

**The Grenville Orogeny in West Texas: Structure, Kinematics, Metamorphism  
and Depositional Environment of the Carrizo Mountain Group**

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Mapping of the 1.38-1.29 Ga metasedimentary and metaigneous Carrizo Mountain Group (CMG) in west Texas shows that predominant CMG protoliths, including a 1.38-1.32 Ga volcanoclastic section, were quartzofeldspathic clastic arenites and pyroclastic rhyolites that suggest deposition in a divergent-margin setting. The age, petrology and isotopic signature of the rhyolites allow correlation with the Southern Granite-Rhyolite Terrane, implying a period of extension, not subduction, in southern Laurentia at 1.38-1.32 Ga.

The structural analysis and metamorphic petrology of the CMG presented herein focuses on Grenville tectonism. The structural/metamorphic domains

defined for the CMG are the Southeast Domain (SED), encompassing exposures in the Wylie and Van Horn Mountains; and from SSE to NNW in the Carrizo Mountains, the Bass Canyon Domain (BCD), Central Carrizos Domain (CCD), and Northwest Carrizos Domain (NWCD). Polyphase Grenville deformation under medium-P metamorphism propagated northwestward from the SED. The SED was at epidote-amphibolite-facies or higher temperatures from  $D_1$  through  $D_3$  or  $D_4$ ; SED deformational phases correlate through at least  $D_3$ . Further NW, dextral transpression with average NW tectonic transport dominated early CCD deformation. Upright-to-northwest-verging  $D_{1\text{CCD}}$  folding at greenschist-facies conditions probably initiated due to orthogonal convergence, but then became more oblique, causing oblique dextral ductile shearing. This shearing and folding continued at peak temperatures of *ca.* 520° C (Grt-Bt thermometry) during  $D_2$ , which tightened km-scale  $F_{1\text{CCD}}$  folds, possibly overturned them to the NW, and produced predominantly outcrop-scale  $F_{2\text{CCD}}$  folds.  $D_1$  and  $D_{2\text{CCD}}$  correlate with  $F_2$  or  $F_3$  folding in the SED. Extensive top-to-the-NNW mylonitic shearing, under Bt-grade conditions, may have started synchronously in the NWCD. NWCD shear zones propagated forward (NW), accommodating several km of shortening

and eventually lifting the higher-grade domains to the same relative elevation as the NWCD. West-verging  $F_3$  and coaxial  $F_4$  folding in the BCD, and  $F_3$  folding in the NWCD, were correlative with  $F_3$  or  $F_{4\text{SED}}$ . These phases were consistent with continued dextral shear.  $^{40}\text{Ar}/^{39}\text{Ar}$  dating indicates a *ca.* 1060 Ma metamorphic peak, and 996-978 Ma thrusting/uplift. Brittle thrusting in the NWCD may have continued into the fold-thrust event that emplaced the CMG over sedimentary rocks in the foreland.