WOODS HOLE OCEANOGRAPHIC INSTITUTION

Ralph A. Stephen, *Senior Scientist*

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Drs. N.O. Eguchi & J.D. Schuffert
iSAS Office
2-15 Natsushima-cho,
Yokosuka, 237-0061,
JAPAN

Re: Proposal No. 631-Pre - Global siting plan for borehole geophysical observatories in the International Ocean Network

Dear Drs. Eguchi/Schuffert,

This is a third Response Letter to bring you up to date on our progress with Pre-Proposal No. 631. The ION community has been active over the past few years in planning and pursuing funding for installing broadband seismometers in existing holes and in coordinating long-term planning and standards with the new permanent seafloor observatory initiatives (OOI/ORION, etc). Figure 1 summarizes the ION "vision" for a network of broadband borehole seismometers to provide uniform seismic coverage over the surface of the globe. Not much has changed since this figure was first published in 2003.

In the last response letter we advocated a staged approach to instrumenting borehole seismic sites. At the sites that are targeted for meeting ION objectives, autonomous borehole seismic stations should be deployed for a year or so, prior to installing the network infrastructure. As we know there are many logistical reasons as well as just plain bad luck that lead to sub-optimal seafloor seismic installations. It makes sense that we should be able to demonstrate that a seismic installation is providing valuable, high quality data before committing to a high cost real-time acquisition system. (This is the plan that is being followed with the four broadband borehole seismic installations in the Western Pacific and Japan Trench [*Araki, et al.*, 2004; *Suyehiro, et al.*, 2002]. The systems are installed in an autonomous recording fashion while their data quality is being evaluated. The option of linking these sites to cables for real-time acquisition is left open for a second stage.)

Although progress towards global borehole sites has been slow, we have been gaining experience with cabled coastal seafloor seismic stations. 1) An autonomous recording seafloor station has been running in Monterey Bay for over three years [*Dolenc, et al.*, 2006; *Stutzmann, et al.*, 2001]. This sensor could possibly be converted to a cabled observatory to MBARI. If a proposal to drill in Monterey Bay is successful this site could also potentially be augmented with a borehole station. 2) A cabled seafloor station has been running for over a year in the Mediterranean off France as part of the Antares project. 3) Testing of the multidisciplinary seafloor observatory, GEOSTAR, has been ongoing [*Monna, et al.*, 2005]. 4) Unfortunately the telemetry to the H2O station has been down for a number of years and it is not clear when this will become operational again. 5) Funding has been sought in Japan and France for a broadband borehole observatory at the Ninety-East Ridge Observatory (NERO) but so far without success. Because the site is so remote, technology is being developed to reduce maintenance efforts. This takes time. 6) Meanwhile the four autonomously recording broadband borehole installations off Japan continue to provide data to the extent that their power supplies, data storage capability, and ships schedules allow.

In the US we have been unsuccessful in securing funding for autonomously recording global borehole seismic stations. The strategy here has been to combine the ocean seismic network objectives with the multidisciplinary global observatory efforts, OOI/ORION, to get real-time continuous global observatories. The OOI/ORION Conceptual Network Design (CND) based on the workshop in Salt Lake City in March 2006 summarizes the thoughts to date. Although the ION Global Siting Plan (Figure 1) had been submitted as an RFA to the OOI/ORION office, compromises had to be made to coordinate these sites with other multi-disciplinary objectives. Figure 2 (from the CND) shows the top three sites that were chosen for the seismic, borehole and multidisciplinary observatories. 1) The mid-Atlantic Ridge site coincides with DSDP Re-entry site 396 that was drilled on Leg 46. 20 Unfortunately the East Pacific Rise site is not co-located with ODP Site 1243A that was drilled on ODP Leg 203. 3) The third site satisfies a strong recommendation from ION to place a seismic observatory in the Southern Pacific Ocean where there is a large gap in coverage. Figure 3 summarizes the OOI Global Siting Strategy after all multidisciplinary interests have been taken into account. The five sites labelled "A" have "top priority" and a priority was not assigned within this group. If the East Pacific Rise (A3) and the Western Southern Pacific (A5) sites are chosen for permanent observatories there would be a strong incentive to drill boreholes at these sites for ION global broadband borehole seismic installations.

