IODP Expedition 329: South Pacific Gyre Microbiology

October 9th-December 13th 2010

Nathalie Dubois and the IODP Expedition 329 Shipboard Science Party

Soon after I defended my PhD thesis at Dalhousie University (Halifax), I had the opportunity to sail on the JOIDES Resolution (JR), for a unique expedition in the South Pacific Gyre (SPG). IODP Expedition 329 was an exceptional undertaking, given that the SPG represents one of the largest expanses of water on Earth, often described as Earth's largest oceanic desert. Along with 30 other scientists, I embarked on October 9th, in Papeete (Tahiti), the busy, if slightly chaotic version of paradise. The JR was to be our home for the next nine weeks and as we watched the Cook Islands – our last sighting of land for 8 weeks – disappear, we could feel the spirit of true exploration into the unknown.

The duration and distance covered during Expedition 329 (61 days, 6655 nmi) represents one of the longest and furthest travelled in scientific ocean drilling history: the seven sites span nearly the entire width of the Pacific plate between 20° and 45°S (Fig. 1). The primary objectives of Exp. 329 were to document the extent and nature of microbial life in the sediments beneath the low-productivity heart of the ocean. Although Exp. 329 focused on microbiology, the recovered cores provide an unprecedented opportunity to document a sedimentary system and basement that has never been explored by scientific ocean drilling.

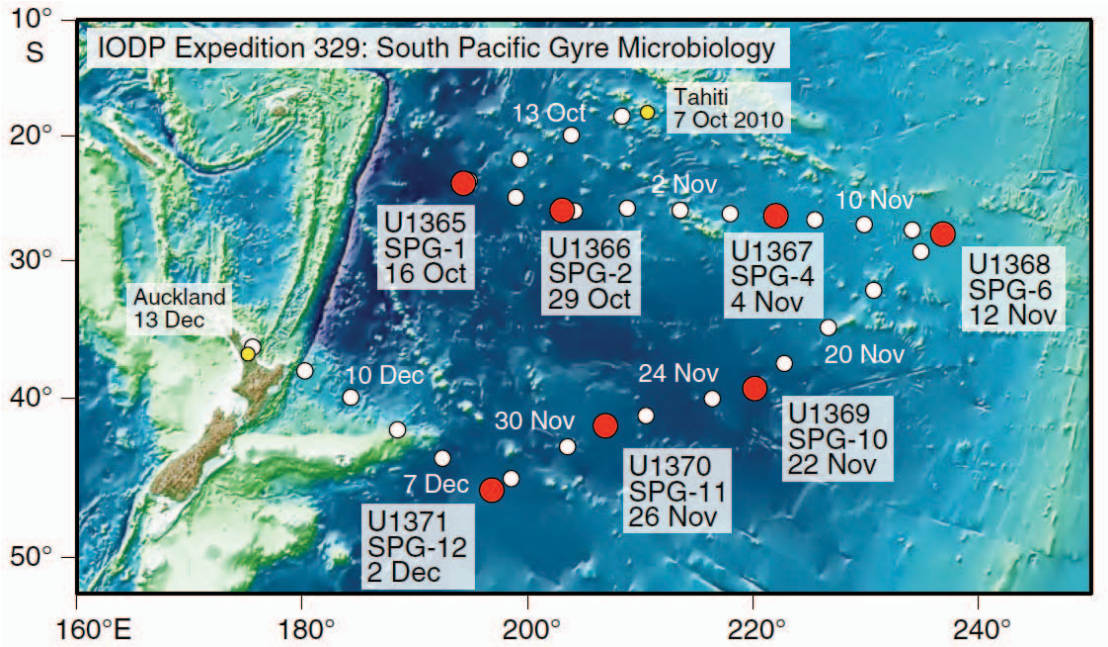

Figure 1. Track map and location of sites drilled on Expedition 329 produced with GMT using the GEBCO One Minute Grid.

