

Stratigraphic review of the Las Flores Formation, Sierra Baguales, Última Esperanza Province, Magallanes

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INTRODUCTION

In spite of its importance for the reconstruction of the regional tectonic history, many Cenozoic lithostratigraphic units of the Patagonian Andes in northern Magallanes have received little attention, lacking adequate or detailed descriptions. All these units are exposed along the western boundary of the foreland basin, identified as a monoclinical structure verging towards the east in the external domain of the fold-and-thrust belt (Ghiglione *et al.*, 2009). One of these units is the Las Flores Formation, initially defined by Cecioni (1957) as the uppermost sedimentary succession in the Sierra Baguales area, formed by 120 m of continental sandstones interbedded with grey siltstones. Since its description, the Las Flores Formation was correlated with the southern continental El Salto Formation (González, 1952a) based on the common occurrence of fossil leaf imprints of *Nothofagus sp.*, and a Late Oligocene - Early Miocene age was proposed for it. Subsequent studies on the stratigraphy of the Última Esperanza Province undertaken by the exploration division of ENAP (i.e., González, 1952a, 1952b; González *et al.*, 1965), and the geological map of Chile at a scale of 1:1,000,000 (Sernageomin, 2003) tacitly recognize this formation as a valid unit.

Important geological advances made by our team over the last years include the recent review, recognition and/or detailed description of the Cenozoic stratigraphic sequences exposed at Sierra Baguales, as well as their paleontological content (i.e., Bostelmann *et al.*, in press; Le Roux *et al.*, 2010; Otero *et al.*, 2012). These studies also contemplate the correlation with equivalent units on the Argentinean side, revealing considerable information on the depositional history of the foreland and the age and regional extent of the stratigraphic horizons. The aim of this study is to revise the status of the Las Flores Formation, in order to determine its validity and potential relations with other lithostratigraphic units in the region.

MATERIALS AND METHODS

The study area comprises the northeastern flank of the Baguales River Valley, 1 km north of the Las Flores Cattle Station and approximately 120 km north of Puerto Natales (Figure 1). A field campaign was carried out between February and March 2013, in which various localities were visited along the Baguales and Bandurrias Rivers. At the Las Flores Cattle Station, a detailed stratigraphic column was measured in the Las Flores Formation stratotype (50°51'24.12"S, 72°19'53.89"O), which crops out on the steep eastern flank of the north-south trending canyon at Torta (León) Hill. A measuring tape and Brunton compass were used to determine the true thickness of the strata according to the section line and general dip. Systematic geological descriptions were made in the field and rocks as well as fossil samples were collected along the

profile. All materials were subsequently transported to the Geology Department of the University of Chile for further studies.

