



Malargüe Group (Maastrichtian–Danian) deposits in the Neuquén Andes, Argentina: Implications for the onset of the first Atlantic transgression related to Western Gondwana break-up

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ABSTRACT

The discovery of marine to brackish and fresh-water carbonates in the inner Agrio fold-and-thrust belt at Pichaihue, Neuquén, Argentina, located to the west of the Andean orogenic front, imposes important constraints on the paleogeography of the first Atlantic transgression in the Neuquén Basin related to the break-up of Western Gondwana. The constraints on the timing and areal extent of these deposits shed light on the early uplift history of the southern Andes. These limestones are part of the Maastrichtian–Danian Malargüe Group, which was previously only known from its exposures in the extra-Andean area, representing foreland basin deposits. The presence of stromatolites, oncoids, serpulids, bivalves and gastropods as well as silicified stems of macrophytes indicates a shallow marine, partially brackish environment associated with non-marine deposits. These strata are interfingered with and overlie distal tuffs and proximal pyroclastic flows, whose geochemical characteristics point to a magmatic arc source. SHRIMP U–Pb dating of volcanic zircons of these tuffs yielded an age of 64.3 ± 0.9 Ma that confirms the correlation to the Maastrichtian–Paleocene marine transgression from the Atlantic Ocean. The change in the paleoslope of the basin from Pacific Ocean transgressions to this Atlantic transgression is related to the uplift and deformation of the Agrio fold-and-thrust belt. The Pichaihue Limestone is unconformably deposited on volcanic agglomerates which in turn unconformably overlie Early Cretaceous deposits. Based on these data, it is confirmed that the Cretaceous uplift of the Andes was episodic at these latitudes, with a first pulse in the Cenomanian and a second one in pre-Maastrichtian times. The episodic uplift is also related to an eastward migration of the thrust front and the volcanic arc, related to a previously proposed shallowing of the subduction zone. These episodes were controlled by the Western Gondwana break-up and the beginning of absolute motion of South America toward the west.

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1. Introduction

The break-up of Western Gondwana generated the first Atlantic marine transgression that reached the foothills of the southern Andes in the Late Cretaceous. The western coastline of this marine transgression is poorly constrained in the Andes of Neuquén, Argentina. The age, distribution, and paleogeography of this marine transgression from the Atlantic Ocean, represented by the Maastrichtian–Danian rocks of the Malargüe Group in the Neuquén Basin, are significant because they provide evidence of an important change in

the basin slope related to the uplift of the Andes (Spalletti and Piñol, 2005; Veiga and Spalletti, 2007). Therefore, the discovery of marine deposits of the Malargüe Group in the most western part of the Neuquén retroarc basin, in the inner sector of the Agrio fold-and-thrust belt, sheds light on the timing of deformation and the related kinematic evolution of the fold-and-thrust belt in this part of the Andean range.

The objective of this paper is to report the discovery of rocks of the Malargüe Group in the inner sector of the Neuquén Basin (Fig. 1). The presence of stromatolites, oncoids, serpulids, bivalves, and gastropods, as well as silicified stems of macrophytes, indicates shallow marine, which ranges from normal to brackish, and fresh-water environments. The rather diverse fossil biota is associated with reworked Plinian ash-fall tuffs, one of which has been precisely dated by SHRIMP U–Pb in zircons. This is the first robust absolute age for

