PALAEONTOLOGICAL PUBLICATIONS - VOL. 7

International Subcommission on Silurian Stratigraphy Meeting 2025

"Advances in Silurian chronostratigraphy and high-resolution correlation"

ISSS Meeting
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Sevilla 2025

Abstracts Book

Seville (Spain)
10th–13th September 2025

Gutiérrez-Marco, J. C., Romero, S.
(Eds.)

Sociedad Española de Paleontología

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(Editors of the Series)

Published by:

SOCIEDAD ESPAÑOLA DE PALEONTOLOGÍA

Series: Palaeontological Publications Nº 7

International Subcommission on Silurian Stratigraphy Meeting 2025. “Advances in Silurian chrono-stratigraphy and high-resolution correlation”. Abstracts Book. Gutiérrez-Marco, J. C., Romero, S. (Eds.). Seville, Spain, 2025.

157 pp, 17x24 cm

ISBN-13: 978-84-09-76490-7

1. Palaeontology - 2. Meeting - 3. Spain - 4. Silurian - 5. Sociedad Española de Paleontología, ed.

It is suggested that either of the following alternatives should be used for future bibliographic references to the whole or part of this volume:

Gutiérrez-Marco, J. C., Romero, S. (Eds.) (2025). International Subcommission on Silurian Stratigraphy Meeting 2025. “Advances in Silurian chronostratigraphy and high-resolution correlation”. Abstracts Book. *Palaeontological publications*, *7*, 157 pp.

Bernárdez, E., Serventi, P., & Gutiérrez-Marco, J. C. (2025). Remarkable Telychian fossils from the A Fonsagrada region (West Asturian-Leonese Zone, NW Spain). In Gutiérrez-Marco, J. C., Romero, S. (Eds.), International Subcommission on Silurian Stratigraphy Meeting 2025. “Advances in Silurian chronostratigraphy and high-resolution correlation”. Abstracts Book. *Palaeontological publications*, *7*, 25–32.

Cover:
From top to bottom, and left to right: *Neodiversograptus* and *Colonograptus*, Gorstian (left); *Spirograptus guerichi*, Telychian (centre); columnal of *Scyphocrinites elegans*, and fragment of *Kopaninoceras fluminense*, Pridoli (right). El Pintado reservoir (Seville). Photos by Gema García Martín.

Back cover:
Field view of the Aeronian / Telychian boundary section at El Pintado 1 (Cazalla de la Sierra, Sevilla), and the *golden spike* for the replacement GSSP for the base of Telychian. Photo by Petr Štorch.

Logo:
Designed by Sara Romero and Juan Carlos Gutiérrez-Marco.

editor@sepaleontologia.es

ISBN-13: 978-84-09-76490-7

Design and layout: Isabel Pérez-Urresti

WENLOCK (SILURIAN) CYCLOSTRATIGRAPHY OF WESTERN LITHUANIA: A PRELIMINARY REPORT

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Keywords: cyclostratigraphy, Sheinwoodian, Homerian, Kurtuvėn*ai-161 well*

INTRODUCTION

Although radiometric, biostratigraphic and chemostratigraphic age dating investigations of the Silurian are intensive, but the Silurian is poor with respect to the amount of cyclostratigraphic and astrochronologic studies (Hinnov & Ogg, 2007). The firsts reports proving the Silurian cyclicity are from the end of last age (*e.g.*, Williams, 1991; Yolkin *et al.*, 1997). In recent decades, there has been an increase in the number of studies of Silurian cyclostratigraphy and astrochronology (*e.g.*, Crick *et al.*, 2001; Nestor *et al.*, 2001; Artyushkov & Chekhovich, 2004; Gambacorta *et al.*, 2018; Hinnov, 2018). However, cyclostratigraphical investigations of the Silurian Period is remains in its infancy. So, the purpose of this small study is to test the natural gamma ray record for the presence of cycles of the Wenlock in the West Lithuania.

GEOLOGICAL SETTING

During the Wenlock, the territory that is now Lithuania was part of the Baltica palaeocontinent and located in the southern hemisphere (Cocks & Torsvik, 2002). There was also an epicontinental sea with sallow palaeoenvironment in the east Lithuania to deep palaeoenvironment in the wet Lithuania (Fig. 1). Kurtuvėnai-161 well is located in the West Lithuania and crosses the deep clayey Wenlock geological succession.

