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CALCAREOUS NANNOFOSSIL ASSEMBLAGES AND THEIR SIGNIFICANCE IN DEFINING THE JURASSIC/CRETACEOUS BOUNDARY

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INTRODUCTION

In the latest Jurassic a major speciation episode for calcareous nannofossils took place with the appearance and rapid evolution of several new genera and species.

In this contribution, we analyzed the calcareous nannofossil biostratigraphy around the Jurassic-Cretaceous boundary of sections from different latitudes and paleogeographic settings.

In **Crimea**, the upper Tithonian to the lower Berriasian was represented by sediments of the **Dvuyakornaya Formation**, Feodosiya region, characterized by calciturbidites, debrites, and pelagic deposits from the deeper part of a distally steepened ramp.

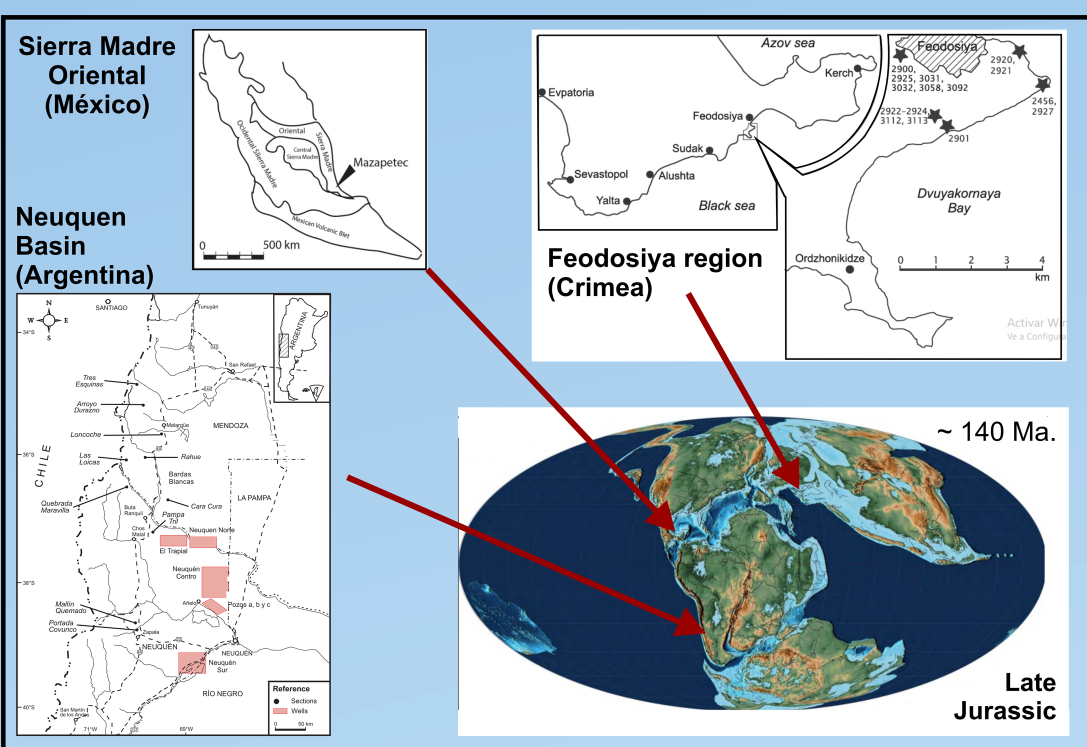
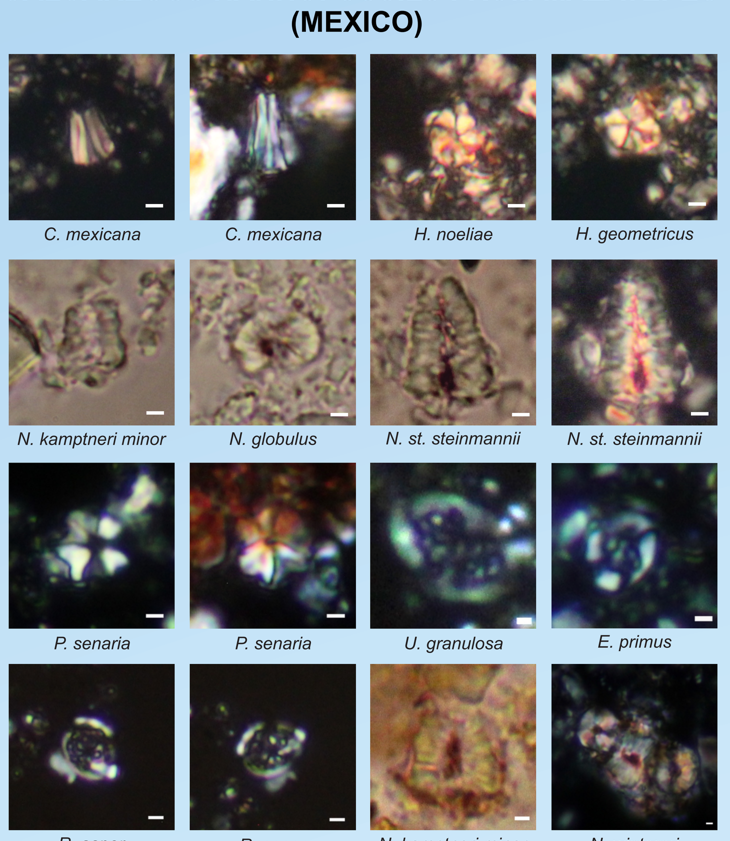


