

**APPENDIX C: FORAMINIFERAL DATA FOR MONTEREY CLASTS**

**Foraminiferal analysis of thin sectioned clasts, interbedded gravel with marine  
Wilson Grove Formation, Sonoma County, California**

**M-1: Sample Locality on Plate 2**

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**MICROSCOPIC ANALYSIS**

**Slide #1N**

Recognizable Planktic Taxa: *Globigerina bulloides*, spongodiscid radiolarian

Recognizable Benthic Taxa: none

P:B Ratio = 50:0

% Planktics = 100.0

**Slide #1A**

Recognizable Planktic Taxa: *Globigerina bulloides*, *Globigerina pseudociperoensis*

Recognizable Benthic Taxa: none

P:B Ratio = 30:2 = 15:1

% Planktics = 93.8

**Slide #2**

Recognizable Planktic Taxa: spongodiscid radiolarian

Recognizable Benthic Taxa: *Siphonodosaria quadrilatera*?

P:B Ratio = 13:5

% Planktics = 72.2

**Slide #3**

Recognizable Planktic Taxa: none

Recognizable Benthic Taxa: none

P:B Ratio = 3:5

% Planktics = 37.5

**Slide #4**

Recognizable Planktic Taxa: *Globigerina bulloides*, *Globigerina pseudociperoensis*,  
*Tenuitellinata angustiumbilitata*

Recognizable Benthic Taxa: *Gyroidina rosaformis*

P:B Ratio = 37:6 = 6:1 (P includes 1 radiolarian)

% Planktics = 86.0

**Slide #5**

Recognizable Planktic Taxa: none

Recognizable Benthic Taxa: none

P:B Ratio = 2:2 = 1:1  
 % Planktics = 50.0

**Slide #6**

Recognizable Planktic Taxa: *Globigerina bulloides*  
 Recognizable Benthic Taxa: *Bolivina* sp., *Siphonodosaria quadrilatera*  
 P:B Ratio = 8:1  
 % Planktics = 72.0

**Slide #7**

Recognizable Planktic Taxa: none  
 Recognizable Benthic Taxa: none  
 P:B Ratio = 4:4 (P includes 1 radiolarian)  
 % Planktics = 50.0

**Slide #8**

Recognizable Planktic Taxa: *Globigerina bulloides*, spongodiscid radiolarian  
 Recognizable Benthic Taxa: *Gyroidina rosaformis*, *Protoglobobulima pseudotorta?*,  
*Siphonodosaria quadrilatera*  
 P:B Ratio = 1:1  
 % Planktics = 50.0  
 Comments: Very meager assemblage

**Slide #9**

Recognizable Planktic Taxa: *Globigerina bulloides*, spongodiscid radiolarian  
 Recognizable Benthic Taxa: none  
 P:B Ratio = 2:5  
 % Planktics = 28.6

**Slide #14**

Recognizable Planktic Taxa: *Globigerina pseudociperoensis*  
 Recognizable Benthic Taxa: none  
 P:B Ratio = 22:0  
 % Planktics = 100.0

**Slide #16**

Recognizable Planktic Taxa: *Globigerina pseudociperoensis*  
 Recognizable Benthic Taxa: none  
 P:B Ratio = 36:0  
 % Planktics = 100.0

**Slide #18**

Recognizable Planktic Taxa: ? *Globigerina pseudociperoensis*, spongodiscid radiolarian  
 Recognizable Benthic Taxa: *Nodogenerina sagrinensis*

P:B Ratio = 10:0  
 % Planktics = 100.0  
 Comments: Most specimens are crushed

#### **Slide #19**

Recognizable Specimens: none  
 P:B Ratio = none  
 % Planktics = none

#### **Slide #20**

Recognizable Planktic Taxa: none  
 Recognizable Benthic Taxa: *Gyroidina rosaformis*  
 P:B Ratio = 0:3  
 % Planktics = 0.0

#### **Slide #21**

Recognizable Planktics: *Tenuitellinata angustiumbilitata*  
 Recognizable Benthics: *Buliminella subfusiformis*, ?*Globobulimina pseudotorta*,  
 P:B Ratio = >9:1  
 % Planktics = >90%  
 Comments: Abundant foram voids; shell material is very scarce

### SUMMARY

The taxa recognized on these 16 slides are among the most commonly occurring and abundant in the Monterey Formation. The slides include 262 specimens that were identifiable as either planktic (227 specimens) or benthic (35 specimens) on the basis of their geometries and test wall structures. The planktics, which include a few radiolarians, account for 86.64% of the total. Thus, the overall P:B ratio is nearly 9:1.

### CONCLUSIONS

#### **Biostratigraphy**

The fauna is typical Luisian-Mohnian, but the predominance of planktics (86.64%), which includes some radiolarians, is generally more characteristic of the Mohnian Stage. The benthic foraminifers include several bathyal-depth indicators.

#### **Depositional Paleoenvironment**

Several of the benthic foraminifers are bathyal-depth indicators. Of these, *Nodogenerina sagrinensis* (represented by a very nice void in Slide 18) has the deepest upper-depth limit (lower middle-bathyal range (1,500-2,000 m)). This depth range is the one most commonly interpreted for the Monterey Formation throughout its geographic range and

biostratigraphic interval. *In situ* middle-bathyal deposits in the coastal basins of California will have high P:B ratios. However, basin-floor deposits in tectonic basins are commonly turbidites bearing mixed assemblages containing abundant benthics that have been displaced from shallower depths. In contrast, the thin-sectioned Cotati sediments are fine-grained and contain no indication of significant downslope displacement.