There are distinguished Riga with Ančia Member and Gėlyva formations of Wenlock in this borehole (Fig. 3) (Kaminskas *et al.*, 2006). These formations are composed of mudstone in different clayey conditions. The graptolite biozones sequence is from *spiralis* Biozone (upper Llandovery) to *nilssoni* Biozone (lower Ludlow) in the investigated interval (Fig. 3). So, *spiralis–lapworthi* biozones interval mark the Adavere, *centrifugus–belophorus* biozones related to the Jaani, *perneri–lundgreni* biozones mark to the Jaagarahu, *parvus–ludensis*

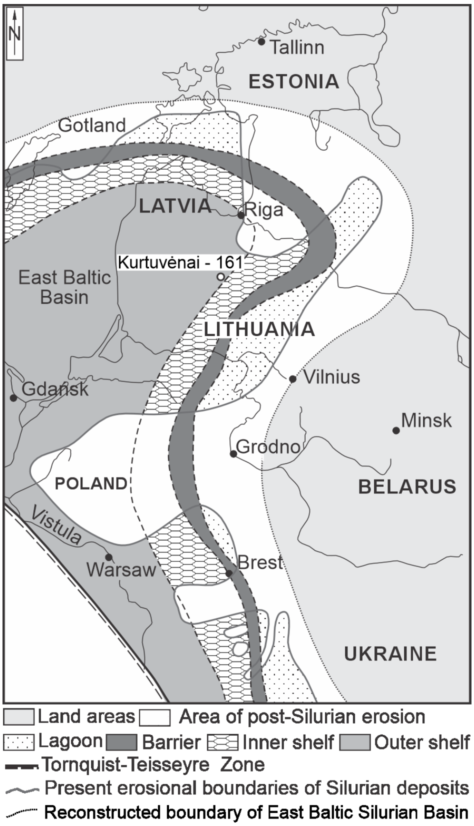

Figure 1. Paleogeographic map of the East Baltic Silurian Basin Platform during the time of *Gothograptus nassa* Zone (Homerian, Wenlock) (Einasto *et al.*, 1986) and location of the Kurtuvėnai-161 borehole.

biozones correspond to the Gėluva and *nilssoni* Biozone mark Dubysa regional stages. So according succession of graptolites biozones there is not big stratigraphical gaps in the investigated interval of Kurtuvėnai-161 borehole.

METHODS

The stratigraphical series of natural gamma which were sampled every 0.1 m meters were processed using two approaches: REDFIT periodogram (Schulz & Mudelsee, 2002) and Morlet wavelet transform in the PAST package (Hammer & Harper, 2008; Hammer *et al.*, 2001; Prokoph & Agterberg, 2000), the approaches which were previously successfully applied in constructing cyclostratigraphies and correlation charts of the Silurian sequences of the Baltic Basin (Radzevičius *et al*., 2014a, 2014b, 2017). The analysis was performed in a window of 166 meters in a range 1440 to 1274 m in depth from ground level.

The stratigraphical time series was pre-processed for the REDFIT analysis, in order to prewhiten it and make it suitable for detection of periodic and quasi-periodic processes. We subtracted parabolic trend by applying LOESS regression and later using its residuals. For the purpose of visualization, we've extracted 16.6 m and 7.2 m periodicities (which were detected in the upper part of the section earlier (Radzevičius *et al.*, 2017) and compared them to the stratigraphical succession of lithology and graptolite ranges (Fig. 2).

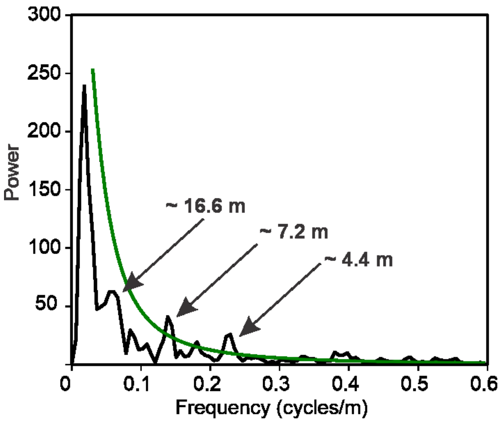

Figure 2. Power spectrum of gamma ray log. Green line shows 95 % False Alarm levels (FA 95%). Highlighted frequencies shown with arrows.

RESULTS AND DISCUSION

Three 4th order cycles were distinguished in the Jaani Regional Stage in the Kurtuvėnai-161 well (Fig. 3). The base of Jaani 4,1 is near *centrifugus/murchisoni* biozones boundary and the top is linking to the *riccartonensis* Biozone upper boundary. Jaani 4,2 cycle is correspond to the *antennularius* Biozone and Jaani 4,3 is linking to the *belophorus* Biozone. There are distinguished seven 5th order cycles in Jaani Regional Stages as well (Fig. 3).

The Jaagarahu Regional Stage also saw the identification of three fourth-order cycles. Jaagarahu 4,1 cycle correspond to the perneri and radians biozones, Jaagarahu 4,2 could be correlate with lower part of the *lundgreni* Biozone and Jaagarahu 4,3 with uppert part of the *lundgreni* Biozone. There are distinguished eight fifth order cycles in the Jaagarahu Regional Stage.

