A.S Carr et al “*An optical luminescence chronology for late Pleistocene aeolian activity in the Colombian and Venezuelan Llanos,*” - **Supplementary data**.

Llanos_colombian_sites_figureS4.tif

**Figure S1**: Pan-sharpened Landsat 8 RGB image of the Colombian Llanos Orientales sampling locations

Supplementary stratigraphy compiled_1.tif

**Figure S2**: Stratigraphies of the sampled sites

**LL11_8_cuervas_strat_revised with ages.tif**

**Figure S2** continued

figure S1.tif

**Figure S3**: Two sets of example EDXA data for sands from LL11/4/1. The peaks from positions 1 and 4 are dominated by Si, Al, and Fe.



**Figure S4** – Additional results of dose recovery preheat experiments for samples LL12/1/3, LL11/5/1 and S1A1. The measured equivalent dose is plotted against preheat 1 temperature (preheat prior to measurement of the natural or regenerated luminescence intensity). All data were measured using a 160 °C, zero second preheat 2 (preheat prior to measurement of the test dose luminescence intensity). The administered dose is indicated in the label and the mean recovered/given ratio for all aliquots is plotted as the horizontal line

**Llanos_LL11_7_LL08_1.tif**

**Figure S5**: Juxtaposed dunes of distinctly different ages (LL11/7 – 12.9 ± 0.7 ka and LL08/1 – 48.2 ± 2.8 ka) at the confluence of the Río Meta and the Caño la Hermosa. The dunes show up as light green. A complex set of abandoned river channels north of LL08/1 suggest that migration of the Caño la Hermosa (presently west of LL11/7) may account for the fragmentary remains of an older dune in this instance (Landsat 8 pan-sharpened image).

**Table S1**: Details of the luminescence dating dosimetry. What contents were estimated as 8 ± 5% except **\*** where saturated (37 ± 5 %) water content used. **#**Active dune sampled at 1.0 m depth ~determined via XRF

