

***Ulrichospira* Donald (Gastropoda – Phanerotrematidae) from the Middle Ordovician of central Sonora, Mexico: Paleobiogeographical considerations**

***Ulrichospira* Donald (Gastropoda – Phanerotrematidae) del Ordovícico Medio del centro de Sonora, México: consideraciones paleobiogeográficas**

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Abstract

The Ordovician gastropod *Ulrichospira* Donald is described from a stratigraphic sequence exposed in the area of Rancho Las Norias in central Sonora, Mexico. This is the first record of the genus from Mexico, and it was associated with abundant fauna composed of bryozoans, brachiopods, gastropods, and trilobites. This gastropods Ordovician association from Las Norias formation displays a clear affinity with the North American craton, including the United States and Canada.

Keywords: Gastropods, Ordovician, Mexico, Paleozoic, Sonora.

Resumen

Se describe el gasterópodo del Ordovícico *Ulrichospira* Donald de una secuencia estratigráfica expuesta en el área del Rancho Las Norias en el centro de Sonora, México. El presente trabajo constituye el primer registro del género para México, el cual se encuentra asociado con una abundante fauna constituida por briozoarios, braquiópodos, gasterópodos y trilobites. La asociación de gasterópodos del Ordovícico de la formación Las Norias muestra una marcada afinidad con el cratón de Norteamérica, incluyendo los Estados Unidos de América y Canadá.

Palabras clave: Gasterópodos, Ordovícico, México, Paleozoico, Sonora.

Cómo citar / How to cite: Cuen-Romero, F.J., Rohr, D.M., Noriega-Ruiz, H.A., Monreal, R., Blodgett, R.B., Palafox-Reyes, J.J., Ochoa-Granillo, J.A., (2022). *Ulrichospira* Donald (Gastropoda – Phanerotrematidae) from the Middle Ordovician of central Sonora, Mexico: Paleobiogeographical considerations. *Paleontología Mexicana* 11(1), 29–34.

Manuscrito recibido: Mayo 30, 2022.

Manuscrito corregido: Mayo 30, 2022.

Manuscrito aceptado: Mayo 31, 2022.



1. Introducción

In Mexico, Ordovician outcrops are mainly distributed in the states of Baja California, Sonora, Chihuahua, and Oaxaca (Buitrón, 1992; Cuen-Romero *et al.*, 2020). Paleontological studies of Ordovician sedimentary sequences are scarce, recording a relatively well-preserved fossil biota made up of algae, sponges, bryozoans, brachiopods, gastropods, cephalopods, trilobites, echinoderms, graptolites, and conodonts (Robison and Pantoja-Alor, 1968; Poole *et al.*, 1995a; 1995b; Almazán-Vázquez *et al.*, 2006; Beresi *et al.*, 2012; Cuen-Romero *et al.*, 2022).

Of these faunas, gastropods are important because they are the most abundant and diverse group of mollusks, present in the fossil record from the Cambrian to recent times. These are adapted to a numerous environments, both marine and terrestrial (Milsom and Rigby, 2010).

Knowledge of gastropods from Ordovician of Mexico is limited, so that there are only two systematic works focused on the group. First one in the state of Oaxaca, the species *Eobucania mexicana* (Yochelson, 1968), is known in the Tiñú Formation from Lower Ordovician, and was associated with bellerophonitiform gastropods'

fragments, which are considered Tremadocian in age (Yochelson, 1968). Second one, written by Cuen-Romero *et al.* (2022) in the state of Sonora, who describes several species of gastropods from the Middle Ordovician of the Rancho Las Norias area, including *Maclurites acuminatus* (Billings, 1865), *?Monitorella* sp., *Lecanospira* sp., *Malayaspira* aff. *M. rugosa* Kobayashi, 1958, *Lophospira perangulata* (Hall, 1847), and *Hormotoma?* sp. Based on the above, and considering the abundance of gastropods from this area, which corresponding to the highest diversity Ordovician gastropod association in the country, a second collection of specimens from the Rancho Las Norias sequence was carried out. The objective of the present work is to describe and illustrate for the first time the species *Ulrichospira?* sp. in Mexico, which allows us to understand the distribution and early evolution of the Ordovician gastropods of Mexico and their affinity with the North American craton.

2. Location of the study area

The study area is located 5 km south of Rancho Las Norias, 30 km east of the Hermosillo city, at 29°1.064'N, 110°39.052'W; 28°58.347'N and 110°35.982'W (Figure 1).