The Ocean Seismic Network community will of course continue to pursue funding for autonomous broadband borehole stations at the existing boreholes sites shown in Figure 1.

It is worth noting that this pre-proposal focused specifically on sites to complete "uniform global seismic" coverage. Although supported by the ION community boreholes for test facilities, for non-seismic objectives, and for regional and local seismic objectives were not addressed.

Yours sincerely,

Ralph Stephen

References

Araki, E., et al. (2004), Improvement of seismic observation in the ocean by use of seafloor boreholes, *Bulletin of the Seismological Society of America*, *94*, 678-690.

Dolenc, D., et al. (2006), Monterey Ocean Bottom Broadband Station (MOBB): data analysis and noise reduction, *Seismological Research Letters*, *77*, 218.

Monna, S., et al. (2005), High Quality Seismological Recordings from the SN-1 Deep Seafloor Observatory in the Mt. Etna Region, *Geophysical Research Letters*, *32*, 1-4.

ORION Program Office (2006), Global observatory conceptual network design for ORION's Ocean Observatories Initiative (OOI), Joint Oceanographic Institutions, Inc., Washington, D.C.

Stutzmann, E., et al. (2001), MOISE: A prototype multiparameter ocean bottom station, *Bulletin of the Seismological Society of America*, *91*, 885-892.

Suyehiro, K., et al. (2002), Deep sea borehole observatories ready and capturing seismic waves in the Western Pacific, *Eos, Transactions, AGU (Supplement)*, *83*, 621, 624-625.

