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U–Pb detrital zircon data of the Rio Fuerte Formation (NW Mexico): Its peri-Gondwanan provenance and exotic nature in relation to southwestern North America

Ricardo Vega-Granillo [a,*], Sergio Salgado-Souto [b], Saúl Herrera-Urbina [a], Víctor Valencia [c], Joaquín Ruiz [c], Diana Meza-Figueroa [a], Oscar Talavera-Mendoza [d]

[a] Departamento de Geología, Universidad de Sonora, Rosales y Encinas S/N, Hermosillo, Sonora 83000, Mexico
[b] Geociencias, Centro de Estudios Superiores del Estado de Sonora, Hermosillo, Sonora 83140, Mexico
[c] Department of Geosciences, The University of Arizona, Tucson, AZ 85721, United States
[d] Unidad Académica de Ciencias de la Tierra, Universidad Autónoma de Guerrero, A.P. 197, Taxco, Guerrero 40200, Mexico

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ABSTRACT

U–Pb detrital zircon studies in the Rio Fuerte Group, NW Mexico, establish its depositional tectonic setting and its exotic nature in relation to the North American craton. Two metasedimentary samples of the Rio Fuerte Formation yield major age clusters at 453–508 Ma, 547–579 Ma, 726–606 Ma, and sparse quantities of older zircons. The cumulative age plots are quite different from those arising from lower Paleozoic miogeoclinal rocks of southwestern North America and of Cordilleran Paleozoic exotic terranes such as Golconda and Robert Mountains. The relative age-probability plots are similar to some reported from the Mixteco terrane in southern Mexico and from some lower Paleozoic Gondwanan sequences, but they differ from those in the Gondwanan-affinity Oaxaca terrane. Major zircon age clusters indicate deposition in an intraoceanic basin located between a Late Ordovician magmatic arc and either a peri-Gondwanan terrane or northern Gondwanaland. The U–Pb magmatic ages of 151 ± 3 Ma from a granitic pluton and 155 ± 4 Ma from a granitic sill permit a revision of the stratigraphic and tectonic evolution of the Rio Fuerte Group. A regional metamorphism event predating the Late Jurassic magmatism is preliminarily ascribed to the Late Permian amalgamation of Laurentia and Gondwana. The Late Jurassic magmatism, deformation, and regional metamorphism are related to the Nevadan Orogeny.

1. Introduction

In the eastern El Fuerte region, northern Sinaloa, Mexico, regional metamorphosed sedimentary and volcanic sequences compose the Rio Fuerte Group (Mullan, 1978). To the west of the El Fuerte region, gneisses with minor schists and amphibolites compose the Francisco Gneiss (Mullan, 1978). The El Fuerte Group and the Francisco Gneiss are grouped either as Sonobari terrane (Campa and Coney, 1983) or as the El Fuerte block (Poole et al., 2005), although these metamorphic units are separated and their geologic relationship is unknown at this time. The Sonobari terrane mostly subcrops under thick Mesozoic and Cenozoic sequences; consequently, its nature, boundaries, age, and units, remain imprecise. The El Fuerte Group underlies the northern Guerrero terrane (Fig. 1; Campa and Coney, 1983), which is a complex of Mesozoic island arcs and interarc basins thrust over older terranes during the Late Cretaceous–Eocene Laramide Orogeny (Talavera-Mendoza and Guerrero-Suástegui, 2000). The El Fuerte region is located south of the Ouachita-Marathon-Sonora orogenic belt, which is made of Paleozoic slope and abyssal sequences (Cortés terrane; Stewart et al., 1990) thrust over mostly coeval platform sequences (Peiffer-Rangin, 1979; Poole et al., 2005) overlying an Early–Middle Proterozoic crystalline basement (Caborca terrane; Campa and Coney, 1983). According to Poole and Madrid (1988), the thrusting of slope and abyssal sequences over platform sequences occurred during Carboniferous and Late Permian times. Paleozoic metamorphic rocks of the El Fuerte region have been regarded as the internal zone of that late Paleozoic orogenic belt (Peiffer-Rangin, 1979) and as tracts of the Gondwana continent that were attached to Laurentia (Poole et al., 2005).

In this work detrital zircon crystals from the older metasedimentary units of the Rio Fuerte Group are studied through U–Pb LA-MC-ICP-MS technique in order to determine its provenance. In addition, U–Pb magmatic zircon analyses of deformed igneous rocks are made to improve the knowledge about the stratigraphy and the sequence of geological events. These data, together with available paleontological data, provide the basis for a tectonic model of this region.

* Corresponding author. Tel.: +52 662 2592110; fax: +52 662 2592111.
E-mail address: rvega@ciencias.uson.mx (R. Vega-Granillo).