To meet the expedition objectives, a wide range of instruments and techniques that are seldom used on scientific ocean drilling expeditions were successfully employed. These included among others: O_2 optodes, microelectrodes, contamination monitoring measurements, flow cytometric cell counting, shipboard cultivation and radiotracer facilities, and GC with HgO reductive gas detector (H_2 analyzer). As a result, the shipboard scientific party composition was rather unusual. I was one of the two organic geochemists, whose official duty is to monitor hydrocarbon and to provide

measurements of the quantity and quality of organic matter in cored sediments. The risk of an uncontrolled release of petroleum hydrocarbons from those sediments was extremely low, as was the organic matter content, making its quantification a real challenge (Fig. 2). Many scientists switched gear from time to time to help the other labs (inorganic geochemistry, sedimentology, petrology, microbiology) and make sure we were able to fulfill the expedition's objective.

Figure 2. Picture of Nathalie Dubois (Photo: Joe Monaco).

In between coring, splitting, describing, sampling, squeezing, analysing, and report writing there were few things more relaxing than staring into the endless deep blue/purple hue of the pacific, which only intensified as we sailed into the gyre (see Fig. 3). Our on-deck BBQ's gave us the opportunity to feed opportunistic white tip sharks. Indeed for a 'lifeless' ocean gyre the presence of mahi-mahi (which occasionally ended up on a dinner plate), white tips, tuna, minke whales, albatross, and even a puffer fish show that life can prevail here, though one suspects that our presence piqued the interest of everything within a 1000 mile radius! It even seemed to attract satellites! On November 3, the Eutelsat W3B satellite (launched Oct. 28) declared a total loss following discovery of a sizable leak in its fuel reservoir was guided toward an atmospheric re-entry above the South Pacific Ocean to be destroyed. Thankfully, the JR just left the "space debris zone" (Fig. 4) as the satellite crashed down. Pool, kite flying, sugar and caffeine fuelled parties, gym, movies – makes it sound like we do no work at all, however the more socially oriented activities remain a very important part of the expedition. Social cohesion and down-time gave us all something else to focus on, helped us work as a team even more effectively, and really underlined the meaning of work hard, play hard.