Fig. 1. Location map of study sections from different regions and latitudes

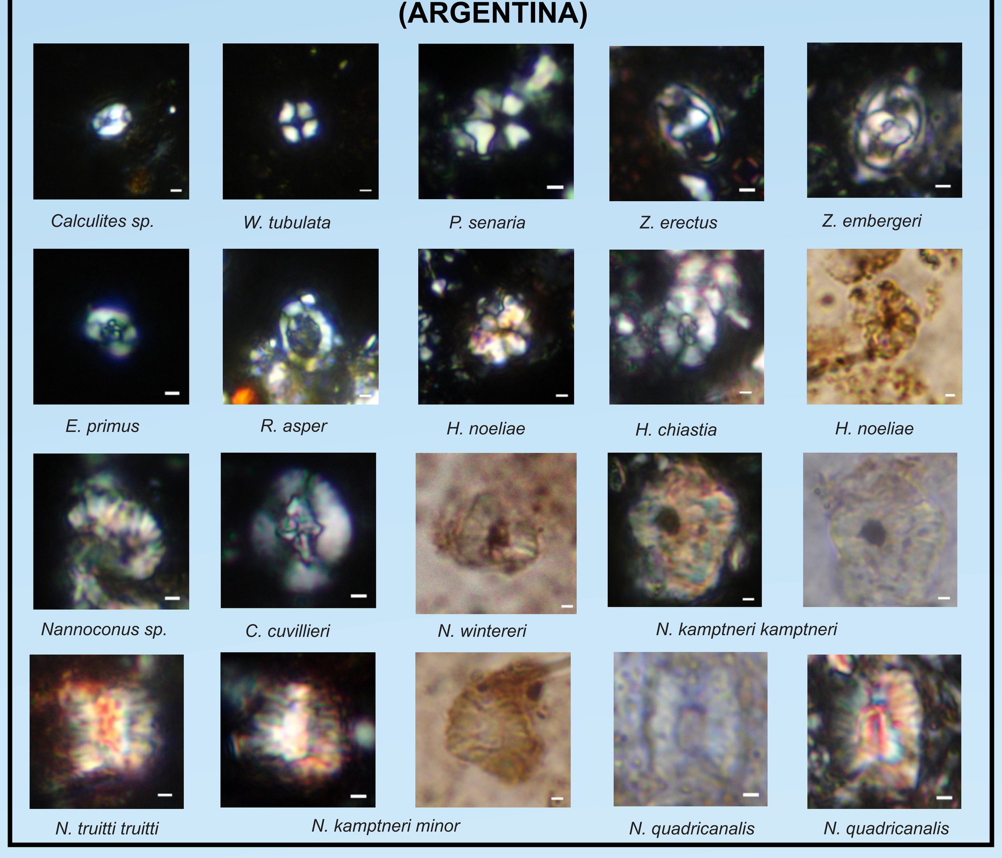
In **Mexico**, at the Sierra Madre Oriental, during the Tithonian to Berriasian, the development of shallow marine environment occurred, characterized by sediments of the **Pimienta Formation** (composed of darkish clayey limestones) and **Tamaulipas Formation** (argillaceous limestones, shales), respectively.

The Tithonian-Berriasian interval in the Neuquén Basin, **Argentina**, was represented by marine shales and limestones of the **Vaca Muerta Formation** deposited as a result of a rapid and generalized paleo-Pacific marine transgression.

