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Supporting Information for

Late Pleistocene Fault Activity and Slip Rate in the Malarguë Fold-Thrust-Belt Front (Southern Central Andes, Argentina)

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Cosmogenic measurements and uncertainties on cosmogenic ages due to erosion rates or burial episode

Table S3 indicates the raw cosmogenic nuclides measurements. The ages presented in this work are ages calculated with a null erosion rate. For a non-null erosion rate, the evaluation of these ages is shifted to larger values. In the present case, characterised by a semi-arid climate and an almost horizontal deposit surface (terrace, cone), the effect of erosion on the age calculation is likely to be minimal (e.g. Portenga and Bierman, 2011). Considering an erosion rate of ~1m/Ma would shift to higher values by ~10%. Here we also explore the possibility of burial, a possibility revealed by a ratio between the concentrations of ^{10}Be and ^{26}Al <6.5. If such burial is considered prior to deposition in the present formation, the age is overestimated, if it is burial by a temporary cover over the present formation, the age is underestimated. For simplicity, we discuss these different effects per site in the following:

1. **Terrace T4-Site 5**: Sample S5-s1 is only consistent with an erosion rate of ~7 m/Ma or less (inferred from its ^{10}Be and ^{26}Al concentration). In terms of burial, samples S5-s1 and S5-s2 show no evidence of burial (e.g. ^{10}Be and ^{26}Al ages are similar). For S5-s3 and S5-s4, there is a discrepancy between the ^{10}Be and ^{26}Al ages which can be explained either by pre-depositional burial (300 and 2000 kyr, respectively) or by analytical results. Sample S5-s4 is difficult to discuss further, due to the large divergence between ^{10}Be and ^{26}Al. Taking S5-s1, S5-s2 and S5-s3 together, the best-case scenario here is no post-depositional burial and an age of 70.8±7.1 ka (Figure 14); the higher age for S5-s1 probably reflects inheritance, i.e. a long pre-depositional transport time.

2. **Terrace T4-Site 4**: The maximum erosion rate is ~8 m/Ma. In terms of burial S4-s1 shows little evidence of burial (300 kyr), and S4-s2, shows some burial before deposition (900 kyr); this may explain their higher age assessments. For the other 3 samples, they are concordant, except for ^{26}Al for S4-s4 which is probably erroneous and give an age between 67

and 86 kyr (70.5±7.6 ka Figure 14). It can be noted that this range is consistent with a slight overestimation by S4-s1, if it has undergone moderate burial.

3. **Terrace T4-summary sites 4 and 5**: the two sites sampled for T4 give similar results. This gives us confidence in the ages obtained and allows us to rule out a complex history (temporary cover) after deposition. The age of 71±7 ka appears robust.

4. **Terrace Q5 at site S2**. On the 4 sampled pebbles, one measurement has failed (S2-s2), each of the others shows a significant burial (0.4 to 1.5 Ma; minimum $^{26}Al/^{10}Be$ ratio ranging 3.11 and 5.44). Considering only pre-depositional burial would lead to ages >57 kyr but below the age adopted for T4 which is unlikely. We could consider a temporary cover for Q5 that must not have exceeded ~200 ka to take into account the difference between ^{10}Be and ^{26}Al. Nevertheless, the closeness of the ^{10}Be-based assessments leads us to consider the average exposure age (75 ± 8 ka) as the most likely, with a somewhat higher age remaining possible in case of temporary cover. The analytical solutions for shortening and slip rates detailed in section 8.2 demonstrate, a posteriori, that considering the uncertainties associated with TCN dating, an age of 75 ka for Q5 aligns with consistent shortening rates of 1.0-1.2 mm/yr during the late Pleistocene.

Table S1: Analytical results of the Terrestrial in situ Cosmogenic Nuclide (TCN) ^{10}Be and ^{26}Al.

