OS11A-1466 Depthmeter drift calibration for longterm observation

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Abstract

Depthmeter drift calibration is necessary for longterm pressure observation. We equipped a test system with a deadweight tester and two isothermo baths for months length sensor evaluation. Here we report the overview of the system, the summary of test run results, and the results of some months or weeks length test of depthmeters.

Our test system was designed for sensor evaluation for longterm observation in IODP borehole. For the case of NanTroSEIZE, C0009 borehole will be extended to the depth of 6000 m bsf and observatory will be installed there. The range of pressure and temperature available in the test system was specified depending on this purpose.

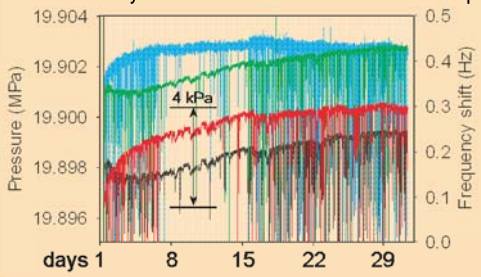
Detection of kPa or hPa pressure variation or mK temperature variation is a key for evaluation of interseismic activity. Subtidal dynamic pressure signal is estimated 1 kPa or less. A observatory should detect some kPa change with 3 or 4 digits to evaluate transient event in seismic zone. The precision of pressure and temperature on this test system specified enough to determine any drifts possibly affects this detection.

The test system successfully supplied stable reference pressure enough to determine one to two kPa depthmeter drift for a month. It depends on the automated deadweight tester and 100 mK level stabilized temperature in the isothermo baths.

DO-NET is another main target of this test system. JAMSTEC is going to distribute tens of seismometers and depthmeters in Kumano basin for real time observation. Capacity of the test system of 13 depthmeters maximum for a test responds the need of this project.

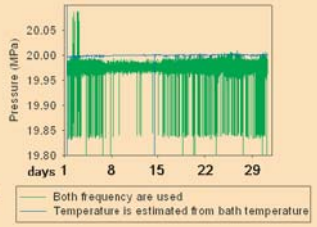
A month-test result of a 8B7000 and 410K-HHT under 20 MPa, 20 degC.

Barometrically corrected 8B7000 and 410K-HHT pressure

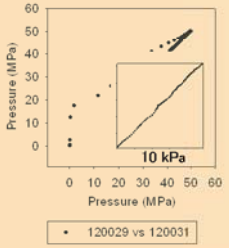


4 kPa drift was observed for depthmeters. It was larger in first one week but still observed for whole period of the test. Same drift was observed in every pressurize so that elapsed time from pressurize should be counted on drift correction. Two 410K-HHT shows almost same drift but it is different from 8B7000 or the monitor, RPM4. Several 8B7000 have own drifts though the devices with near serial numbers tend to show similar drifts. The monitor also showing drift means results must be checked by multiple monitoring devices carefully determined for drift.

- 8B7000-2-500
- 410K-HHT
- 410K-HHT
- Monitor



For both frequency output transducers, 8B7000-2-500 and 410K-HHT, temperature output was not stable.

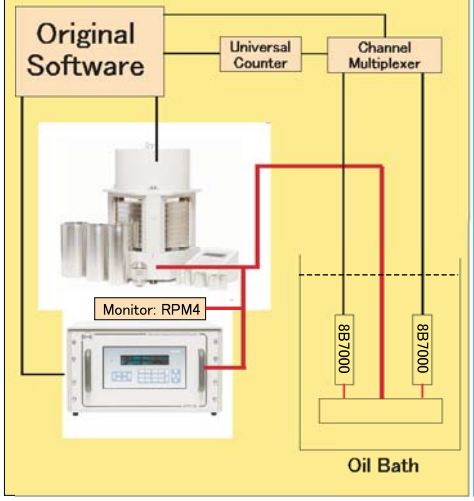


Two 8B7000Is were connected to the line. They were pressurized to 50 Ma but the pump lost control and pressure dropped to 40 MPa in six days. During pressure drop both depthmeters reported consistent pressures so that symbols were almost on a line: remember normal 8B7000 shows 10 kPa noize because of instability of its temperature output.

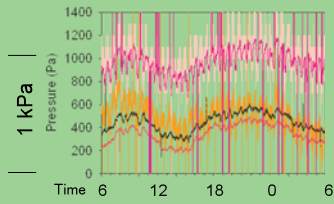
Requirements

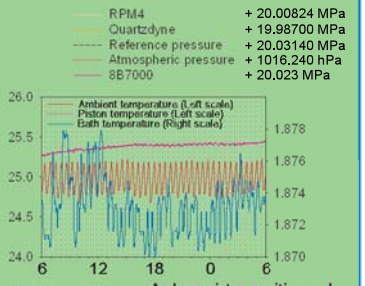
The test system should satisfy the requirements below:
1. It supplies range of pressures until that of equivalent to 10 km (3 + 7 km) depth from sealevel.
2. It supplies precise pressure to detect drift of depthmeters.
3. It supplies range of temperatures from seafloor to bottom of borehole (180 degree Celsius in 0.03 K/m typical geothermal gradient around Japan).
4. It supplies precise temperature to detect thermometer drift or to stabilize pressure variation because of temperature change.

Our Oil Operated Virtual Environment Equipment satisfies the conditions above.



A Day of OOVEE

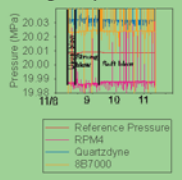




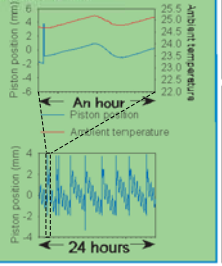
Depthmeter pressure, reference pressure, and atmospheric pressure finally cohered after 32 hours from pressurize. Atmospheric pressure gives additional load and the behavior of pressure is composition of weight of deadweights, atmospheric pressure, and residual factors. Air conditioner differently affected to primary monitor, RPM4 and to other devices report pressure. The deadweight tester and depthmeters report same trend, and it suggests that strong air conditioning can cause misunderstanding about pressure.

Tips:
* Reference pressure and atmospheric pressure must be monitored to correct bias.
* Pressure is transient for over 30 hours from pressurize.
* Air conditioning should be operated calmly.

Three days air conditioner effect test: Pressure behaves differently in strong blow period



An hour piston position and temperature



Conclusion

Depthmeters should be corrected for its drift for longterm pressure observation. Our new test system enables months-length depthmeter evaluation under seafloor or borehole environment with kPa or hPa precision. It is enabled by combination of calmly operating pump, precision deadweight tester, and original control software.

Acknowledgments

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