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Depth (m)** | **K (%)** | **U (ppm)** | **Th (ppm)** | **Beta dose rate**  **(Gy ka -1)** | **Gamma dose rate**  **(Gy ka -1)** | **Cosmic dose (Gy ka -1)** | **Total dose rate**  **(Gy ka -1)** | **De (Gy)** | **Age (ka)** |
| LL11/1/2 | 0.5 | 0.07 | 1.27 | 2.62 | 0.246 ± 0.020 | 0.312 ± 0.021 | 0.201 ± 0.020 | 0.76 ± 0.04 | 4.01 ± 0.25 | 5.3 ± 0.4 |
| LL11/1/1 | 0.8 | 0.05 | 1.39 | 3.47 | 0.203 ± 0.018 | 0.256 ± 0.021 | 0.178 ± 0.012 | 0.64 ± 0.03 | 10.3 ± 0.41 | 16.2 ± 1.0 |
| LL11/2/1 | 0.65 | 0.04 | 1.31 | 2.65 | 0.205 ± 0.018 | 0.261 ± 0.021 | 0.185 ± 0.015 | 0.65 ± 0.03 | 3.29 ± 0.20 | 5.1 ± 0.4 |
| LL11/2/2 | 1.0 | 0.05 | 1.22 | 2.99 | 0.206 ± 0.017 | 0.268 ± 0.022 | 0.173 ± 0.004 | 0.65 ± 0.03 | 6.85 ± 0.34 | 10.4 ± 0.7 |
| LL11/2/3 | 1.65 | 0.06 | 1.30 | 3.64 | 0.235 ± 0.019 | 0.308 ± 0.025 | 0.161 ± 0.005 | 0.70 ± 0.03 | 10.4 ± 0.50 | 14.8 ± 1.0 |
| LL11/3/1 | 0.6 | 0.06 | 0.88 | 3.14 | 0.180 ± 0.014 | 0.242 ± 0.020 | 0.189 ± 0.015 | 0.61 ± 0.03 | 2.77 ± 0.19 | 4.5 ± 0.4 |
| LL11/3/2 | 1.2 | 0.07 | 0.84 | 2.99 | 0.181 ± 0.014 | 0.233 ± 0.019 | 0.169 ± 0.004 | 0.58 ± 0.02 | 3.69 ± 0.28 | 6.3 ± 0.5 |
| LL11/4/1 | 1.0 | 0.04 | 0.69 | 1.87 | 0.181 ± 0.015 | 0.244 ± 0.020 | 0.173 ± 0.005 | 0.60 ± 0.03 | 7.81 ± 0.46 | 13.0 ± 1.0 |
| LL11/4/2 | 1.8 | 0.07 | 1.21 | 2.85 | 0.218 ± 0.018 | 0.275 ± 0.022 | 0.157 ± 0.004 | 0.65 ± 0.03 | 10.0 ± 0.36 | 15.5 ± 0.9 |
| LL12/1/1 | 1 | 0.05 | 0.74 | 2.30 | 0.146 ± 0.011 | 0.188 ± 0.015 | 0.177 ± 0.005 | 0.51 ± 0.02 | 8.31 ± 0.42 | 16.2 ± 1.0 |
| LL12/1/2 | 2 | 0.03 | 0.75 | 2.00 | 0.129 ± 0.011 | 0.172 ± 0.014 | 0.155 ± 0.008 | 0.46 ± 0.02 | 9.37 ± 0.43 | 20.6 ± 1.3 |
| LL12/1/3 | 3 | 0.05 | 0.84 | 2.30 | 0.156 ± 0.013 | 0.198 ± 0.016 | 0.136 ± 0.003 | 0.49 ± 0.02 | 8.97 ± 0.63 | 18.3 ± 1.5 |
| LL12/1/4 | 4 | 0.04 | 0.74 | 2.00 | 0.134 ± 0.011 | 0.173 ± 0.014 | 0.120 ± 0.006 | 0.43 ± 0.02 | 10.0 ± 0.39 | 23.4 ± 1.4 |
| LL12/1/5 | 5 | 0.07 | 1.19 | 4.11 | 0.235 ± 0.019 | 0.318 ± 0.026 | 0.106 ± 0.005 | 0.66 ± 0.03 | 14.3 ± 0.76 | 21.6 ± 1.6 |
| LL12/1/6 | 6 | 0.10 | 1.38 | 4.82 | 0.284 ± 0.022 | 0.375 ± 0.031 | 0.094 ± 0.005 | 0.75 ± 0.04 | 19.5 ± 0.85 | 25.9 ± 1.7 |
| LL11/5/2 | 1 | 0.07 | 1.22 | 2.85 | 0.215 ± 0.018 | 0.266 ± 0.021 | 0.175 ± 0.005 | 0.66 ± 0.03 | 8.29 ± 0.49 | 12.6 ± 0.9 |