Sample	Lat (°N)	Long (°E)	Altitude (m)	Pebble size (cm)	Number of clasts	Quartz mass (g)	^{9}Be added atoms	Measured ^{10}Be/^{9}Be ratio	Measured ^{10}Be/^{9}Be error	^{10}Be concn. (10^5 atoms/g)	^{10}Be concn. uncertainty (10^5 atoms/g)	^{27}Al measured (atoms)	^{27}Al measured, uncertainty (atoms)	Measured ^{26}Al/^{27}Al ratio	Measured ^{26}Al/^{27}Al error (%)	^{26}Al concn. 10^5 atoms/g	^{26}Al concn. uncertainty (10^5 atoms/g)
E5S1	-35,07	-69,64	1660	10	1	28,68	2,02035E+19	1,856E-12	3,03	**13,08**	**0,40**	3,0057E+20	6,2366E+18	8,229E-13	4,29	**86,25**	**8,62**
E5S2	-35,07	-69,64	1660	15	1	25,60	2,01752E+19	1,279E-12	2,90	**10,08**	**0,29**	1,2068E+20	2,4631E+18	1,383E-12	3,01	**65,20**	**6,52**
E5S3	-35,07	-69,64	1660	13	1	24,99	2,01975E+19	1,149E-12	3,92	**9,28**	**0,36**	4,1900E+20	6,7108E+18	3,282E-13	5,94	**55,03**	**5,50**
E5S4	-35,07	-69,64	1660	14	1	25,96	2,00639E+19	1,893E-12	2,93	**14,64**	**0,43**	1,7688E+20	2,1757E+18	6,316E-13	5,02	**43,04**	**4,30**
E5S5	-35,07	-69,64	1660	14	1	26,69	2,00842E+19	Measurement failure									
E2S1	-35,11	-69,6	1700	14	3	22,37	1,9036E+19	1,232E-12	2,98	**10,45**	**0,31**	1,7426E+20	2,6108E+18	5,631E-13	5,60	**43,86**	**4,39**
E2S2	-35,11	-69,6	1700	15	1	24,88	2,01024E+19	Measurement failure									
E2S3	-35,11	-69,6	1700	17	1	21,98	2,0242E+19	1,181E-12	3,35	**10,88**	**0,36**	3,1368E+20	2,2418E+19	4,149E-13	5,90	**59,21**	**5,92**
E2S4	-35,11	-69,6	1700	15	5	22,64	1,89814E+19	1,187E-12	3,27	**9,95**	**0,33**	1,7917E+20	1,6725E+18	3,912E-13	4,87	**30,96**	**3,10**
E4S1	-35,09	-69,61	1700	14	2	23,12	2,04524E+19	1,489E-12	2,96	**13,17**	**0,39**	1,9546E+20	2,5878E+18	9,055E-13	4,95	**76,55**	**7,66**
E4S2	-35,09	-69,61	1700	16	1	27,21	1,92667E+19	2,441E-12	2,65	**17,28**	**0,46**	9,0760E+19	1,3008E+18	2,371E-12	2,94	**79,08**	**7,91**
E4S3	-35,09	-69,61	1700	14	1	23,69	1,4963E+19	1,415E-12	3,27	**8,93**	**0,29**	1,4438E+20	1,8472E+18	1,015E-12	4,14	**61,85**	**6,19**
E4S4	-35,09	-69,61	1700	14	1	20,92	1,99708E+19	1,056E-12	2,90	**10,08**	**0,29**	3,7594E+20	1,7503E+19	5,886E-13	5,67	**105,76**	**10,58**
E4S5	-35,09	-69,61	1700	14	1	19,90	2,01954E+19	1,062E-12	2,92	**10,77**	**0,31**	3,4889E+20	5,5928E+18	4,256E-13	5,84	**74,60**	**7,46**
Chemical blank							2,02622E+19	4,201E-15	**1,627E-15**					**7,873E-16**	**5,569E-16**		

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Table S2: Dating Results: description and location of samples S2 (Q5), S4 and S5 (Q4). The dating is based on Terrestrial in situ Cosmogenic Nuclide (TCN) ^{10}Be and ^{26}Al via the Web Cronus Calculator (Balco et al., 2008). The calculations were performed at constant production rate (Lal (1991) / Stone (2000)) assuming an erosion rate of zero. The SMA standard used by the CEREGE is the 07KNSDT (for more details refer to website http://hess.ess.washington.edv/math/al-be-v22/standard-names.html). The Q1/2 are 1.36 Ma and 0.72 Ma for the 10Be and 26Al. sst: sandstone.