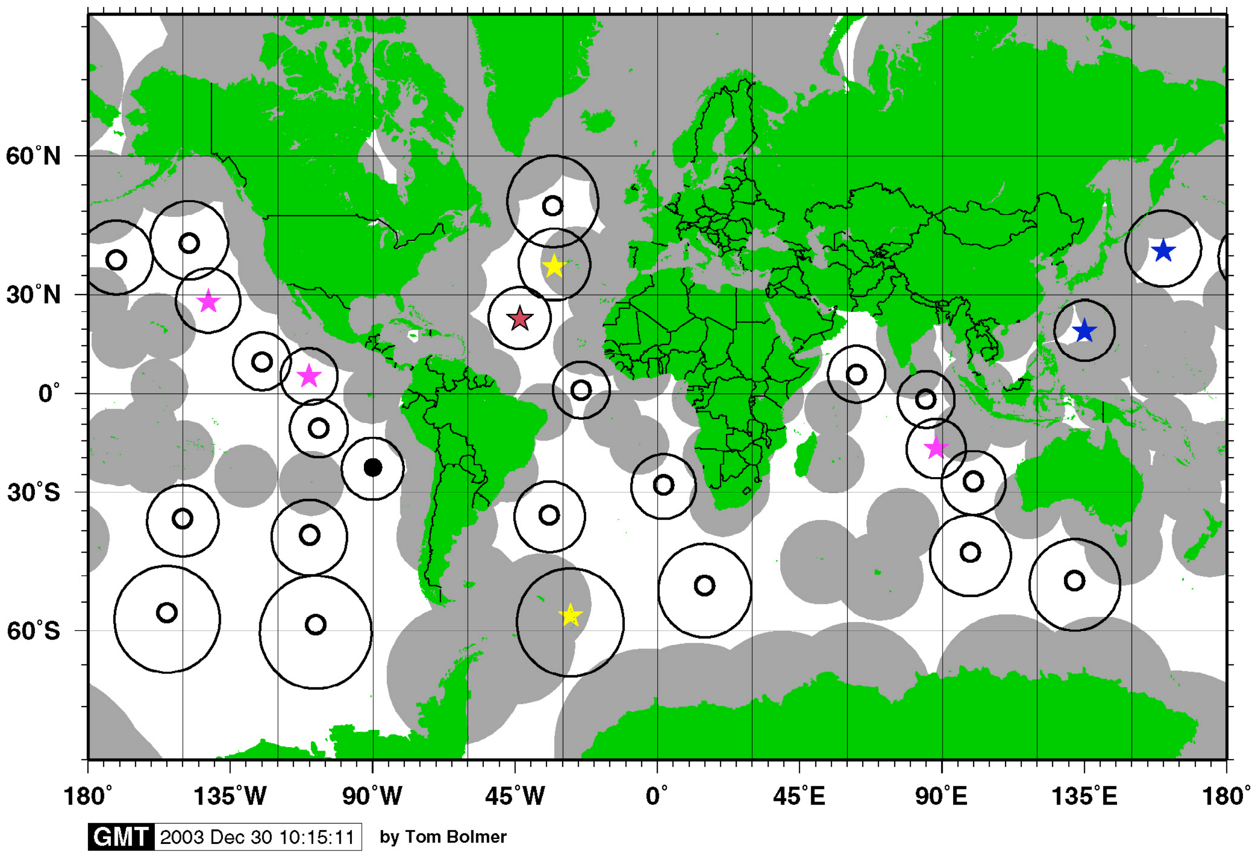

Figure 1: This figure summarizes the role of ocean borehole sites in global seismic coverage. The grey shaded regions indicate the surface coverage out to 1000km from continent and island stations. (These are distorted in the projection.) White spaces are gaps in the land based coverage. Existing and proposed ocean stations for global coverage are indicated by symbols surrounded by black circles at approximately 1000km radius. The different symbols show different levels of progress at the ocean sites: red star - the Mid-Atlantic Ridge test site (the OSNPE and Japan Sea regional test sites are not shown), blue stars - presently operating borehole observatories (the Japan Trench regional sites are not shown), maroon stars - sites at which boreholes have been drilled but have not yet been instrumented, solid and open black circles - high priority ION sites proposed in 1996 but not yet drilled and yellow stars - other proposed sites which have not yet been drilled [*Butler*, 1995; *Purdy and Dziewonski*, 1988; *Stephen et al.*, 2003].