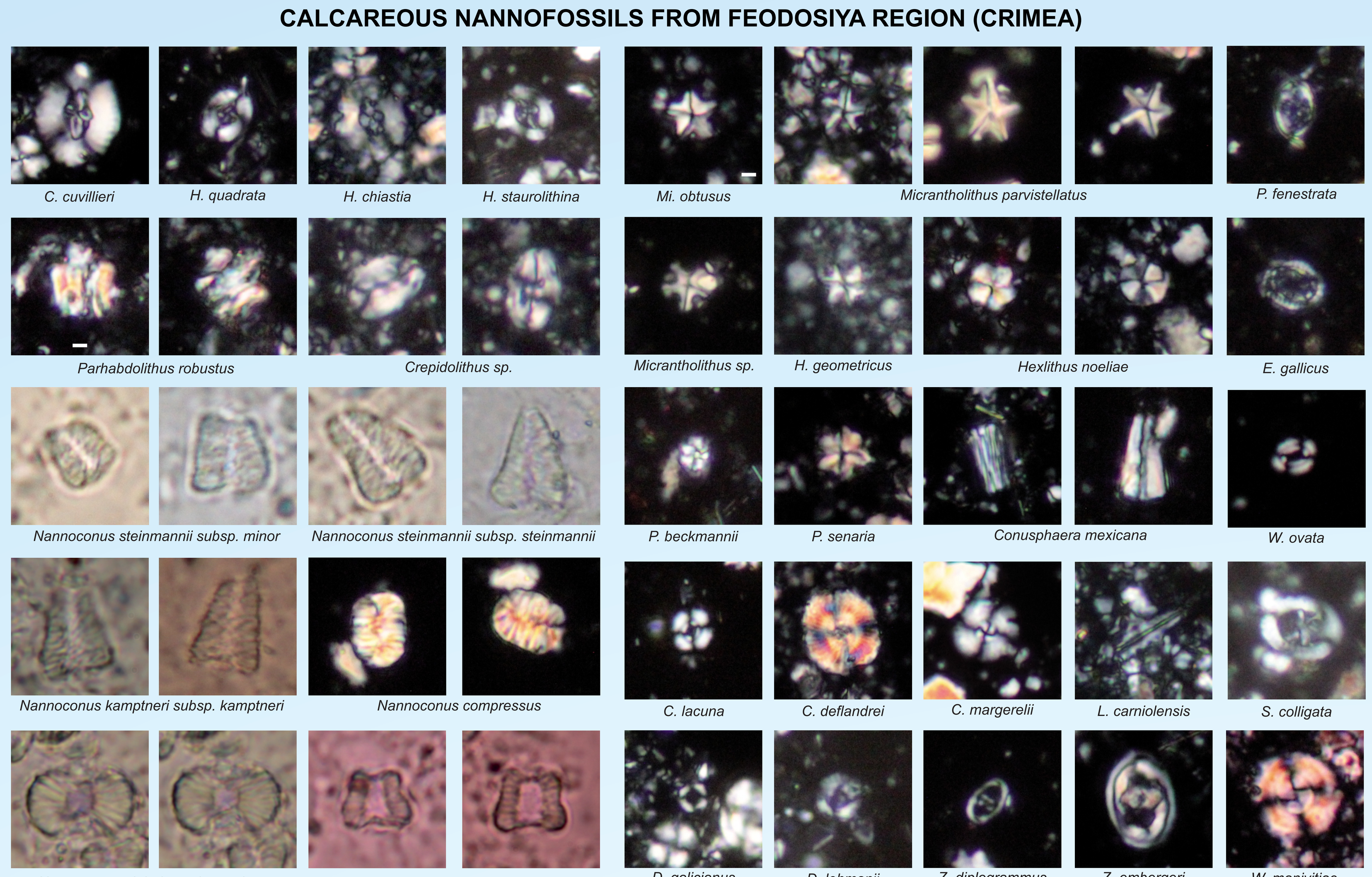
CALCAREOUS NANNOFOSSILS FROM MAZATEPEC (MEXICO)



CALCAREOUS NANNOFOSSILS FROM NEUQUEN BASIN (ARGENTINA)



CALCAREOUS NANNOFOSSILS FROM FEODOSIYA REGION (CRIMEA)



