Research Note

Foraminifera from tide pools near Capelinhos volcano, Faial Island, Azores

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ABSTRACT

A collection of beach sand was obtained on 3 July 2022 from Porto Pim (beach), Horta, Faial Island, Azores. The collection location is in a protected bay adjacent to the town of Horta, i.e., on the side of the island opposite the western tip of Capelinhos (which experienced a major volcanic eruption in 1957-58). The sample (ca. 24 cm^3) was collected at the extreme southern corner of Porto Pim Beach. The beach consists entirely of a medium-dark-tan, fine-to-very-fine sand. The sample was taken at the water line, which was without any significant wave action

Examination of the collection with a binocular microscope showed it to contain large numbers of foraminifera. These forams are practically all benthic species. This note presents images of the collected foraminifera.

In a sample of about 0.5 cm^3, more than 250 specimens of foraminifera were present, comprising ca. 25 species. The sizes of nearly all foraminifera, as well as nearly all the sand grains, were ca. 0.2-0.5 mm. Most of the specimens are of planospiral geometry. It is estimated that the collection contains more than 35 species, and perhaps more than 50 species on the entire beach.

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This document is subject to future revisions.

INTRODUCTION

During 27 June – 7 July 2022, the author was on three of the Azore islands: Terceira, Faial, and Sao Miguel. The purpose of the visit was to prepare for a scientific expedition to Faial (and possibly other islands) during the 3rd and 4th weeks of September, 2022. Several meetings were held with personnel of the Oceanic Institute of the University of the Azores, and two visits were made to the primary site for the September expedition (Capelinhos, on the westernmost tip of Faial Island).

The purpose of the project is to study the process of repopulation of microfauna after a complete extinction event due to volcanic eruption. In this context, the publications by Hess, et al. (1996, 2001), describe a study procedure for Mt. Pinatubo that is essentially the same as the present project, namely investigation of foraminifera from volcanically devastated areas. The papers of di Bella, et al. (2014, 2015) and Quartau, Mitchell, et al., (2007, 2010, 2012,2013) are particularly important: they provide information about the dynamics of an island shelf. Zhou, et al. (2019) provide many details about the submarine platform at Capelinhos during and after the 1957-58 eruptions.

Regarding foraminifera offshore from Capelinhos, Faial, the following Abstract is taken from the Project Proposal [Schmieder, et al., 2022]:

> It is proposed to investigate foraminiferal assemblages on the western shelf of Faial Island, Azores. In 1957-58 this area was destroyed by a series of offshore volcanic eruptions that built an extension of the westernmost tip of the island (now known as Capelinhos). The event caused destruction of the entire biological community on the shelf including microscopic organisms living in sediment deposits. After the cessation of volcanic activity, erosion reduced the new shoreline to about one-fifth of its post-eruption extent and created new deposits of sediment. Presumably these deposits have been, or are being, repopulated with foraminifera from outlying reservoirs.
>
> This document is a proposal to study the process of repopulation by investigating foraminiferal assemblages on the shelf adjacent to Capelinhos. The field work will include collection of bottom sediments, processing to extract numerically significant numbers of foraminifera, and comparison with (presumably) undisturbed assemblages elsewhere on Faial and/or other Azores islands.
>
> The goal is to elucidate the dynamics of repopulation of the shelf. Attempts will be made to model the dynamics, including species-specific efficacy of transport, growth of newly established populations, mass movement of sediment by shallow slumping, entrainment in ocean flows, and other processes. A specific goal is to assess the extent to which the shelf biota appears to be approaching, or has reached, equilibrium.

During the June-July visit it was not possible to make any collections in the Capelinhos vicinity. However, one collection was made at the opposite end of Faial Island, at the Porto Pim Beach adjacent to the town of Horta. The beach is nestled in a protective bay and is mainly used for recreation. On 3 July 2022 the author collected ca. 40 cm^3 of the fine-to-very-fine sand at the water's edge, at the southern corner of the beach. The water was completely calm and clear, with no wave action. The sand was clean and free of debris or plant material. It was air-dried and kept in a plastic ZipLoc bag.

After thorough mixing of the dried collection, a small fraction (ca. 0.5 cm^3) was separated for examination with a stereo microscope (AmScope SM-2TZ-LED-5M). The microscope has an LED camera connected to the Win 7 computer. AmScope software (Version x64, 3.7.12924.20180915, build 16 Sep 2018 09:47:46) was used to save images.

A surprisingly large number of foraminifera tests was found in the collected sand: ca. 400/cm^3 (we might have expected zero, since the collection was made at the water's edge). Thus, in the 0.5 cm^3 fraction there were about 200 foraminifera. After picking the forams from this sample we, we had about 166 individual foraminifera. These are pictured in the contact sheets below.

