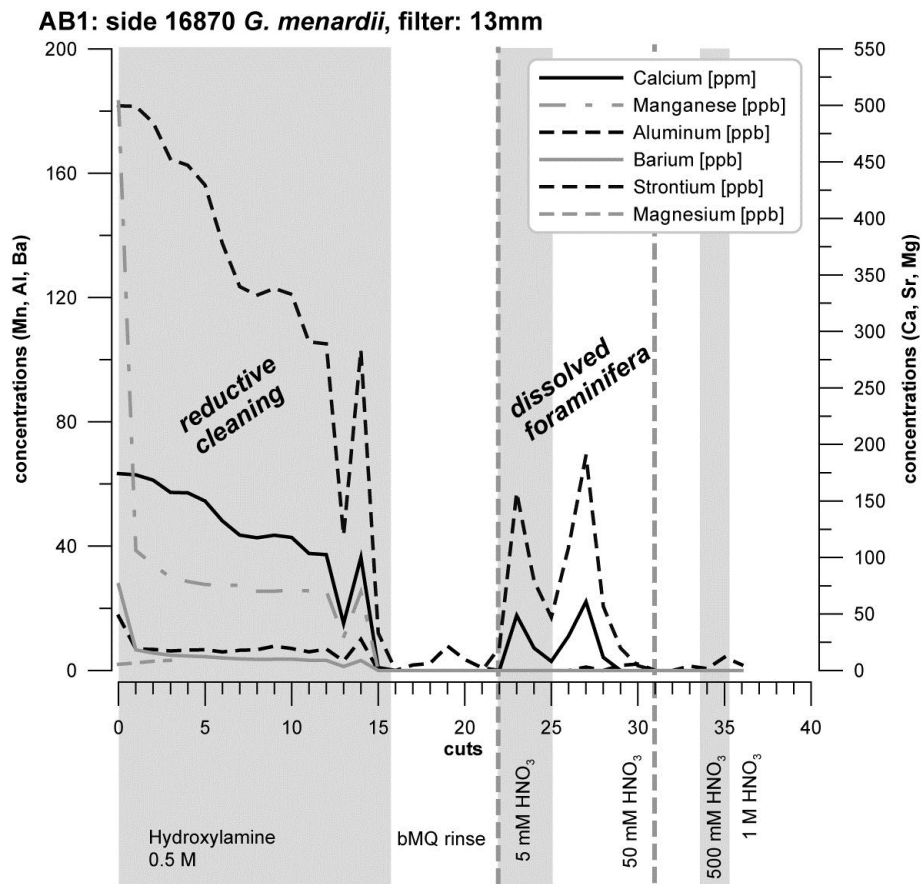


1 **Supplementary Material**

2 **S 1 Flow Through cleaning method:**

3 Differences between the procedures shown in Table 1 and Table 2

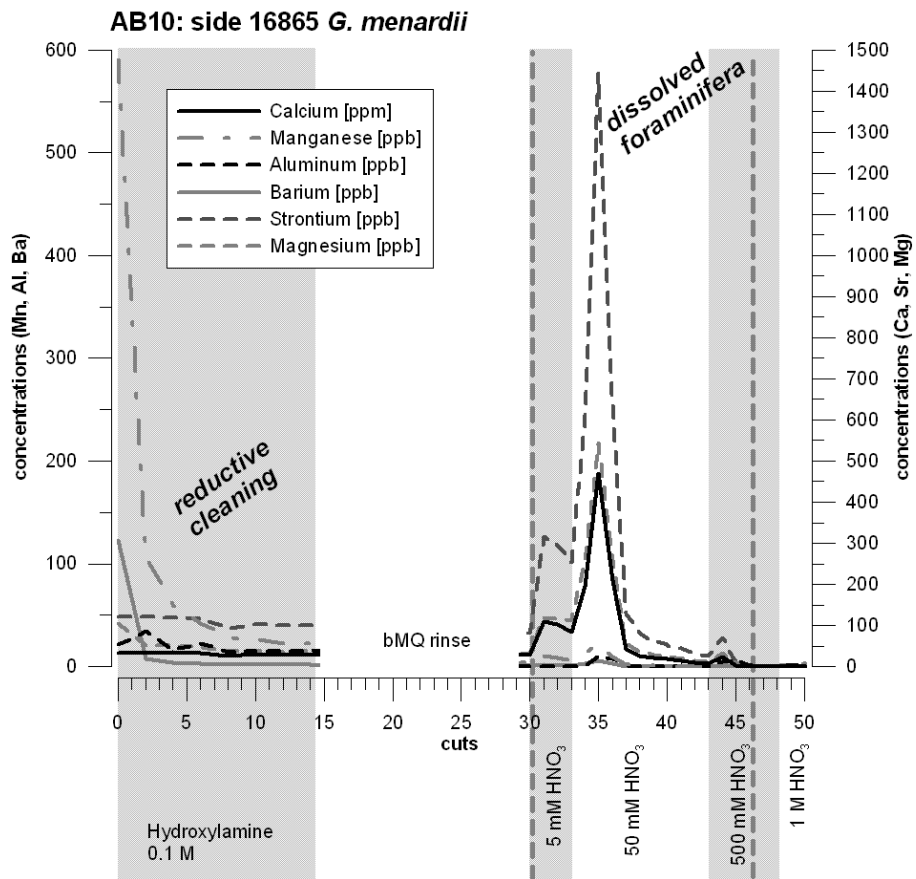


4

5 **Figure S 1A:** Elemental concentrations of sample AB1, treated as described in Table 2, with

6 the strongest HYDRX solution (0.5 M), the dashed lines frame the cuts in which

7 the dissolved foraminiferal calcite was collected



8

9 **Figure S 1B:** Elemental concentrations of sample AB10, treated as described in Table 3,

10 representative for all samples, cleaned with the flow through procedure (0.1 M

11 HYDRX), the dashed lines frame the cuts in which the dissolved foraminiferal

12 calcite was collected

13 **S 2 Residual sediments**

14 **Table S 2:** Sediment treatment procedure for complete dissolution of the residual sediments

