

Surface uplift and topographic rejuvenation of a tectonically inactive range: Insights from Anti-Atlas and Siroua Massif (Morocco)

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Introduction

This supporting information comprises:

- Tables S1, S2 with data of knickpoint and river profiles of the Anti-Atlas.
- Table S5 summarizes the results of the knickpoints celerity model.

Table S1. Non-lithological knickpoint and river profile data from log-log of channel slope vs. drainage area.

Stream ^a	Long.	Lat.	Elevation	DFD ^b	DFM ^c	Drainage area	Stream parameters			
							Downstream		Upstream	
	°W	°N	(m)	(m)	(m)	(m ²)	k_{sn} (m ^{0.9})	θ	k_{sn} (m ^{0.9})	θ
NCAA1	637465.1	3379132.5	1731	20354	280487	1.58E+08	108 ± 2	0.45 ± 0.15	11.5 ± 2.4	0.27 ± 0.09
NCAA2	613556.8	3372613.8	1424	56831	257482	4.33E+08	113 ± 3	0.47 ± 0.18	32.6 ± 2.9	0.056 ± 0.14
NCAA3	608426.8	3354013.8	1565	23537	266134	1.42E+08	99.8 ± 2.8	0.51 ± 0.13	28.7 ± 1.5	0.32 ± 0.084
NCAA4	596666.8	3351313.8	1492	18508	257691	1.03E+08	104 ± 3	0.42 ± 0.11	44.5 ± 1.2	0.38 ± 0.17
NCAA5	589316.8	3345523.8	1529	11566	266423	2.64E+07	76.5 ± 8	0.28 ± 0.085	34.7 ± 2.6	0.096 ± 0.13
NCAA6	561056.8	3341233.8	1506	13041	185763	3.52E+07	96.4 ± 2.4	0.52 ± 0.092	37.1 ± 2.5	0.25 ± 0.13
NCAA7	555176.8	3340753.8	1324	16987	185931	4.73E+07	98.4 ± 1.6	0.38 ± 0.093	39.7 ± 4.3	0.083 ± 0.11
NCAA8	550076.8	3341713.8	1387	20427	187603	4.69E+07	96.9 ± .7	0.4 ± 0.089	21.8 ± 2.2	0.28 ± 0.11
NCAA9	543836.8	3339913.8	1334	21396	162843	69549300	97.9 ± 2.8	0.53 ± 0.39	30.8 ± 4.8	-0.084 ± 0.14
NCAA10	525536.8	3328513.8	1175	24446	128875	80991900	135 ± 5	0.45 ± 0.34	50.7 ± 3.7	0.15 ± 0.11
Mean NCAA ^d							102.6 ± 4.7	0.44 ± 0.02	33.2 ± 3.5	0.18 ± 0.04
σ^e							14.8	0.07	11.1	0.14
WAA1	497197.4	3309532.6	1111	15696	137453	54819423	70.1 ± 3.8	1.1 ± 0.3	75.6 ± 3.2	0.55 ± 0.077
WAA2	443907.4	3255074.6	857	25669	106609	1.49E+08	71.7 ± 6.4	0.91 ± 0.3	42.9 ± 4.6	-0.065 ± 0.19
WAA3	433249.4	3252884.6	849	29224	62967	1.11E+08	78.6 ± 2.3	1.1 ± 0.78	19.9 ± 2.8	0.098 ± 0.094
WAA4	422883.4	3241277.6	854	11251	115444	12464531	49.8 ± 1.4	0.6 ± 0.079	25.9 ± 1.2	0.38 ± 0.31
WAA5	428504.4	3236605.6	1012	12228	128546	22472393	55.3 ± 4.1	1.1 ± 0.17	12.9 ± 1.3	0.28 ± 0.2
WAA6	445513.4	3233028.6	982	14909	143614	29352132	74.8 ± 1.1	0.49 ± 0.087	39.8 ± 7.9	0.055 ± 0.13
WAA7	471939.4	3246752.6	1272	10221	206751	30897542	59.7 ± 0.7	0.41 ± 0.037	25 ± 5.6	-0.24 ± 0.41
WAA8	482670.4	3251424.6	1294	11699	208687	33460791	62.5 ± 0.7	0.45 ± 0.057	33.6 ± 5	0.019 ± 0.15
WAA9	483765.4	3234050.6	971	43222	187564	2.55E+08	63.2 ± 0.8	0.63 ± 0.18	23.5 ± 1.8	0.14 ± 0.11
Mean WAA							65.07 ± 3.1	0.75 ± 0.1	33.23 ± 6.1	0.14 ± 0.07
σ							9.45	0.3	18.5	0.22
SCAA1	497927.4	3246825.6	1181	27564	430725	1.62E+08	81 ± 1.6	0.61 ± 0.19	15.6 ± 2.4	0.22 ± 0.091