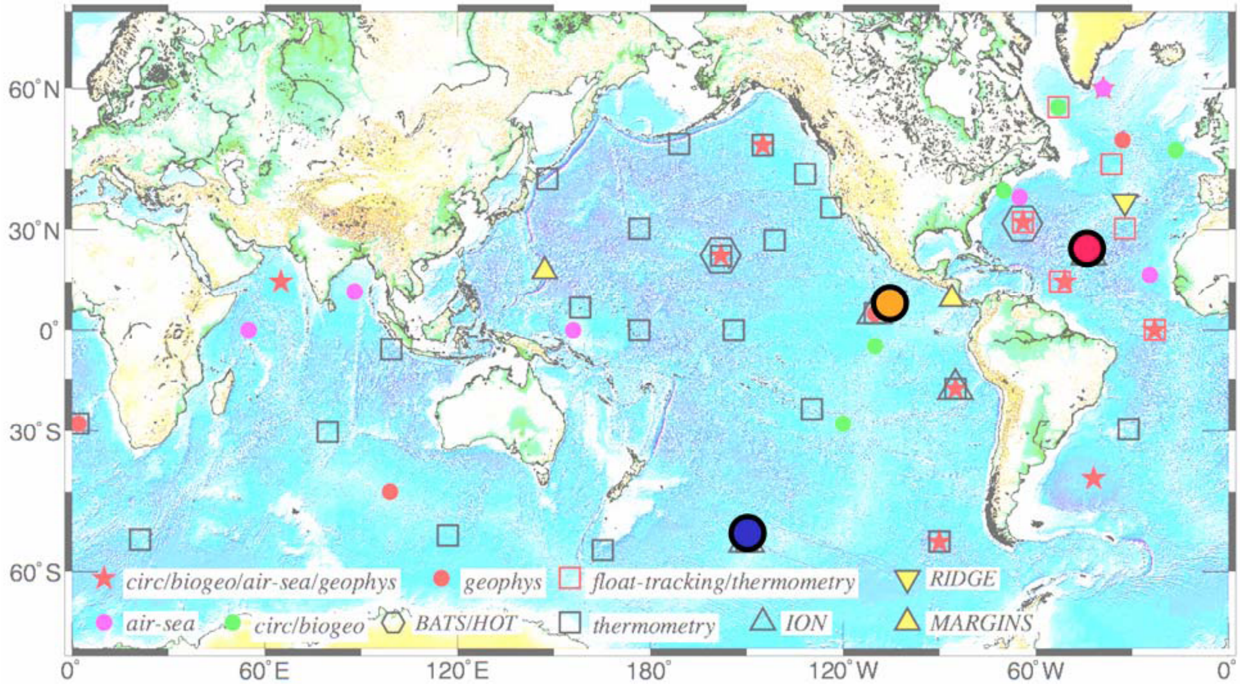

Figure 2. Recommended seismic, borehole, or multidisciplinary seafloor observatory sites. [*ORION Program Office*, 2006]

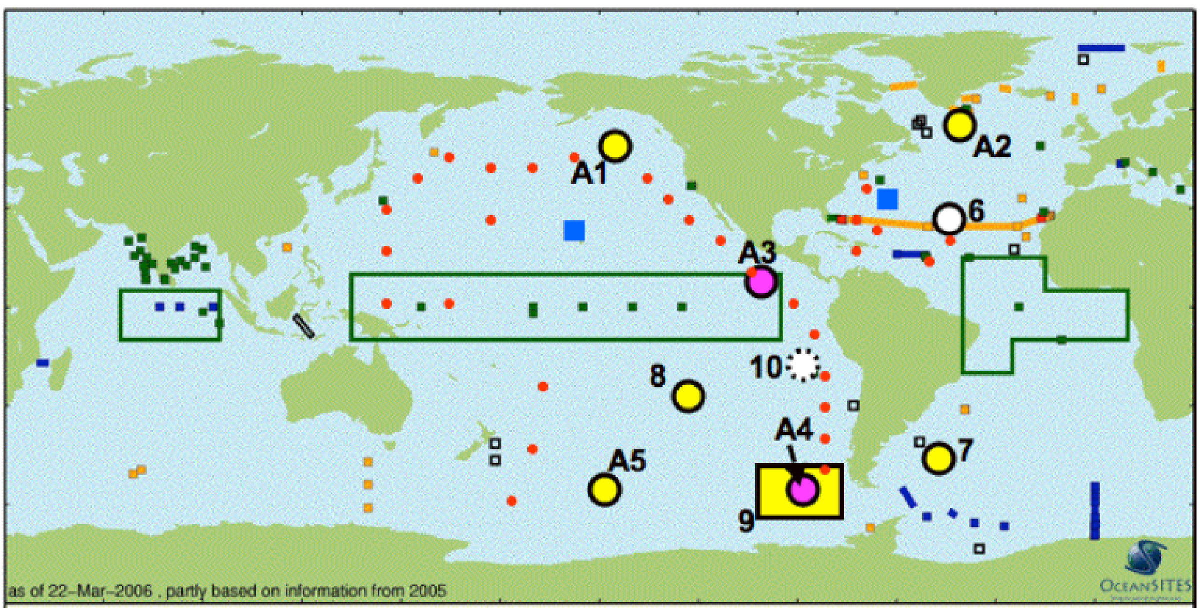

Figure 3. Distribution of Global OOI Sites (large labeled filled circles and rectangle) relative to the OceanSITES near-term network and future DART buoy locations (red dots). The Global sites labeled "A"n have the highest but equal priority; the priorities of the remaining Global sites increase with label number. Mooring types are indicated by color: yellow disks for acoustically-linked discus buoy, purple disks for SPAR buoy; and white disks for discus buoys with electrical-optical-mechanical (EOM) cables. The yellow square shows one possible location for the relocatable Global Pioneer Array, which will consist of a backbone of four sub-surface moorings and four gliders. The existing long-term oceanographic time series sites at Hawaii and Bermuda are shown by the blue rectangles. [*ORION Program Office*, 2006]