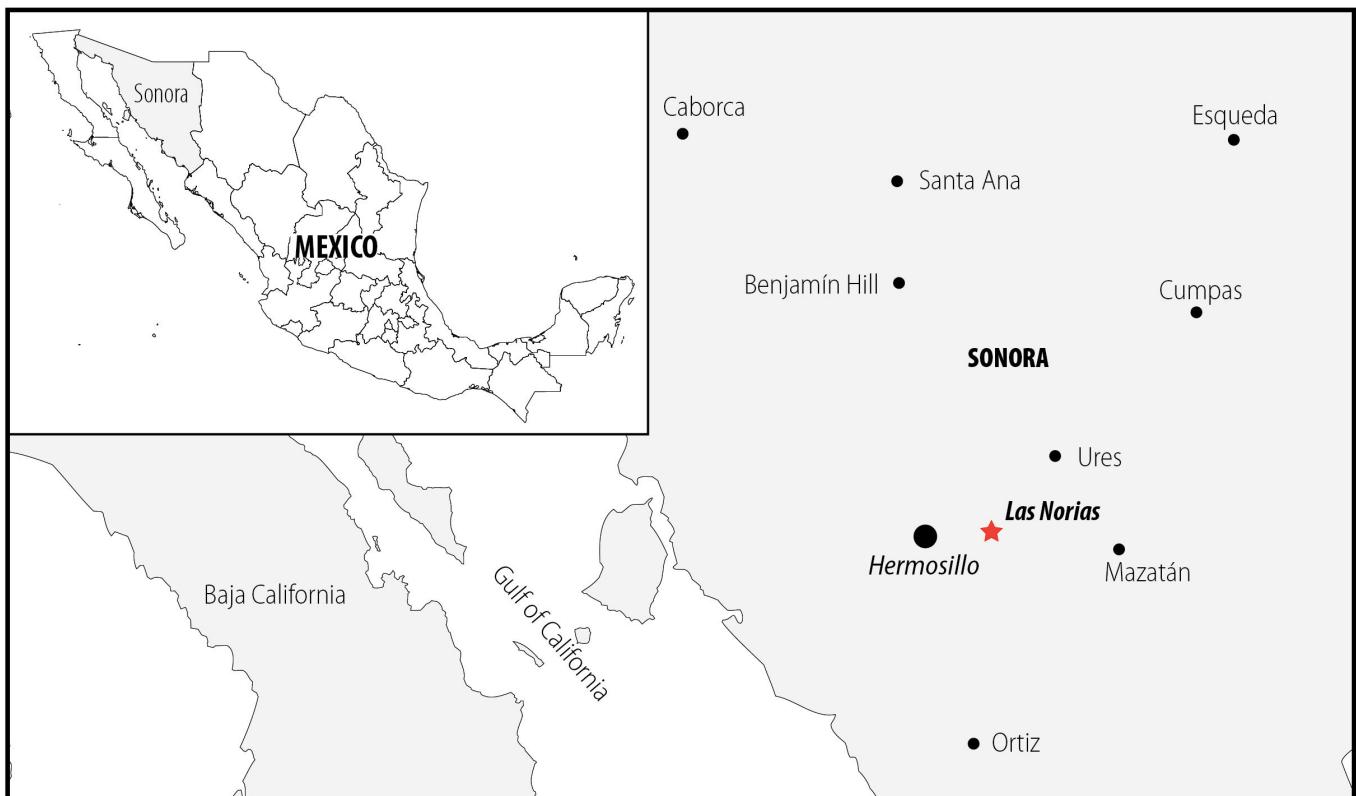


Figure 1. Location map of the study area.

3. Previous works

The geological works made in this area are scarce, and have been focused mainly on stratigraphic, paleontological, and microfacies studies. (Vega-Granillo and Araux-Sánchez, 1987; Page *et al.*, 2003; Almazán-Vázquez *et al.*, 2006; Beresi *et al.*, 2012; Cuen-Romero *et al.*, 2022). Stratigraphy for the study area was established by Vega-Granillo and Araux-Sánchez (1987), who described a succession of limestone with intraclasts, shale, fossiliferous limestone, dolomite and quartzite. Fauna at this unit was very abundant and composed of brachiopods, gastropods and trilobites, which was assigned to the Ordovician (Vega-Granillo and Araux-Sánchez, 1987).