Sample name (Site(i)-sample(j))	Alluvial level	Rock type	Latitude (DD)	Longitude (DD)	Elevation (m)	Thickness (cm)	Shielding correction	[^{10}Be] (10^5 atoms.g^{-1})	[^{26}Al] (10^5 atoms.g^{-1})	R ([^{26}Al]/[^{10}Be])	^{10}Be exposure ages						^{26}Al exposure ages					
											Constant prod rate		Variable prod				Constant prod rate		Variable prod			
											Lal (1991) and Stone (2000)		Desilets *et al.* (2003, 2006)	Dunai (2001)	Lifton *et al.* (2005)	Lal (1991) and Stone (2000)	Lal (1991) and Stone (2000)		Desilets *et al.* (2003, 2006)	Dunai (2001)	Lifton *et al.* (2005)	Lal (1991) and Stone (2000)
											Exposure age (kyr)	Production rate (spallation) (atoms/g/yr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Production rate (spallation) (atoms/g/yr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)
S2-s1		sst	-35,11	-69,6	1700	14	1	10.49 +/- 0.31	43.86 +/- 4.39	*4,18*	79,11 +/- 7,41	13,21	75,25 +/- 9,33	73,11 +/- 9,02	72,39 +/- 6,567	72,16 +/- 7.55	50,05 +/- 6,80	89,13	46,95 +/- 7,43	45,67 +/- 7,20	45,18 +/- 6,49	45,17 +/- 6,04
S2-s3	Q5	sst	-35,11	-69,6	1700	17	1	10.89 +/- 0.36	59.21 +/- 5.92	*5,44*	83,78 +/- 7,97	12,95	79,75 +/- 9,97	77,38 +/- 9,63	76,65 +/- 8,13	76,39 +/- 7,06	69,55 +/- 6,98	87,37	66,28 +/- 18,60	64,50 +/- 8,32	63,89 +/- 7,09	63,66 +/- 6,22
S2-s4		sst	-35,11	-69,6	1700	15	1	9.95 +/- 0.33	30.96 +/- 3.10	*3,11*	75,48 +/- 7,14	13,12	71,81 +/- 8,95	69,75 +/- 8,65	69,08 +/- 7,30	68,87 +/- 6,34	35,30 +/- 4,76	88,54	34,47+/- 5,42	33,47 +/- 5,25	33,42 +/- 4,77	33,16 +/- 4,41
S4-s1		sst	-35,09	-69,61	1700	14	1	13.17 +/- 0.39	76.55 +/- 7.66	*5,81*	99,95 +/- 9,41	13,2	94,90 +/- 11,82	92,25 +/- 11,43	91,50 +/- 9,64	91,14 +/- 8,33	89,07 +/- 10,48	89,08	84,76 +/- 12,20	82,23 +/- 11,78	81,47 +/- 10,34	81,15 +/- 9,35