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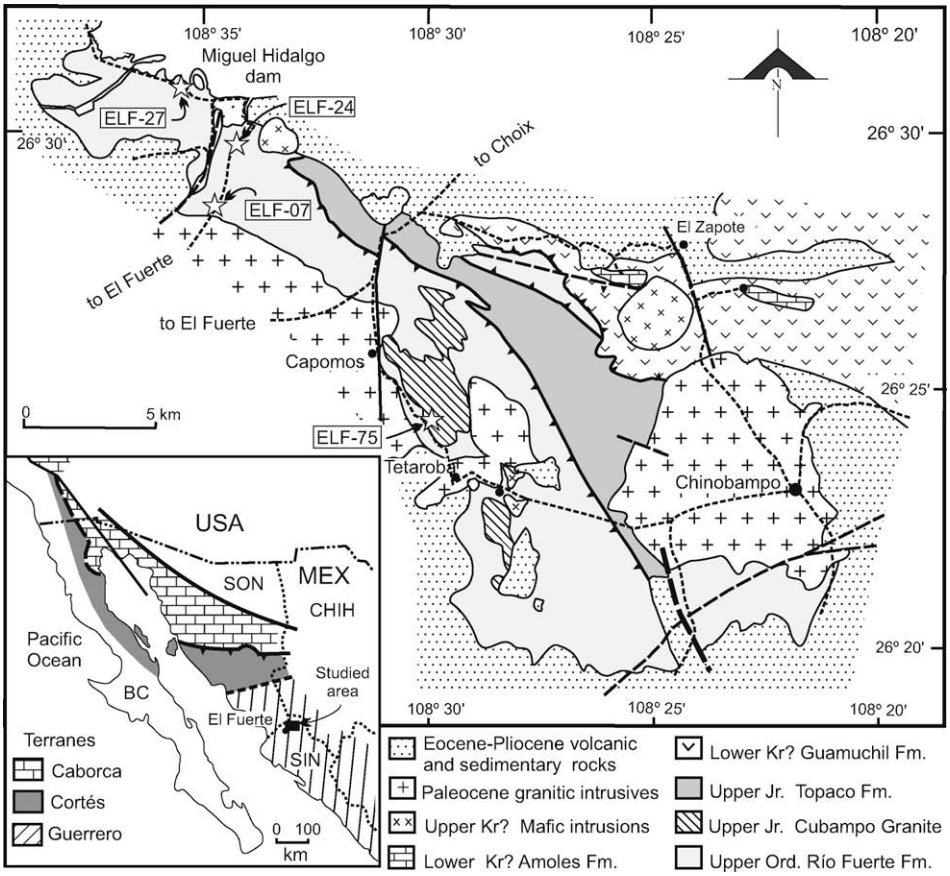

Fig. 1. Geological map of the El Fuerte region (modified from Mullan, 1978). Insert: Map of the main terranes of northwestern Mexico (adapted from Poole et al., 2005). BC: Baja California; CHIH: Chihuahua; SIN: Sinaloa; SON: Sonora.

2. Geological setting

A NW-trending belt of metasedimentary and metavolcanic rocks, surpassing 5000-m thick, crops out (Fig. 1) in northern Sinaloa, northwestern Mexico, where it is known as the Rio Fuerte Group (Mullan, 1978). This group includes the Rio Fuerte, Corral Falso, and Topaco formations (Mullan, 1978). The Rio Fuerte Formation consists of thin-bedded chert, quartzite, argillite, and a few carbonate rocks. A thin turbiditic, marbleized limestone bed in this formation yielded Mid–Late Ordovician conodonts (Poole et al., 2005). The undated Corral Falso Formation is made of finely laminated graphitic slates, phyllites and quartzites mostly indistinguishable from the Rio Fuerte Formation (Poole et al., 2005). The undated Topaco Formation consists of metasedimentary rocks at the base, which are overlain by a thick sequence of metavolcanic rocks. Mullan (1978) regards the Topaco Formation as laterally transitional with the Corral Falso Formation. Mullan (1978) separated the Rio Fuerte Formation from the overlying Corral Falso Formation based on a conspicuous rhyolite flow, less than 2 m thick, named the Nodular Rhyolite member. Mullan (1978) regards the Nodular Rhyolite also separating the upper and lower members of the Topaco Formation. The rhyolite layer borders with the metasedimentary and metavolcanic layers are straight and sharp. A summary of the previously described stratigraphy is in Fig. 2A. The meta-agglomerates forming the upper member of the Topaco Formation have clasts both of the metasedimentary rocks and the nodular rhyolite. For that reason, the contact between the Río Fuerte and the Topaco formations is considered as an angular discordance. The actual position of the Rio Fuerte Formation over the Topaco Formation and the parallelism of the foliation in both units indicate the contact is a thrust fault.

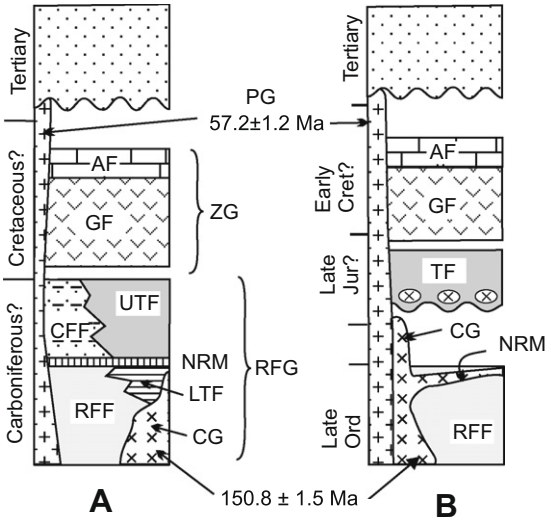

Fig. 2. Stratigraphic columns proposed by (A) Mullan (1978); (B) this article. AF: Los Amoles Formation; CFF: Corral Falso Formation; CG: Cubampo Granite; GF: Guamuchil Formation; LTF: lower member Topaco Formation; NRM: Nodular Rhyolite member; PG: Paleocene granite; RFF: Rio Fuerte Formation; RFG: Rio Fuerte Group; TF: Topaco Formation; UTF: upper member Topaco Formation; ZG: El Zapote Group.