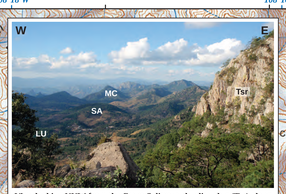
Geologic map of the Cerocahui-Guazapares region, northern Sierra Madre Occidental, Chihuahua, Mexico (Supplemental Figure S1)

This figure accompanies Murray, B.P., Busby, C.J., Haines, W.E., and Andrews, G.D.M., 2025, Revised timing of Oligocene magmatism and extensional basin development in the Cerocahui-Guazapares region of the northern Sierra Madre Occidental silicic large igneous province, Chihuahua, México, in Riggs, N., Pavlis, K., and Wakabayashi, J., eds., *The Virtue of Fieldwork in Volcanology, Sedimentology, Structural Geology, and Tectonics—Celebrating the Career of Cathy Busby*: Geological Society of America Special Paper 563, p. 323–347, https://doi.org/10.1130/2025.2563(14).



View looking NNW from the Cerro Salitrera rhyolite plug (Tsr) along the main mineralized structure of Guazapares fault zone, showing the primary resource areas of the Guazapares Mining District described in detail by Murray and Busby (2015). Main resource areas include La Unión (LU) San Antonio (SA) and Monte Cristo (MC).

Very large-scale cross-bedded rhyolitic ignimbrite (Txsi) located near Cerro Salitrera, with person (outlined) standing on set boundary. The orientation of cross-stratification is emphasized by black dashed lines. Dark colored band to left of person (arrow) is a lithic-rich layer with ~50% volcanic lithic fragments; lighter colored bands contain ~10%–20% lithic fragments (from Murray et al., 2013).

LEGEND

Lithostratigraphic correlation chart

Qa — Quaternary alluvium

unconformity

Sierra Guazapares Group

- Tsrw — high-silica rhyolite intrusion
- Tsv — silicic volcaniclastic & fluvial/lacustrine deposits
- Tsr — rhyolite lava
- Tsp — rhyolite intrusion
- Tsrb — silicic brecciated intrusion
- Tsb — basalt lavas
- Ts — Sierra Guazapares Group (undiff.)

unconformity

Témoris Formation

- Tti — rhyolite ignimbrite
- Tsi — rewarked tuff
- Tv — Cerocahui
- Tvc — El Volcán
- Tvc — Cerro Colorado
- Tvr — El Rodeo
- Tvcl — Cerocahui clastic unit
- Tvi — ignimbrites
- Tv — andesitic volcanic center
- Tsa — andesitic intrusion
- Tta — andesite lava
- Ttb — debris flow deposits: andesitic volcanic fragments
- Tty — ingnyim ignimbrite
- Tss — fluvial sandstone: intermediate/silicic volcanic fragments (includes basal sediments)
- Tsa — andesite lapilli-tuff
- Tlsa — fluvial sandstone: intermediate volcanic fragments
- Ttb — basaltic trachy-andesite lava
- Ttda — debris flow deposits: andesitic volcanic fragments
- Tba — basalt to andesite lava
- Tbt — talus & debris flow deposits
- Tti — silicic tuff
- Ttd — debris flow deposits: welded ignimbrite fragments
- Tt — Témoris Formation (undiff.)

unconformity

Parajes Group

- Tpr — Traza ignimbrite
- Tpk — KM ignimbrite
- Tpr — Rancho de Santiago ignimbrite
- Tpb — Puerto Blanco ignimbrite
- Tpe — Portero ignimbrite
- Tpe — Encinachi ignimbrite
- Tpch — unnamed ignimbrites
- Tpch — unnamed ignimbrites
- Tpc — Chepe ignimbrite
- Tph — fluvial deposits: sandstone, conglomerate, & reworked tuff
- Tp — Parajes Group (undiff.)