Page *et al.* (2003), made a biostratigraphical study of the sequence, reporting the presence of an abundant biota made up by brachiopods, gastropods, cephalopods, trilobites, and conodonts from the *Histiodellella donnae* to *Histiodellella holodentata* Zone (Floian, Darriwillian). The above enabled dating the sequence for the first time with high precision. Then, Almazán-Vázquez *et al.* (2006) extended the geographic occurrence of this sequence to Rancho Pozo Nuevo, central Sonora.

After that, Beresi *et al.* (2012) made an Ordovician microfacies study in El Salazar hill at Rancho Las Norias. In this study, the authors documented the presence of abundant biota, in addition to conodonts from the *Oepikodus communis* to *Tripodus laevis* zones (Floian, Dapingian).

Recently, Cuen-Romero *et al.* (2022) made the first systematic study of Ordovician gastropods from the Rancho Las Norias sequence, documenting the presence of the species *Maclurites acuminatus*, ?*Monitorella* sp., *Lecanospira* sp., *Malayaspira* aff. *M. rugosa*, *Lophospira perangulata*, and *Hormotoma*? sp., and also relates these species to the North American craton and the Argentine Precordillera.

4. Stratigraphy

The studied sequence is composed mainly of limestone, silty and sandy limestone with dolomite and chert horizons, with abundant fossil fauna including brachiopods, gastropods, cephalopods, trilobites and conodonts from the Early–Middle Ordovician (Vega-Granillo and Araux, 1987; Page *et al.*, 2003; Cuen-Romero *et al.*, 2022). This unit overlies a Cambrian sequence consisting of sandstone and orthoquartzite, and discordantly underlies a Middle Devonian sequence (Vega-Granillo and Araux-Sánchez, 1987).

Intraclastic limestone package with intercalations of calcareous shale and massive limestone, which contains silicified annelid tubes and gastropods are placed at the base of the sequence (Cuen-Romero *et al.*, 2022). The middle part is composed of highly fossiliferous intraclastic limestone intercalated with calcareous shale moderately bioturbated while fossiliferous

content is depicted by the presence of gastropods (*Maclurites acuminatus*, ?*Monitorella* sp., *Lecanospira* sp., *Malayaspira* aff. *M. rugosa*, *Lophospira perangulata*, *Hormotoma*? sp.), and abundant orthid brachiopods (*Orthidiella* sp.) (Cuen-Romero *et al.*, 2022). The upper part of the sequence consists of sandy limestone and sandy dolomite with horizons of silty limestone and cross-bedded quartz sandstone lenses (Cuen-Romero *et al.*, 2022). According to Page *et al.* (2003) there are abundant orthid brachiopods, the gastropods *Maclurites* and *Palliseria*, and cephalopods (e.g., *Endoceras*) in the upper part of this unit (Figure 2).

5. Material and methods

The specimens were mechanically cleaned with a chisel and air hammer pen (34000 bpm, 0.1/*0.2 /0.3 mm, steel casing). Subsequently, analysis and photography were carried out at the Paleontology Laboratory, Department of Geology, University of Sonora, to complete the description of the material studied. First, it was necessary to apply colloidal graphite to each specimen and then stain the surface of the fossil with a

