STRUCTURAL ANALYSIS AND DETRITAL ZIRCON PROVENANCE IN THE WESTERN LLANO UPLIFT: IMPLICATIONS FOR A SOUTHERN COLLIDER

by

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Structural and metamorphic analysis, mapping and detrital zircon geochronology was conducted within the Mesoproterozoic Valley Spring Gneiss, in the western Llano Uplift, along an 8 km section of the Llano River west of Castell, TX. Comprising granitic gneisses and pelitic schists, with volcanic, plutonic and supracrustal protoliths, the protolith to the Valley Spring Gneiss was deposited on Laurentia and records an uppermost amphibolite facies, polyphase deformation history consistent with continent-continent collision during the Grenville orogeny.

The Valley Spring Gneiss is characterized by both ortho- and paragneisses. To determine the provenance, three paragneiss samples were analyzed using laser-ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to establish ages for 80 zircons from each sample. All three samples show a major peak at 1200-1350 Ma and a smaller Paleoproterozoic peak. One sample had a small Archean peak. All data are consistent with a Laurentian origin for the sediment, with Mesoproterozoic sediment derived locally. Kalahari and Amazonia, which have been proposed as colliders with Laurentia, are unlikely sediment sources for rocks of the Llano Uplift.

Six phases of synmetamorphic deformation have been documented. The mineral assemblage, including K-feldspar and sillimanite, indicates conditions above the second sillimanite isograd. Evidence for supersolidus conditions throughout deformation are widespread. Three types of leucosomes, indicative of partial melting, are parallel to early foliations. Pegmatites and granitic dikes are associated with late-stage folds and ductile shear zones; they increase in abundance eastward. The earliest deformation is characterized by two generations of isoclinal folds and penetrative metamorphic foliations, S 1 and S 2, which together form the dominant, northwest-striking, northeast- dipping metamorphic layering. The third phase, F 3, is characterized by tight folds that fold the S 1/S 2 foliation with an associated axial planar foliation. The F 3 fold axes plunge moderately to the southeast; axial planes are dominantly northwest-striking. Open, late generation folds (F 4 and F 5) refold earlier structures on both outcrop and map scales. F 4 and F 5 folds are northeast-plunging with northeast- to east-striking axial planes and southeast-plunging with northwest- striking axial planes, respectively. Late boudinage and shear zones containing melt are associated with an extensional D 6 phase of deformation. Granite and pegmatite

intrusions are both syn- and post-tectonic as indicated by the presence or absence of the S 1/S 2 foliation, folding and boudinage.

The sequence, style and orientation of the structures in this area correlate with those within the Packsaddle Schist and the Lost Creek Gneiss of the western Uplift. Orientations, structural stacking and definition of domain boundaries differ between the eastern and western portions of the Uplift, supporting the likelihood that deformation in the eastern Uplift was controlled by collision of the exotic arc terrane present there, whereas the western Uplift, where the island arc is absent, directly records deep-seated effects of a continent-continent collision.