Contacts & Faults

- Contact
- Contact - Approximately located
- Contact - Inferred from aerial photography
- Fault
- Fault - Approximately located
- Fault - Inferred from aerial photography
- Fault - Concealed
- Normal fault - tick mark on hanging wall

Symbols

- Strike and dip of inclined bedding
- Approximate strike and dip of inclined bedding
- Strike and dip of inclined foliation and flow banding in igneous rock
- Strike and dip of inclined compaction foliation in ash-flow tuff
- Estimated strike and dip of inclined bedding
- Estimated strike and dip of inclined foliation in ash-flow tuff
- Horizontal bedding
- Horizontal compaction foliation in ash-flow tuff
- Strike of vertical foliation and flow banding in igneous rock
- fault dip direction
- Trend and plunge of slip lineation on fault surface
- Zone of heavy alteration
- $^{40}Ar/^{39}Ar$ sample (this study)
- U-Pb ICP-MS sample (Murray et al., 2013; 2014)
- Geochemistry sample (this study; Murray et al., 2013)

1:25,000

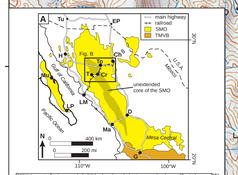
0 0.5 1 2 3

Kilometers

Contour interval = 20 m

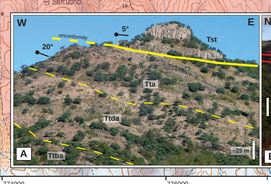
Map datum: WGS84 UTM zone 12N

Mapped by B.P. Murray & C.J. Busby, June-Dec 2008; March 2010

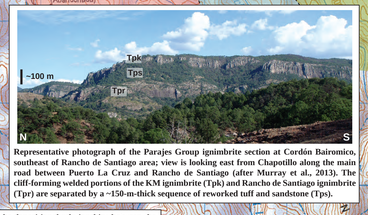


(A) Generalized map of northwestern México showing the extent of the Sierra Madre Occidental (SMO) silicic large igneous province, the location of the relatively unextended core (horizontal lines), and the main highways and railways that transect the region (after Henry and Aranda-Gómez, 2000; Ferrari et al., 2002; Bryan and Ferrari, 2013; Ferrari et al., 2018b). Localities: Ch—Chihuahua; Cr—Creel; D—Durango; EP—El Paso; G—Guadalajara; H—Hermosillo; LM—Los Mochis; LP—La Paz; Ma—Mazatlán; Mu—Mulegé; T—Témoris; TMVB—Trans-Mexican Volcanic Belt; To—Tomochic; Tu—Tucson.

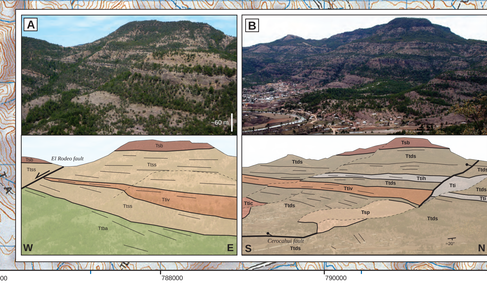
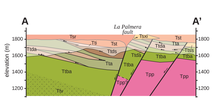
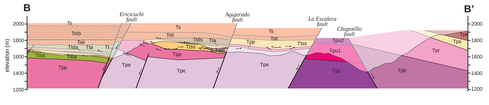
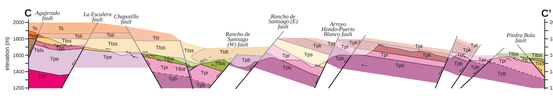
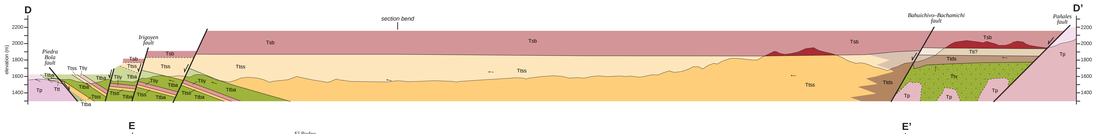
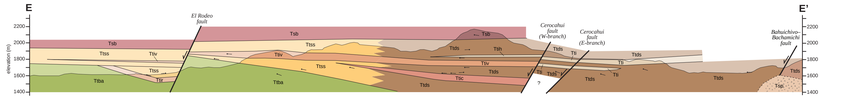
(B) Map of the Chihuahua-Témoris region, showing the location of normal faults (gray lines) and confirmed or inferred calderas (dashed black lines) identified in the northern SMO (after Ferrari et al., 2007 and references therein; Ferrari et al., 2018b). Location of the Cerocahui-Guazapares region (this map; Fig. DR1) is shown by the black box. Calderas: CC—Copper Canyon; CM—Caldera Majalca; E—El Comanche; LV—Las Varas; M—Manzanita; O—Ocampo; To—Tomochic; SJ—San Juanito; SP—Sierra Pastoria.



