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GR letter

Fast sediment underplating and essentially coeval juvenile magmatism in the Ordovician margin of Gondwana, Western Sierras Pampeanas, Argentina

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ABSTRACT

Metasedimentary high-pressure upper amphibolite facies gneisses (1.2 ± 0.1 GPa and 780 ± 45 °C) at Las Chacras, Sierra de Valle Fértil, are tectonically juxtaposed to the westernmost parts (outboard) of the Famatinian (Early Ordovician) magmatic arc, which underwent syn-plutonic middle crust high-grade metamorphism at lower pressure. U–Pb SHRIMP zircon data suggest that the gneisses contain Famatinian igneous detritus, so that their sedimentary protoliths were probably deposited in a forearc basin and then rapidly underthrust and accreted to the lower crust of the arc, essentially coevally with arc magmatism at 468 ± 4 Ma. Chemically and isotopically juvenile garnetiferous amphibolites within the gneisses are recognised as representing the most primitive magmas so far observed in this belt, which has often been considered to be a continental arc derived from isotopically mature sources. This is consistent with the idea that at least part of the dominant Famatinian magmatism originated in depleted mantle but was heavily contaminated by crustal components.

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1. Introduction

Processes within the lower crust of magmatic arcs along active continental margins are poorly known because this setting is currently inaccessible and is poorly exposed in the geological record. The associated magmatism often exhibits a chemical contribution from the continental crust and in consequence the possible involvement of subduction-related juvenile magmas cannot be confirmed. Two alternative processes may be involved. One is that the crustal component is incorporated into juvenile mantle-wedge derived basalts in the deep crust of the arc or at the crust–mantle transition (e.g., Hildreth and Moorbath, 1988). Subsequent magmatic diversification takes mainly place in the deep lower crust of the arc, resulting in intermediate to acidic magmas that are emplaced in the middle to upper crust or extruded (e.g., Annen et al., 2006). The main alternative involves direct partial melting of less depleted mantle or older crustal protoliths in the deep crust of the arc (e.g., Pankhurst et al., 2000; Chappell and White, 2001). Identifying input of juvenile magmas at the root of the magmatic arc is thus important to the petrogenesis of subduction-related magmatism (e.g., Ram Mohan et al., 2012; Straub and Zellmer, 2012). We show that in the Ordovician Famatinian magmatic arc of western Argentina outboard sediments were buried and accreted to the root of the arc essentially coevally with the magmatic event. They were injected by almost contemporaneous juvenile magmas, thus providing evidence for mantle involvement in the arc magmatism.

2. Geological setting

The Early Ordovician Famatinian arc along western South America (Fig. 1) consists of intermediate to acid, I- and S-type plutons and volcanic rocks (Pankhurst et al., 1998, 2000; Dahlquist et al., 2008; Otamendi et al., 2009, 2012) and has been unanimously related to subduction along the western margin of Gondwana between ca. 495 and 465 Ma (e.g., Chernicoff et al., 2010). The granitoids display a significant crustal isotopic signature (initial $^{87}Sr/^{86}Sr$ mostly > 0.707; εNdt mostly < -4).

The Sierra de Valle Fértil represents the outermost part of the Famatinian arc (Fig. 1). It consists mainly of elongated bodies of gabbro, tonalite, granodiorite and granite (the Valle Fértil plutonic suite, VFPS), largely concordant with foliation of the host rocks. Field relations suggest that gabbros are the oldest intrusive rocks with tonalites and granodiorites being slightly younger. The host rocks are medium pressure upper amphibolite to granulite facies metasedimentary rocks (0.6 ± 0.1 GPa, 800 ± 40 °C; Otamendi et al., 2008), predominantly metapelitic sillimanite–garnet (± cordierite) migmatitic gneisses of middle to late Cambrian age (Casquet et al., 2011; Cristofolini et al.,

