NILE SR-ISOTOPE BUDGETS - MATHCAD WORKSHEET and SPREADSHEET WITH PRIMARY DATA

Notes

- The mass balance must be used realistically with respect to regional climate and hydrology. e.g. It would be unrealistic to put the discharge of the "torrents" at maximum when the the other rivers are at a minimum. (See table of input variables on following page).

- Because of the close proximity of the Victoria inflow to the Nile outflow from L. Albert, water from Victoria does not mix thoroughly with waters originating from other parts of the Albert catchment. For this reasons the two are treated as separate entities: (i) Victoria Nile contribution, (ii) Edward/Ruwenzori/Albert catchment contribution.

- A working MathCad worksheet file is available on request from the first author (michael.talbot@geol.uib.no).

Strontium budget for Lake Albert

(Discharge in m3/sec)

$Sd := 63.4$ Semliki discharge from Edward
$Ssr := 0.7073$ Sr isotopic composition of outflow from Edward
$Sc := 8.65$ Sr conc. of outflow (Palmer & Edmond - P & E)

$S := Sd \cdot Ssr \cdot Sc$ $Sr := Sd \cdot Sc$
$Rd := 50.7$ Discharge from w. Ruwenzori into Semliki R.
$Rsr := 0.7108$ Sr composition of w. Ruwenzori (initially same as L. George - 0.7108 - P&E)
$Rc := 0.49$ Sr. conc. of w. Ruwenzori rivers (same as Malagarasi - 0.49 - P&E)

$R := Rd \cdot Rsr \cdot Rc$ $Rr := Rd \cdot Rc$

$Od := 53.9$ Discharge of other rivers entering L. Albert
$Osr := 0.724$ Sr isotopic composition of other rivers (based on Kafu - P&E)
$Oc := 0.12$ Sr conc. of other rivers (based on Kafu - P&E)
$O := Od \cdot Osr \cdot Oc$ $Or := Od \cdot Oc$

$$Asr := \frac{S + O + R}{Sr + Or + Rr}$$

$Asr = 0.7076$ Composition of Albert-Edward contribution to White Nile

BUDGET FOR WHITE NILE

Input variables:

Discharge: m3. sec-1	Mar/Apr	June	August	Oct/Nov	Dec/Jan
Ad	135	71	67	250	176
Vd	875	962	995	985	915
Td	5	205	290	290	20
SOd	46	405	636	790	393

For no overflow from Victoria, Vd=0
For no overflow from Victoria or Albert, Vd=0, Ad=0

Contribution from L. Edward & Albert catchments

$Ad := 71$ Discharge from Albert other than that from Victoria
$Ac := 7.44$ Sr conc. of L. Albert
$A := Ad \cdot Asr \cdot Ac$ $Ar := Ad \cdot Ac$

Victoria Nile below L. Kyoga (data from Shahin, Table 8.7)
$Vd := 962$ Discharge into L. Albert
$Vsr := 0.712$ (see below. Kyoga shell: 0.7154 - not from main body of lake)
$Vc := 3.3$ (based on 3x enrich. in Ca)
$V := Vd \cdot Vsr \cdot Vc$ $Vr := Vd \cdot Vc$

Torrents (Aswa, etc.) that join Bahr el Jebel
$Td := 205$ Discharge
$Tsr := 0.7251$ (Same as Ora, Uganda - P&E)
$Tc := 0.49$ (Same as Malagarasi - P&E)
$T := Td \cdot Tsr \cdot Tc$ $Tr := Td \cdot Tc$

(nb. P & E's quoted Sr conc. for the Ora - 0.94 - is unusually high for a trop. river draining cryst. basement, not just in Africa. Even if correct it probably cannot be applied to larger rivers like the Aswa)

Composition of Bahr el Jebel

$B := \frac{(A + T + V)}{(Ar + Tr + Vr)}$ $B = 0.7117$ (Composition measured at Bor - 0.7117)

Loss of water at Sudd

$Fr := 0.51$ Fraction of Bahr el Jebel passing through Sudd (today ca. 0.51 - Shahin, p. 362)

$Ns := (Ad + Td + Vd) \cdot Fr$

$Ns = 631.38$ Discharge from Sudd

$$Nc := \frac{Ad \cdot Ac + Vd \cdot Vc + Td \cdot Tc}{Ad + Vd + Td} \cdot 1.25$$

Calc. Sr concentration in Bahr el Jebel, based on Ca enrichment of 1.25

$Nc = 3.84$

Sobat River

$SOd := 405$ Discharge

$SOsr := 0.7062$ (same as Blue Nile in Sudan)

$SOc := 1.5$ (rivers draining Ethiopian Plateau - P&E)

White Nile

$$Wsr := \frac{Ns \cdot B \cdot Nc + SOd \cdot SOsr \cdot SOc}{(Ns \cdot Nc + SOd \cdot SOc)}$$

$Wsr = 0.7106$ **Sr isotopic composition of the White Nile**

Mass balance for Victoria Nile below L. Kyoga

$VNd := 908$ Discharge from L. Victoria (Shahin, Tab. 8.5)

$VNsr := 0.7114$ Composition of Victoria Nile

$VNc := 1.1$ Sr conc. of Victoria Nile

$KRd := 92.15$ Addional inflow to L. Kyoga (Shahin, Tab. 8.6)

$KRsr := 0.7232$ Sr comp. of additional inflow (Kafu R.)