Step 1	3 ml conc. HCl	Reflux over night at 140°C	Evaporate to dryness afterwards
	1 ml conc. HNO ₃		
	2 ml HF		
Step 2	1 ml conc. HNO ₃	Reflux over night at 140°C	Afterwards evaporate at 120-140°C
	5 ml HF		
Step 3	2.5 ml conc. HNO ₃	Reflux over night at 140°C	Evaporate to dryness at 180°C
	0.5 ml perchloric acid		
	2.5 ml HF		
Step 4	4 ml 6 M HNO ₃	Reflux over night at 120°C	Evaporate to dryness at 180°C
Step 5 & 6	4 ml 6 M HNO ₃	Evaporate to dryness at 180° to 190°C	
Step 7	4 ml 6 M HNO ₃	Reflux at 120°C	
	100 µl H ₂ O ₂	wait until reaction completed (open vials with lids loose on)	
	200 µml H ₂ O ₂	wait until reaction completed (open vials with lids loose on) min. 1 h	
	200 µml H ₂ O ₂	wait until reaction completed (open vials with lids loose on) min. 1 h	
		Evaporate to dryness afterwards	
Step 8	1 ml 6 M HNO ₃	reflux	
Step 9	centrifuge (1.5 ml safe lock tubes), pipette into Teflon and evaporate		
Step 10	Preparation for column chemistry		