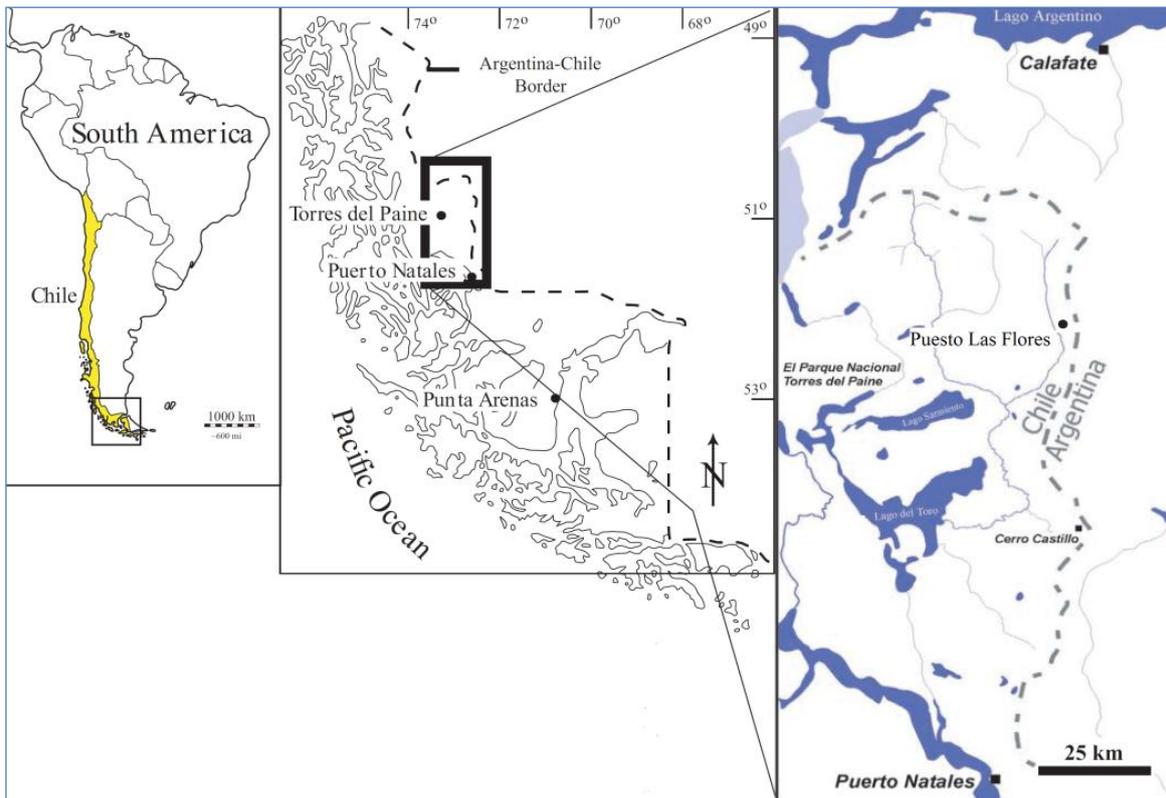


Figure 1: Study area in northern Magallanes (Modified from Fildani *et al.* 2007).

RESULTS

All the known exposures assigned to the Las Flores Formation occur along a deep ravine in the extra-Andean plain. The eastern flank has a slope of more than 70° (Figure 2a, b, c), whereas the western flank is less steep. The strata are cut by a stream, which also allows the underlying strata to be well exposed. Each sub-unit presents strongly contrasting hues, in addition to important differences in hardness and grain-sizes. The stratigraphic column is composed of six well-defined units totalizing 56.8 m of exposed sequence, subdivided as (Figure 2d): A.- Basal siltstones and sandstones, poorly exposed because of numerous debris slides up to 2 m thick, generally very fine-grained, with bluish grey to light yellow colors [0-6.5 m]. B.- Medium-grained sandstone with planar cross-bedding and mostly vertical traces, which become more silty towards the top [6.5-13 m]. C.- Reddish, very fine to medium-grained sandstones with vertical and horizontal traces, heterolithic stratification and dish structures. The arenaceous strata show inverse gradation at the base and normal gradation towards the top [13-23 m]. D.- Bluish grey sandstones with planar cross-bedding containing dark red concretions up to 1 m in diameter [23-33.7 m]. E.- Heterolithic, medium-grained, yellow sandstones and greyish siltstones, which contain numerous light to dark brown leaf imprints in which *Nothofagus spp.* is the most common element, and light grey calcareous concretions up to 20 cm in diameter [33.7-46.5 m]. F.- Medium-grained, light yellow sandstone with bivalve molds, fragmentary shark teeth and abundant bioturbation in the basal 2 m. The dominant structure is medium-angle planar cross-lamination [46.5-56.8 m]. The top of the sedimentary succession has no fossils. Higher up on the valley flank basaltic sills reaching a thickness of ~80-100 m crop out.