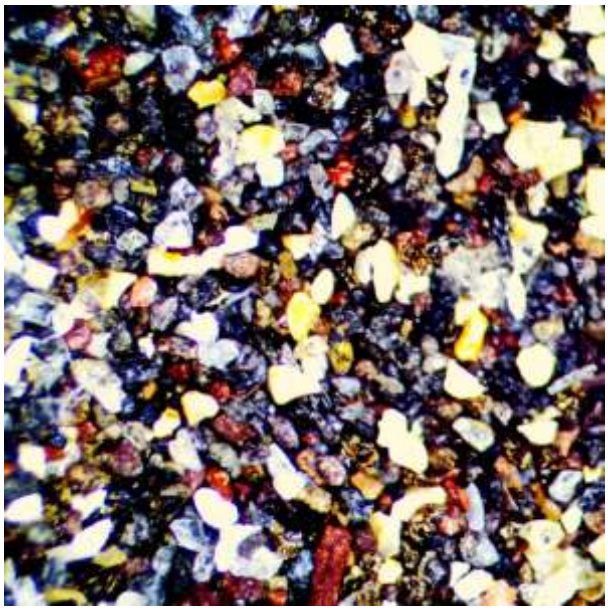
LOCATION OF THE COLLECTION

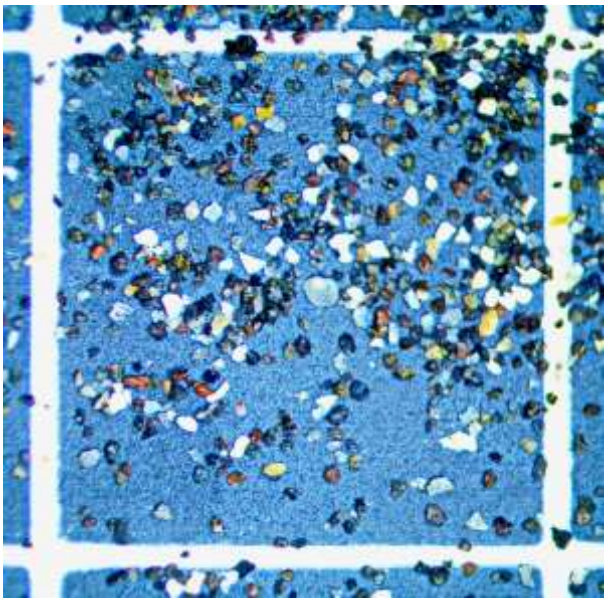
Azores/Faial Island

Porto Pim Beach. The collection was made at the lower left corner of the lower picture.

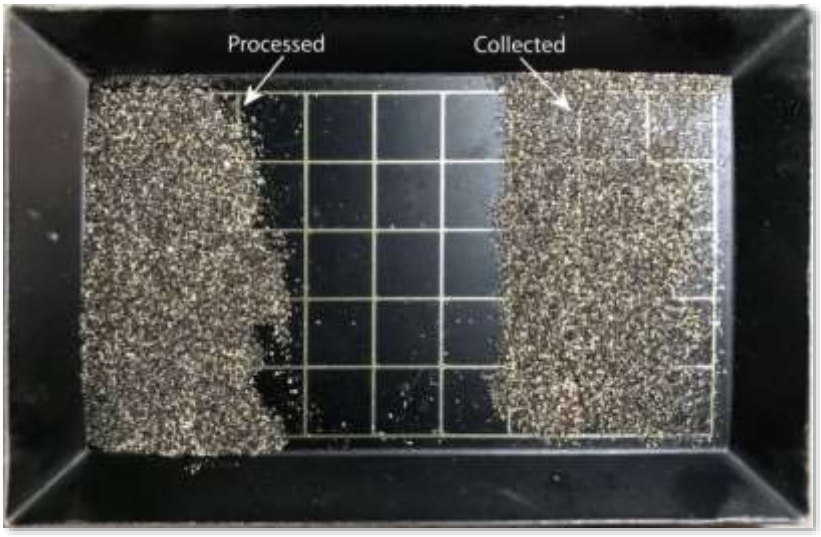
THE COLLECTION

The collection





The sediment is shown in the left-hand image above. The right-hand image shows the grid ruled on the picking tray (shown on the next page). The grid is 1 cm x 1 cm (between line midpoints).



Picking tray

THE SLIDE (FA01)

The slide has 60 cells, each 4 mm x 4 mm (between boundary midlines). Individual forams were picked from the collection and placed in cells 13-20, with 10-20 forams per cell. The entire collection illustrated in these contact sheets is to scale. The cell boundaries provide calibration of the scale for the contact sheets, which is the same in all cases. A scale bar of 0.5 mm was placed in each contact sheet.

