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The Permian mafic dyke swarm of the Panticosa pluton (Pyrenean Axial Zone, Spain): simultaneous emplacement with the late-Variscan extension

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ABSTRACT

The Panticosa dyke swarm was emplaced into the late Carboniferous (301 ± 7 Ma) Panticosa pluton. It consists of diabase and lamprophyre dykes. According to their composition, two lithotypes are differentiated: (i) an early system of calc-alkaline affinity and N–S average trend and (ii) a late system of alkaline affinity and E–W average trend. The fracture pattern distribution with respect to both dyke systems suggests that all dykes occupied pre-existing fractures. The magnetic fabric analysis and petrological data indicate that the emplacement model differed for each dyke system. For the calc-alkaline dykes, magma flow and tectonic stress conditions influenced emplacement. The emplacement of alkaline dykes, on the other hand, was mainly controlled by tectonic stress. The combined interpretation of structural and magnetic fabric data suggests an emplacement history for all late-Variscan dykes during a constant regional N–S trending extension. This study emphasizes the role of pure extension in the late-Variscan evolution of the Pyrenean Axial Zone.

1. Introduction

The Panticosa pluton is part of the Panticosa-Cauterets granitic complex, located in the westernmost sector of the Pyrenean Axial Zone (Fig. 1A). This plutonic complex includes three different bodies: the West-Cauterets pluton, the East-Cauterets pluton and the Panticosa pluton. The complex is calc-alkaline, aluminous and, according to recent U–Pb datings (Guerrot, C., 1998; Majesté-Menjoulàs et al., 1999; Ternet et al., 2004), late-Carboniferous in age (301 ± 7 Ma). From the structural analysis of the host rocks, the complex was firstly considered syn-tectonic (Mirouse, 1966; Valéro, 1974; Moreau, 1975). Later, Debon (1975) proposed that it was emplaced after the main D_2 phase of Variscan deformation during the Pennsylvanian as the result of progressive forceful intrusions and later collapse of their roof (Valéro, 1974). Finally, on the basis of its magnetic fabric, its emplacement has been considered syn-tectonic with respect to the main D_2 Variscan tectonic phase, within a transpressive regime related to a N–S trending regional compression (Gleizes et al., 1998; Santana, 2001).

The Panticosa pluton displays a network of mafic dykes. They show variable strikes and are intermediate to basic in composition (Debon, 1972, 1980; Galé, 2005) (Fig. 1B). Petrologically, the intermediate dykes have a calc-alkaline affinity whilst the basic dykes are alkaline (Debon, 1972; Galé, 2005). Field structural observations indicate that the alkaline dykes post-date the calc-alkaline ones. Debon and Zimmerman (1993) reported K–Ar ages of 268 ± 7 Ma for the kaersutite megacrysts carried by the alkaline dykes and Rodríguez et al. (2011) obtained a 259.2 ± 3.2 Ma U/Pb SHRIMP-zircon age for an alkaline dyke cross-cutting the Devonian limestones outside of the pluton. Additional U/Pb isotope dates from zircons yield an age of 278 ± 5 Ma (Innocent, 1989) for the calc-alkaline dykes associated to the volcanism of the nearby Pic du Midi d'Ossau (Bixel, 1988).

Within the tectono-magmatic scheme proposed to explain the transition between the Variscan and the Alpine cycles (Bixel, 1988), the calc-alkaline dykes correspond to the third episode, of early Permian age, while alkaline ones are linked to the last (fifth) episode, of Middle Permian age (Lago et al., 2004; Galé, 2005). According to these data, the emplacement of these mafic dykes post-dates the main Variscan compressive phase (D_2 dextral compressive Pennsylvanian event, Zwart, 1979). Nevertheless, other authors (Santana et al., 2006) have postulated that the emplacement of the doleritic dykes in the Panticosa

