

Summary Report for Tolstoy4 Cruise, April 2006
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We boarded the RV Knorr in the Galapagos, and sailed on March 28th. This was primarily a mapping and dredging cruise, at a fracture zone south of the equator, and our OBS work was an add on at the end. We arrived at 9°N on Monday, April 24th, and began deploying 12 instruments at 4am.

The first unit was tracked to the bottom, and ranged for position. This drift offset was 133m to the WNW. The remaining 11 launch positions were adjusted to compensate. We had begun arranging frames the day before, and were able to get all but one unit over the side by 4pm. One logger had a disk drive that refused to spin up on the disk exercise routine. Having no spare, we set it aside, with the possibility of taking a good one out of a unit we planned to recover. We did not follow the rest of the units to the bottom, as time was a consideration. We had only 2.5 ship days for all our work, and the deadline to leave for San Diego was firm.

Robert Weekly is a research assistant for Maya Tolstoy, and was sailing as my helper. He emailed Maya, and the decision was made to skip site 306, in the middle of the array, in order to balance the remaining coverage.

After the last good unit was deployed we began recoveries, beginning at the northern end of the array. The first unit, site 209, responded immediately, surfaced in 75 minutes (34 m/min), and was aboard 30 minutes after surfacing. The computer was running and logging data. Clock drift was about -1.2 sec, and the disk was full.

The second unit, site 208, was mute. We tried moving the ship to several different directions from the drop site, but to no avail. We moved on to the third unit, site 212, which responded on the first command, but refused to lift off, even after five release commands. Acoustic communications were good, but after the burn, the ranges were constant. The Knorr holds position well, and the ranges didn't vary more than a meter.

At this point we broke off to allow another piece of gear to be placed on the ocean floor. I opened the first unit to try to dump the data, and perhaps use the good disk in the one unit we were not able to deploy. The transfer program crashed after only 0.04% complete. I tried two more times, and it crashed at the same point, having never really gotten a good transfer rate started. I gave up, rather than risking ruining the data.

We began again at 5am, and recovered site 207 on the first command. The CPU was running, but the data blocks weren't incrementing. Clock drift was good, but shift 'D' did not produce the expected output. It looked like no data had been collected. Thinking that this might be usable as a replacement for the bad disk, I ran the disk exercise routine, which worked fine. I then thought to List the directory, and found that there were tons of blocks. I don't know if the block headers are written when the disk is initialized, or if this represents real data. I did nothing further, and gave up on the idea of reusing a drive for the 12th unit.

The next unit, site 206, was alive, but did not release, despite several release commands. The ranges were rock steady, indicating not only did it not lift off, but it wasn't even drifting along the ocean floor. Site 211 was mute. At this point we decided to get whatever we could, and moved on without spending a lot of time at each site. This is a small work area, so it was easy to come back.

The next two units, sites 205 & 204, both released on the first command, and were on deck within 30 minutes of each other. They both were running, counting time, incrementing data, and had good clock drift, but site 205 closing block number was strange, and the shift 'D' format didn't look right. The unit at site 210 talked, but would not release, and the last three units, sites 202, 203, & 201, were totally mute.

By this point I noticed that the only units we recovered were at the outer edges of the work area, the two furthest west, the furthest east, and the furthest north. Robert Weekly has been working with the data recovered in 2005, and told me that there was indication of increased activity toward the southern end of the array. Maya had also told him that there was indication that something had happened more recently. We began to consider that there had been an eruption, which had inundated our missing gear.

During the dredge portion of the cruise, we deployed a NOAA data collector called a MAPR (Miniature Autonomous Plume Recorder), which records temperature and particulate density with a nephelometer. We were looking for indications of vent activity in the area we were surveying. We found a couple of small spikes in the particle density, which indicated possibilities. Chief scientist Don Forsyth decided to do a series of short vertical profiles of the lower 500 meters, spaced every half kilometer along the spreading axis, from north to south. The first survey was on board by midnight Tuesday, April 25th, and recorded huge signals from the nephelometer, an order of magnitude larger than what we saw at any of the other sites. The data from the northern third was lost due to computer errors, but the southern portion indicated that something big had happened.

Wednesday, April 26th, we extended the survey south another 8 minutes of latitude. The signal weakens to the far south. We repeated the northern half of the first survey, and the signal is the largest we have seen, by a factor of two, indicating that the source is about in the middle of the work area. Data sent from the beach indicates that this event is giving signals ten times larger than the eruption in the early 1990's. Wednesday evening, we dredged a site south of the work area, and recovered half a dredge of very recent glass that can be dated by short lived isotopes.

As we passed over the 11 units we deployed on Monday, I pinged them by sending a Disable command, to see if they were still alive. I was concerned that we may have deployed them into active magma. On Tuesday, we passed over 8 along the main axis and the eastern portion, and all were responding. On Wednesday, I pinged the other three units, and two were mute, sites 305 & 303, and site 310 was no longer responding, even though it has replied the day before. The bridge has been monitoring the RDF the entire time, and nothing has surfaced.

The evidence we are collecting has stirred a great deal of interest from the RIDGE 2000 group. This is the kind of event they have been looking for, and this location was chosen because it has happened before and was likely to happen again. Unfortunately, we have lost a lot of gear in the process, and may have throw more into the fire, so to speak. The next time Alvin works in this location, they should make an effort to photograph each of our instrument locations. We might also consider increasing our drop fees in hazardous areas.

The four units we did recover showed little signs of corrosion. A few washer have left rust streaks, but this is typical for year long deployments. There were no major failures of components. All the clocks had drifted less than 1.2 seconds. The IDE drives seemed to have worked fine, despite running in 10" of vacuum. The digital batteries were down about 1 volt, the +analog voltage were 5.6 on three of the four, and the -analog voltages were -7.3 volts. The units rise at about 34 meters per minute, which is slow, but much better than I had feared. The added syntactic floatation should help with that. All the radios were working. The recoveries were during the day, so I don't know about the lights.

The data loggers of the 11 units we launched checked out well, and all the release units worked very well on the rosette test. I used the small vacuum gauge to make sure that the vacuum was 3-5" on all units, although it looks like this isn't as serious an issue as we feared. The 3xL28 sensor pressure cases have to be installed with the connector toward the outboard edge. Half of them were reversed, and had to be changed to allow the floats to sit all the way down. The syntactic foam prevents the float mounting bolts from being installed from the outside, but there was enough room to put the bolt in from the inside. The syntactic blocks need to be secured in a different manner. There is a space between the block and the frame side, which puts a torque on the block when the lag bolt is secured, which could potentially crack the block.

Overall, everything went very well, with the exception of the recovery problems, which I think time will show was an inundation by magma.

Recovery Summary

201	Mute
202	Mute
203	Mute
204	Recovered
205	Recovered
206	Stuck
207	Recovered
208	Mute
209	Recovered
210	Stuck

Launch Summary

301	alive 25APR06
302	alive 25APR06
303	mute 26APR06
304	alive 25APR06
305	mute 26APR06
306	not deployed
307	alive 25APR06
308	alive 25APR06
309	alive 25APR06
310	alive 25APR06, but mute 26APR06

211 Mute
212 Stuck

311 alive 25APR06
312 alive 25APR06