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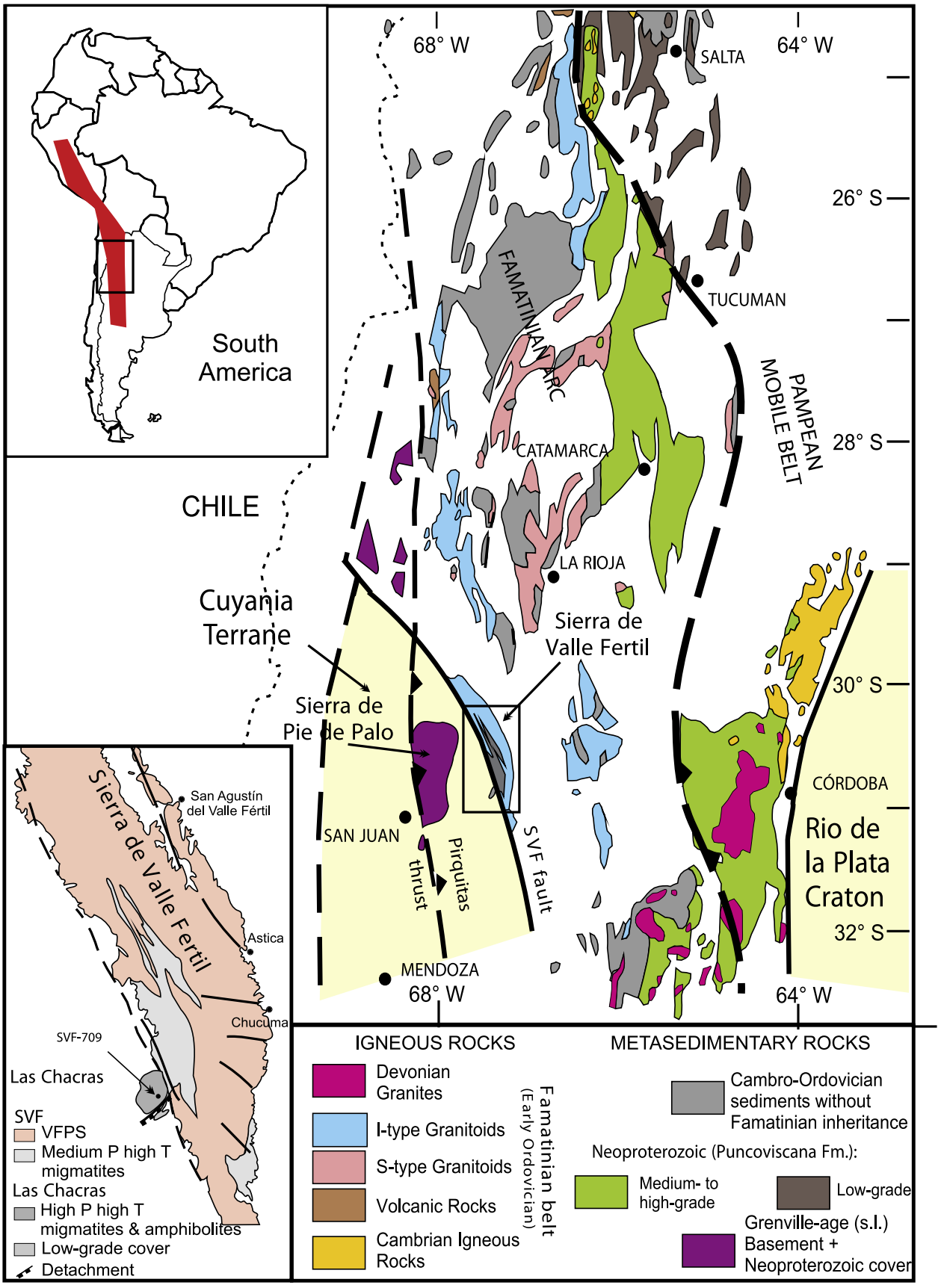

Fig. 1. Geological sketch of the Sierras Pampeanas showing the location of the Sierra de Valle Fértil and the Las Chacras outcrop. Upper inset shows the extent of the Famatinian orogenic belt in western South America. Lower inset shows the Las Chacras outcrop enlarged and the location of sample SVF-709.

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