

Jurassic Brachiopods from the Dejen-Gohatsion Section, Blue Nile Basin, Central Ethiopia: Systematics, Paleoecology and Biogeographic Implications

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A B S T R A C T

The Blue Nile Basin of central Ethiopia preserves thick Jurassic marine successions deposited during repeated Tethyan transgressions. This study documents and systematically describes Jurassic brachiopods from the Dejen-Gohatsion section, based on 360 collected specimens, of which 38 well-preserved samples were selected for detailed analysis. The assemblage is represented by two orders: Rhynchonellida and Terebratulida, comprising five taxa: *Daghanirhynchia sp.*, *Somalirhynchia africana*, *Cymatorhynchia sp.*, *Monsardithyris sp.*, and *Cererithyris sp.*

Morphological descriptions, taxonomic classification, and stratigraphic distribution indicate that the fauna inhabited a shallow marine carbonate environment dominated by marly limestone deposition. The assemblage shows strong affinity with Middle-Late Jurassic Tethyan faunas of North and East Africa, Arabia, and the Levant. Biogeographic comparison supports the existence of an Ethiopian Province during the Callovian-Kimmeridgian stages, although its extent appears more restricted than previously proposed. The absence of similar assemblages in Tanzania and India suggests paleolatitudinal control on faunal distribution.

This study improves understanding of Jurassic marine paleoenvironments in the Blue Nile Basin and contributes to regional paleobiogeographic correlation within the southern Tethyan realm.

Keywords: Brachiopoda, Jurassic, Blue Nile Basin, Ethiopian Province, Tethys, Paleoecology, Biogeography

Introduction

Jurassic sedimentary basins of Ethiopia record major paleogeographic and tectonic events associated with the breakup of Gondwana and the opening of the Indian Ocean. The Blue Nile (Abay) Basin represents one of the most significant Mesozoic sedimentary basins on the Northwestern Ethiopian Plateau. Its stratigraphy includes thick marine carbonate sequences deposited during repeated Jurassic transgressions.

Brachiopods are important marine benthic fossils widely used in:

- Biostratigraphy
- Paleoenvironmental reconstruction
- Paleobiogeographic analysis
- Evolutionary studies

Despite extensive research on stratigraphy and sedimentology

of the Blue Nile Basin, systematic paleontological studies of Jurassic brachiopods remain limited. This study aims to document, describe, and interpret Jurassic brachiopod assemblages from the Dejen–Gohatsion section.

2. Geological Setting

The Dejen-Gohatsion section is located within the Blue Nile (Abay) Basin of central Ethiopia on the Northwestern Ethiopian Plateau. The basin is underlain by Precambrian basement rocks and contains thick Mesozoic sedimentary sequences, including Jurassic carbonate units. The brachiopod fossils were collected from marly limestone beds within the Jurassic succession, particularly in the Antalo Limestone equivalent. These deposits were formed during repeated marine transgressions related to the opening of the Indian Ocean and the breakup of Gondwana, which led to the development of shallow marine environments across the basin.

3. Materials and Methods

Study area

The study was conducted in the Dejen-Gohatsion section of the Blue Nile (Abay) Basin, central Ethiopia. The area is located within the Northwestern Ethiopian Plateau and consists of well-exposed Jurassic sedimentary sequences, particularly marly limestone beds containing brachiopod fossils. Fossiliferous outcrops were examined at three localities: Gelegele, Dembeza, and Filikilik.

Field methods

Fieldwork was carried out through systematic stratigraphic logging and fossil collection. Lithological descriptions were recorded for each stratigraphic unit, including rock color, texture, sedimentary structures, fossil content, and stratigraphic relationships. Fossil-bearing layers were documented using photography and GPS coordinates. A total of 360 brachiopod specimens were collected from the selected sections. Sampling was conducted to ensure representation of the complete stratigraphic succession. Standard geological field equipment was used, including a GPS device, geological hammer, Brunton compass, measuring tape, hand lens, sample bags, notebook, and camera.