GTS 2020	AGE			Bralower *et al.* (1989)			Casellato and Erba (2021)	Crimea	Mexico	Argentina
	CRET.	Berriasian	Early	**NK1**		FAD *N. steinmannii steinmannii*	**NC1** FAD *N. steinmannii steinmannii*	*N. st. steinmannii*	*N. st. steinmannii*	*N. st. steinmannii*
143					NJK-D	***N. steinmannii minor*** FAD *N. steinmannii minor*	**NC0b** FAD *N. steinmannii minor* y *N. kamptneri minor*	*N. kamptneri minor*	*N. kamptneri minor*	*N. kamptneri minor*
	JURASSIC	Tithonian	Late	**NJK** ***Microstaurus chiastius***	NJK-C	***R. laffittei*** FAD *R. laffittei*	**NC0a** FAD *N. wintereri*	*N. wintereri*		*N. wintereri*
					NJK-B	***U. granulosa granulosa***	**NJT 17**			*R. asper*
144						FAD *U. granulosa granulosa*	FAD *N. globulus minor*	*H. geometricus*		*U. granulosa*
145					NJK-A	***H. noeliae***	**NJT 16b** FAD *N. infans*	*P. senaria*		
			Early			FAD *Microstaurus chiastius*	**NJT 16a** FAD *H. chiastia*, *H. noeliae* y *P. senaria*	*H. chiastia*	*H. noeliae*	*P. senaria*; *H. noeliae*
146				**NJ-20** ***Conusphaera mexicana***	NJ20B	***P. beckmannii*** FAD *P. beckmannii*	**NJT 15b** FAD *P. beckmannii*			
147										*P. beckmannii*
					NJ20A	***H. cuvillieri*** FAD *C. mexicana minor*	**NJT 15a** FAD *C. mexicana minor*		*C. mexicana minor*	

Fig 5. Tithonian- Early Berriasian Calcareous Nannofossils biovents recognized at different latitudes (Crimea, Mexico and Argentina).

STUDY SECTIONS

The Feodosian section is comprised by independent outcrops (2901, 2922-2924, 3112, 3113, 2456, 2927, 2920, and 2921) of the Dvuyakornaya Formation hosted by coastal cliffs of the Black Sea in Feodosiisky Cape, Cape of Saint Ilya, and in Dvuyakornaya Bay, at the southern edge of the Feodosiya city (Fig. 1). The section comprised by calciturbidites, debrites and pelagic deposits of the deeper part of a distally steepened ramp (Arkadiev *et. al.*, 2019) of about 400 m total thickness.

Out of the 43 samples from the four Crimea sections that were examined for calcareous nannofossils, 38 were fossiliferous. Assemblage of calcareous nannofossils of the Eastern Crimea is remarkable species and is represented by over 67 Tethyan species (Fig. 3).

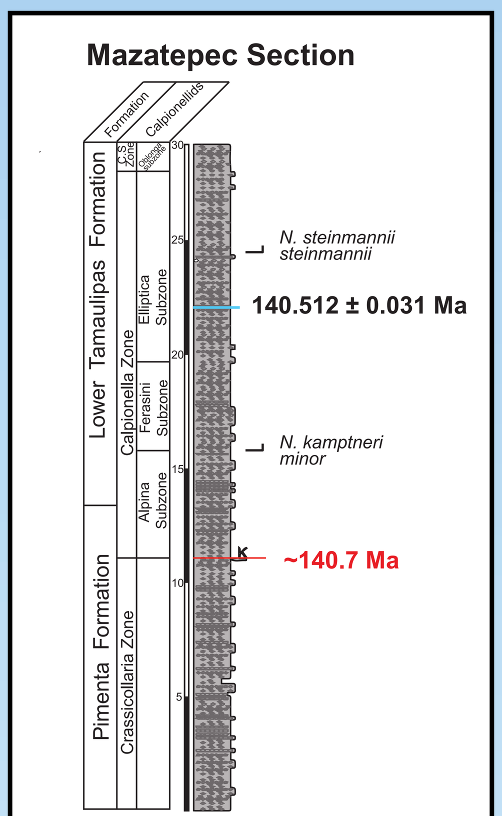


Fig. 2. Calpionellid biozonation, nannofossils bioevents and U-Pb age of the Mazatepec section.