| LL11/5/1 | 2 | 0.06 | 0.69 | 1.87 | 0.140 ± 0.011 | 0.167 ± 0.013 | 0.154 ± 0.004 | 0.46 ± 0.02 | 10.1 ± 0.43 | 21.8 ± 1.2 |
| LL12/2/2 | 2 | 0.07 | 1.03 | 3.10 | 0.201 ± 0.016 | 0.258 ± 0.021 | 0.154 ± 0.008 | 0.61 ± 0.03 | 10.4 ± 0.49 | 16.9 ± 1.1 |
| LL12/2/3 | 3 | 0.06 | 0.98 | 2.84 | 0.187 ± 0.015 | 0.239 ± 0.019 | 0.136 ± 0.007 | 0.56 ± 0.03 | 11.2 ± 0.47 | 20.0 ± 1.2 |
| LL12/2/4 | 4 | 0.12 | 1.18 | 3.09 | 0.245 ± 0.019 | 0.284 ± 0.022 | 0.120 ± 0.006 | 0.65 ± 0.03 | 12.8 ± 0.61 | 19.8 ± 1.3 |
| LL12/2/5 | 5 | 0.08 | 0.84 | 2.69 | 0.182 ± 0.014 | 0.223 ± 0.018 | 0.106 ± 0.005 | 0.51 ± 0.02 | 9.71 ± 0.60 | 19.0 ± 1.4 |
| LL12/2/6**\*** | 6 | 0.10 | 4.57 | 12.4 | 0.562 ± 0.047 | 0.801 ± 0.064 | 0.094 ± 0.005 | 1.46 ± 0.08 | 30.7 ± 1.19 | 21.1 ± 1.4 |
| LL11/6/1 | 0.65 | 0.13 | 1.32 | 3.21 | 0.267 ± 0.022 | 0.305 ± 0.024 | 0.186 ± 0.014 | 0.76 ± 0.03 | 7.98 ± 0.55 | 10.5 ± 0.9 |
| LL11/6/2 | 1.2 | 0.17 | 1.38 | 5.27 | 0.336 ± 0.025 | 0.411 ± 0.033 | 0.169 ± 0.004 | 0.92 ± 0.04 | 21.6 ± 1.11 | 23.6 ± 1.6 |
| LL11/6/3 | 1.75 | 0.16 | 0.99 | 4.07 | 0.271 ±0.020 | 0.317 ± 0.025 | 0.157 ± 0.004 | 0.75 ± 0.03 | 24.3 ± 0.98 | 32.6 ± 1.9 |
| LL11/7/1 | 0.75 | 0.16 | 1.23 | 4.09 | 0.297 ± 0.022 | 0.345 ± 0.027 | 0.179 ± 0.013 | 0.82 ± 0.04 | 10.6 ± 0.37 | 12.9 ± 0.7 |
| LL11/8/1 | 0.5 | 0.07 | 1.14 | 3.47 | 0.222 ± 0.018 | 0.286 ± 0.023 | 0.196 ± 0.018 | 0.70 ± 0.03 | 3.93 ± 0.26 | 5.6 ± 0.5 |
| LL11/8/2 | 1.3 | 0.11 | 1.11 | 3.39 | 0.241 ± 0.018 | 0.288 ± 0.023 | 0.166 ± 0.005 | 0.70 ± 0.03 | 6.95 ± 0.29 | 10.0 ± 0.6 |
| LL08/1/1 | 1.0 | 0.15 | 0.88 | 2.56 | 0.227 ± 0.017 | 0.237 ± 0.018 | 0.173 ± 0.004 | 0.64 ± 0.03 | 30.7 ± 1.32 | 48.2 ± 2.8 |
| LL08/1/2 | 2.0 | 0.14 | 0.68 | 2.06 | 0.190 ± 0.015 | 0.192 ± 0.014 | 0.152 ± 0.004 | 0.53 ± 0.02 | 35.0 ± 1.77 | 65.6 ± 4.2 |
| S2 B1 | 1.0 | 0.06 | 0.52 | 2.70 | 0.134 ± 0.010 | 0.184 ± 0.016 | 0.176 ± 0.009 | 0.49 ± 0.02 | 5.23 ± 0.20 | 10.6 ± 0.6 |
| S2 A1 | 2.0 | 0.07 | 0.60 | 1.79 | 0.136 ± 0.010 | 0.157 ± 0.012 | 0.154 ± 0.008 | 0.45 ± 0.02 | 6.99 ± 0.26 | 15.6 ± 0.8 |
| S3 B1 | 1.0 | 0.08 | 0.89 | 1.89 | 0.171 ± 0.014 | 0.192 ± 0.015 | 0.176 ± 0.009 | 0.54 ±0.02 | 5.23 ± 0.19 | 9.7 ± 0.5 |
| S3 A1**\*** | 2.0 | 0.04 | 0.51 | 1.51 | 0.077 ± 0.006 | 0.098 ± 0.008 | 0.154 ± 0.008 | 0.33 ± 0.01 | 5.10 ± 0.19 | 15.5 ± 0.8 |
| S1A1**#** | 1.0 | nd | nd | nd | nd | nd | nd | nd | 0.2 ± 0.1 | nd |