Laboratory methods

In the laboratory, collected specimens were cleaned using mechanical preparation methods. The fossils were washed and examined carefully to remove matrix material. From the total collection, 38 well-preserved specimens were selected for detailed taxonomic study. Morphological features such as shell shape, size, ornamentation, fold and sulcus development, commissure type, and beak characteristics were measured and described. Identification and classification were carried out following the systematic framework presented in the Treatise on Invertebrate Paleontology¹. Comparative analysis was conducted using previously published literature and regional brachiopod records.

Data Analysis

The collected data were used for taxonomic classification, stratigraphic interpretation, paleoenvironmental reconstruction, and biogeographic comparison. Morphological comparisons were made with Jurassic brachiopod assemblages from other

Ethiopian regions and selected Tethyan localities to assess paleobiogeographic relationships.

Systematic Paleontology

Classification follows Moore¹, Treatise on Invertebrate Paleontology.

Phylum Brachiopoda Duméril, 1806

Subphylum Rhynchonelliformea Williams et al., 1996

Class Rhynchonellata Williams et al., 1996

Order Rhynchonellida Kuhn, 1949

Family Tetrarhynchiidae Ager, 1965

Subfamily Tetrarhynchiinae Ager, 1965

Genus Daghanirhynchia Muir-Wood, 1935

Type species: *Daghanirhynchia daghaniensis* Muir-Wood²

Daghanirhynchia sp.

- **Material examined:** Five specimens collected from Gelegele, Dembeza, and Filikilik localities (Sample codes: DG1, DG2, DD1, DF1, DF2).
- **Stratigraphic horizon:** Upper marly limestone beds.
- **Diagnosis:** Shell dorsibiconvex; width slightly greater than length; anterior commissure rectimarginate; fold absent; beak short and acute; surface ornamented with fine radial costae, occasionally bifurcating.

Description

Shell small to medium-sized, wider than long. Maximum width occurs at mid-length. Ventral valve slightly depressed medially, producing a weak commissural furrow. Costae fine and evenly distributed on both valves. Pedicle opening prominent. Dorsal valve more convex than ventral valve.

- **Remarks:** Externally similar to *D. daghaniensis*. Identification is based on shell morphology; internal features were not observed.
- **Locality:** Gelegele, Dembeza, Filikilik.
- Genus *Somalirhynchia* Weir, 1935
- **Type species:** *Somalirhynchia africana* Weir, 1925

Somalirhynchia africana Weir

- **Material examined:** Ten specimens from Gelegele, Dembeza, and Filikilik (SG1–SF4).
- **Stratigraphic horizon:** Marly limestone beds.
- **Age:** Oxfordian–Kimmeridgian.
- **Diagnosis:** Large shell; subtrigonal outline; strong fold and sulcus; numerous coarse costae (26–35); anterior commissure strongly uniplicate.

Description

Shell large and thick, maximum width at mid-length. Dorsal valve convex with distinct fold. Ventral valve bears broad sulcus. Costae strong, subangular, and well developed on both valves. Beak robust with well-defined ridges.

- **Remarks:** Distinguished from *Daghanirhynchia* by larger size and more developed fold and interarea.
- **Distribution:** North and East Africa, Arabia, Middle East, Europe.

Genus *Cymatorhynchia* Zieten, 1830

- **Type species:** *Cymatorhynchia quadriplicata* (Zieten, 1830)
- *Cymatorhynchia* sp.
- **Material examined:** Fourteen specimens from all three localities (CG1–CF4).
- **Stratigraphic horizon:** Marly limestone beds.
- **Age:** Aalenian–Upper Bajocian.
- **Diagnosis:** Medium-sized shell; subquadrate outline; moderate fold and sulcus; fewer but strong costae; anterior commissure uniplicate.

Description

Shell moderately dorsibiconvex. Ventral valve with shallow sulcus bearing several costae. Dorsal valve with low fold. Beak short to suberect. Costae strong and subangular.