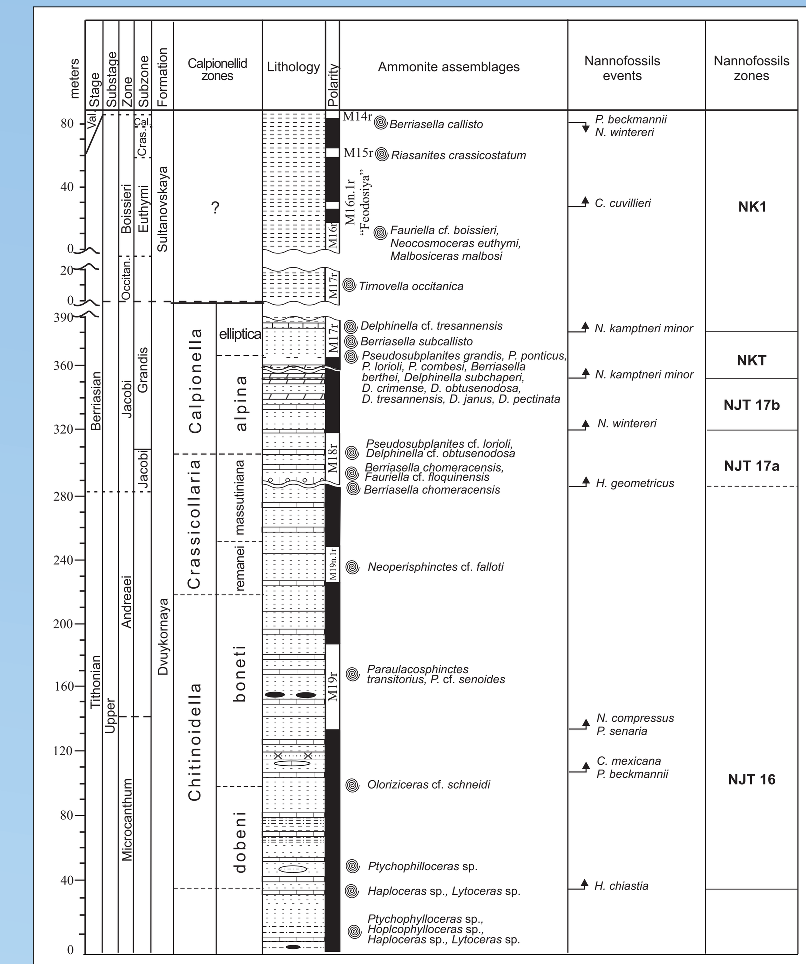


Fig. 3. Compiled Tithonian–Berriasian section of Eastern Crimea and its bio-stratigraphic and magnetostratigraphic zonation.

The **Mazatepec section** exposes the Pimienta and the lower Tamaulipas formations of the Eastern Sierra Madre geological province, Mexico (Fig. 1).

The section has a dense occurrence of calpinellids belonging to Late Tithonian Crassicollaria Zone (Colomi Subzone) and Early Berriasian calpionellids from Calpionella Zone, (Alpina, Ferasini, and Elliptica Subzones) to Calpionellopsis Zone (Oblonga Subzone) (Fig. 2).

The Mazatepec section has a dense and well-established calpionellid zonation like that of classical western Tethyan zonation.

Seventeen samples from the Mazatepec section were examined for calcareous nannofossils (BAFC-NP: Nº 4190-4206).

Information concerning Tithonian–early Valanginian calcareous nannofossils from the **Vaca Muerta Formation** comprises a moderate number of studies with hydrocarbon exploration aims and more recent papers that have focused on biostratigraphy and correlations.

Nannofossil data compiled from several outcrops and wells in the Vaca Muerta Formation are presented here. They are mainly located in southern Mendoza province and the northwestern area of Neuquén province and the surroundings of the Huincul High, and in several wells scattered in the Vaca Muerta play (Fig. 1).

The nannofossil bioevents determined in the Vaca Muerta Formation include some presence of reliable species and the combination of the first (FO) and/or last occurrences (LO) of *Polycostella beckmannii, Hexalithus noeliae, Polycostella senaria, Umbria granulosa, Eiffellithus primus, E. windii, Rhagodiscus asper Cruciellipsis cuvillieri, Nannoconus wintereri, N. kamptneri minor, N. steinmannii,* and *N. kamptneri* (Fig. 4).