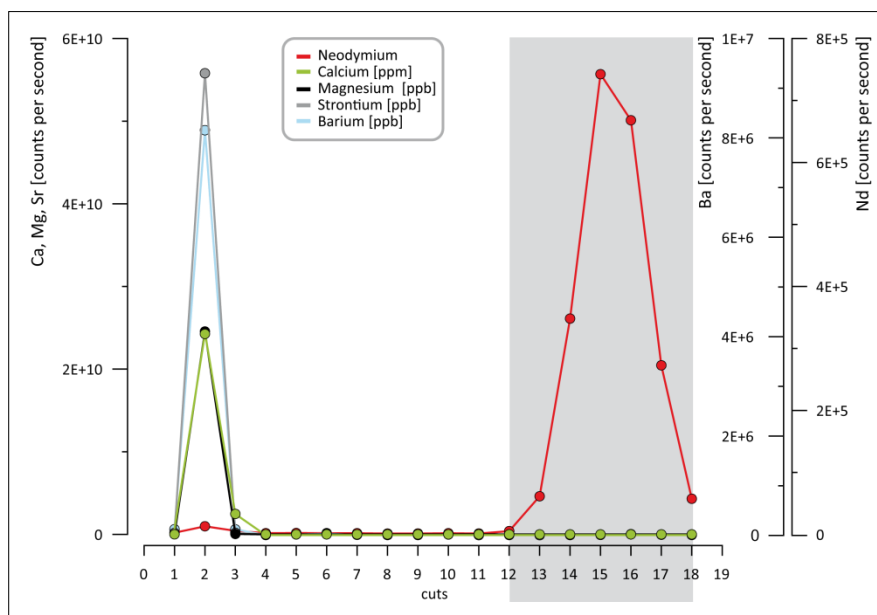
Conc. HCl ~10.5 M, quartz-distilled
 Conc. HNO₃ ~ 14.5 M, quartz-distilled
 HF 40% sp.
 Perchloric acid 70%
 H₂O₂ ~30% sp.

15 **S 3 Neodymium separation from dissolved foraminifera**

16 **Table S 3: Nd separation of foraminiferal samples with 3.14 ml Eichrom Ln-spec resin (50-**

17 **100 μm)**

<i>Volume</i>	<i>Acid</i>	<i>stage</i>
8 ml	6 M HCl	pre-clean
0.5 ml	0.1 M HCl	pre-conditioning
1 ml	0.1 M HCl	pre-conditioning
0.5 ml	0.1 M HCl	sample load
0.5 ml	0.1 M HCl	wash-in
10 ml	0.25 M HCl	elute LREE
2 ml	0.3 M HCl	elute LREE
6 ml	0.3 M HCl	collect Nd
8 ml	6 M HCl	clean
1 + 1 ml	0.3 M HCl	pass and store



18

19 **Figure S 3: Yield test for adapted neodymium separation (3.14 ml Eichrom Ln-spec resin, 50**

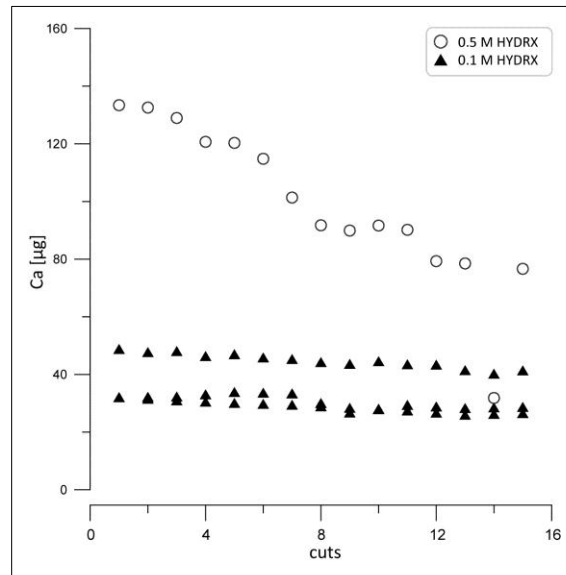
20 **- 100 μm , see Table S 2), without Sr-REE separation, sample: synthetic carbonate**

21 **solution (~2.8 % Ca, 106 ppb REE, 70 ppm Mg, 65 ppm Sr, 50 ppb Ba), the LREE**

22 **elution and the Nd collection step was divided into 18 cuts of 1 ml each. The gray**