SCAA2	520922.4	3281573.6	1628	14831	482538	39338678	79.2 ± 0.8	0.5 ± 0.066	18.5 ± 2.9	0.036 ± 0.19
SCAA4	529390.4	3272156.6	1588	6291	485819	9485620	75.3 ± 2.2	0.66 ± 0.12	8.44 ± 3.8	0.041 ± 0.4
SCAA5	549465.4	3322015.6	1580	12837	592340	32309727	94.3 ± 0.9	0.41 ± 0.065	17.3 ± 1.2	0.41 ± 0.073
SCAA6	564284.4	3324643.6	1448	17885	608379	1.51E+08	83.5 ± 2.2	0.6 ± 0.13	43.7 ± 1.5	0.5 ± 0.1
SCAA7	618961.4	3336542.6	1773	13358	685609	21443896	88.5 ± 2	0.61 ± 0.089	15.4 ± 3.8	0.065 ± 0.17
SCAA8	636992.4	3343550.6	1476	22860	672273	86074008	74.1 ± 2	0.65 ± 0.13	39.9 ± 3.8	0.091 ± 0.11
Mean SCAA							82.2 ± 2.7	0.57 ± 0.03	22.7 ± 5.1	0.17 ± 0.07
σ							7.2	0.09	13.5	0.2
Mean tot							84.1 ± 3.8	0.58 ± 0.04	30.4 ± 2.9	0.17 ± 0.03
σ							19.7	0.22	14.8	0.18

^a NCAA : rivers draining the northern flank of Anti-Atlas; WAA : rivers draining the western flank of Anti-Atlas; SCAA : rivers draining the southern flank of Anti-Atlas.

^b Distance from divide.

^c Distance from river mouth.

^d Mean and standard error values.

^e Standard deviation of the data.

Table S2. Non-lithological knickpoint and river profile data from χ -plot (data from Clementucci et al., 2022).

Stream ^a	Long.	Lat.	Elevation	DFD ^b	DFM ^c	Drainage area	Stream parameters			
							Downstream		Upstream	
	°W	°N	(m)	(m)	(m)	(m ²)	k_{sn} (m ^{0.9})	θ	k_{sn} (m ^{0.9})	θ
NCAA1	637465.1	3379132.5	1731	20354	280487	1.58E+08	114.6 ± 0.2	0.42	15 ± 0.3	0
NCAA2	613556.8	3372613.8	1424	56831	257482	4.33E+08	118.5 ± 0.4	0.58	42.6 ± 0.78	0
NCAA3	608426.8	3354013.8	1565	23537	266134	1.42E+08	108.5 ± 0.4	0.43	35.5 ± 0.5	0.25
NCAA4	596666.8	3351313.8	1492	18508	257691	1.03E+08	111.5 ± 0.43	0.41	43 ± 0.4	0.3
NCAA5	589316.8	3345523.8	1529	11566	266423	2.64E+07	90.4 ± 0.5	0.28	30 ± 0.3	0.34
NCAA6	561056.8	3341233.8	1506	13041	185763	3.52E+07	102 ± 0.55	0.49	46 ± 0.7	0.2
NCAA7	555176.8	3340753.8	1324	16987	185931	4.73E+07	105 ± 0.42	0.35	63.7 ± 1	0.38
NCAA8	550076.8	3341713.8	1387	20427	187603	4.69E+07	103 ± 0.43	0.34	39 ± 0.9	-0.1
NCAA9	543836.8	3339913.8	1334	21396	162843	69549300	99.5 ± 0.47	0.56	45.2 ± 1.2	-0.18
NCAA10	525536.8	3328513.8	1175	24446	128875	80991900	136.8 ± 0.44	0.46	57 ± 0.56	0.27
Mean NCAA ^d							109 ± 3.9	0.43 ± 0.03	41.7 ± 4.2	0.15 ± 0.06
σ^e							12.6	0.09	13.5	0.19
WAA1	497197.4	3309532.6	1111	15696	137453	54819423	61.5 ± 0.2	0.6	37.5 ± 1.17	0.86
WAA2	443907.4	3255074.6	857	25669	106609	1.49E+08	72.16 ± 0.6	0.8	49 ± 1.1	0.1
WAA3	433249.4	3252884.6	849	29224	62967	1.11E+08	79.9 ± 0.4	0.63	35.3 ± 0.75	-0.1
WAA4	422883.4	3241277.6	854	11251	115444	12464531	62.7 ± 0.3	0.33	30.7 ± 0.43	0.02
WAA5	428504.4	3236605.6	1012	12228	128546	22472393	67.8 ± 0.37	0.39	20.24 ± 0.6	-0.18
WAA6	445513.4	3233028.6	982	14909	143614	29352132	66.2 ± 0.37	0.63	45.4 ± 3.44	-0.90
WAA7	471939.4	3246752.6	1272	10221	206751	30897542	66.86 ± 0.17	0.37	25.26 ± 0.85	-0.10
WAA8	482670.4	3251424.6	1294	11699	208687	33460791	68.8 ± 0.14	0.36	18.1 ± 0.47	0.08
WAA9	483765.4	3234050.6	971	43222	187564	2.55E+08	72.5 ± 0.21	0.42	33.6 ± 0.43	0.02
Mean WAA							68.7 ± 1.8	0.5 ± 0.05	32.7 ± 3.5	0 ± 0.14
σ							5.6	0.16	10.5	0.44
SCAA1	497927.4	3246825.6	1181	27564	430725	1.62E+08	82.56 ± 0.21	0.51	25.9 ± 0.57	0.76
SCAA2	520922.4	3281573.6	1628	14831	482538	39338678	79.58 ± 0.1	0.38	24 ± 0.38	0.04
SCAA4	-	-	-	-	-	-	-	-	-	-
SCAA5	549465.4	3322015.6	1580	12837	592340	32309727	86.4 ± 0.1	0.43	27.86 ± 0.23	0.47
SCAA6	564284.4	3324643.6	1448	17885	608379	1.51E+08	79.85 ± 0.26	0.52	49.15 ± 0.35	0.37
SCAA7	618961.4	3336542.6	1773	13358	685609	21443896	89.76 ± 0.67	0.63	15.7 ± 0.5	-0.03
SCAA8	636992.4	3343550.6	1476	22860	672273	86074008	70.85 ± 0.3	0.63	46.17 ± 0.6	0.20
Mean SCAA							81.5 ± 2.4	0.51 ± 0.03	31.4 ± 5	0.30 ± 0.1

