan et al., ApJ 521 (1999) 194
[2] K.-L. Kratz et al.,, New Astronomy Reviews 48 (2004) 105
[3] K.-L. Kratz et al., this Annual Report
[4] K. Farouqi et al., this Annual Report
[5] K.-L. Kratz and B. Pfeiffer, *Nuclear Structure and Dynamics,* Hirschegg (2003) 276
[6] B. Pfeiffer et al., Verhandl.DPG(VI)39, HK28.3 (2004)

Table 1: Abundance ratios of r-chronometer pairs using different fit criteria and seed compositions.

R-chronom. pair	Fe-seed				Zr-seed
	Old fit [1]	New fit A	New fit B	Th(B)/$X_\odot$	New fit
Th/U-238	1.805(3)	1.557(11)	1.568(11)		1.475(1)
U-235/U-238	1.602(6)	1.464(14)	1.464(14)		1.758(2)
Th/Os	0.0990(24)	0.0980(11)	0.0927(14)	0.0750	0.0735(16)
Th/Ir	0.0923(19)	0.0948(30)	0.0890(31)	0.0703	0.0676(11)
Th/Pt	0.0239(6)	0.0255(11)	0.0235(11)	0.0360	0.0316(5)
Th/3^{rd}peak	0.0159(4)	0.0167(6)	0.0155(6)	0.0181	0.0166(3)
Th/Eu	0.481(23)	0.530(23)	0.453(17)	0.422	0.479(18)

New fit A, B are least-square fits for $N_{r,\odot}$ in the mass ranges A=83-209 and A=125-209, respectively.