Mason, C.C., et al., 2019, Detrital zircons reveal sea-level and hydroclimate controls on Amazon River to deep-sea fan sediment transfer: Geology, https://doi.org/10.1130/G45852.1

Description of Supplementary Materials for "Detrital zircons reveal sea-level and hydroclimate controls on Amazon river-to- deep-sea fan sediment transfer"

The supplementary materials consist of four tables, two data files, one figure, explanations for mixture modeling discussed in the main text, and ten image (.jpg) files.

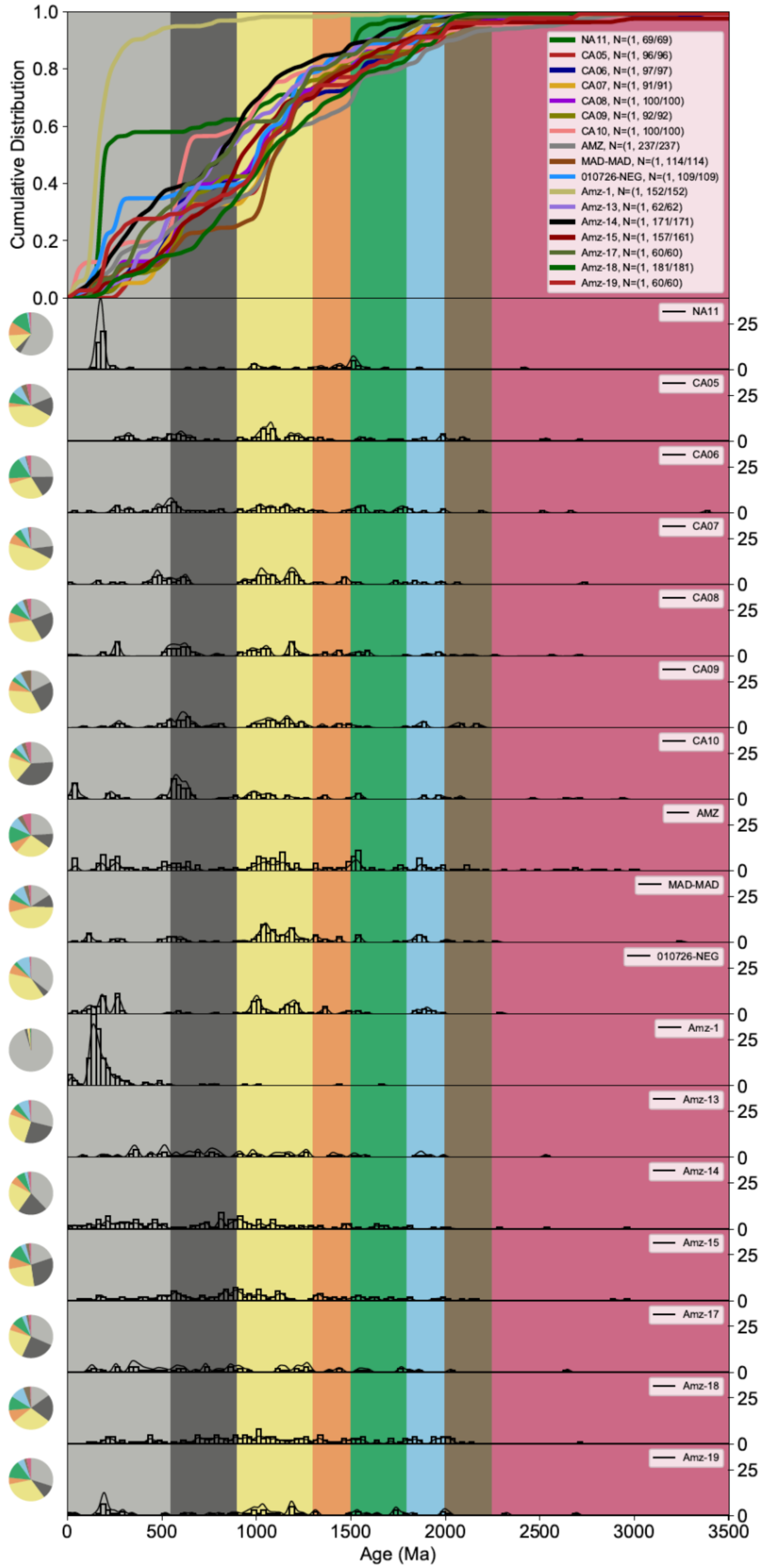
Contents

Supplementary Table 1: Fractions of detrital zircon ages in the onshore upper and lower Amazon River and submarine fan

	Mapes (2009) samples 1-12 Upper Amazon	Mapes (2009) samples 13-15+ Campbell and Allen (2008) samples Lower Amazon	upper + lower Amazon	all fan
<550	41	25	37	31
550-900	14	17	15	16
900-1300	32	22	29	29
1300-1500	5	9	6	5
1500-1800	5	11	7	7
1800-2000	1	8	3	5
2000-2250	1	3	2	4
>2250	1	4	1	2

Age bins corresponds to pie 'slices' in main text Fig. 1

Data from Mapes (2009), Campbell and Allen (2008). See Mapes (2009) for reference to Sample numbers.



