PETROPHYSICS QA/QC Report

Background: This report is to be considered a work in progress. We start with the action item that generated this report and follow with petrophysics specific issues. This report ends with the official SciMP recommendations voted on in June, 2004, SciMP meeting in Boston.

Action Item 03-02-12: In consultation with the IOs, each SciMP WG explicitly prepare draft plans for QA/QC and calibration issues for presentations at next SciMP meeting. The plans should determine way forward for all measurements, on all platforms and shore-based facilities. At least three issues need be considered: (a) instruments requiring 3rd party calibration (onshore), (b) inter-facility standards, (c) blind calibration tests, and (d) establishing a means of recording the use of, performance of, identification of problems, and drifts/anomalies, in operation of measurement capabilities in a readily accessible manner.
<u>Action to be taken by</u>: *Lead SciMP panelists (Saito, Lovell, Neal) and IO's.*

(a) 3rd party measurements. These include downhole logs run by independent contractors, and any instruments brought into the program by individuals. Usually the calibration procedures are defined, but there should be some means of assessing whether these are adequate.

(b) Inter-facility standards refer to different platforms and core repositories. Where these involve the same instrument or measurement technique we should aim for the same QA/QC procedures and calibration process. These should be reported to SciMP formally at each meeting.

(c) Blind calibration tests. This is a simple means of ensuring different platforms/repositories are producing consistent data. The aim should be for minimal effort but with sufficient detail to ensure confidence in the data. These are lower priority than (b) until inter-facility standards for measurements have been established and performance records are implemented in the databases. An ad-hoc SciMP group could be established as per Clive Neal's suggestion.

(d) Performance records: these should enable easy identification of problems, drifts/anomalies in measurements. Thus a scientist sailing on a platform should have easy access to these records, preferably prior to sailing as well as during. Equally other platforms/repositories should be able to access these to identify issues that are across multiple instruments. These records should enable clear identification of both short-term (daily) and long-term (monthly) issues.

Specific Petrophysics Issues:

We should involve the community to help establish standard materials for regular testing, starting with the most common (ODP-style) measurements that everyone will be using. Only few such standards exist currently, and only informally (e.g., Al-water segments in core liner for GRA density in PP). Although most measurement systems and procedures will be very similar among IOs, they will never be exactly the same (different instrument vendors, models, vintages; alternative analytical procedures for different materials/conditions, etc.). The inter-facility standards will ensure that the results are comparable even if different calibration or analytical procedures are used in different labs.

The best types of standards are single-component materials, either synthetics that can be easily produced or natural materials that last forever. However, in many cases more complex mixtures are needed to account for matrix effects.

<u>Laboratory physical properties</u>

MSCL:
Guidelines and recommendations for calibration and spreadsheet for calculations provided by Geotek (Chikyu and MSP/Arctic).

The standards are based around a core liner, filled appropriately for the various sensors - distilled water for P waves - Al and water for density – the magnetic susceptibility check piece centred in the liner - and a saline water check piece for resistivity. Use of different sized core liners necessitates different calibration pieces.

Useful to review the checks and calibrations on the MST and in particular it would be valuable to run a standard more often. Apparently on Leg 204 there was a discrepancy in the gamma density data, which was impossible to back check because the standards were not run often enough.

In addition to providing calibration standards, IOPD needs to ensure the procedures in place are both adequate and are adhered to.

Discrete measurements:
Need similar standards for discrete measurements of Vp, thermal conductivity, magnetic susceptibility.

Examples:

Petrophysics example: Need two materials for magnetic susceptibility, one with a (low) diamagnetic value (water, plastic, limestone) and one with a high-end value (magnetite-rich rock or solution). The IOs should be able to produce the standards with the geometry that the cores have, i.e., any particular core diameter, half-core segment, etc.

XRD example: establish a set of standard powder mixtures typical of the materials we often recover, and share the material among the IOs. The task of producing and distributing the standards should be contracted to a well-trusted organization as it is too sensitive and elaborate to be done by each IO on a shoe string.

Imaging example: Ensure that all IOs image the same standard color reference tiles with each image. This appears to be the only feasible approach because imaging technology advances fast. Besides, image "quality" depends heavily on the timing of imaging as oxidation and drying of the sample surface changes color significantly - no ideal condition exists.

Downhole Tools (temperature and pressure)

1) Temperature calibration (once a year): Each Temperature Tool (APCT or DVTP or TAP) should be shipped to a service company which owns a large-scale bath which is capable of hosting at least the first half meter of the tool (e.g., companies which manufacture CTDs, such as Seabird). During tool deployments, mud line temperature should be compared to the bottom water temperature which one can get from either a global oceanographic data base or from individual measurements. This comparison should be included in the Site Reports to flag any problems associated with the temperatures, and, if possible, should be incorporated into the database.