S4-s2		sst	-35,09	-69,61	1700	16	1	17.28 +/- 0.46	79.08 +/- 7.91	*4,58*	134,00 +/- 12,58	13,03	123,79 +/- 15,43	120,51 +/- 14,95	119,06 +/- 12,52	119,24 +/- 10,86	93,41 +/- 8,71	87,91	88,93 +/- 11,11	86,25 +/- 10,71	85,46 +/- 8,96	85,10 +/- 7,68
S4-s3	Q4	sst	-35,09	-69,61	1700	14	1	89.36 +/- 0.29	61.85 +/- 6.18	*6,92*	67,26 +/- 6,35	13,2	64,24 +/- 7,99	62,52 +/- 7,74	61,91 +/- 6,53	61,68 +/- 5,66	71,34 +/- 7,95	89,08	67,90 +/- 9,40	66,05+/- 9,10	65,42 +/- 7,92	65,20 +/- 7,10
S4-s4		sst	-35,09	-69,61	1700	14	1	10.08 +/- 0.29	105.6 +/- 10.58	*10,49*	76,03 +/- 7,10	13,2	72,34 +/- 8,95	70,24 +/- 8,64	69,56 +/- 7,27	69,35 +/- 6,29	125,22 +/- 12,03	89,08	116,16 +/- 14,82	113,05 +/- 14,34	111,78 +/- 11,10	111,81 +/- 10,37
S4-s5		sst	-35,09	-69,61	1700	14	1	10.77 +/- 0.31	74.60 +/- 7.46	*6,93*	81,36 +/- 7,61	13,2	77,40 +/- 9,59	75,14 +/- 9,26	74,44 +/- 7,80	74,20 +/- 6,74	86,70 +/- 8,51	89,08	82,52 +/- 10,60	80,02 +/- 10,22	79,26 +/- 8,65	78,96 +/- 7,52
S5-s1		sst	-35,07	-69,64	1660	10	1	13.08 +/- 0.40	86.25 +/- 8.63	*6,6*	99,41 +/- 9,38	13,18	94,67 +/- 11,82	92,00 +/- 11,41	91,28 +/- 9,63	90,71 +/- 8,31	101,14 +/- 10,54	88,91	96,10 +/- 12,82	93,40 +/- 12,39	92,67 +/- 10,62	92,11 +/- 9,34
S5-s2	Q4	sst	-35,07	-69,64	1660	15	1	10.08 +/- 0.29	65.20 +/- 6.52	*6,47*	78,75 +/- 7,36	12,75	75,11 +/- 9,29	66,37 +/- 8,98	72,27 +/- 7,56	71,86 +/- 6,52	78,13 +/- 7,65	85,99	74,49 +/- 9,54	72,32 +/- 9,21	71,62 +/- 7,80	71,22 +/- 6,77
S5-s3		sst	-35,07	-69,64	1660	13	1	9.28 +/- 0.36	55.03 +/- 5.50	*5,93*	71,49 +/- 6,94	12,92	68,22 +/- 8,62	70.50 +/- 8,35	65,77 +/- 7,09	65,41 +/- 6,18	64,66 +/- 7,11	87,14	62,01 +/- 8,50	60,29 +/- 8,23	59,68 +/- 7,14	59,30 +/- 6,37
S5-s4		sst	-35,07	-69,64	1660	14	1	14.64 +/- 0.43	43.04 +/- 4.30	*2,94*	114,65 +/- 10,82	12,83	107,57 +/- 13,43	104,72 +/- 13,01	103,71 +/- 10,95	103,38 +/- 9,47	50,55 +/- 5,24	86,56	47,56 +/- 6,27	46,23 +/- 6,07	45,74 +/- 5,21	45,66 +/- 4,62

