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Geochemical Evidence for Sediment Accretion in the Costa Rica Frontal Prism

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Sampling and Analytical Methods

We analyzed 22 residues from ODP Leg 205 interstitial water whole round squeezed cakes, each consisting of 20-40 cm of compressed core from Sites 1254 (20 samples) or 1255 (2 samples) via ICP-MS. Leg 205 recovered core from pre-determined intervals in the sediment column, geared for locating zones of fluid flow, based on Leg 170 shipboard results. This work covers the suite of Leg 205 samples only.

In a microwave-assisted protocol, ~0.1 g of sediment were digested in acid (6 mL HNO₃ and 2 mL HF; modified from EPA Method 3052) and brought up to volume in dilute HNO₃ for a total dilution of 1/1000. ICP-MS analyses were carried out using an ELEMENT ThermoFinnegan instrument outfitted with a mixing tee delivery system for blending internal standard and sample solutions. Raw data underwent internal standard (In, mass = 115) normalization and blank subtraction prior to construction of calibration curves using standard reference materials (SRMs) from the U. S. Geological Survey (USGS; MAG-1, SCO-1, SDO-1, and SGR-1) and Canadian Research Council (CRC; MESS-1). Concentrations of procedural

blanks were typically <2% of unknowns, <8% for Cs. Replicate analyses agreed within 7% for Li, Rb, Cs, Ba; replicates agreed within 3% for Fe, Ti, Nb, Y. Measured and accepted values for SRMs agreed within error, except for Fe, which measured 7% too low with respect to MESS-3, Rb, which measured 6% too low with respect to SDO-1, and Li, which was consistently high and was normalized by applying a constant factor correction. Sample depths in meters below seafloor and vertical distance in meters above the nearest fault are provided.

3-component mixing model

In a 3-component mixing calculation, ASH, LPS, and UPS were considered as endmembers. After consultation with P. Clift regarding the best available data for the ASH endmember, ASH data from Clift et al. (2005) were adopted as the best available sampling diversity with high silica pumice values from Deering et al. (2007) where elemental data for ash were lacking. LPS is the mean of six, Site 495 (off Guatemala) hemipelagic sediments available in the GEOROC database, chosen to capture as much of the natural variability in Cocos Plate sedimentary veneer as possible. UPS is an ODP Leg 170 core sample of frontal prism background sediment: Site 1041, 16X-6, 55-82 cm (Kimura et al., 1997).

A triangular mixing space was constrained by Ti and Nb concentrations in each endmember, and x's in Fig. 3 indicate mixing paths in 5% increments, connecting each endmember. For example, along the ASH-LPS mixing trajectory, the bulk sediment Ti and Nb contents for each endmember were identified; the ASH point is defined as 100% ASH, one step towards LPS is 95% ASH + 5% LPS, the next step towards LPS is 90% ASH + 10% LPS, and so forth. All observed data for Site 1254/1255 sediments fall within the Ti-Nb mixing space, and the relative proportions of each endmember were thus inferred after gridded lines for each 2.5% contour were overlain on the plot.

Table DR1. Selected sediment geochemical data for ODP Leg 205 sediments. Concentration units are ppm. mbsf=meters below seafloor. mafb=meters above fault base. Note that Al and K data are from ODP Leg 205 Initial Reports (Morris et al., 2003).

Site	Core	Section	Interval (cm)	Cur. depth	1040 eq.depth	Unit	Ti	Fe	Y	Nb	Rb	Ba	K	Al
1254A	1R	3	52-87	153.5	123.5	UPS	5682	56017	23.1	5.6	41.1	326.6	18595	85738
1254A	2R	4	125-160	161.3	131.3	UPS	5543	53981	23.2	5.8	42.4	332.8		
1254A	3R	3	125-165	169.4	139.4	UPS	5063	112863	21.9	5.3	38.2	279.7	16602	94206
1254A	4R	5	45-90	181.1	151.1	UPS	5596	54485	24.3	6.2	42.3	323.2	18512	93836
1254A	5R	5	50-90	190.4	160.4	UPS	5282	58938	23.5	5.6	43.8	318.3	15772	82086
1254A	6R	1	121-162	195.3	165.3	UPS	5224	44345	14.4	5.6	13.4	129.0		
1254A	6R	2	125-166	197.0	167.0	UPS	5532	56710	22.7	5.7	43.2	357.8	17931	90237
1254A	7R	5	34-74	209.6	179.6	UPS	5066	51714	23.6	5.5	38.8	272.6	16187	92036
1254A	8R	4	0-45	217.7	187.7	UPS	4765	52735	22.7	5.7	33.3	297.7	15274	89866
1254A	9R	5	0-40	305.5	305.5	UPS	4614	57600	27.2	5.6	42.2	293.4	17931	90872
1254A	10R	6	0-40	316.7	316.7	UPS	4943	54267	25.8	6.6	38.5	283.9	15274	84891
1254A	11R	1	78-117	320.1	320.1	UPS	4972	48068	12.4	5.9	15.8	243.4		
1254A	11R	5	63-103	325.7	325.7	UPS	5080	53263	24.2	5.8	38.6	291.8	17599	91348
1254A	12R	1	101-141	329.9	329.9	UPS	4868	53440	39.0	5.9	36.4	253.5	16519	90184
1254A	13R	3	100-145	342.5	342.5	UPS	4791	55052	22.0	6.0	44.3	276.4	18678	93624
1254A	13R	5	69-109	344.7	344.7	UPS	4597	50379	26.0	5.7	40.6	318.3		
1254A	14R	3	0-40	350.8	350.8	UPS	4546	47562	23.0	6.3	31.3	239.1		
1254A	14R	6	52-97	354.3	354.3	UPS	4512	49189	23.3	6.2	31.6	280.4	15440	92512
1254A	15R	3	0-44	360.7	371.2	LPS	4247	50365	20.4	5.8	39.1	731.8	14444	81134
1254A	16R	3	49-89	366.2	376.8	LPS	4124	46628		6.1	51.6	1641.0	15689	79228
1255A	2R	2	0-43	133.9	360.9	UPS	4550	45907	20.5	7.1	38.3	363.5	15275	85156
1255A	4R	1	0-38	152	378.9	LPS	4002	47043	22.6	5.0	21.3	1194.5	14528	83092

Table DR2. Endmember concentrations for elements of interest. All data in ppm.

Sample	Rb	Sr	Ba	Ti	Fe	Ni	Y	Zr	Nb	Ce	K	Al
UPS* (Kimura et al., 1997)	42.1	212.8	650.0	6774	69733	77.0	20.1	112.0	6.6	21.0	18537	91031
LPS** (GEOROC) (Clift et al., 2005; Deering et al., 2007)	40.8	336.2	3941.5	3489	43715	170.4	31.1	105.1	4.2	28.1	15275	62557
ASH***	42.6	149.2	1424.9	1229	8030	74.7	6.7	83.3	9.7	41.9	26565	64886

NB. UPS* = ODP Leg 170, Site 104116-X-6, 55-82 cm, 132.6 mbsf

LPS** = ODP Leg 67, Site 495, mean of six Cocos Plate hemipelagic sediments

ASH*** = Sediment ash sequences or Costa Rica pumice