Cumulative Distribution
1.0
0.8
0.6
0.4
0.2
0.0
NA11, N=(1, 69/69)
CA05, N=(1, 96/96)
CA06, N=(1, 97/97)
CA07, N=(1, 91/91)
CA08, N=(1, 100/100)
CA09, N=(1, 92/92)
CA10, N=(1, 100/100)
AMZ, N=(1, 237/237)
MAD-MAD, N=(1, 114/114)
010726-NEG, N=(1, 109/109)
Amz-1, N=(1, 152/152)
Amz-13, N=(1, 62/62)
Amz-14, N=(1, 171/171)
Amz-15, N=(1, 157/161)
Amz-17, N=(1, 60/60)
Amz-18, N=(1, 181/181)
Amz-19, N=(1, 60/60)
NA11
CA05
CA06
CA07
CA08
CA09
CA10
AMZ
MAD-MAD
010726-NEG
Amz-1
Amz-13
Amz-14
Amz-15
Amz-17
Amz-18
Amz-19
25
0
0
500
1000
1500
2000
2500
3000
3500
Age (Ma)

Supplementary Figure 1: Cumulative distribution functions, pie charts, kernel density estimates and histograms for all onshore Amazon system detrital zircon data used in the main text. U-Pb ages binned at 25 Myr intervals. Sample codes: NA = northern Andes, CA = central Andes (Pepper et al., 2016), AMZ = lower Amazon River (Campbell and Allen, 2008), MAD = Madeira River of Campbell and Allen (2008), NEG = Negro River (Campbell and Allen 2008), AMZ-1 through AMZ-19 from Mapes (2009). Figure produced using code from Sharman et al. (2018).

Supplementary Table 2: Cross-correlation of kernel density estimation
(after Saylor and Sundell, 2016)

sample	# grains (n)	945-1	946-2	946-3	946-4	946-5	946-6	946-7	936-2	946-8	946-9
945-1	137	1	0.584	0.517	0.389	0.588	0.610	0.450	0.413	0.369	0.494
946-2	129	0.584	1	0.401	0.433	0.605	0.451	0.382	0.446	0.378	0.551
946-3	129	0.517	0.401	1	0.402	0.425	0.401	0.313	0.319	0.346	0.488
946-4	131	0.389	0.433	0.402	1	0.422	0.394	0.332	0.536	0.411	0.440
946-5	138	0.588	0.605	0.425	0.422	1	0.641	0.405	0.474	0.530	0.575
946-6	145	0.610	0.451	0.401	0.394	0.641	1	0.526	0.433	0.565	0.414
946-7	143	0.450	0.382	0.313	0.332	0.405	0.526	1	0.441	0.497	0.322
936-2	135	0.413	0.446	0.319	0.536	0.474	0.433	0.441	1	0.391	0.401
946-8	135	0.369	0.378	0.346	0.411	0.530	0.565	0.497	0.391	1	0.445
946-9	142	0.494	0.551	0.488	0.440	0.575	0.414	0.322	0.401	0.445	1

Selecting Detrital Zircon Samples for Mixture Models

We use U-Pb detrital zircon (DZ) geochronology and mixture modeling to quantify relative contributions of sediment from geographically and geologically distinct sources within the Amazon catchment to: (1) the modern lower Amazon River, and (2) the Pleistocene Amazon submarine fan. While several major tributaries to the Amazon River have been sampled for U-Pb DZ dating of modern river sands (the Negro, Madeira, Purus), many large tributaries are not characterized yet in published literature. Thus, we created parent end members for mixture models based on the geography of existing samples within the Amazon drainage basin. The end-member sediment source areas are the Central Andes, the Northern Andes, and a cratonic source characterized by samples from the Negro River (See Supplementary Table 3 below). Samples and data sources for onshore DZ data are presented bow in Supplementary Table 3.

