A note on the biostratigraphy of Paleocene-Eocene larger foraminifera from western Cuba

Silvia Blanco-Bustamente1, Gena Fernández-Rodríguez1 and Richard H. Fluegeman2

1 Oil development Research Centre, CUPET, P. O. Box 118, Havana, Cuba
2 Dept. of Geology, Ball State University, Muncie, IN 47306-0475, USA
E-mail: rfluegem@gw.bsu.edu

ABSTRACT: Larger foraminifera were collected from various Paleocene and Eocene localities in western Cuba. Included was a measured section at San Francisco de Paula in Ciudad de la Habana Province in the Apolo and Capdevila Formations. This section spans the Paleocene/Eocene boundary and has been the focus of intensive biostratigraphic work. In this study, the stratigraphic occurrences of the larger foraminifera were correlated to biozonations based on planktonic foraminifera, calcareous nannofossils, radiolaria, and smaller benthic foraminifera already identified at San Francisco de Paula. Most of the above localities consist of synorogenic sedimentary rocks and the larger foraminifera collected from these sites have in fact been transported to deep water. In order to obtain some in situ larger foraminifera, additional upper Paleocene and lower Eocene samples were obtained from 10 wells in episutural basins from throughout Cuba.

In all, eleven species of larger foraminifera were identified from the upper Paleocene and lower Eocene of Cuba. These are: Ranikothalia catenula (Cushman and Jarvis) (=Operculina catenula 1932), Discocyclina barkeri Vaughan and Cole, Discocyclina anconensis Barker, Discocyclina weaveri Vaughan, Eoconuloides lopesrigoi (Palmer) (=Amphistegina lopesrigoi 1934), Eoconuloides wellsi Cole and Bermudez, Esafabiania cushmani (Vaughan) (=Discocyclina cushmani 1929), Athecocyclina stephensi (Vaughan) (=Discocyclina stephensi 1929), Pseudophargmina cedarkeysensis, Cole, Hexagonocyclina cristaensis (Vaughan) (=Orbitoclypeus? cristaensis 1924), and Cushmania americana (Cushman) (=Conulites americana 1919). The larger foraminifera from Paleocene age samples contain an assemblage recognized throughout the Caribbean and Gulf Coastal Plain as the Ranikothalia catenula fauna. Eocene samples contain an assemblage of larger foraminifera refered to here as the Eoconuloides wellsi fauna. Based on data collected at the San Francisco de Paula section, the change from the Ranikothalia catenula fauna to the Eoconuloides wellsi fauna appears to post-date the benthic faunal turnover associated with the bathyal realm.

INTRODUCTION

Larger foraminifera from the Paleocene and Eocene of Cuba have been the focus of paleontologic study for many years. Among the most significant are the works of Cole and Bermúdez (1947), Bermúdez (1950), Cole and Gravell (1953) and Sachs (1957). These studies were predominantly taxonomic in their focus and no attempt was made to place any of these fossils within a biostratigraphic framework. Other papers which included Cuban larger foraminiferal data as part of broad regional studies include the work of Vaughan (1945) and Cole (1959). Both of these studies did address the issue of stratigraphic position of various taxa and assemblages in the

TEXT-Figure 1
Map of Cuba showing the location of wells used in this study. Identified basins are from Iturralde-Vinent (1994).
Paleocene and Eocene. Cole (1959) identified the Operculina catenula fauna as being characteristic of the late Paleocene in the Caribbean and Gulf Coastal Plain. Although loosely defined, this was the first widely recognized Paleogene larger foraminiferal “biozone” established in the Caribbean region.

More recent works on the Paleocene-Eocene larger foraminifera of Cuba have focused on the stratigraphic distribution of taxa within the synorogenic formations of La Habana, Ciudad de la Habana, and Piñar del Río Provinces. Among these important studies are Sachs (1957), Brönnimann and Rigasi (1963), Blanco-Bustamente and Díaz (1985), and Blanco-Bustamente et al. (1987).
<table>
<thead>
<tr>
<th>FM.</th>
<th>Lithology</th>
<th>SAMPLES</th>
<th>LARGER FORAMINIFERA</th>
<th>BIOZONES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPDEVILA</td>
<td></td>
<td></td>
<td></td>
<td>P7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P6b</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P4</td>
</tr>
</tbody>
</table>

**TEXT-Figure 4**
Distribution of larger foraminifera at the San Francisco de Paula section.
The Paleocene and Eocene larger foraminifera of Cuba are of special interest to biostratigraphers. Most of the known Paleocene and Eocene localities in western Cuba (Pinar del Rio and La Habana Provinces) that have produced assemblages of larger foraminifera contain abundant planktonic foraminifera as well as calcareous nannofossils (Blanco-Bustamente et al. 1987). Blanco-Bustamente et al. (1987) identified eleven species of macroforaminifera from these localities and correlated them with planktonic foraminiferal biozones. This provides the framework for the correlation of larger foraminiferal bioevents to the global geochronologic scale of Berggren et al. (1995) and may assist in the development of a regionally recognized biozonation. A summary of the work of Blanco-Bustamente et al. (1987) is shown in text-figure 2.