**Foraminiferal analysis of thin-sectioned clasts from the Garrity Member of the Contra Costa Group, Contra Costa County, California  
(San Pablo Avenue).**

*By Kenneth L. Finger, Ph.D., Consulting Paleontologist, 7/5/01*

**“UPPER SUBMEMBER” OF THE GARRITY MEMBER OF THE CONTRA  
COSTA GROUP**

**Slide G-1**

Section parallel to bedding.

Assemblage: *Bolivina advena* (4), *Gavelinopsis* sp. (1), *Globigerina bulloides* (1),  
*Globigerina pseudociperoensis* (2), *Pseudoparrella subperuviana* (1),  
*?Siphonodosaria quadrulata* (1), *Tenuitellinata angustiumbilitata* (19)

P:B Ratio = 22:9 (71% planktics)

**Slide G-2**

Section parallel to bedding.

Assemblage: About a dozen specimens, mostly voids and mostly planktics (including  
*Globigerina bulloides*)

**Slide G-3**

Section oblique to bedding.

< 6 planktics; very poor condition, indeterminate

**Slide G-4**

Section oblique to bedding.

Assemblage: 3 spongodiscid radiolarians (planktics)

**Slide G-5**

Section parallel to bedding.

Assemblage: *Bolivina advena* (1), *Globigerina bulloides* (1), and a few planktic  
fragments

Slide G-5 w/ “maybe?” label

Section parallel to bedding.

Assemblage: *Bolivina advena?* (1), *Bolivina brevior* (1), *Globigerina bulloides* (2), and a  
few foram fragments

**Slide G-6**

Section oblique to bedding, but too thick!

Assemblage: very few *Bolivina* and *Globigerina*, and spongodiscid radiolarian

P:B Ratio = indeterminate

**Slide G-7**

Section oblique to bedding, but too thick!

Assemblage: a couple if partial indeterminate forams.

P:B Ratio = indeterminate

**Slide G-8**

?Section oblique to bedding, but too thick!

Assemblage: *Bolivina advena* (3), *Globigerina bulloides* (14), *Tenuitellinata angustiumbilitata* (11)

P:B Ratio = 25:3 (99%)

**Slide G-9**

Section oblique to bedding

Assemblage: *Bolivina advena* (2), *Globigerina bulloides* (5), indeterminate planktic forams (6)

P:B Ratio = 11:2 (85%)

**Slide G-10**

Section oblique to bedding

Assemblage: *Bolivina advena* (4), *Buliminella subfusiformis* (1), *Globigerina bulloides* (3), indeterminate planktic forams (12)

P:B Ratio = 3:1 (75%)

**Slide G-11**

Section parallel to bedding

Assemblage: *Bolivina advena* (2), *Bolivina brevior* (1), *Globigerina bulloides* (2), *Gyroidina rosaformis* (5), *Protoglobobulimina pseudotorta* (1), indeterminate planktic forams (3)

P:B Ratio = 5:9 (36%)

**Slide G-12**

Section parallel to bedding

Assemblage: *Bolivina advena* (1), *Bolivina brevior* (3), *Buliminella elegantissima* (1), *Gyroidina rosaformis* (3), *Tenuitellinata angustiumbilitata* (1)

P:B Ratio = 1:8 (11%)

**Slide G-13**

Section oblique to bedding; mostly too thick

Assemblage: A few forams, but too poor to recognize.

**Slide G-14**

Section oblique to bedding

Assemblage: A very few indeterminate planktics

**Slide G-15**

Section oblique to bedding, but too thick!

Assemblage: very few *Bolivina* and *Globigerina*

**Slide G-16**

Section parallel to bedding

Assemblage: *Globigerina bulloides* (3), spongodiscid radiolarians (3), and numerous voids, many appear to be of *Globigerina bulloides*

P:B Ratio = 100% planktics

**Slide G-17**

Section oblique to bedding

Assemblage: *Globigerina bulloides* and a spongodiscid radiolarian, and a very few indeterminate forams

**Interpretation of the Garrity Pebbles**

The 18 thin-sections of pebbles in the Garrity Formation have assemblages that more-or-less typify the Miocene Monterey Formation, but none have index species that would enable assignment to a foraminiferal stage. Most of the species recognized are very common and abundant throughout the Monterey. Although the low numbers of specimens do not make these statistically valid, it is perhaps significant to note that the composite assemblage is dominated by planktic foraminifera in association with radiolarians. This suggests offshore deposition at bathyal depths, which further supports the interpretation that these pebbles have been derived from the Monterey.

**BASAL WILSON GROVE FORMATION SANDSTONE MATRIX**

Slide WG-1A

Section consists of unconsolidated material

Assemblage: ?*Anomalinoidea salinasensis* (2), bryozoan? sp. A (2), bryozoan? sp. B (1), ?*Anomalinoidea salinasensis* is a benthic species that ranges Saucesian-Mohnian, but is most common in the Luisian and relatively rare in the Mohnian.

**Interpretation of forams from the basal Wilson Grove sandstone matrix:**

Numerous voids and clasts have shapes and features similar to large benthic foraminifers, but their nature is uncertain. A couple of partial whorls resembling those of the benthic

foraminifer *Anomalinoides salinasensis* are present. This benthic species ranges from Saucesian to Mohnian, but is most common in the Luisian and relatively rare in the Mohnian.