A Key Section for the Early Pannonian (Late Miocene) of the Transylvanian Basin (Romania): Integrated Stratigraphic Results from the Guşteriţa Clay Pit* 

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Abstract

The Transylvanian Basin (TB), enclosed between the Eastern and Southern Carpathians and the Apuseni Mts. in Romania, accommodates a several-hundred-meter thick Upper Miocene (Pannonian) sedimentary sequence. Data on its fossils are few and scattered in the literature, consequently its biochronostratigraphic assessment implies much uncertainty. The magnetostratigraphic correlation of some recent polarity measurements partly remained disputable. Radiometric age measurements have never been published from these formations. To improve the stratigraphic resolution and the reliability of correlations in the Pannonian of the TB, we investigated 17 outcrops of deep-water formations across the TB. The largest and one of the most fossiliferous outcrops is Guşteriţa (today part of Sibiu), therefore we regard it a reference section for the entire TB. The deep-water Pannonian marl, outcropping in ~55 m thickness in the clay pit of Guşteriţa, has been mined there for more than hundred years, and consists of grey, laminated and massive silty marl layers and thin, very fine, cross-laminated sand intercalations. We studied four sections within the clay pit. In October 2015, macrofossils and marl samples for authigenic ¹⁰Be/⁹Be isotopic measurements were collected from the lower, middle, and upper parts of the mine (Guşteriţa 1, 2, and 3). Later, in June 2017, the uppermost 25 metres of the quarry (Guşteriţa 4) was sampled for macro- and microfossils, and a detailed magnetostratigraphic investigation was carried out as well. All the four studied sections can be assigned into the Undulotheca rotundata mollusc lineage....
subzone of the *C. banatica* mollusc assemblage zone (~11–10.2 Ma) and into the *Hemicytheria tenuistriata?* and *Propontoniella candeo* ostracod biozones. According to the palynological and calcareous nannoplankton studies, the Guşteriţa 4 section belongs to the *Spiniferites bentorii* oblongus (~11.3–10.8 Ma) and the *Pontiadinium pcesvaradense* (~10.8–10.6 Ma) organic-walled microplankton biozones. All samples from the Guşteriţa 3 and 4 profiles contain endemic Pannonian calcareous nannofossils represented by the species *Isolithus semenenko*, *I. pavelici*, *Noelaerhabdus jerkovici*, and *Praenoelaerhabdus banatensis*. Blooms of ascidian spicules (*Perforocalcinella fusiformis*) in some of the samples were observed. Samples also contain calcareous nannofossils redeposited mostly from the Middle Miocene. Nine samples were analyzed for authigenic $^{10}$Be/$^9$Be isotopic measurements. The calculated age data suggest an interval of ~11–10.6 Ma. Magnetostratigraphic samples showed normal polarity for the entire Guşteriţa 4 section, therefore, taking into consideration the biostratigraphic data, we correlate it with the C5n.2n magnetic chron (11.056–9.984 Ma, ATNTS2012).

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A key section for the Early Pannonian (Late Miocene) of the Transylvanian Basin (Romania): integrated stratigraphic results from the Gusterita clay pit

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Why to study the Pannonian (Late Miocene) of the Transylvanian Basin (TB)?

1. The TB accommodates a several-hundred-meter thick Early Pannonian sedimentary sequence. Sediments of similar facies and age are mostly deeply buried in the Pannonian Basin (PB) proper.

2. Data on the Pannonian fossils of the TB are few and scattered in the literature, consequently its biostratigraphic assessment implies much uncertainty.

3. The magnetostratigraphic correlation of some recent polarity measurements partly remains disputed (Yaslev et al. 2010 & Ste-Lucie et al. 2013).

4. Radiometric age measurements have never been published from these formations.

Objective: To improve the stratigraphic resolution and the reliability of correlations in the Pannonian of the TB. We investigated 17 outcrops of deep-water formations across the basin. The largest and one of the most fossiliferous outcrops is Gusterita (today part of Sibu), therefore we regard it as a reference section for the entire TB.

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Clay pit of Gusterita and sedimentary log of the lower part of the mine. a: The mining site, with view from the upper part (Gus 3). The three sampled levels are indicated by the captions; b: Cleared surface in the lower section (Gus 1). Yellow outlines mark vertical burrows; c: Very fine cross-laminated sand lenses in the upper part (Gus 3); d: Light grey laminated calcareous marl with Diplomaticerin isp. traces on the bedding plane in the upper part of the quarry (Gus 3)

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Plate A: Deep-water molluscs of the Cingaria barantisens biozone
1. Cingariella barantisens
2. Lymnaeomarginata
3. Oppianella laxa
4. Upperella rhodina
5. Undulatella r. nulaka
6. Undulatella r. rufata

Plate B: distribution of the Hemitriteclamidae and Phylloceratidae clade ostracod biozones
1. Hemitriteclamidae
2. Aminotylus rarus
3. Cardita (Therizinocerina) apapa
4. Cardita (Therizinocerina) herbacea
5. Cardita meridiana
6. Cardita (Therizinocecidina) typica
7. Cardita (Neothripides) typica
8. Cardita (Phylloceratida) sp. nov.
9. Lopatites (Aminotylus) stenomegala
10. Lopatites (Phyllocerids) graminea

Plate C: Dinoflagellates of the Spirilina bentonii oblonga and Pontithamnion cf. carpathicus biozone
1. Spirilina bentonii oblonga
2. Urgilandia sphaera
3. Urgilandia allatis
4. Urgilandia plicata
5. Urgilandia unimaginalis
6. Pontithamnion confusum
7. Pontithamnion peregrinum
8. Pontithamnion syntaxoideum
9. Chelmsfordiella carpatillicola
10. Spirilina sp. (cold-water form)

Plate D: Results of isotopic measurements (5 samples from Gusterita, 1, 2, 3 and 4 samples from Gusterita 6 (Gus 6); 1, 2, 3 and 4 samples from Gus 6; 5 and 6 samples from Gus 6)

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Conclusions
3 samples for authigenic 238–238 isotopic measurements: weighted mean value of 10.84 ± 0.4 Ma
Magnetostratigraphic samples: normal polarity, C5n/5n magnetic chros (19.065–9.986 Ma, ATN2012)

Taking into consideration all the age data:
-11.05–10.6 Ma age is suggested for the entire section

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