2) Pressure: The sensor should be calibrated by the manufacturer in regular intervals (once a year?). During all deployments, a stop at mudline should be made. In addition, periodically (once per tool per leg in which it is used?) a quality check should by made by stopping during the lowering of the pressure tool (such as the DVTP&P) in the drill pipe, recording pressures over ~3 - 5 min and repeat that at least two more times during the descent (no pumping of course) plus mudline. These pressures should be compared with pressures calculated from coring line depths. Note: this will not be a high quality calibration but a quality check, showing if there are significant problems. Prior to deployments, laboratory measurements at atmospheric pressures should be taken checked.

For both temperature and pressure tools, coring line depths should be archived along with deployment details, and tool maintenance information. If possible, the calibration, deployment information and tool performance records, and output data, should be available online. It is also recommended that site reports note and comment on unsuccessful tool deployments.

<u>Downhole logging</u>

QA/QC of individual tools: Logging contractors (e.g. Schlumberger) do calibration tests on their tools and provide that data to us. As such the QA/QC of individual tools is the responsibility of the logging providers and it is the responsibility of the IO to ensure that this happens.

All IO's should ensure contractor's adequately calibrate their tools.

Cross-platform calibration: Calibration between platforms and different logging providers is more complex. The IOs could work together to compare the "calibration standards" of different logging providers for similar tools, the results of which can be made public (if possible). Ideally it would be good to make the same measurement, in the same borehole with different tools from different providers. This may prove to be somewhat difficult, although the IODP logging consortia (European Petrophysics Group, USIO/LDEO-BRG, CDEX) have considerable experience of working together and may be able to achieve this.

A t the start of ODP, tools were run in the USGS Denver test facility (for Schlumberger tools alone).

Output of log analysis: It is important to strive for compatible output format of log data in databases. It is also imperative that the nature of raw /processed data and any post-acquisition processing is fully documented.

Training

Given the importance of adequate calibration across all platforms is there a need for more explicit training in QA/QC and calibration to ensure data accuracy and precision are comparable? This sharing of knowledge and experience could tie in with the proposals for technical support to rotate between IO’s. Training and attentiveness to calibration across all platforms is vital for the attainment of comparable measurements. The IO’s plans for this should be requested.

Performance records

Example from MST: The data from the GRA calibrations using Al-water core liner segments are accessible at http://iodp.tamu.edu/janusweb/physprops/gracal.cgi (use a leg >1 yr <4 yr ago; don't select a standard). The calibration data are useful to us for troubleshooting the system. Control measurements taken routinely on the small water-filled liner segment mounted on the core boat unfortunately are not available even though they are more important than the calibration data for the general user.

Example from MAD system: A metallic calibration sphere is measured regularly in each of the five gas pycnometer cells to monitor if the latest calibration is still valid - if the value is off by a certain amount, the cells are re-calibrated. Had these control measurement been recorded and archived, we would have a better idea which cells tend to be performing poorly, and volume measurements could be corrected for the drift (related to environmental changes and other sources) if warranted.

To enable rigorous and acceptable QA/QC procedures to be implemented across IODP platforms the following recommendations are made to SPC. Many of these relate to other areas (e.g. Chemistry WG) with significant overlap, but are formulated from the Petrophysics viewpoint.

Recommendation 04-06-09: SciMP recommends to SPC acceptance of the Petrophysics QA/QC report, and requests SPC distribute it to the IO’s and IMI as soon as possible. The full report is found in Appendix 17. Specific recommendations include:

a. IO’s be requested to provide details of proposed QA/QC measures, including calibration, for all petrophysics measurements appropriate to their platform. These should address initial calibration, and quality assurance and control on a short term (daily) and long term (monthly) timescale for routine continuous and discrete measurements and occasional measurements.

b. IO’s be requested to provide details of how they propose assessing and recording QA/QC with respect to 3^{rd} parties (e.g. logging contractors). This request primarily concerns how the 3^{rd} party calibration is dealt with and initially assumes there will not be any additional burden on 3^{rd} parties.

c. IO's be requested to provide details and implementation plans for performance records: these should enable easy identification of problems, drifts/anomalies in measurements, and address how the science party can access the records.

d. IO's be requested to provide suggestions for explicit training of scientists and technicians in QA/QC and calibration to ensure data accuracy and precision are comparable. This should concern individual and cross-platform issues.