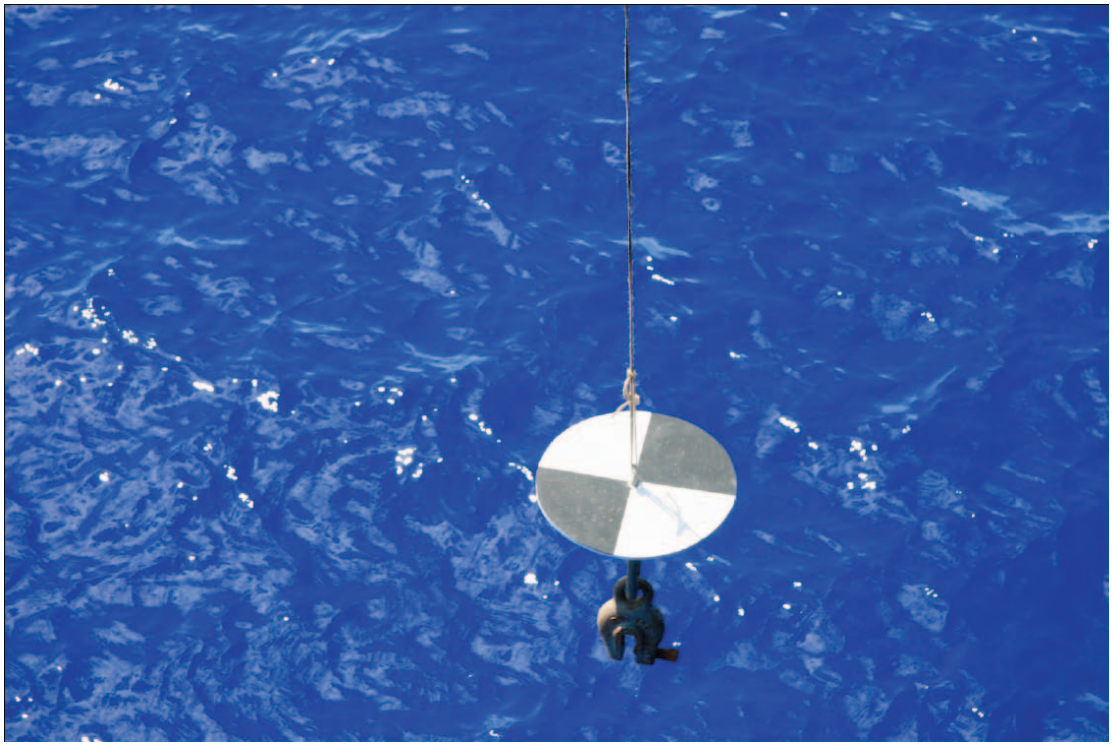

Figure 3. Picture of the deployment of the Secchi Disk at Site U1365 (Photo: Carlos Alvarez-Zarikian).

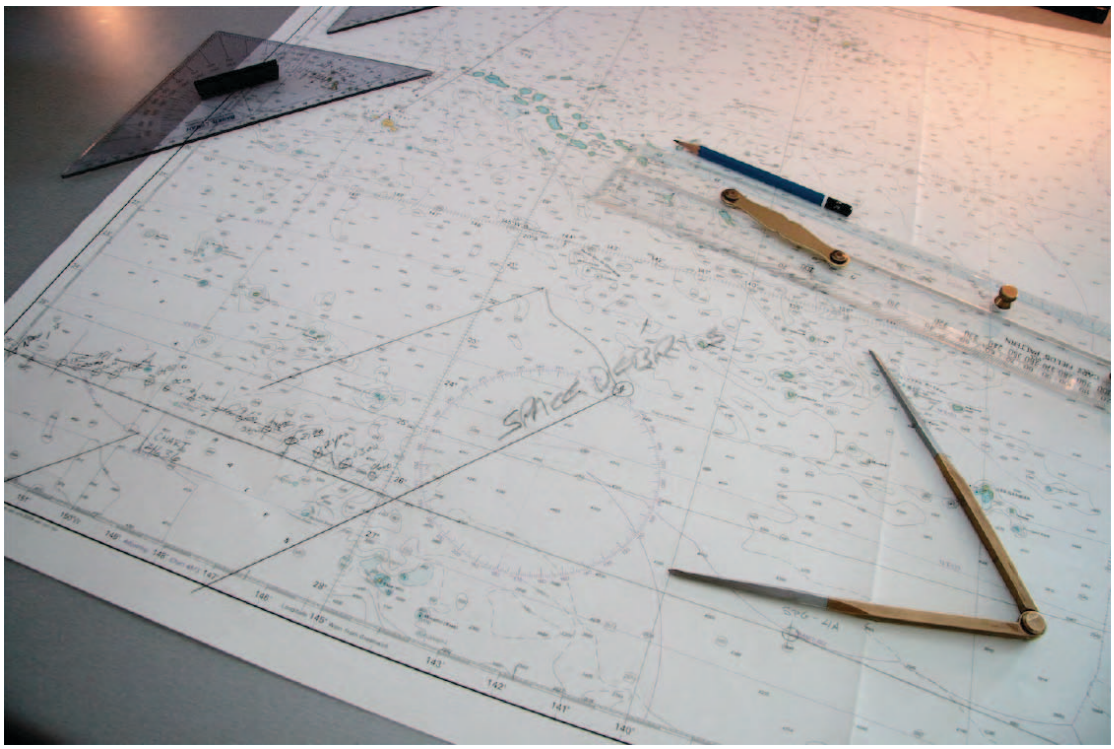

Figure 4. Space debris zone (Photo: Jill Lynch).