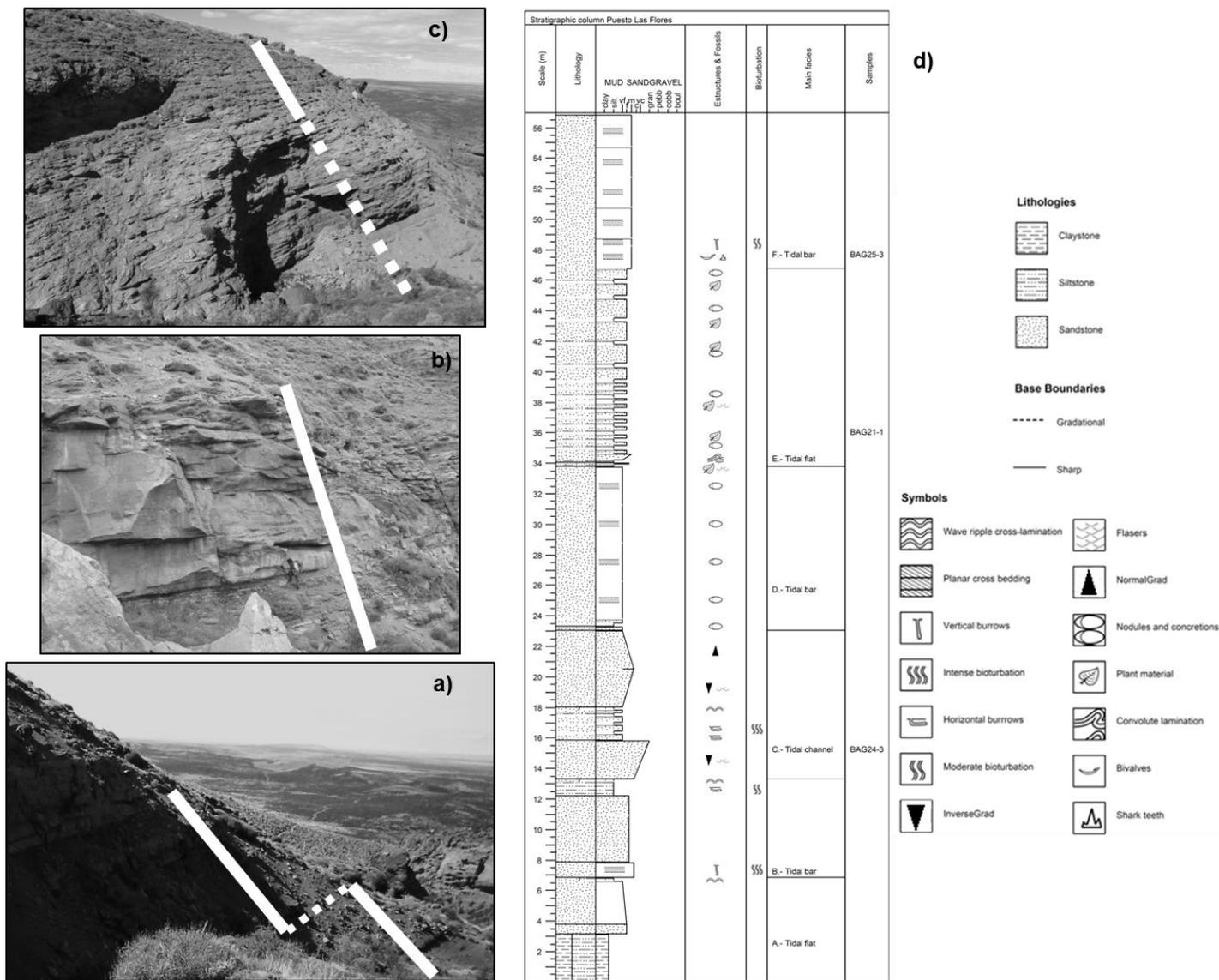


Figure 2: Stratigraphic column of the Las Flores Formation stratotype. a) Outcrops of A, B and C sub-units. b) Outcrops of C and D sub-units c) Outcrops of E and F sub-units. d) Stratigraphic profile with associated symbology. 1:200 scale.

DISCUSSION AND CONCLUSION

Undoubtedly, a continental origin for the deposition of the Las Flores Formation cannot be sustained. The lithological composition and fossil content correlates it with a shallow coastal environment, here interpreted as representing a tide-dominated estuary, with 3 characteristic lithofacies: Tidal flats (A, E), tidal bars (B, D, F), and tidal creeks (C). The succession unconformably underlies the continental Río Leona Formation and conformably (in paraconcordance?) overlies the reddish, shallow marine Middle Eocene Man Aike Formation (Piatnitzky, 1938; Feruglio, 1938), previously attributed to the Río Baguales Formation in the area (Cecioni, 1957; Le Roux *et al.*, 2010). Lithological similarities are also noted between these strata and the upper member of the Río Turbio Formation (Hünicken, 1955), especially in the exposed section at the side of route 40, a few kilometers north of the town of Río Turbio, Argentina (Pearson *et al.*, 2012). Based on these affinities, its contacts, thickness, and the inferred depositional environment, we propose that the name “Las Flores Formation” should be discarded and the strata be re-assigned, at least temporarily, to the Man Aike Formation. Further radiometric dating

and more detailed lithostratigraphic analysis of the Eocene marine successions in the area - especially the composite Río Turbio Formation - would prove to be fundamental to finally outline the real extent and correct limits of the Paleogene stratigraphic units present on both sides of the border.

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