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Petrology and provenance of the Toro Negro Formation (Neogene) of the Vinchina broken-foreland basin (Central Andes of Argentina)

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ABSTRACT

Detrital modes of sandstones and conglomerates of the Toro Negro Formation (Late Miocene-early Pliocene) were used to analyze the evolution of the broken-foreland stage of the Vinchina Basin (28°30′–29°00′ S and 68°30′–68°20′ W) of NW Argentina. This basin located in the Western Sierras Pampeanas is bounded to the west by the Precordillera and to the east by the Famatina System. Three sandstone petrofacies: plutonic-metamorphic, volcanic and mixed petrofacies and three conglomerate lithic associations: basement, sedimentary and volcanic lithic associations were recognized, allowing to establish three source areas: Western Sierras Pampeanas (Toro Negro and Umango Ranges), Cordillera Frontal and Precordillera.

During the Late Miocene, the Toro Negro Range (to the north) together with the Cordillera Frontal and Precordillera (to the west) were the main sources for depositional sequences I and II (lower member of the Toro Negro Formation). On the contrary, during the latest Miocene-early Pliocene, Depositional Sequence III (upper member) exhibited a progressive increase in the supply from the eastern Precordillera (to the west) with additional material from the Umango Range to the south. Besides, evidence of synchronic volcanism is recorded in the upper part of Depositional Sequence II and the lower part of Depositional Sequence III.

The coexistence of the three source areas and the changing distribution patterns due to re-accommodation of sediment dispersal routes demonstrate that the evolution of this type of basin is much more complex than previously envisaged. Therefore, an integrated analysis using different tools (sedimentary facies, paleocurrent measurements, sandstone petrography and conglomerate composition) is needed for a clearer understanding of broken-foreland basins.

1. Introduction

The modal composition of sandstones is a useful tool not only for establishing source areas but also to look into the relation between shifts in compositional framework and paleogeographic modifications in sedimentary basins (Ingersoll, 1983; Net and Limarino, 2006; Garzanti et al., 2007; Caracciolo et al., 2011; Spalletti et al., 2012). Sandstone composition does not depend exclusively on the source rocks, since it may also be affected by the physiography and chemical weathering in the source area, the reworking and abrasion of the sediments during transportation and sedimentation, and diagenetic effects (e.g. Dickinson and Suczek, 1979; Espejo and López-Gamundi, 1994; Scasso and Limarino, 1997; Amorosi and Zuffa, 2011). Notwithstanding, the study of sandstone composition and conglomerate clasts may help to determine the tectonic evolution of the basin and allows to be established the historical uplift of the different mountain ranges (source areas).

The Toro Negro Formation (Turner, 1964; Late Miocene-early Pliocene) corresponds to the upper infill of the Vinchina Basin, an Andean composite foreland basin, in northwestern Argentina (Fig. 1). This unit records sedimentation during the transition from the transpressional foreland stage into the broken-foreland stage of Ciccioli et al. (2011). The Toro Negro Formation was divided into two members (Ramos, 1970). The lower member is composed of sandstones, mudstones, intraformational breccias and conglomerates with some tuff layers and overlies a high-relief unconformity carved in the underlying Vinchina Formation (Turner, 1964; Miocene). Two depositional sequences were recognized in the

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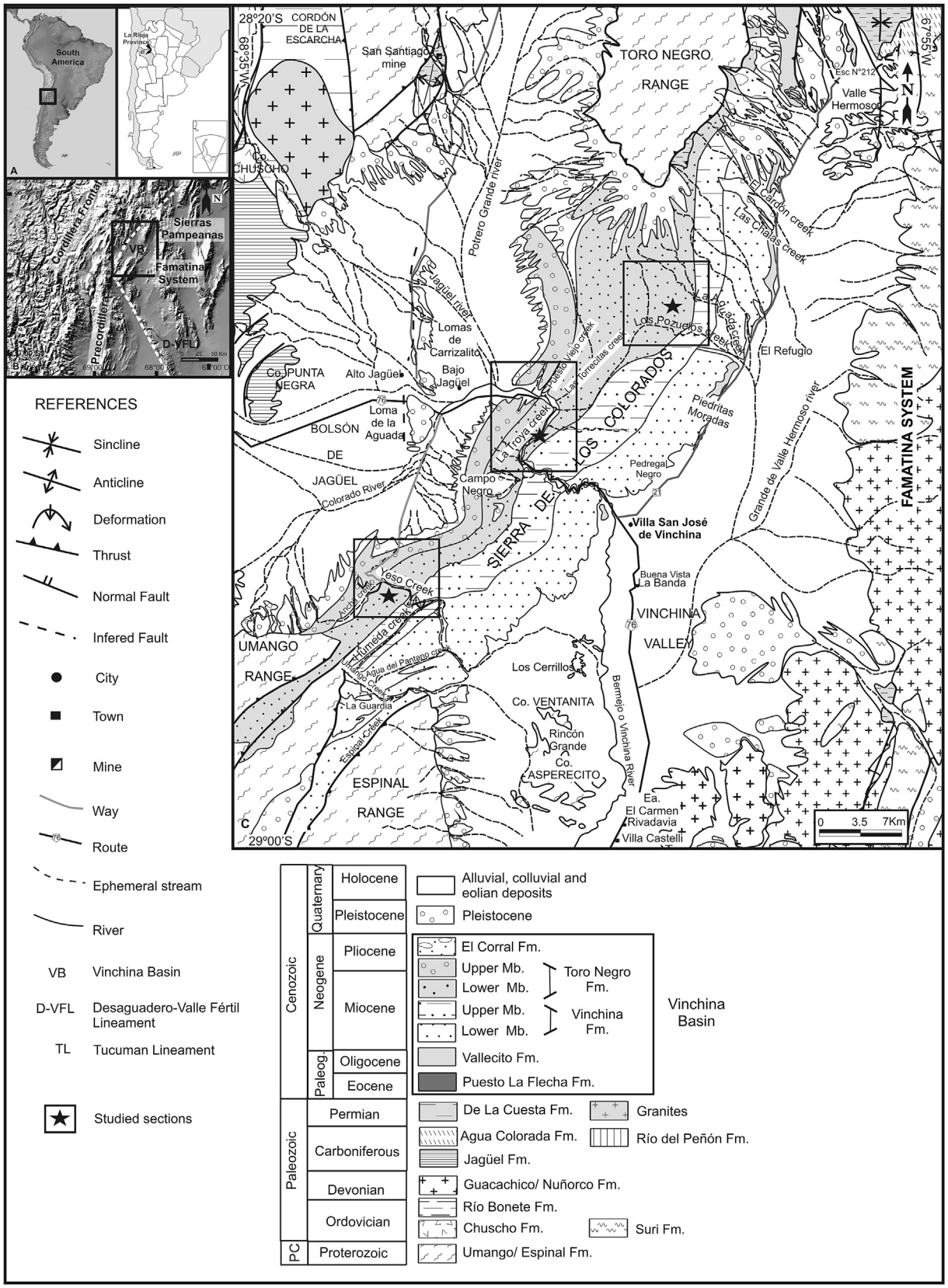

Fig. 1. Geological map of Vinchina Basin and surroundings showing the location of the three studied sections and the main morphostructural units. Modified from Ciccioli and Marenssi (2012).