- **Remarks:** Closely related to *Kutchirhynchia*; represents typical Tethyan Middle Jurassic element.
- **Distribution:** Europe, Africa, Arabia, India, China.
- **Order Terebratulida Waagen, 1883**
- **Family Lissajousithyrididae Cooper, 1983**
- **Subfamily Lissajousithyridinae Cooper, 1983**
- **Genus Monsardithyris Alméras, 1971**
- **Type species:** *Terebratula ventricosa* Hartmann

Monsardithyris sp.

- **Material examined:** Three specimens (MG1, MD1, MF1).
- **Stratigraphic horizon:** Marly limestone beds.
- **Diagnosis:** Small, smooth shell; subcircular outline; weak or absent fold and sulcus; large foramen.
- **Description:** Shell smooth and biconvex. Commissure rectimarginate to weakly uniplicate. Beak short with prominent foramen. Growth lines faint.
- **Remarks:** Specimens likely represent juvenile or young adult forms due to small size and weak ornamentation.
- **Distribution:** Jurassic of Europe, Africa, Arabia, and Asia.

Genus *Cererithyris* Buckman

Cererithyris sp.

- **Material examined:** Five specimens (CrD1, CrG1, CrF1, CF2).
- **Stratigraphic horizon:** Marly limestone beds.
- **Diagnosis:** Elongate globular shell; smooth surface; weak median costa; sulcinate anterior margin.
- **Description:** Shell small, moderately globular. Beak low with large foramen. Fold and sulcus very weak. Considerable intraspecific variation observed.
- **Remarks:** Identification limited to genus level due to morphological variability.
- **Distribution:** Aalenian–Upper Bajocian; widespread in Tethyan Realm.

Paleoenvironmental Interpretation

The brachiopod assemblage is dominated by rhynchonellid and terebratulid taxa, which typically indicate normal marine conditions. The presence of well-preserved articulated shells

within marly limestone suggests deposition in a shallow, low- to moderate-energy marine environment, likely on a carbonate ramp or inner shelf setting. The fossil association, together with the lithology, indicates stable marine conditions with adequate oxygenation and normal salinity during Middle to Late Jurassic transgressive phases.

Biogeographic Implications

The studied brachiopod fauna shows strong affinity with contemporaneous Tethyan assemblages from North and East Africa, Arabia, and the Levant. This supports the existence of a Jurassic Ethiopian Paleobiogeographic Province during the Callovian–Kimmeridgian stages. However, comparisons suggest that the geographic extent of this province was more restricted than traditionally proposed, with Tanzania and India showing distinct faunal characteristics, possibly due to paleolatitudinal climatic differences within the southern Tethys realm.

4. Conclusion

The Jurassic brachiopod fauna from the Dejen-Gohatsion section comprises five taxa belonging to the orders Rhynchonellida and Terebratulida and occurs within marly limestone beds of the Blue Nile Basin. The assemblage reflects shallow marine Tethyan conditions and contributes valuable information on the taxonomy, paleoecology, and biogeography of Jurassic brachiopods in Ethiopia. The results support the presence of an Ethiopian Province during the Middle-Late Jurassic and enhance regional stratigraphic and paleobiogeographic correlations within the southern Tethyan domain.

5. Recommendations

- Further systematic paleontological studies should be conducted in additional stratigraphic sections of the Blue Nile Basin to improve the completeness and reliability of the brachiopod record.
- Expanded sampling across different lithostratigraphic units is recommended to better understand the vertical distribution and evolutionary trends of Jurassic brachiopods in the basin.
- Advanced laboratory techniques, such as Scanning Electron Microscopy (SEM), should be applied to examine shell microstructures and improve taxonomic resolution.
- Quantitative paleoecological and biogeographic analyses should be incorporated in future studies to refine interpretations of the Ethiopian Province and its relationship to the Tethyan Realm.
- Integration of brachiopod data with other fossil groups (e.g., ammonites, bivalves, foraminifera) is recommended for improved biostratigraphic correlation and paleoenvironmental reconstruction.
- Collaborative interdisciplinary research combining paleontology, stratigraphy, sedimentology, and geochemistry is strongly encouraged to enhance understanding of Jurassic marine environments in Ethiopia.

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