Table S3: TCN ages for erosion rates of 1.3 m/Ma obtained by Baker et al. (2009) along the Diamante River. See the tables S1 and S2 for more details on samples and analytical results.

Sample name Site(i)-sample(j))	Alluvial level	Be-10 exposure ages						Al-26 exposure ages					
		Constant prod rate		Variable prod				Constant prod rate		Variable prod			
		Lal (1991) and Stone (2000)		Desilets et al. (2003. 2006)	Dunai (2001)	Lifton et al. (2005)	Lal (1991) and Stone (2000)	Lal (1991) and Stone (2000)		Desilets et al. (2003. 2006)	Dunai (2001)	Lifton et al. (2005)	Lal (1991) and Stone (2000)
		Exposure age (kyr)	Production rate (spallation) (atoms/g/yr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Production rate (spallation) (atoms/g/yr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)	Exposure age (kyr)
S2-s1	Q5	85.24 +/- 8.64	13.21	80.93 +/- 10.81	78.34 +/- 10.39	77.56 +/- 8.74	77.26 +/- 7.55	52.41 +/- 75	89.13	49.20 +/- 8.15	47.69 +/- 7.86	47.15 +/- 7.07	47.15 +/- 6.59
S2-s3		90.70 +/- 9.38	12.95	86.15 +/- 11.67	83.38 +/- 11.21	82.59 +/- 9.46	82.25 +/- 8.21	74.251 +/- 10.92	87.37	70.44 +/- 12.03	68.33 +/- 11.60	67.65 +/- 10.45	67.42 +/- 9.70
S2-s4		81.03 +/- 8.26	13.12	76.88 +/- 10.29	74.51 +/- 9.90	73.78 +/- 8.35	73.52 +/- 7.24	36.44 +/- 5.08	88.54	35.47 +/- 5.76	34.43 +/- 5.57	34.37 +/- 5.06	34.11 +/- 4.68
S4-s1	Q4	110.06 +/- 11.48	13.2	103.00 +/- 14.12	100.03 +/- 13.61	99.10 +/- 11.45	98.85 +/- 9.91	97.04 +/- 14.75	89.08	91.98 +/- 16.20	89.03 +/- 15.57	88.22 +/- 14.03	87.82 +/- 13.00
S4-s2		153.19 +/- 16.66	13.03	140.26 +/- 19.99	135.54 +/- 19.12	133.64 +/- 15.95	133.93 +/- 13.84	102.25 +/- 15.66	87.91	96.48 +/- 17.10	93.56 +/- 16.47	92.75 +/- 14.85	92.36 +/- 13.76
S4-s3		71.61 +/- 7.22	13.2	68.03 +/- 9.01	66.08 +/- 8.69	65.44 +/- 7.33	65.20 +/- 6.36	76.31 +/- 11.26	89.08	72.40 +/- 12.40	70.14 +/- 11.94	69.43 +/- 10.75	69.19 +/- 9.97
S4-s4		81.67 +/- 8.22	13.2	77.48 +/- 10.29	75.07 +/- 9.90	74.34 +/- 8.33	74.07 +/- 7.19	142.07 +/- 23.06	89.08	129.97 +/- 24.19	125.81 +/- 23.21	124.02 +/- 20.78	124.24 +/- 19.40
S4-s5		87.87 +/- 8.92	13.2	83.42 +/- 11.17	80.77 +/- 10.73	79.97 +/- 9.02	79.65 +/- 7.79	94.23 +/- 14.26	89.08	89.39 +/- 15.68	86.50 +/- 15.07	85.66 +/- 13.58	85.27 +/- 12.58
S5-s1	Q4	109.40 +/- 11.43	13.18	102.72 +/- 14.10	99.76 +/- 13.58	98.87 +/- 11.44	98.39 +/- 9.88	111.65 +/- 17.33	88.91	104.54 +/- 18.75	101.44 +/- 18.06	100.47 +/- 16.27	100.01 +/- 15.07
S5-s2		84.82 +/- 8.57	12.75	80.76 +/- 10.77	78.16 +/- 10.35	77.41 +/- 8.70	76.93 +/- 7.50	84.14 +/- 12.55	85.99	80.06 +/- 13.86	77.47 +/- 13.32	76.72 +/- 12.00	76.24 +/- 11.10
S5-s3		76.43 +/- 7.96	12.92	72.76 +/- 9.84	70.50 +/- 9.47	69.81 +/- 8.03	69.41 +/- 6.99	68.69 +/- 10.02	87.14	65.56 +/- 11.12	63.69 +/- 10.74	63.08 +/- 9.68	62.67 +/- 8.95
0S5-s4		128.27 +/- 13.66	12.83	118.57 +/- 16.55	115.14 +/- 15.94	113.77 +/- 13.36	113.55 +/- 11.57	52.96 +/- 7.56	86.56	49.91 +/- 8.28	48.34 +/- 7.98	47.80 +/- 7.18	47.68 +/- 6.67