Statistical Treatment of Detrital Zircon U-Pb Age Data

We apply a top-down sediment unmixing approach (sensu Sharman and Johnstone, 2017; Mason et al., 2017; Fildani et al., 2018). Following published methods, we to calculate mixing coefficients of parent components present in daughter composites using U-Pb detrital zircon ages in samples from the modern onshore Amazon system and Pleistocene submarine fan (after Amidon et al., 2005; Mason et al., 2017; Fildani et al., 2018). For a discussion of the implicit assumptions of our mixture model, see Mason et al. (2017).

RESULTS

The result of mixture models are discussed in the main text, and presented below in Supplementary Table 4.

Supplementary Table 3: Published detrital zircon samples used in mixture models

Component/composite Name	Sample ID	n	River/location	Latitude	Longitude	Data Source
Northern Andes component						
	NA11	69	Tena River	-1.0438	-77.7967	Pepper et al., 2016; Geosphere
	Amz-1	152	Napo River	0.04857	-77.3057	Mapes, RW, 2009 - Dissertation
Craton component (Negro River)						
	Amz-18	181	Negro River	-2.4352	-61.0622	Mapes, RW, 2009 - Dissertation
	Amz-19	60	Negro River	-3.1807	-60.0054	Mapes, RW, 2009 - Dissertation
	010726-NEG	109	Negro River	-3.1429	-60.12423	Campbell & Allen, 2008 - Nature Geosci
Central Andes Component						
	Amz-17	60	Purus River	-4.026	-61.514	Mapes, RW, 2009 - Dissertation
	MAD-MAD	114	Madeira River	-3.66899	-59.06288	Campbell & Allen, 2008 - Nature Geosci
	CA05	96	Hualaga River	-5.89649	-76.1025	Pepper et al., 2016; Geosphere
	CA06	97	Ucayali River (Pucalpa Ox Bow)	-8.33793	-74.5946	Pepper et al., 2016; Geosphere
	CA07	91	Huanuco River	-9.65693	-76.7189	Pepper et al., 2016; Geosphere
	CA08	100	Unnamed river (La Union pueblo)	-9.7608	-76.796	Pepper et al., 2016; Geosphere
	CA09	92	Madre de Dios River	-12.6	-69.094	Pepper et al., 2016; Geosphere
	CA10	100	Pachachaca Abancay River	-13.6613	-72.9379	Pepper et al., 2016; Geosphere
Lower Amazon Composite						
	AMZ	237	Amazon River	-1.49762	-52.1511	Campbell & Allen, 2008 - Nature Geosci
	Amz-13	62	Amazon River	-3.3742	-58.7233	Mapes, RW, 2009 - Dissertation
	Amz-14	171	Amazon River	-2.2835	-56.3744	Mapes, RW, 2009 - Dissertation
	Amz-15	161	Amazon River	-2.4326	-54.3714	Mapes, RW, 2009 - Dissertation
Submarine Fan Composite						
	945-1	137	submarine fan	6.9503	-47.9288	This study
	946-2	129	submarine fan	6.9496	-47.9193	This study
	946-3	128	submarine fan	6.9496	-47.9193	This study
	946-4	131	submarine fan	6.9496	-47.9193	This study
	946-5	138	submarine fan	6.9496	-47.9193	This study
	946-6	145	submarine fan	6.9496	-47.9193	This study
	946-7	143	submarine fan	6.9496	-47.9193	This study
	936-2	134	submarine fan	5.6322	-47.7355	This study
	946-8	135	submarine fan	6.9496	-47.9193	This study
	946-9	142	submarine fan	6.9496	-47.9193	This study

Supplementary Table 4: Unmixing coefficients for DZ samples from the modern lower Amazon and Pleistocene Amazon submarine fan

Sample ID	Northern Andes	Craton (Negro)	Central Andes
Lower Amazon (Holocene)	0.00	0.67	0.33
945-1 (MIS-2)	0.08	0.26	0.66
945-1 (MIS-2)	0.03	0.38	0.59
945-1 (MIS-2)	0.06	0.23	0.72
945-1 (MIS-2)	0.00	0.00	1.00
946-5 (MIS-3/4)	0.02	0.29	0.68
946-5 (MIS-3/4)	0.06	0.00	0.94
946-5 (MIS-3/4)	0.07	0.07	0.87
936-2 (MIS-6)	0.07	0.12	0.81
936-2 (MIS-6)	0.07	0.02	0.91
936-2 (MIS-6)	0.11	0.16	0.73
All fan samples (Pleistocene)	0.05	0.17	0.78

SUPPLEMENTARY REFERENCES

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