



ELSEVIER

Precambrian Research 85 (1997) 53–79

Precambrian  
Research

## Petrogenesis of Mid-Proterozoic granitic magmas: examples from central and west Texas

Diane R. Smith <sup>a,\*</sup>, Calvin Barnes <sup>b</sup>, William Shannon <sup>b,1</sup>, Robert Roback <sup>c,2</sup>,  
Eric James <sup>c</sup>

<sup>a</sup> Department of Geosciences, Trinity University, 715 Stadium Drive, San Antonio, TX 78212-7260, USA

<sup>b</sup> Department of Geosciences, Box 41053, Texas Tech University, Lubbock, TX, 79409-1053, USA

<sup>c</sup> Department of Geological Sciences, The University of Texas at Austin, Austin, TX, 78712-1101, USA

Received 11 February 1997; accepted 13 June 1997

### Abstract

Circa 1.1 Ga granitic magmatism in Texas was manifested as two compositional groups: (1) the 1.12 Ga Red Bluff granitic suite in west Texas; and (2) 1.12–1.07 Ga granites of the Llano uplift of central Texas. Both suites share some characteristics typical of ‘anorogenic’ granites (e.g. potassium- and iron-rich bulk compositions, Fe-rich hydrous silicates, emplacement conditions involving low oxygen fugacities and water contents) and exhibit similar isotopic characteristics. However, rock associations, mineral chemistries, and trace element compositions of the two suites are distinct and no single petrogenetic model for the two suites is possible.

The Red Bluff granitic suite includes cogenetic syenites, quartz syenites and granites; transitional ferrobasaltic dikes are also present. In contrast, syenitic and mafic rocks are not associated with the Llano granites. The Llano granites contain biotite and calcic amphibole with lower Fe/(Fe+Mg) ratios compared to those occurring in the Red Bluff rocks. Alkali amphiboles (e.g. arfvedsonite) occur in the Red Bluff granites but not in the Llano granites. The Red Bluff granitoids are characterized by high FeO<sup>T</sup>/MgO ratios, high (Na<sub>2</sub>O+K<sub>2</sub>O), high concentrations of HFSE and rare earth elements (REE), and other features typical of A-type, ‘within-plate’ granites [e.g. the Pikes Peak batholith (PPB)]. The Llano granites are geochemically distinct with generally higher P<sub>2</sub>O<sub>5</sub> and Sr, lower Na<sub>2</sub>O, FeO<sup>T</sup>/MgO, Zr, Y and REE, and much lower Ta and Nb. Nd isotopic data overlap between the two granite suites and have ‘juvenile’ signatures. However, trace element data suggest different petrogeneses for the two suites. The Red Bluff suite is interpreted as having a direct derivation from mantle sources via extended fractional crystallization of basaltic parental magmas, with minor crustal assimilation. The Llano granites appear to represent anatexic melts derived from slightly older, juvenile crustal sources; some melts underwent fractional crystallization controlled by feldspar and accessory minerals.

The petrology and geochemistry of ~1.1 Ga granites in Texas indicate that they should not be considered as part of a single ‘anorogenic’ magmatic event. The Red Bluff granitic suite was emplaced into a shelf sequence, north of the Grenville Front, within a broad zone characterized by mild extension. In contrast, Llano granites are late-stage

\* Corresponding author. Fax: 00 1 210 736 8264; e-mail: dsmith@trinity.edu

<sup>1</sup> Present address: 9180 Coors Road NW, Apt. 3606, Albuquerque, NM 87120, U.S.A.

<sup>2</sup> Present address: Mailstop J-514, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, USA.

intrusions emplaced into multiply deformed and metamorphosed crust, south of the Grenville Front, during or after waning stages of Grenville orogenesis. © 1997 Elsevier Science B.V.

*Keywords:* Geochemistry; Granite; Proterozoic; Texas

---