Interpreted photographs of the depositional relationships between the Témoris Formation and the Sierra Guazapares Group in the Puerto La Cruz area (from Murray et al., 2013): (A) Angular unconformity between gently dipping (~5° NE) massive and stratified rhyolite ignimbrites of the Sierra Guazapares Group (Tst) and the underlying moderately dipping (~20° E) lavas (Ttba, Tta) and debris flow deposits (Ttda) of the Témoris Formation. View is north toward Cerro Cuadro Blanco from Puerto La Cruz. (B) View northeast from C. Batopilas toward the silicic plug (Tsi) that intrudes the La Palmera fault, which is the source for the silicic lava (Tsl) that flowed to the northwest over silicic ignimbrites of the Sierra Guazapares Group (Tst) and the tilted rocks of the Témoris Formation (Tt). The dip of flow banding (thin red lines) in the lava increases in proximity to the plug, where the flow banding is subvertical.



Representative photograph of the Parajes Group ignimbrite section at Cordón Bairomico, southeast of Rancho de Santiago area; view is looking east from Chapotillo along the main road between Puerto La Cruz and Rancho de Santiago (after Murray et al., 2013). The cliff-forming welded portions of the KM ignimbrite (Tpk) and Rancho de Santiago ignimbrite (Tpr) are separated by a ~150-m-thick sequence of reworked tuff and sandstone (Tps).



Overview photographs and geologic interpretations of growth strata in the Cerocahui basin (modified from Murray et al., 2014): (A) View of the outcrops adjacent to the El Rodeo fault in the south-central section of the Cerocahui basin, looking NNW from Cerro El Volcán. The dip of the units change from ~20° E in the lowermost Témoris Formation mafic-intermediate lavas (Ttba), through 10° to 5° within the Cerocahui clastic unit (Ttss), to ~0° in the capping Sierra Guazapares Group basalt lavas (Tsb), and the thicknesses of the Cerocahui clastic unit and El Volcán ignimbrite (Ttiv) also increase eastward, indicating syndepositional extension of the eastern fault-bounded margin of the Cerocahui basin. (B) View of the southeastern Cerocahui basin (looking west from 27.29390° N, 108.03736° W), showing moderately E-dipping (to ~15° NE) Cerro Colorado ignimbrite (Ttic) and Cerocahui clastic unit (Ttds) below gently N-dipping to sub-horizontal Cerocahui clastic unit, El Volcán ignimbrite (Ttiv), Cerocahui ignimbrite (Ttih), and undifferentiated silicic ignimbrites (Tti). Basalt lavas (Tsb) of the Sierra Guazapares Group are conformably deposited over the Cerocahui clastic unit. The N-trending Cerocahui fault (tick marks on hanging wall) downdrops the Cerocahui clastic unit to the west, with a silicic hypabyssal intrusion (Tsp) emplaced along the fault and crosscutting it.