**Table S2**: Particle size data

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Depth (m)** | **% coarse Sand** | **% medium Sand** | **% fine sand** | **% silt** | **% clay** | **Median (φ)** | **Mean (φ)** | **Sorting (φ)** | **Skewness** | **Kurtosis** |
| **LL11/1** | 0.3 | 3 | 33 | 50 | 14 | 0 | 2.3 | 2.6 | 1.2 | -0.4 | 1.4 |
|  | 0.6 | 2 | 28 | 53 | 17 | 0 | 2.4 | 2.7 | 1.3 | -0.5 | 1.3 |
|  | 1.2 | 2 | 26 | 51 | 21 | 0 | 2.5 | 2.9 | 1.4 | -0.5 | 1.0 |
|  | 1.5 | 3 | 30 | 51 | 17 | 0 | 2.3 | 2.7 | 1.3 | -0.5 | 1.2 |
|  | 1.9 | 2 | 26 | 53 | 19 | 0 | 2.4 | 2.8 | 1.3 | -0.5 | 1.1 |
| **LL11/2** | 0.4 | 6 | 44 | 38 | 13 | 0 | 2.0 | 2.3 | 1.3 | -0.5 | 1.7 |
|  | 0.8 | 5 | 41 | 38 | 15 | 0 | 2.1 | 2.4 | 1.4 | -0.5 | 1.5 |
|  | 1.2 | 7 | 37 | 34 | 22 | 1 | 2.2 | 2.7 | 1.7 | -0.5 | 1.1 |
|  | 1.7 | 11 | 43 | 23 | 22 | 1 | 1.9 | 2.6 | 1.8 | -0.6 | 1.0 |
|  | 1.9 | 9 | 42 | 27 | 20 | 1 | 2.0 | 2.6 | 1.7 | -0.6 | 1.1 |
|  | 2.1 | 9 | 41 | 31 | 19 | 1 | 2.0 | 2.6 | 1.7 | -0.5 | 1.2 |
| **LL11/3** | 0.6 | 8 | 49 | 36 | 7 | 0 | 1.9 | 2.0 | 1.0 | -0.3 | 1.7 |
|  | 1.2 | 32 | 62 | 6 | 1 | 0 | 1.2 | 1.2 | 0.5 | 0.0 | 1.1 |
|  | 1.8 | 49 | 49 | 2 | 0 | 0 | 1.0 | 1.0 | 0.5 | 0.0 | 1.1 |
|  | 2.3 | 5 | 52 | 42 | 0 | 0 | 1.9 | 1.9 | 0.6 | 0.0 | 1.1 |
| **LL11/4** | 0.8 | 3 | 40 | 52 | 4 | 1 | 2.1 | 2.2 | 0.8 | -0.2 | 1.3 |
|  | 1.2 | 2 | 35 | 58 | 5 | 0 | 2.2 | 2.3 | 0.8 | -0.2 | 1.2 |
|  | 1.8 (lamella) | 3 | 33 | 52 | 10 | 2 | 2.3 | 2.4 | 1.3 | -0.4 | 2.1 |
| **LL11/5** | 0.4 | 2 | 32 | 58 | 8 | 0 | 2.3 | 2.4 | 1.0 | -0.4 | 1.7 |
|  | 0.7 | 2 | 26 | 60 | 11 | 1 | 2.4 | 2.6 | 1.2 | -0.4 | 1.7 |
|  | 1.2 | 6 | 42 | 36 | 15 | 2 | 2.0 | 2.5 | 1.5 | -0.5 | 1.8 |
|  | 1.6 | 4 | 47 | 41 | 7 | 1 | 2.0 | 2.1 | 1.0 | -0.4 | 2.1 |
|  | 2 | 4 | 54 | 40 | 1 | 0 | 1.9 | 1.9 | 0.5 | 0.0 | 1.1 |
| **LL11/6** | 0.3 | 2 | 26 | 62 | 10 | 0 | 2.4 | 2.6 | 1.0 | -0.3 | 1.3 |
|  | 0.8 | 2 | 25 | 51 | 21 | 1 | 2.6 | 2.9 | 1.5 | -0.5 | 1.2 |
|  | 1.1 | 3 | 31 | 48 | 17 | 1 | 2.4 | 2.7 | 1.5 | -0.5 | 1.4 |
|  | 1.65 | 1 | 24 | 63 | 10 | 2 | 2.4 | 2.5 | 1.2 | -0.4 | 2.3 |
| **LL11/7** | 0.3 | 1 | 25 | 53 | 20 | 0 | 2.5 | 2.9 | 1.4 | -0.5 | 1.2 |
|  | 0.8 | 2 | 28 | 51 | 19 | 0 | 2.4 | 2.8 | 1.4 | -0.5 | 1.3 |
| **LL11/8** | 0.3 | 7 | 37 | 40 | 16 | 1 | 2.2 | 2.5 | 1.5 | -0.5 | 1.4 |
|  | 0.7 | 6 | 33 | 35 | 25 | 1 | 2.4 | 2.9 | 1.8 | -0.5 | 1.0 |
|  | 1.2 | 7 | 36 | 30 | 25 | 1 | 2.2 | 2.8 | 1.8 | -0.5 | 0.9 |
|  | 1.7 | 6 | 34 | 33 | 27 | 1 | 2.3 | 2.9 | 1.8 | -0.5 | 0.9 |
| **Rivers** | Río Meta | 4.8 | 58.7 | 35.6 | 0.8 | 0.0 | 1.8 | 1.9 | 0.6 | -0.2 | 1.3 |
|  | Caño La Hermosa | 2.7 | 34.0 | 61.6 | 1.7 | 0.0 | 2.2 | 2.3 | 0.7 | -0.1 | 1.1 |
|  | Río Yatea | 11.1 | 62.2 | 26.5 | 0.2 | 0.0 | 1.7 | 1.7 | 0.6 | -0.1 | 1.1 |
|  | Río Yatea | 17.7 | 55.8 | 25.2 | 1.3 | 0.0 | 1.6 | 1.6 | 0.7 | 0.0 | 1.1 |
|  | Río Guachiria | 2.6 | 33.8 | 59.7 | 3.9 | 0.0 | 2.2 | 2.3 | 0.7 | -0.2 | 1.2 |

