# SUPPLEMETARY MATERIAL

for the paper:

## Evidence for quaternary seismic activity of the La Alberca-Teremendo fault, Morelia region, Trans-Mexican Volcanic Belt

by:

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Supplementary Table 1. Main tectonic structures with regional influence in the study area. The total length of the regional faults are measured on the sinuous scarp and include the visible trace on surface and the inferred sub-surface trace.

| **Name** | **Total length** (km) | **Direction** | **Throw** (m) | | **Type of displacement** |
|---|---|---|---|---|---|
| | | | Min | Max | |
| La Cañada | 9.047 | WSW – ENE | 10 | 60 | Dip slip |
| Lobato | 8.049 | WSW – ENE | 10 | 28 | Dip slip |
| Tecacho – Pantoja | 4.434 | WSW – ENE | 5 | 30 | Dip slip |
| El Malpaso – El Salto | 25 | WSW – ENE | 4 | 70 | Dip slip – Left lateral |
| Puruátiro | 12.059 | WSW – ENE | 5 | 50 | Dip slip |
| El Caracol | 4.3 | WSW – ENE | 2 | 20 | Dip slip |
| La Alberca – Teremendo | 26.176 | WSW – ENE | 1.4 | 50 | Dip slip – Left lateral |
| Cayihuanatin | 8.034 | SW – NE | 10 | 76 | Dip slip |
| *Alignments* | | | | | |
| Alignment 21 | 2.253 | SW – NE | --- | --- | Alignment |
| El Tzirate | 16.723 | SSW – NNE | --- | --- | Alignment |

Supplementary Table 2. Classification of normal faults exposed in trench T1, according to the displacement generated on the phreatomagmatic sequence of the La Alberca de Guadalupe maar.

| **Categories** | **Percentaje of phreatomagmatic sequence affected** | **Vertical displacement** (cm) | **Horizontal Opening** (cm) |
|---|---|---|---|
| First order | 100%<br>Reach the surface | 20 – 70 | 5 – 65 |
| Second order | 90%<br>Do not reach the surface | 7 – 20 | 0 |
| Third order | <90% >30% | 4 – 7 | 0 |
| Fourth order | <30% | <4 | 0 |

Supplementary Table 3. Physicochemical properties of the soils exposed in T2 trench. Data results were obtained at the Laboratorio de Edafología of the Universidad Michoacana de San Nicolás de Hidalgo and the Laboratorio de Suelos of Centro de Investigaciones en Geografía Ambiental, Universidad Nacional Autónoma de México.

| **Parameter** | | **Surface soil** | | | | **Buried soil** | |
|---|---|---|---|---|---|---|---|
| | | A1p layer | A2p layer | Btss layer | Css layer | 2C1ss layer | 2C2ss layer |
| Depth (cm) | | 0 – 4 | 4 – 16 | 16 - 50 | 50 – 80 | 80 – 112 | 112 – 124 |
| Ph | $H_2O$ | 7.2 | 7.3 | 7.3 | 7.8 | 7.9 | 8.1 |
| | KCl | 6.3 | 6.3 | 5.8 | 6.1 | 6.3 | 6.4 |
| | NaF+phe | Positive for the presence of non-crystalline components | | | | | |
| Humidity (%) | | 7.0 | 14.5 | 15.4 | 13.3 | 14.6 | 17.5 |
| Organic matter (%) | | 10.3 | 6.9 | 4.5 | 2.4 | 4.8 | 5.5 |
| Organic carbon (%) | | 6 | 4 | 2.6 | 1.4 | 2.8 | 3.2 |
| COLE | | 0.07 | 0.12 | 0.20 | 0.14 | 0.17 | 0.12 |
| Soil separates (%) | Sand | 27.2 | 28.4 | 9.2 | 8.8 | 9.4 | 10.2 |
| | Silt | 44.4 | 41.3 | 38.0 | 41.2 | 39.8 | 33.4 |
| | Clay | 28.4 | 30.4 | 52.8 | 50.0 | 50.8 | 56.4 |
| Textural classification | | Clay loam | Clay loam | Clay | Silty clay | Silty clay | Clay |
| Exchangeable basic cations (cmol (+) / kg) | $K^+$ | 0.83 | 0.31 | 0.34 | 0.33 | 0.31 | 0.37 |
| | $Na^+$ | 0.11 | 0.15 | 0.73 | 0.83 | 0.89 | 1.03 |
| | $Ca^{+2}$ | 19.14 | 20.10 | 15.42 | 13.19 | 14.43 | 15.08 |
| | $Mg^{+2}$ | 6.85 | 7.44 | 10.52 | 9.41 | 10.57 | 9.56 |
| | SUM | 26.93 | 27.99 | 27.00 | 23.77 | 26.20 | 26.03 |
| CEC (cmol (+) / kg) | | 31.20 | 31.30 | 30.51 | 26.70 | 26.80 | 26.50 |
| Base saturation (%) | | 86.32 | 89.44 | 88.48 | 89.02 | 97.77 | 98.82 |
| Phosphate retention (%) | | 38 | 39 | 33 | 30 | Undetermined | |
| AlO (%) | | 0.9 | 0.9 | 0.9 | 1.0 | Undetermined | |
| FeO (%) | | 1.8 | 1.8 | 1.6 | 2.0 | Undetermined | |
| SiO (%) | | 0.78 | 0.71 | 0.54 | 0.71 | Undetermined | |
| Alpy (%) | | 0.2 | 0.3 | 1.1 | 1.0 | Undetermined | |
| AlO + ½FeO (%) | | 2 | 2 | 2 | 2 | Undetermined | |
| Alpy/Alox (%) | | 0.23 | 0.30 | 1.15 | 0.98 | Undetermined | |