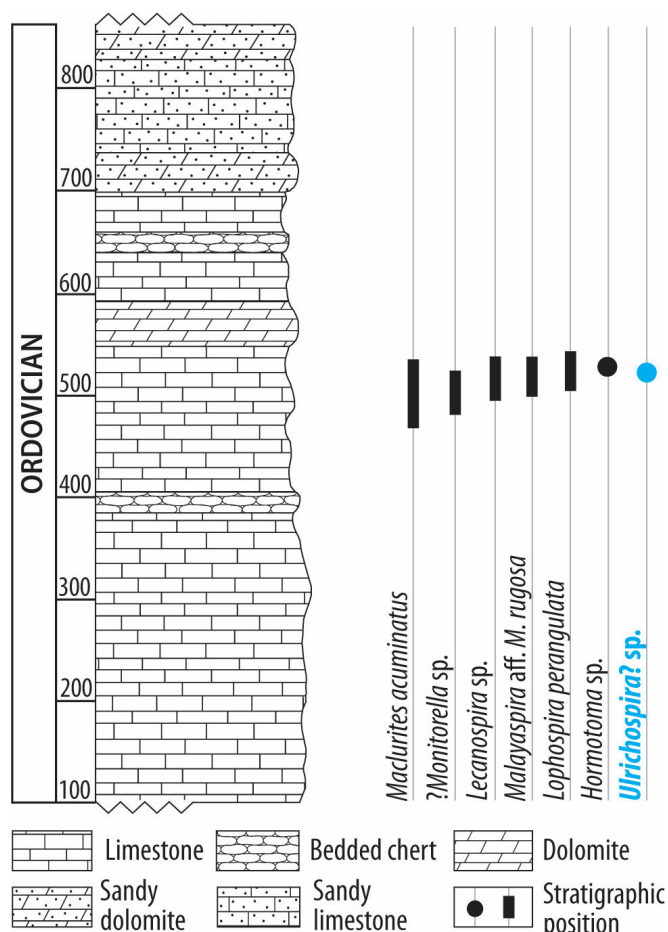


Figure 2. Stratigraphic column of the study area (Modified from Cuen-Romero *et al.*, 2022).

thin white film of ammonium chloride. The previously applied colloidal graphite absorbs the ammonium chloride and progressively the appropriate staining point for the sample is obtained.

Repository and institutional abbreviation: The material studied is deposited in the Paleontology Collection, Department of Geology, University of Sonora, with the acronym USDG. Classification of gastropods was based on the nomenclatural work of Bouchet *et al.* (2017).

6. Systematic Paleontology

Class Gastropoda Cuvier, 1795
Order Murchisoniina Cox and Knight, 1960
Superfamily Eotomarioidea Wenz, 1938
Family Phanerotrematidae Knight, 1956

Genus *Ulrichospira* Donald, 1905

Type species. *Ulrichospira similis* Donald, 1905. Silurian of Wales.

Ulrichospira? sp.
Figure 3.1–3.

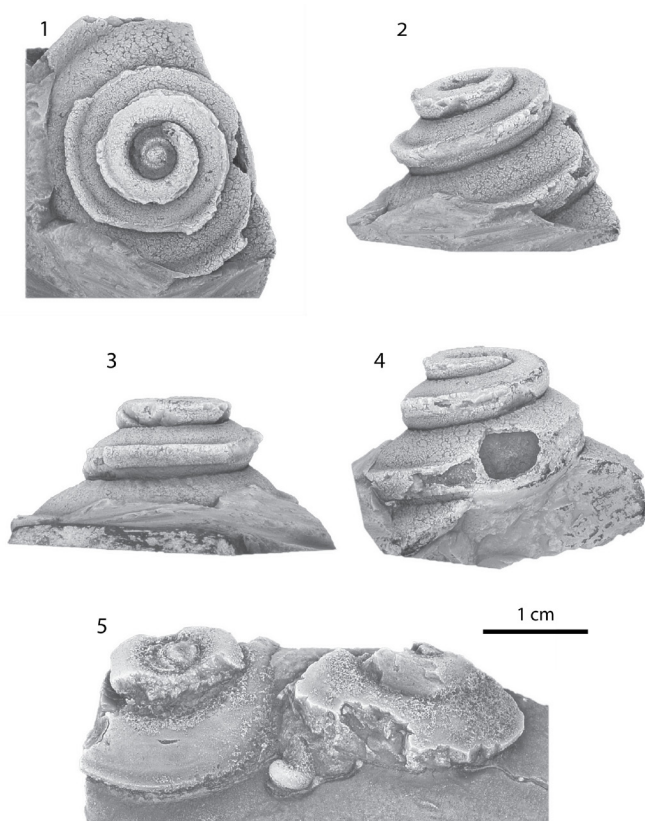


Figure 3. *Ulrichospira?* sp. from Las Norias formation. All specimens are from Las Norias area, central Sonora. (1–4) *Ulrichospira?* sp. USDG 401; (5) *Ulrichospira?* sp. USDG 402 and USDG 403.

Description. Apical angle about 75 degrees, sharp midwhorl angulation, upper whorl broadly convex from impressed suture to outer edge, outer margin appears to support a cord, base of shell unknown, no ornament present. Nature of aperture unknown.

Occurrence. Rancho Las Norias area, Lower–Middle Ordovician, Sonora, Mexico.

Material. Three illustrated specimens USDG 401, USDG 402 and, USDG 403. USDG 401 is the best-preserved due to silicification of the shell, beekite rings are clearly visible (Fig. 3.1–3.4). Specimens USDG 402 and USDG 403 are preserved as an inner calcareous moulds.

