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 volcaniclastic 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\textsubscript{1} through D\textsubscript{3} or D\textsubscript{4}; SED deformational phases correlate through at least D\textsubscript{3}. Further NW, dextral transpression with average NW tectonic transport dominated early CCD deformation. Upright-to-northwest-verging D\textsubscript{1}\textsubscript{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\textsubscript{2}, which tightened km-scale F\textsubscript{1}\textsubscript{CCD} folds, possibly overturned them to the NW, and produced predominantly outcrop-scale F\textsubscript{2}\textsubscript{CCD} folds. D\textsubscript{1} and D\textsubscript{2}\textsubscript{CCD} correlate with F\textsubscript{2} or F\textsubscript{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.