σ	6.5	0.1	13.2	0.29
Mean tot	87.9 ± 4.07	0.47 ± 0.02	36.01 ± 2.5	0.12 ± 0.07
σ	20.35	0.12	12.3	0.34

^a NCAA : rivers draining the northern flank of Anti-Atlas; WAA : rivers draining the western flank of Anti-Atlas; SCAA : rivers draining the southern flank of Anti-Atlas.

^b Distance from divide.

^c Distance from river mouth.

^d Mean and standard error values.

^e Standard deviation of the data.

Table S5. Celerity model of non-lithological knickpoints in the NCAA, WAA and SCAA sectors.

Stream ^a	Elevation	DFD	DFM	Drainage area	Model constrains						Model results					
					K		m		Time (Ma)		K	m	Time (Ma)		Model DFM	RMSE
	(m)	(m)	(m)	(m ²)	Min	Max	Min	Max	Min	Max	Value	Value	Value	Error	(m)	
NCAA1	1731	20354	280487	1.58E+08	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.29E-05	0.66	10.1	4.2	280488	0.198181
NCAA3	1565	23537	266134	1.42E+08	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	6.14E-05	0.69	9.9	4.4	266254	0.065654
NCAA6	1506	13041	185763	3.52E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	6.33E-05	0.69	9.8	4.3	185763	0.031449
NCAA9	1334	21396	162843	6.95E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.84E-05	0.69	10.7	4.3	163048	0.012972
NCAA10	1175	24446	128875	8.10E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	6.04E-05	0.67	9.3	4.1	129128	0.066367
Mean											5.93E-05	0.68	9.9	4.3		
WAA1	1111	15696	137453	5.48E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.91E-05	0.64	9.2	4.1	137453	0.051899
WAA2	857	25669	106609	1.49E+08	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.22E-05	0.61	9.2	4.0	106609	0.138172
WAA3	849	29224	62967	1.11E+08	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.48E-05	0.58	9.8	4.5	62967	0.090955
WAA5	1012	12228	128546	2.25E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.53E-05	0.65	9.1	3.9	128547	0.20324
WAA7	1272	10221	206751	3.09E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.34E-05	0.68	9.0	4.2	206752	0.186591
Mean											5.50E-05	0.63	9.2	4.1		
SCAA1	1181	27564	430725	1.62E+08	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	5.47E-05	0.68	10.2	4.2	430725	0.128857
SCAA2	1628	14831	482538	3.93E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	6.69E-05	0.71	10.8	4.0	482538	0.11664
SCAA4	1588	6291	485819	9.49E+06	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	7.00E-05	0.72	11.0	3.8	485819	0.022455
SCAA5	1580	12837	592340	3.23E+07	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	6.63E-05	0.71	9.8	3.8	592340	0.147208
SCAA6	1448	17885	608379	1.51E+08	10 ⁻⁷	10 ⁻⁴	0	0.75	3.8	18.6	6.42E-05	0.70	10.2	4.3	608379	0.109103
Mean											6.44E-05	0.70	10.4	4.0		
Mean tot											5.96E-05	0.67	9.9	4.1		

^a NCAA : rivers draining the northern flank of Anti-Atlas; WAA : rivers draining the western flank of Anti-Atlas; SCAA : rivers draining the southern flank of Anti-Atlas.

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