Two 4th order and five 5th order cycles were distinguished in the Gėluva Regional Stage in the Kurtuvėnai-161 well (Fig. 3). The results of the new study were the same as those of the earlier study (Radzevičius *et al*., 2017). We will not mention it in more detail.

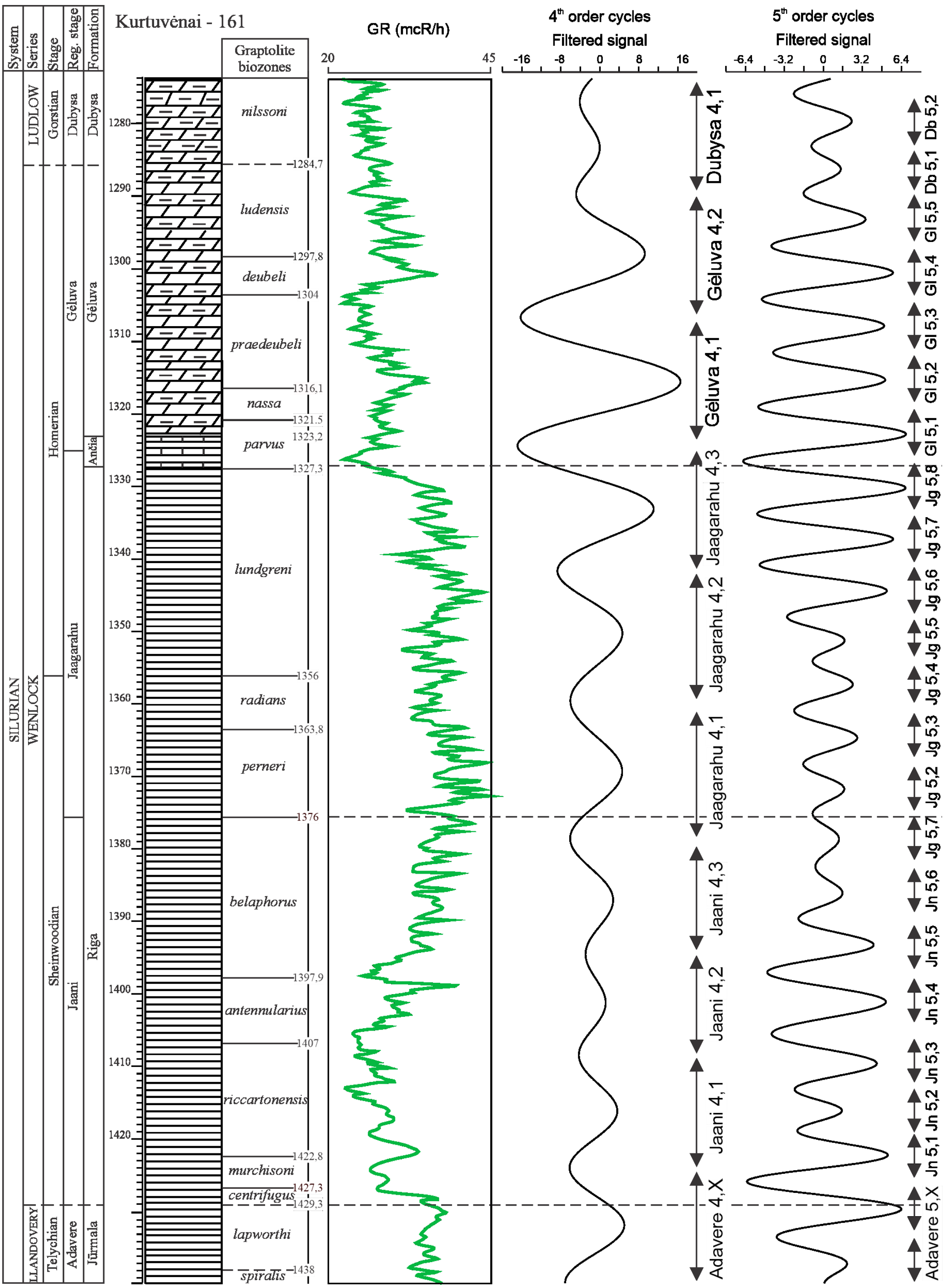

Figure 3. Lithology, graptolite biozones, gamma-ray log and interpretation for fourth- and fifth-order cycles of the Wenlock in the Kurtuvėnai-161 borehole.

Two cycles with different lengths or periods were identified. The fourth (4th) order a 16.6 m long cycle and the fifth (5th) 7.2 m long cycle. Based on our study, the cycles are best explained as two Milankovitch eccentricity cycles (400 and 100 kyr). If this interpretation is correct, then it gives us a good tool for understanding the tempo of sedimentation, the duration of the Ireviken and Mulde events as well the riccartonensi and the lundgreni extinctions and biotic recoveries.

Acknowledgements: AS was supported by the Research Council of Lithuania project S-MIP-24-62 BretEvoGeneralized.

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