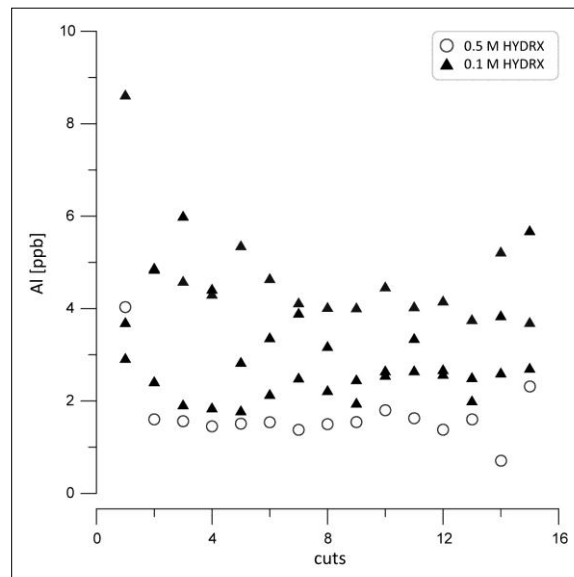
23 **bar frames the cuts which were used for isotopic analyses.**

24 **S 4 Foraminiferal element concentrations in the reductive solution of the Flow**
25 **Through (FT) cleaning method**



26

27 **Figure S 4A:** Ca concentrations in the reductive cleaning solution (HYDRX) measured in
28 cuts of about 3.5 ml, cleaning included clay removal and oxidative cleaning



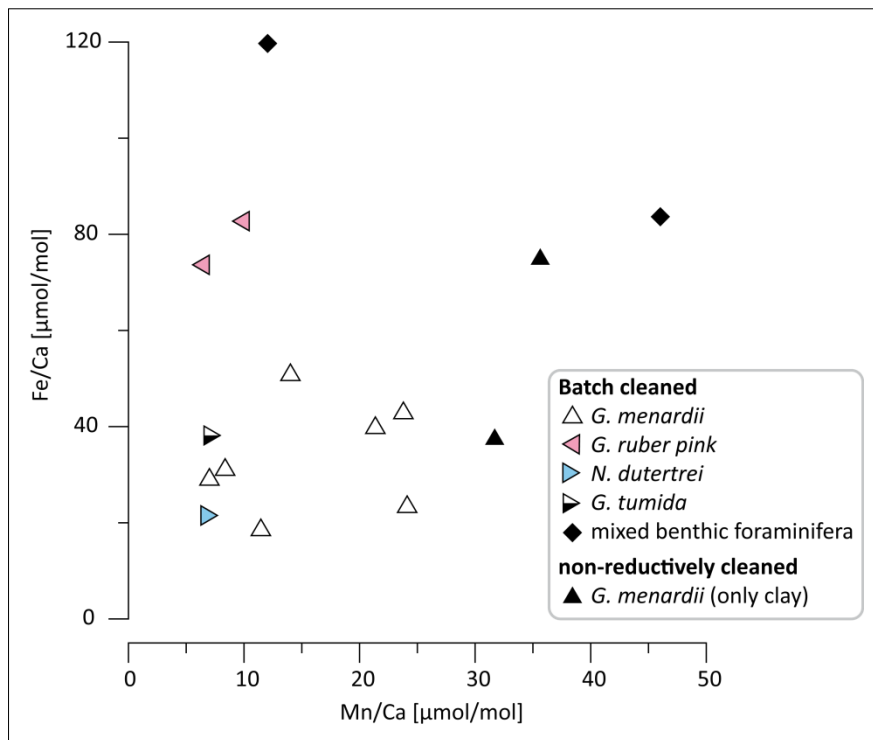
29

30 **Figure S 4B:** Al concentration in 1 ml of the reductive solution (HYDRX) measured in cuts
31 of about 3.5 ml, cleaning included clay removal and oxidative cleaning