NaF+phe = pH measured in NaF and phenolphthalein. COLE = coefficient of linear extensibility (Simon *et al*., 1987). SUM = Addition of all exchangeable basic cations. CEC = cation exchange capacity; AlO, FeO, SiO = acid oxalate-extractable aluminum, iron and silicon; Alpy = pyrophosphate-extractable aluminum; AlO+½FeO = Oxalate index; Alpy/Alox = Andic properties index.

Supplementary Table 4. Empirical relations used to assess the potential magnitude ($M_w$ and $M_s$) for a displacement event of a given fault, input parameters and particularities. These selection corresponds to the more suitable relations for the characteristics of the study area.

| **Author** | **Relation** | **Parameters** |
|---|---|---|
| Wells and Coppersmith (1994) | $M_w$ = 6.94 + 1.14log ($VD_{aver}$) | $VD_{aver}$ (average vertical displacement in m) |
| | $M_w$ = 5.08 + 1.16 * log (SRL) | SRL (Surface Rupture Length in km) |
| | *Specifications:* used for normal faults, constant stress drop (30 bar). | |
| Hanks and Kanamori (1979) | $M_w$ = log ( (μ (4/3 LRS) $WD_{prom}$) – 16.05) / 1.5 | μ (Crust rigidity) |
| | | W (Width of the fault plane) |
| | | $D_{aver}$ (average vertical displacement) |
| | *Specifications:* used for earthquakes worldwide. | |
| Anderson *et al*., (1996) | $M_w$ = 5.2 (±0.12) + 1.16 (±0.07) * log(LRS) – 0.20 (±0.04) * logS | SRL in km |
| | | S (slip rate in mm/year) |
| | *Specifications:* for a given value of SRL, faults with minor slip rates are associated to bigger magnitudes than faults with higher slip rates. The data base combine information from interplate and intraplate earthquakes. | |
| Stirling *et al*., (2002) | $M_w$ = 5.88 (±0.17) + 0.80 (±0.1) * log (SRL) | SRL in km |
| | SPECIFICATIONS: applies to surface ruptures with >5 km lengths. | |
| Wesnousky (2008) | $M_w$ = 6.12 + 0.47 * log (SLR) | SRL in km |
| | *Specifications:* used for normal faults in landscapes with >10km-thick crusts | |
| Mohammadioun and Serva (2001) | $M_s$ = 2 * Log L + 1.33 * log Δσ + 1.66 | L (fault length in km) |
| | | Δσ (stress drop in bar) |
| | *Specifications:* the stress drop varies for crustal earthquakes (> 30 bar), according to the depth of the rupture, increasing with depth (> 15 km). Events with higher stress drops have comparatively smaller rupture surfaces for a given magnitude. This could be invalid for events M <5. | |