SECTIONS STUDIED

Most outcrops across the upper Paleocene-lower Eocene interval in Cuba consist of synorogenic sedimentary rocks. These rocks were deposited during the collision of the Cuban segment of theGreater Antillean Arc with the North American Plate (Bralower and Ituralde-Vinent 1997; Ituralde-Vinent and McPhee 1999). The San Francisco de Paula section in Ciudad de la Habana is the focus of current Paleocene-Eocene biostratigraphic studies in Cuba (Fernández-Rodriguez et al. 1999; Sanfilippo and Hull 1999; Fluegeman 1999; Aubry 1999, all this volume) and is section formed in this active tectonic setting. As most of the larger foraminifera at San Francisco de Paula are found in turbidites derived from the shelf, it is unreasonable to expect a complete stratigraphic record of this group at this location. In order to develop a comprehensive biostratigraphic record of the larger foraminifera, several deep wells located throughout Cuba in episutural ("piggy-back") basins of Ituralde-Vinent (1994) were examined. In all, cuttings and cores from ten wells were used in this study. These wells are shown in text-figure 1.

PALEOCENE-EOCENE LARGER FORAMINIFERA IN "PIGGY-BACK" BASINS

Eight species of larger foraminifera were identified from samples in the ten wells. Planktonic foraminifera were studied from the wells by Fernández-Rodriguez and Blanco-Bustamente (1985) and each interval was assigned to a standard biozone. The ranges of the Paleocene-Eocene larger foraminifera relative to these biozones is shown in text-figure 3. The composite biostratigraphic ranges of the seven species compare favorably to their ranges observed in other regions. Especially significant are the ranges of biostratigraphically important species such as Ranikothalia catenula, Athecocyclina stephensoni, Hexagonocyclina cristensis, Eoconuloides wellsii, and Eoconuloides lopeztrigoi. The composite biostratigraphic ranges of these species in Cuba are similar to their ranges recently identified in Jamaica by Robinson and Wright (1993).

The Paleocene assemblage in Cuba consists of Ranikothalia catenula, Discocyclina barkeri, Eoconuloides lopeztrigoi, Hexagonocyclina cristensis, and Athecocyclina stephensoni. This assemblage is nearly identical to the one identified by Sachs (1957) from the Madruga Formation of La Habana Province. Similar associations of larger foraminifera have been identified from Paleocene age rocks from Jamaica (Robinson and Wright 1993), Mexico (Vaughan 1924 1929; Barker 1939), Trinidad (Vaughan and Cole 1941; Caudri 1944, Vaughan 1945), Venezuela (Caudri 1944; Cizancourt 1951, Barbados (Vaughan 1945), Alabama (Vaughan 1936 1945; Toulmin 1941; Bryan et al. 1997), and Georgia (Cole and Herrick 1953). This assemblage is assignable to the Operculina catenula assemblage (henceforth referred to as the Ranikothalia catenula assemblage) of Cole (1959). As used in this paper, the Ranikothalia catenula assemblage is recognized in Cuba by the co-occurrence of Ranikothalia catenula, Discocyclina barkeri, Hexagonocyclina cristensis, Athecocyclina stephensoni, and Eoconuloides lopeztrigoi in the absence of Eoconuloides wellsii.

The biostratigraphic range of the Ranikothalia catenula assemblage in Cuba is from the upper Paleocene Planorotalites pseudomenardii planktonic foraminiferal biozone (Zone P4) of Berggren et al. (1995) through the Morozovella velascoensis biozone (Zone P5) of Berggren et al. (1995). This restricts the Ranikothalia catenula assemblage to the upper Paleocene in Cuba.

The upper limit of the Ranikothalia catenula assemblage in Cuba is recognized by the first stratigraphic occurrence of Eoconuloides wellsii. Also at approximately the same horizon is the last stratigraphic occurrence of Athecocyclina stephensoni. Both of these biostratigraphic markers occur at the boundary of the Morozovella velascoensis planktonic foraminiferal zone (Zone P5) and the Morozovella subbotinae planktonic foraminiferal biozone (Zone P6) as defined by Berggren et al. (1995). The boundary of these two biozones is recognized as the Paleocene-Eocene boundary in Cuba. Thus, the Ranikothalia catenula assemblage extends to the Paleocene-Eocene boundary throughout Cuba.

The assemblage of macroforaminifera associated with the lowermost Eocene in Cuba consists of Eoconuloides wellsii, Ranikothalia catenula, Eoconuloides lopeztrigoi, Hexagonocyclina cristensis, Eoconuloides wellsii, and Eoconuloides lopeztrigoi. The composite biostratigraphic ranges of these species in Cuba are similar to their ranges recently identified in Jamaica by Robinson and Wright (1993).