32 **Table S 5:** Rare Earth element (REE) concentrations
 33 Normalized to PAAS (ppm) (Nance and Taylor, 1976), results $\times 10^3$

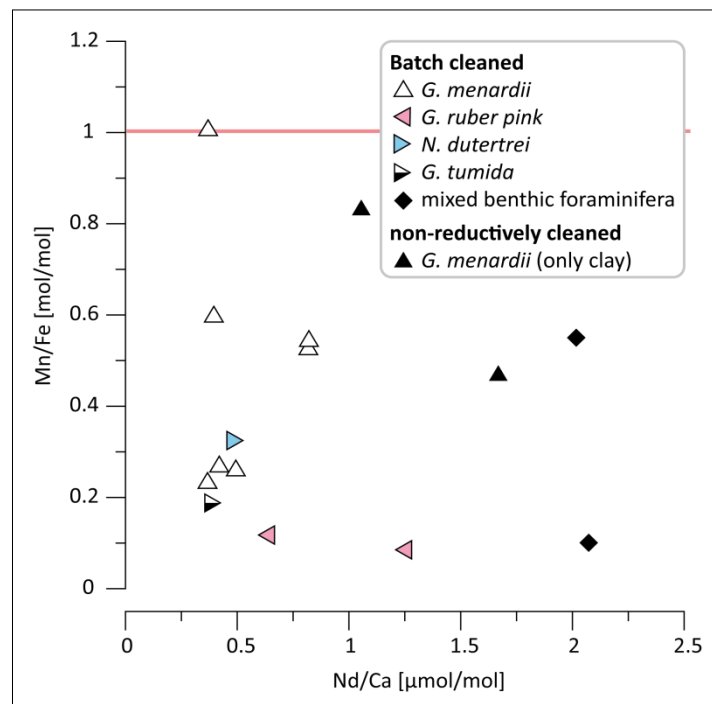
sample	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
<i>Niger site east</i>														
SK-AD 46, <i>G. ruber pink</i>	45	15	49	53	71	78	79	72	69	54	52	47	44	39
SK-AD 43, <i>G. menardii</i>	16	5	19	22	26	29	28	27	26	23	23	19	21	15
SK-AD 51, <i>N. dutertrei</i>	16	7	22	25	34	37	37	34	33	26	26	23	22	19
SK-AD 52, <i>G. tumida</i>	6	2	7	9	11	11	12	11	10	9	9	7	8	6
SK-AD 52, <i>G. tumida</i>	6	2	8	9	11	11	11	11	11	10	10	7	9	6
SK-AD 52, <i>G. tumida</i>	13	5	16	17	24	25	26	24	23	18	19	18	15	13
SK-AD 47, mixed benthic foraminifera	51	10	44	48	47	50	49	43	43	37	36	30	32	24
SK-AD 42, <i>G. menardii</i> , non-reductively cleaned	55	22	65	73	88	97	96	90	87	76	74	57	64	52
<i>Niger site west</i>														
SK-AD 45, <i>G. menardii</i>	13	5	14	16	21	23	24	22	22	17	18	16	16	14
SK-AD 49, mixed benthic foraminifera	46	13	42	48	50	54	55	50	49	42	42	34	39	29
SK-AD 44, <i>G. menardii</i> , non-reductively cleaned	38	16	41	45	61	68	71	64	64	52	51	45	45	39

34 **S 6 Element to calcium ratios**



35

36 **Figure S 6A: Fe/Ca versus Mn/Ca**



37

38 **Figure S 6B: Mn/Fe versus Nd/Ca**

39 **References**

- 40 Boyle, E. A. (1983) Manganese carbonate overgrowths on foraminifera tests. *Geochimica Et*
41 *Cosmochimica Acta*, **47**, 1815-1819.
- 42 Nance, W. B. & Taylor, S. R. (1976) Rare-Earth Element Patterns and Crustal Evolution .1.
43 Australian Post-Archean Sedimentary-Rocks. *Geochimica Et Cosmochimica Acta*, **40**,
44 1539-1551.