Slide FA01

Cells 4 mm x 4 mm

Slide cels 38

Faial Island, Azores

Capelinhos, Tide pools

Collected 2 July 2022, water's edge
Robert W. Schmieder

Sheet 1 of __

Slide FA01 Cell 38

THE SPECIMENS

The contact sheets on the following pages contain images of 166 individual foraminifera (plus 23 non-foram objects) in 24 contact sheets. The numbers adjacent to the images are roughly in the order in which the specimens appear in the cells on the slide, numbered sequentially in (English) reading order. Images 14.5, 15.7, 18.1, 19.21, 20.16, 22.6-7, 22.11-12, 22.14-15, 24.19, and 24.21 are not forams (mostly they are gastropods). No contact sheet was made for cell 16.

For the contact sheets for cells 13-20, the image saturation has been reduced, making them nearly gray scale. For cells 21-24, the images retain their original color seen in the microscope and recorded by the software.

We estimate there are roughly 25 species of forams in these images, but due to the limitations of the optical microscope, there might well be more that cannot be distinguished in these images. We have not attempted to identify any of these species.

CONCLUSION

Even without species identifications, we can see roughly 25 different species in the 0.5 cm^3 fraction of the Horta Porto Pim Beach sand that we examined. From this, we estimate that there are likely more than 35 species in the full collection (24 cm^3), and perhaps more than 50 species on the whole beach.

REFERENCES

Di Bella, L, Frezza, V, Conte, A.M., Falese, F., Martorelli, E., Sposato, A., and Chiocci, F.L., 2014. Foraminiferal assemblages in active volcanic areas: two study cases from Azores Archipelago (Atlantic Ocean) and Pantelleria Island (Mediterranean Sea). Conference: CONGRESSO SGI-SIMP 2014 "The Future of the Italian Geosciences - The Italian Geosciences of the Future". Milan. Volume: **31**.

Di Bella, L, Frezza, V, Conte, A.M., and Chiocci, F.L., 2015. Benthic foraminiferal assemblages in active volcanic area of the Azores Islands (North Atlantic Ocean). *Italian J. Geosciences* **134**(1). DOI:10.3301/IJG.2014.22

Hess, S. and Kuhnt, W, 1996. Deep-sea benthic foraminiferal recolonization of the 1991 Mt. Pinatubo ash layer in the South China Sea. *Marine Micropaleontol*ogy **28**:171-197.

Hess, S., Kuhnt, W., Hill., S., Kaminski, M.A., Holbourn, A, and de Leon, M., 2001. Monitoring the recolonization of the Mt Pinatubo 1991 ash layer by benthic foraminifera. *Marine Micropaleontology* **43**:119-142.

Quartau, R. (2007). The insular shelf of Faial: Morphological and sedimentary evolution. PhD thesis. University of Aveiro, p. 301.

Quartau, R., Trenhaile, A. S., Mitchell, N.C., & Tempera, F., 2010. Development of volcanic insular shelves: Insights from observations and modelling of Faial Island in the Azores Archipelago. *Marine Geology* - MAR GEOLOGY, **275**:66–83. https://doi.org/10.1016/j.margeo.2010.04.008.

Quartau, R., Tempera, F., Mitchell, N.C., Pinheiro, L., Duarte, H., Brito, P., Bates, C., Monteiro, J., 2012. Morphology of the Faial Island shelf (Azores): The interplay between volcanic, erosional, depositional, tectonic and mass-wasting processes. *Geochemistry Geophysics Geosystems*, **13**. https://doi.org/10.1029/2011gc003987 .

Ramalho, R., Quartau, R., Trenhaile, A., Mitchell, N.C., Woodroffe, C., & Ávila, S., 2013. Coastal evolution on volcanic oceanic islands: A complex interplay between volcanism, erosion, sedimentation, sea-level change and biogenic production. *Earth-Science Reviews*, **127**:140–170. https://doi.org/10.1016/j.earscirev.2013.10.007.

Schmieder, R.W., Belton, F., and McGann, M., 26 June 2022. Investigation of foraminiferal assemblages in volcanically disturbed marine shelf sediments: Capelinhos, Faial Island, Azores. Research Informal proposal prepared for the Oceanic Institute, University of Azores, Horta, Faial, Azores.

Valente, E., 2020. Sedimentary dynamics on insular shelves of volcanic ocean islands: Insights from two marine cores of Faial shelf, Azores. Department of Biology, School of Sciences, University of Lisbon Report.

Zhao, Z., Mitchell, N., Quartau, R., Tempera, F., and Bricheno, L., 2019. Submarine platform development by erosion of a Surtseyan cone at Capelinhos, Faial Island, Azores. In: *Earth Surface Processes and Landforms*, (J. Wiley Online Library).

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