Remarks. Description is based on specimen USDG 401. This shell is lower spired than the type species, *U. similis*. The midwhorl angulation resembles *Lophospira*, but *Lophospira* is higher spired. The Sonora specimen is similar in size, spire, shape and prominent selenizone to *Ulrichospira notabilis* (Ulrich in Ulrich and Scofield, 1897) which was described from the Middle Ordovician Carter's Creek Limestone from Maury County, Tennessee and Mercer County, Kentucky. However, the Mexican specimens has no ornamentation and the aperture is not preserved, therefore, it is not possible to make a reliable determination. The shell is like *Schizolopha* described by Ulrich and Scofield (1897, pl. 65, fig. 30); however, Knight's photograph (1941, pl. 33, fig. 2) of the single known specimen illustrates that Ulrich and Scofield's drawing is not accurate. The Devonian *Ulrichospira kanekoi* Kase and Nishida 1986, is similar to *U. similis* but it has thicker cords which are not present on the Sonora specimens. *U. similis* of Pitcher (1939) is higher spired.

7. Paleobiogeographic considerations

As mentioned above, the gastropod association of the Rancho Las Norias sequence is composed of *Maclurites acuminatus*, *Monitorella* sp., *Lecanospira* sp., *Malayaspira* aff. *M. rugosa*, *Lophospira perangulata* and *Hormotoma?* sp. In the previous faunal assemblage of the Rancho Las Norias, there is a poorly preserved specimen, which does not expose the base; however, it is identified within the genus *Ulrichospira* Donald due to the form of the spire. The genus *Ulrichospira* was distributed mainly in the Silurian of Europe.

The Rancho Las Norias gastropod association has a wide geographical distribution, and the species documented in this region have also been described from Greenland, Canada, United States, Argentina and Mexico (Table 1).

8. Conclusions

The gastropod *Ulrichospira* sp. from the Middle Ordovician (Whiterockian) of central Sonora is reported for the first time for Mexico. The Ordovician

Table 1. Distribution of gastropod species of Ordovician Rancho Las Norias. GR= Greenland, CA= Canada, US= United States of America, MX= Mexico, AR= Argentina

Species	Formation	Location	Country
<i>Maclurites acuminatus</i>	Narwhale Sound	Greenland	GR
	Table Point	Newfoundland	CA
	Fort Cassin	Vermont	
<i>Lecanospira</i> sp.		Quebec	CA
		Newfoundland	
		Labrador	
		Alberta	
		Alaska	
		Georgia	US
		Maryland	
		Minnesota	
		New York	
		North Dakota	
		Pennsylvania	
		Texas	
		Utah	
		Sonora	MX
		Alberta	CA
<i>Malayaspira</i> aff. <i>M. rugosa</i>	Skoki	British Columbia	
	Kechika	Newfoundland	
	Table Point	Labrador	
	Precordillera of San Juan Province	Western Argentina	AR
	Las Norias	Sonora	MX
<i>Lophospira perangulata</i>	Narwhale Sound	Greenland	GR
	Cape Calhoun	Province of Ontario	CA
	Gull River		
	Bobcaygeon		
	Verulam		
	Lindsay		
	Lowville		
	Watertown		
	Table Point	Newfoundland	CA
		Labrador	
		Alaska	US
		California	
		Colorado	
		Illinois	
		Iowa	
		Indiana	
		Kentucky	
		Minnesota	
		Missouri	
		Nevada	
		New York	
		Ohio	
		Pennsylvania	
		Tennessee	
		Virginia	
		Sonora	MX
<i>Hormotoma</i> ? sp.		Ontario	CA
		Quebec	
		Manitoba	
		Nunavut	
		North Territories	
		Alaska	US
		Arkansas	
		California	
		Georgia	
		Illinois	
		Iowa	
		Indiana	
		Kentucky	
		Maryland	
		Michigan	
		Minnesota	
		Missouri	
		Montana	
		New York	
		Ohio	
		Oklahoma	
		Texas	
		Vermont	
		Virginia	
		Wisconsin	
		Wyoming	
<i>Ulrichospira notabilis</i>	Las Norias	Sonora	MX
	Carter's Creek Limestone	Tennessee	US
		Kentucky	
<i>Ulrichospira</i> ? sp.	Las Norias	Sonora	MX

paleocommunity of Rancho Las Norias was developed in a shallow marine environment, in the Laurentia platform. The similarity of the species documented for this region with those of Canada, United States and Argentina demonstrates the affinity of the biota of Mexico with North America during the Ordovician.

Acknowledgments

The authors are grateful to the Department of Geology of the University of Sonora for providing financial support to carry out this research. The authors also thank two anonymous reviewers for improvements made to the manuscript.

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