Unfortunately, due to the moratorium period and the current status of our Expedition's manuscript (under review), I am unable to share our detailed findings. However I can still present a brief summary offering a glimpse of the interesting and diverse science that took place during Exp. 329 and will take place during post-cruise studies. Lithology at the older deeper sites was dominated by zeolitic metalliferous clay (Sites U1365, U1366, U1369, and U1370). We found manganese nodules at the

seafloor and intermittently within the upper sediment column at these sites (Fig. 5). Carbonate ooze is dominant at the youngest and shallowest sites (Sites U1367, U1368), while siliceous ooze is dominant at the southernmost site (U1371). Concentration profiles of dissolved oxygen, dissolved nitrate, dissolved phosphate, dissolved inorganic carbon, dissolved hydrogen, total solid-phase organic carbon and total solid-phase nitrogen, as well as microbial cell counts were used to determine microbial activity and habitability. Documentation of genetic composition and additional aspects of biomass, the role of radiolysis, and sedimentary and basaltic habitability must await shore-based study.

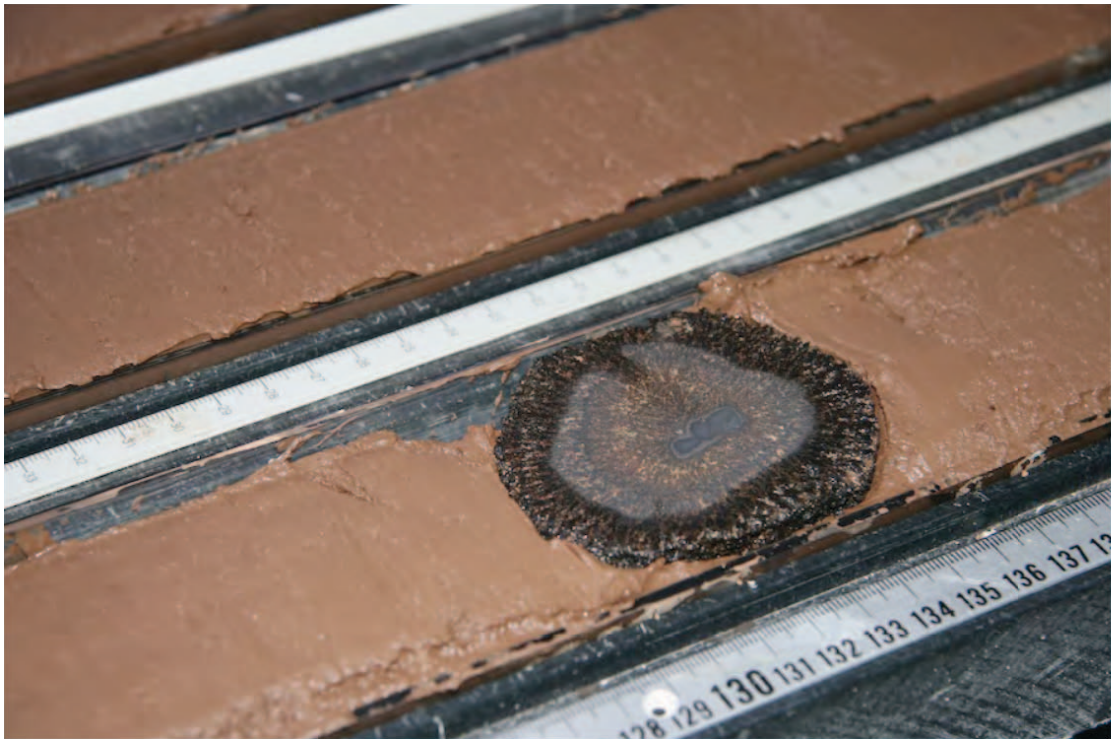

Figure 5. Picture of a manganese nodule (Photo: John Beck).

Acknowledgments

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Participants in Expedition 329

D'Hondt, S., F. Inagaki, C. Alvarez Zarikian, H. Evans, N. Dubois, T. Engelhardt, T. Ferdelman, B. Gribsholt, R. N. Harris, B. W. Hoppie, J.-H. Hyun, J. Kallmeyer, J. Kim, J. E. Lynch, S. Mitsunobu, Y. Morono, R. W. Murray, T. Shimono, F. Shiraishi, D. C. Smith, C. E. Smith-Duque, A. J. Spivack, B. O. Steinsbu, Y. Suzuki, M. Szpak, L. Toffin, G. Uramoto, Y. Yamaguchi, G.-L. Zhang, X.-H. Zhang, W. Ziebis