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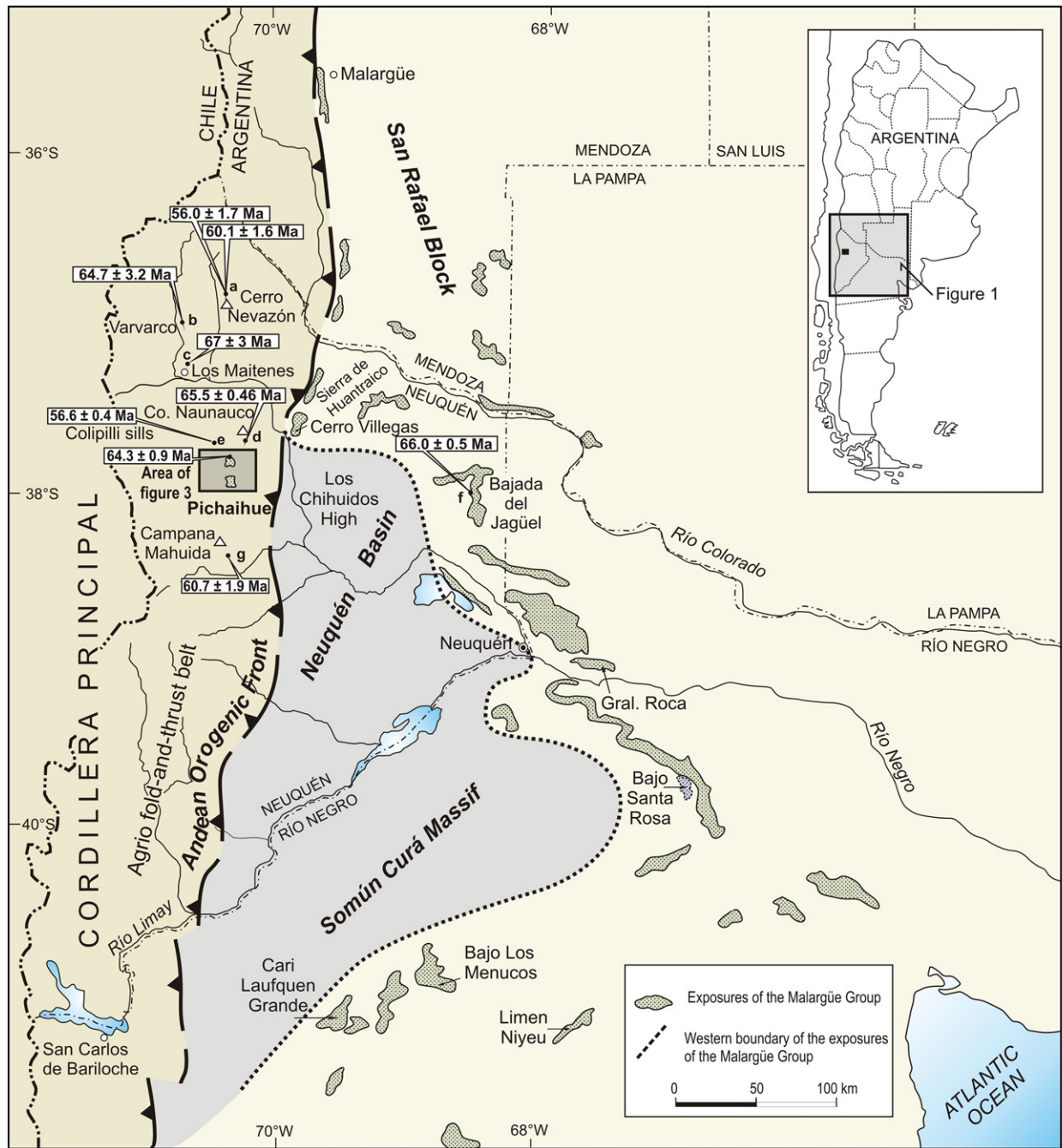


Fig. 1. Outcrops of rocks of the Malargüe Group and the eastern extension of the Maastrichtian–Danian Neuquén Basin with location of the study sections in the Pichaihue area and other localities cited in the text. The exposures of the Pichaihue Limestone are west of the present Andean orogenic front. Note that west of the present exposure boundary, the Malargüe Group was not deposited or eroded away. Available absolute dates are also indicated: a) and g) from Franchini et al. (2003, 2007); b, d, e) from Zamora Valcarce et al. (2006); c) from Domínguez et al. (1984) and f) after Palamarczuk et al. (2002).

that unit in the basin and confirms the Maastrichtian–Danian age given to this sequence on biostratigraphic grounds.

2. Geological framework

The Andean system along the western margin of Gondwana records the development of a series of forearc and retroarc basins of different types, as predicted by the hypothesis of supercontinent break-up advanced by Murphy et al. (2009). One of these basins, the retroarc Neuquén Basin, is located in the eastern foothills of the Andes between 32° and 40°S (Ramos, 1999). It is exposed in the Cordillera Principal as a narrow belt that, south of 36°S, expands towards the eastern foreland forming the large Neuquén embayment (Legarreta

and Uliana, 1991, 1999). This retroarc basin has a history controlled by the changing tectonic setting of the western margin of Gondwana. It contains Late Triassic to Early Cretaceous marine and continental sequences, which are several thousand meters thick and accumulated under a variety of conditions, mostly as a result of important marine transgressions from the Pacific Ocean to the west (Legarreta and Gulisano, 1989; Legarreta and Uliana, 1991) in a setting similar to the paleogeography proposed by Michaux (2009). It is bounded to the east by the San Rafael Block and to the southeast by the Somún Curá Massif (Fig. 1). The western margin of the basin is defined by an almost continuous volcanic arc.

The Late Cretaceous is represented by synorogenic deposits that define the beginning of the flexural subsidence and the establishment

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