**Table S3**: XRF and chemical index of alteration (CIA) results for two Llanos dunes compared to sand samples (n=7 and n = 3) from the Orinoco River in the eastern and western parts of the Venezuelan Llanos (from Johnsson et al. 1991).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **SiO2 (%)** | **TiO2 (%)** | **Al2O3 (%)** | **Fe2O3 (%)** | **MnO (%)** | **MgO (%)** | **CaO (%)** | **Na2O (%)** | **K2O (%)** | **CIA** |
| **LL12/1/1** | 97.6 | 0.08 | 0.88 | 1.05 | 0.008 | <0.004 | 0.01 | 0.01 | 0.061 | **92.0** |
| **LL12/1/3** | 97.9 | 0.06 | 0.74 | 0.99 | 0.010 | <0.003 | 0.00 | 0.01 | 0.059 | **91.6** |
| **Western Llanos** | 98.7 | 0.05 | 0.33 | 0.38 | 0.01 | <0.001 | 0.03 | 0.01 | 0.05 | **78.6** |
| **Eastern Llanos** | 98.6 | 0.06 | 0.33 | 0.17 | 0.01 | 0 | 0.04 | 0 | 0.1 | **70.2** |

**Table S4**: Site names, sampling codes and coordinates

|  |  |  |  |
| --- | --- | --- | --- |
| **Site name** | **Field code** | **Latitude (DD)** | **Longitude (DD)** |
| La Hermosa | LL08/1 | 5.5409 | -70.4427 |
| Finca Diamante | LL11/1 | 5.1331 | -71.3171 |
| Finca el Danubia | LL11/2 | 5.3638 | -70.8594 |
| Finca El Clavo (1) | LL11/3 | 5.3631 | -71.0303 |
| Finca El Clavo (2) | LL11/4 | 5.3500 | -71.0010 |
| Finca El Clavo (3) | LL11/5 | 5.3546 | -71.0256 |
| Finca Palestina | LL11/6 | 5.6127 | -70.5932 |
| Finca La Hermosa | LL11/7 | 5.5361 | -70.4545 |
| Cuervas Wells Gaitan | LL11/8 | 5.5966 | -70.8284 |
| Finca El Clavo (2) | LL12/1 | 5.3500 | -71.0010 |
| Finca El Clavo (3) | LL12/2 | 5.3546 | -71.0256 |
| Hato la Fe | S2 | 8.5033 | -67.5916 |
| Masaguaral | S3 | 8.5700 | -67.5844 |
| Río Verde | S1 (active dune) | 7.0953 | -67.6358 |
| Caño La Hermosa | - | 5.6174 | -70.5619 |
| Río Yatea | - | 5.3019 | -70.8719 |
| Río Meta | - | 5.5288 | -70.4207 |
| Río Guachiria | - | 5.4561 | -71.0602 |