PLATE 1

1 Ranikothalia catenula (Cushman and Jarvis). Megalospheric axial section of a specimen from the Taguasco 2 well.

2 Ranikothalia catenula (Cushman and Jarvis). Megalospheric axial section of a specimen from the Apolo Formation at the San Francisco de Paula section.

3 Ranikothalia catenula (Cushman and Jarvis). Microspheric oblique section of a specimen from the Apolo Formation at the San Francisco de Paula section.
cyclina inflata, Discocyclina Barkeri, Discocyclina anconensis, and Pseudophragmina cedarkeysensis. This assemblage is herein referred to as the Eoconuloides wellsi assemblage and is defined as consisting of the above association of species in the absence of Helicostegina gyralis Barker and Grimsdale.

The biostratigraphic range of the Eoconuloides wellsi assemblage in Cuba is from the Morozovella subbotinae planktonic foraminiferal biozone (Zone P6) of Berggren et al. (1995) through the Morozovella aragonensis planktonic foraminiferal biozone (Zone P8) of Berggren et al. (1995).

LARGER FORAMINIFERA FROM THE SAN FRANCISCO DE PAULA SECTION

The San Francisco de Paula section consists of 53 meters of interbedded turbidite sands and clays of the Apolo and Capdevila Formations (Paleocene-Eocene age). Of the 118 samples collected for biostratigraphic study at San Francisco de Paula, only 7 contained macroforaminifera. All of these samples were collected from within the Apolo Formation. This scarcity of larger foraminifera is not surprising given that the San Francisco de Paula section was deposited under bathyal conditions (Fluegeman 1999, this volume). The distribution of larger foraminifera at San Francisco de Paula is shown in text-figure 4.

Larger foraminifera present at San Francisco de Paula include Ranikothalia catenula, Discocyclina Barkeri, Hexagonocyclina inflata, Eoconuloides Lopeztrigoi, and Athecocyclina stephensi. This assemblage is characteristic of the Ranikothalia catenula fauna. The uppermost sample containing macroforaminifera is at the base of a large conglomerate bed interpreted as an olistostrome. The fossils from this sample were not identified to species level and appear to be reworked.

Other outcrops of the Apolo Formation in the vicinity of Ciudad de la Habana have produced larger foraminifera. Brönimnan and Rigassi (1963) report an assemblage from an outcrop of the Apolo Formation at Reparto Alta Habana approximately 10 km to the west of San Francisco de Paula (see Bröninan and Rigassi 1963, p. 286.) This section contained an assemblage of larger foraminifera from three poorly sorted, biofragmental limestone beds. Taxa in this assemblage included Ranikothalia catenula, Discocyclina Barkeri, Discocyclina cf. Barkeri, Proporocyclina cf. cedarkeyensis, Discocyclina anconensis, and Eoconuloides Lopeztrigoi. As at San Francisco de Paula, the assemblage is characteristic of the Ranikothalia catenula fauna.

The Capdevila Formation at the San Francisco de Paula section did not contain identifiable larger foraminifera.

DISCUSSION

The stratigraphic distribution of Paleocene and Eocene larger foraminifera in Cuba is similar to the patterns seen elsewhere in the Caribbean. The change from the Ranikothalia catenula fauna to the Eoconuloides wellsi fauna is associated with the Paleocene-Eocene transition in Cuba. The absence of the Eoconuloides wellsi fauna from the San Francisco de Paula section however, did not permit a more precise correlation of this faunal turnover. What can be said from the present study is that taxa characteristic of the Ranikothalia catenula fauna are found stratigraphically above the highest occurrence of the smaller benthic foraminifera Stensoina beccariformis and Osangularia velascoensis at San Francisco de Paula (Fluegeman, this volume). The disappearance of these two species is associated with the global bathyal benthic foraminiferal extinction. The occurrence of the Ranikothalia catenula fauna above this level suggests that the turnover in larger foraminiferal faunas is not related to the benthic foraminiferal extinction in the bathyal realm. Further sampling at more complete Paleocene and Eocene sections in Cuba and elsewhere in the Caribbean region may reveal more about the true nature of this faunal turnover.

REFERENCES


PLATE 2

1 Athecocyclina stephensi (Vaughan). Axial section of specimen from the Apolo formation at the San Francisco de Paula section. X100.

2 Discocyclina weaveri (Vaughan). Axial section of specimen from the Granma well. X100.

3 Discocyclina weaveri (Vaughan). Axial section of specimen from the Granma well. X100.

4 Eoconuloides wellsi Cole and Bermudez. Axial section of specimen from the Guayacanes 7 well. X25.

5 Cushmania americana (Cushman). Axial section of specimen from the Granma 1 well. X25