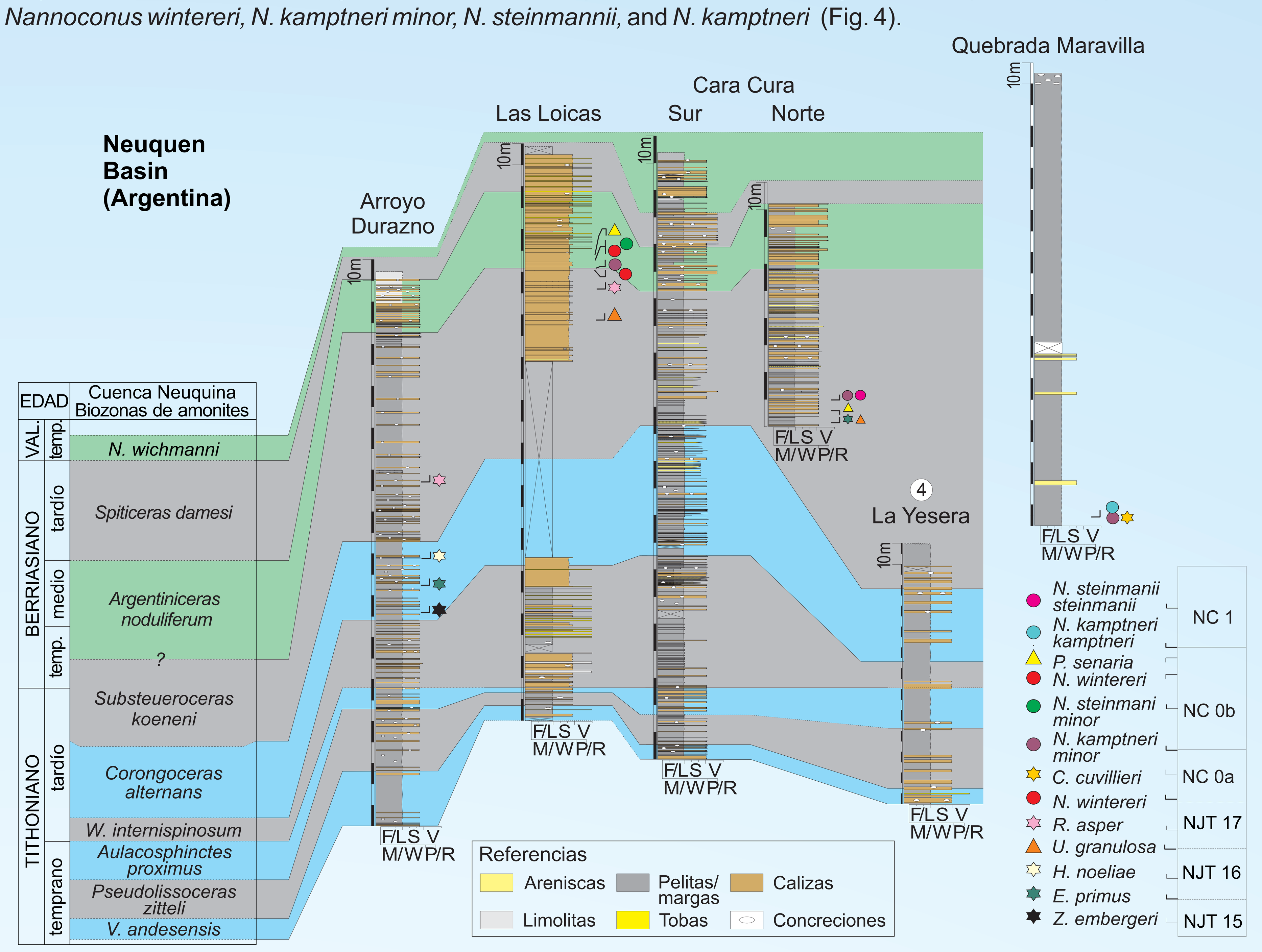


Fig 4. Tithonian- Valanginian Cronostratigraphic correlation scheme of the Vaca Muerta Formation, Neuquen Basin, Argentina.

CONCLUDING REMARKS

In these localities five nannofossil bioevents indicated high reliability (FOs of *Polycostella beckmannii, Helenea chiastia, Nannoconus wintereri, Nannoconus kamptneri minor* and *Nannoconus steinmannii steinmannii*), and four of them indicated moderate confidence (FOs of *Hexalithus noeliae*, *Hexalithus geometricus, Cruciellipsis cuvillieri* and the LO of *P. beckmannii*) determining five biozones (NJT 15, NJT 16, NJT 17, NC0, and Nc1) (Fig. 5).

In the three sedimentary basins, the FOs of *N. wintereri* and *N. kamptneri minor* were the most confident bioevents to approximate the Jurassic/Cretaceous boundary, and they correlated the Andean with middle latitude regions, improving our knowledge about the marine connections established between the southeastern Pacific and the Tethyan Realm during those times.

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