$KRc := 0.12$ Sr. conc. of additional inflow (Kafu R.)

$$Vky := \frac{VNd \cdot VNsr \cdot VNc + KRd \cdot KRsr \cdot KRc}{VNd \cdot VNc + KRd \cdot KRc}$$

$Vky = 0.712$ Sr. composition of Nile below L. Kyoga

P & E - Palmer and Edmond (1989)
Discharge data from Hurst (1952) and Shahin (1985)

Table A. Analytical data

	lab #	sample	age	87/86Sr measured	2S error	87/86Sr corrected	Locality	Material
1	mt-1972	Vic 2	Modern	0.711266	9.00E-006	0.711291	L. Victoria	mollusc
2	mt-1973	Vic 3	Modern	0.711274	8.00E-006	0.711299	L. Victoria	mollusc
3	mt-1969	Ibis 1-4/1	L. Pleistocene	0.711214	8.00E-006	0.711239	L. Victoria	mollusc
4	mt-1970	Ibis 1-4/2	L. Pleistocene	0.711224	9.00E-006	0.711249	L. Victoria	mollusc
5	mt-1971	Vic 1	Modern	0.711256	8.00E-006	0.711281	Victoria Nile	mollusc
7	mt-1974	ED 1	Modern	0.707392	9.00E-006	0.707417	L. Edward	mollusc
8	mt-1975	ED 2	Modern	0.707430	8.00E-006	0.707455	L. Edward	mollusc
9	mt-1976	ED 3	Modern	0.707433	9.00E-006	0.707458	L. Edward	mollusc
12	mt-1988	Alb 4Pc/a	Modern	0.709991	8.00E-006	0.710004	L. Albert	mollusc
13	mt-1989	Alb 4Pc/b	Modern	0.710449	9.00E-006	0.710462	L. Albert	ostracode
14		Alb 1	modern	0.710285	1.40E-005	0.710280	L. Albert	mollusc
15	mt-1990	AF 3	L. Pleistocene	0.713766	8.00E-006	0.713779	L. Albert	ostracode
17		WN13	modern	0.711663	1.40E-005	0.711658	W.Nile, Bor	mollusc
19	mt-1977	WN 1	Modern	0.709682	9.00E-006	0.709707	Esh Shawal	mollusc
20	mt-1996	WN 11	Modern	0.710886	8.00E-006	0.710899	Esh Shawal	mollusc
21		WN5 (av.)	Modern			0.710873	Esh Shawal	mollusc
	mt-1981	WN 5	Modern	0.710868	8.00E-006	0.710881		mollusc
	mt-2028	WN 5A	Modern	0.710778	8.00E-006	0.710803		mollusc
	mt-2029	WN 5B	Modern	0.710829	8.00E-006	0.710854		mollusc
	mt-2030	WN 5C	Modern	0.710827	8.00E-006	0.710852		mollusc
	mt-2031	WN 5D	Modern	0.710913	8.00E-006	0.710938		mollusc
	mt-2032	WN 5E	Modern	0.710885	8.00E-006	0.710910		mollusc

Table A, continued

22	mt-1978	WN 2	Modern	0.709499	8.00E-006	0.709524 Esh Shawal	mollusc
23	mt-1997	WN 12	11500	0.709699	9.00E-006	0.709712 Esh Shawal	mollusc
24	mt-1983	WN 7a	11300	0.709607	8.00E-006	0.709620 Esh Shawal	mollusc
25	mt-1984	WN 7b	11300	0.710870	9.00E-006	0.710883 Esh Shawal	mollusc
26	mt-1982	WN 6	11250	0.709711	9.00E-006	0.709724 Esh Shawal	mollusc
27	mt 2257	ES 2 - 100/1	11250	0.709214	9.00E-006	0.709261 Esh Shawal	mollusc
28	mt 2258	ES 2 - 100/2	11250	0.709246	8.00E-006	0.709293 Esh Shawal	catfish spine
29	mt-1987	WN 10	5500	0.709868	9.00E-006	0.709881 Guli	mollusc
30	mt-1986	WN 9	3030	0.709891	8.00E-006	0.709904 Tagra	mollusc
31	mt-1985	WN 8	8130	0.707823	9.00E-006	0.707836 Tagra	mollusc
32	mt-2033	WN 8A	8130	0.707955	8.00E-006	0.707979 Tagra	mollusc
33	mt-1991	SH 1	7050	0.708000	9.00E-006	0.708013 Shabona	mollusc
34	mt-1992	SH 2	7050	0.708460	8.00E-006	0.708473 Shabona	mollusc
35	mt-1993	SH 3	7050	0.708607	8.00E-006	0.708606 Shabona	mollusc
37	mt-1979	WN 3	Modern	0.706160	9.00E-006	0.706185 Gezira canal	mollusc
38	mt-1995	BN 2	11800	0.707052	8.00E-006	0.707065 Atra	mollusc