

Structure of the Carrizo Mountain Group, southeastern Carrizo Mountains, west Texas:

A transpressional zone of the Grenville orogen

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Received 9 July 2001; revised 9 August 2002; accepted 16 September 2002; published 7 February 2003.

[1] The west Texas segment of the Grenville orogen includes an oblique, dextral, transpressive zone. The orogen exposed near Van Horn, Texas, displays a transition from the mid-amphibolite-facies metamorphic core to a foreland fold and thrust belt. In this paper, detailed structural mapping and analyses, presented for key exposures of the metamorphic rocks, the Mesoproterozoic Carrizo Mountain Group, show a southeastward increase in number of deformational phases and intensity of deformation. The central portion is dominated by oblique northwest convergence, which produced two phases of northwest verging folds and synchronous, oblique reverse and dextral shearing. The thick parts of pre-tectonic mafic plutons, which had been emplaced as locally discordant sills, control the spatial distribution of structures. Two dominant phases of folds form Type 0 interference patterns (essentially coaxial and coplanar; i.e., fold tightening was dominant). This central belt also contains an echelon reverse to oblique shear zones and comprises a transfer zone within the orogen between structurally higher and lower major shear zones. Overall, the mapped part of the central Carrizo Mountains represents localized dextral transpression within a larger region dominated by reverse motion, possibly indicating a change through time from orthogonal to oblique contraction. Further south in the Bass Canyon region, the earlier fold generations are refolded into Type 2 ("mushroom") interference patterns. These structures show a westward vergence and are kinematically linked to those further north across a zone of disharmonic folding and heterogeneous shear. The structure and kinematics of the polyphase deformation and ductile shearing in the metamorphic portion of the orogen is compatible with that seen in the foreland fold-thrust belt, suggesting that in both foreland and hinterland, transpression was a characteristic feature of the west Texas Grenville orogeny. The timing and

kinematics of deformation in the Van Horn exposures contrasts with that seen in the Llano uplift, but compares favorably with those of the Natal belt, South Africa, a relationship with implications for recently proposed reconstructions of Rodinia. *INDEX TERMS:* 8102 Tectonophysics: Continental contractional orogenic belts; 8159 Tectonophysics: Evolution of the Earth: Rheology—crust and lithosphere; 8005 Structural Geology: Folds and folding; 9619 Information Related to Geologic Time: Precambrian; *KEYWORDS:* Grenville, Texas, transpression, Precambrian, Carrizo, Van Horn. *Citation:* Grimes, S. W., and S. Mosher, Structure of the Carrizo Mountain Group, southeastern Carrizo Mountains, west Texas: A transpressional zone of the Grenville orogen, *Tectonics*, 22(1), 1003, doi:10.1029/2001TC001316, 2003.

1. Introduction

[2] Apart from the extensive exposures in Canada and New York State comprising the southeast margin of the Canadian shield, the Grenville orogen in Laurentia is best displayed in two Precambrian uplifts more than 3000 km to the southwest: near Llano in central Texas, and Van Horn in west Texas (Figure 1a). Unlike allochthonous Grenville blocks exposed in the U.S. Appalachians or Chihuahua, Mexico, these two Texas exposures are largely unaffected by Phanerozoic metamorphism, penetrative deformation, or translation. The Llano exposures are deep within the metamorphic core of the orogen, as much as 300 km behind the deformation front (Figure 1a), whereas the west Texas exposures are at the frontal region, where metamorphic rocks have been thrust over foreland sedimentary rocks. Evidence from the Llano uplift of continent-continent, as well as arc-continent, collision during the assembly of Rodinia has led to recent reconstructions, such as *Dalziel et al.* [2000] and *Tohver et al.* [2002], that place a continental block off the southern margin of Laurentia during this time. Understanding the structural evolution and kinematics of the Grenville exposures in west Texas is critical to understanding their relationship to the Grenville Orogeny as a whole, and to evaluating such reconstructions.

[3] Proterozoic rocks near Van Horn are exposed in several horsts produced by Basin and Range faulting (Figure 1a). The Grenville orogen in this area comprises two main elements: the polydeformed, mid-amphibolite- to lower-greenschist-facies metasedimentary and metaigneous rocks of the CMG and the deformed sedimentary and volcanic rocks of the Hazel, Allamoore and Tumbledown Formations [*King and Flawn*, 1953; *Muehlberger et al.*,

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