IODP Standard for Downhole Measurements (FINAL DRAFT)

iSciMP Downhole Measurements Working Group
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1. Introduction

Downhole logging has been increasingly and successfully integrated into drilling and sampling programs for scientific ocean drilling, and the vision for the future builds on that success. Scientific objectives require the widest range of logging technology and availability as well as improvements in logging capabilities, such as working in more hostile environments (e.g., higher temperatures) and making higher resolution logging measurements. Logging and measurement while drilling (MWD: some online data, LWD: only memory data) is especially important for the near future. These points have to be considered when summarizing the minimum required downhole measurements in IODP.

The most important issue to be considered by downhole logging is borehole safety, which also means that downhole measurements which are necessary to assure borehole safety have first priority (e.g., caliper for borehole breakouts or over pressure zone). The importance of the use of tool combinations in deep hole drilling cannot be over-emphasized, as it is important to minimize logging trips and thus preserve maximum borehole stability. In soft and unstable formations, LWD should become a must.

In this WG report, we summarize common standards for all drilling platforms and specific statements for each platform.

2. Common standard for all drilling platforms

2.1. Minimum requirements for downhole measurements

The following items are necessary to provide data consistency across all IODP drilling platforms. The data should be obtained continuously regardless of casing schedule (there should not be any gap at the casing boundaries).

2.1.1. Basic wireline logging

- Borehole environments: caliper and temperature (equilibrium temperature estimation using logs or downhole tools)

- Lithological logs: natural gamma ray
- Nuclear logs: porosity (accelerator or nuclear source) and density
- Electrical resistivities: deep/shallow
- Sonic logs: at least P-wave
- Magnetism: magnetometer and magnetic susceptibility

2.1.2. Borehole imaging
- Electrical and/or ultrasonic

2.1.3. Seismic check shots
- Vertical seismic profiling or at least seismic check shots

2.2. Data QC for acquisition and processing

2.2.1. Data acquisition
- A repeat run is recommended to increase measurement reliability.
- Reasonable measurement resolution and sampling interval should be carefully considered based on each project objectives. Minimum required sampling interval is 15 cm for basic logging and 1 cm for imaging.
- Sonic frequency should be carefully considered for any sonic-related logging tools.
- Appropriate calibration should be carried out for all measurements. All calibration data should be collected and stored.

2.2.2. Data processing
- Required minimum on-site data processing should be carefully considered based on Expedition objectives.
- Required level of data correction for data storage should be defined. Whatever corrections are made, they must be stored with sufficient description to be able to get back at raw data.
- Required skill level for the processing should be considered.

Recommendation-1: QA/QC data, for both logging and other downhole tools, such as calibration data, QC logs, correction parameters should be stored in the science database where possible so that scientists can access the data.

Action Item-1: IO's in consultation with SciMP identifies the minimum level of on-site data processing and necessary skill level for the processing for each measurement across all drilling platforms.

Action Item-2: SciMP Petrophysics working group, in consultation with IO's, will identify temperature and pressure downhole tools whose standard operating and interpretation procedures need be developed or updated.

Consensus Statement-1: Sonic log has a huge potential, however it also has a lot of issues before scientists utilize its data; especially stoneley wave and S (flexural) data. Sonic waveform data should be distributed by standard format in science community. Sonic waveform data should be obtained. IO need to understand the DSI concepts and limitations, and provide scientists every information to utilize the data.

2.3. Data management

- A loggingdatabase should be established and maintained for each logging IO.
- All logging data produced by IODP as well as ODP legacy data are required to be distributed to the IODP community and public via the "IODP Information Service Center".
- Advanced processing/analysis routines for core-log-seismic integration should be developed.
- Log data analysis centers need to be organized that work across all drilling platforms.

3. Specific platforms

Each drilling platform in IODP requires a different standard for downhole measurements. And each logging program must be carefully prepared to assure the goals of each drilling project.

3.1. Non-Riser platform

- Maintain current ODP logging standard at minimum
- Standard use of seismic check shots
- Use of new standard tools (use innovation potential)

3.2. Chikyu (riser platform)

3.2.1. Maximize advantages of large diameter logging tools

- Industrial standard combinations with necessary modification that match scientific needs
- Imaging tools (fullbore electrical imaging and ultrasonic borehole televiewer)
- Dynamic formation tester and sampling tools with extensive modification from oil and gas field conditions to meet our scientific conditions
- Magnetic resonance tools
- Dipole shear sonic tools
- Hostile environment tools

Recommendation 2: SciMP recommends that logging plans for the riser platform take advantage of availability of large diameter

tools to maximize scientific achievements.

3.2.2. Frequent deployments of logging-while-drilling (LWD) and measurement while drilling (MWD)

- LWD/MWD deployment for safety
- LWD deployment in geotechnical hole (pilot hole) or uncored intervals
- Use of new standard tools (use innovation potential)
- Development of Logging-while-Coring

Recommendation 3: For both operational and scientific purposes, SciMP recommends frequent and effective use of LWD/MWD for drilling.

Background: MWD/LWD provides data for safety and decision-making as well as high quality data for science. Riser operations enable switching from coring to LWD/MWD at any depth. Such flexible operations are effective in approaching the drilling target efficiently and avoid of coring risks in deeper environments.

3.3. Mission Specific Platform

- MSP's have special requirements due to operational limitations. Logging strategy and detailed implementation should be planned carefully on a project by project basis (Project Scoping Group).
- For borehole safety and data QC, equipment for a rig-floor data acquisition system to record parameters such as depth control, heave compensation, cable tension, and head tension should be considered carefully.
- For slim-hole logging programs, 2.5 in diameter tools are able to meet the IODP minimum required measurement plan .

4. Downhole tools, borehole experiments, and long-term monitoring

In situ measurement of stress, pore-fluid composition, of gas, and of temperature and pressure are required by a number of scientific objectives, and downhole microbial measurements would benefit deep biosphere science. Downhole experiments are identified in some thematic areas, and some objectives call for long-term monitoring of holes.

Action item-3: SciMP facilitates development of general policies for downhole tools, borehole experiments, and long-term monitoring. SciMP will form an *ad hoc* working group to investigate the development of these policies.