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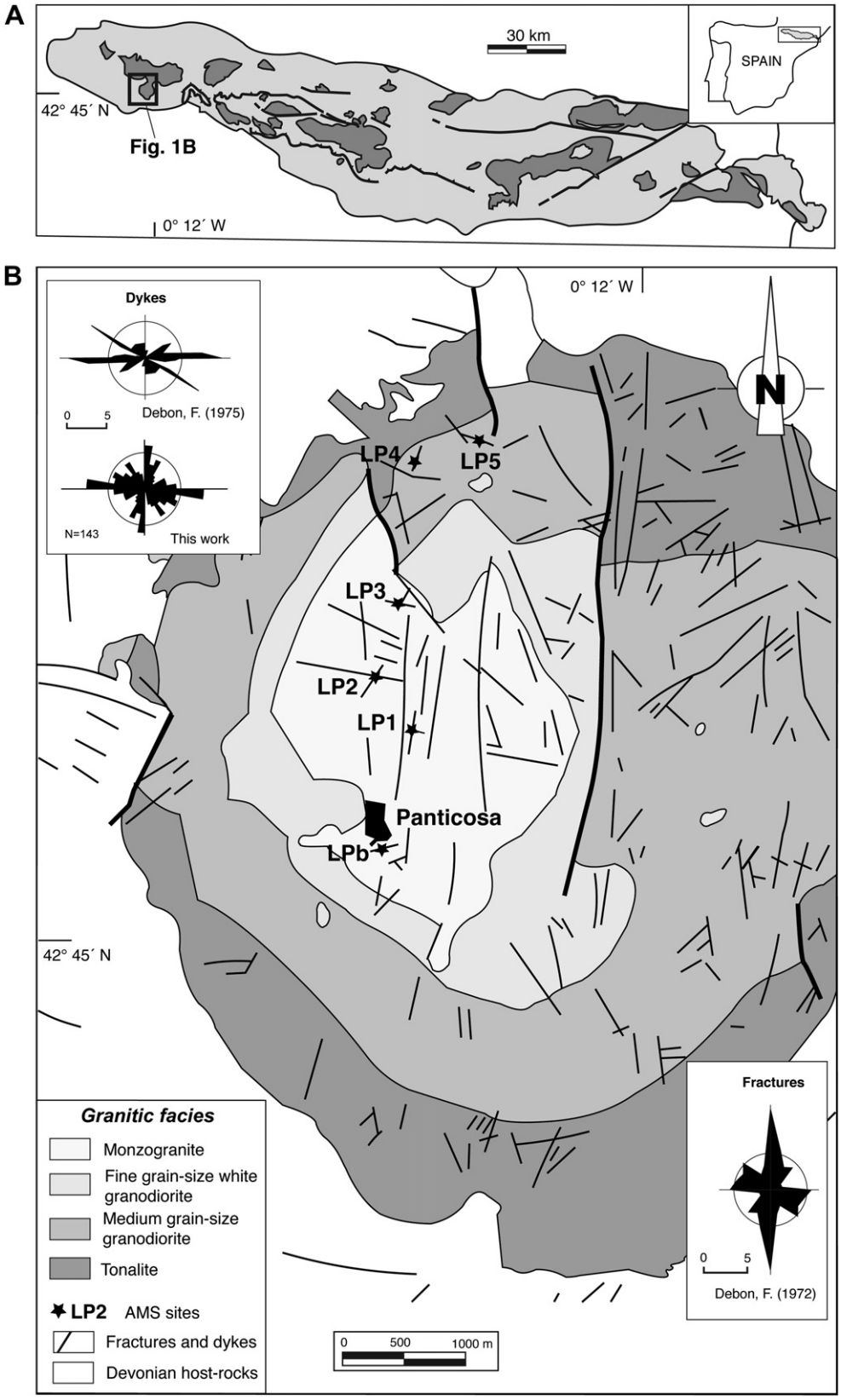

Fig. 1. A) Location of the Panticosa pluton within the Pyrenean Axial Zone. All late-Variscan plutons are represented in dark gray. B) Simplified geological map of the Panticosa pluton (after Galé, 2005). Insets correspond to: 1) rose diagram of dyke strikes after Debon (1975) and after this work, 2) rose diagram of fracture strikes after Debon (1972).