# Draft Agenda
# Data Management Coordination Group Meeting #1
## Kochi, Japan

**February 2nd – 3rd, 2005**

## Theme: Standards on handling digital images and metadata

**Participants:**

| | | |
|---|---|---|
| John Beck | (TAMU / USIO) | beck@iodp.tamu.edu |
| Peter Blum | (TAMU /USIO) | blum@iodp.tamu.edu |
| Colin Graham | (BGS / ESO) | ccg@bgs.ac.uk |
| Shin'ichi Kuramoto | (CDEX) | s.kuramoto@jamstec.go.jp |
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| Shigemi Matsuda | (CDEX) | matsudas@jamstec.go.jp |
| Rakesh Mithal | (TAMU /USIO) | mithal@iodp.tamu.edu |
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| Kyoma Takahashi | (CDEX) | kyoma@jamstec.go.jp |
| Hans Joachim Wallrabe-Adams | (Univ. Bremen / ESO) | hwallrabe@uni-bremen.de |

* possibly attending Feb. 3/4th.

**Observer:**

| | | |
|---|---|---|
| Jun Fukutomi | (AESTO) | fukutomij@aesto.or.jp |

**Overview of discussion items:**

Two main topics will make up most of the agenda of this meeting. The first task is, discuss a joint statement for SciMP about how the IOs will handle digital images and related techniques throughout the program. The second task will be to define standards on IODP metadata handling. An IODP overall metadata database could form the core for the upcoming ISC. These points will be the most important topics of this meeting, while everything else is optional as time permits. The meeting is scheduled for Feb. 2-3, but the discussion on these items can be continued on the morning of Feb. 4th, as attendance allows.

### 1. Response to SciMP on the standard procedure handling digital images

The background of this discussion lies in one of the action items from SciMP:

> **Action Item 03-12-07:** Digital imagery issues regarding, standards, calibration, archival, and implementation need to be urgently reviewed by SciMP. We request a coordinated single report from the three IOs to be presented to SciMP during the next SciMP meeting, with specific information on:
>
> - Equipment and resolution of digital imagery, and comparison with present archival imagery,
> - Protocol of imagery acquisition during core flow process,
> - Personnel requirements for different possible scenarios,
> - Standards and calibration to ensure imagery homogeneity both during the duration of program and across platforms (riser, non-riser, MSPs).

To start the discussion, each IO should give some statements on

- what imaging equipment was/is/will be used on their platforms. Please also specify technical options/limitations of the instruments as necessary,

- describe their standard procedure of image processing, if it exists, mentioning the personnel required to perform the different steps.
- Make suggestions on standards and calibrations to maintain homogeneous imaging storage across platforms and repositories.

**2. Defining standards on metadata collection for IODP**

Currently there exists no common metadata standard, or metadata database for IODP. It is IODP-MIs intent to develop an IODP metadatabase in preparation for a possible Information Service Center (ISC). Several steps need to be taken, which will be discussed in detail with the IOs:

a) Adopting metadata standards (i.e. ISO19115, Dublin Core)

b) Defining a schema (minimum and optional requirements) and define a metadata profile for IODP

c) Choosing packaging tool/language for the MetaData (i.e. XML, SGML, ...)

d) Contribution to Open Archive initiative(s), make database accessible/searchable

e) Search engine (i.e. ISO23950, Z39.50, SOAP, ...)

f) Data and Database Interoperability/Interportability (XML, SOAP, ...)

Decisions on the above mentioned topics influence possible further developments including

g) Data interactions (Tools, Retrieval, Display, Manipulate, ...)

h) Adding superstructural elements (publications, videoconferencing, alerts and so on)

**3. Datamodels**

Examining the data structure of JANUS and J-CORES it is obvious, that the two data models may in general be similar, however looking at the details, many problems were solved very differently. At this point it is necessary to start a discussion on what the differences between the data models are, and which problems and chances result from this fact. This is in particular important, as the mapping of metadata into a common database is dependent on the structure of the source databases.

**4. Discuss a standard procedure on the Lithology / VCD handling**

A structured handling of VCD data has been under discussion for a long time. This is an important issue, where standards should be set throughout the IODP program, to maintain comparability of data. It is however not clear how to approach this problem, and how to define standards, that will be acceptable to the majority of the scientists.

**5. Starting to discuss and compile a list of data standards and standard data handling procedures necessary for IODP**

Standardization of measurements and procedures has to be achieved among the different platforms. This topic is to discuss and brainstorm the different areas other than the ones defined here, where standards need to be defined. This includes, but is not limited to

- recording error ranges with data
- defining QA/QC standards. Is data verified after measurements? Is data verified after upload to the database?
- Outline a catalog of minimum measurements on all platforms, to go for SciMP consideration.

The intention is to identify fields in data management, where coordination and communication among the IOs and IODP-MI is necessary, and which discussions need to be brought up within this group in the near future.

**6. Other matters**

Will be added as necessary.

# Agenda:

## February 2nd

**Chair: E. Soeding**

**8:30 - 10:00 Start**

Welcome, agenda and introduction of participants (Soeding/Miville)

**Response to SciMP on the standard procedure handling digital images**

*Reports on Equipment, standards and suggestions:*

CDEX presentation *(30 min maximum, could be shorter) + Question and Answer*

USIO presentation *(30 min maximum, could be shorter) + Question and Answer*

**10:30 – 11:00 Tea / Coffee break**

ESO presentation *(30 min maximum, could be shorter) + Question and Answer*

Discussion intro: Brief summary of options *(15 minutes) (Soeding/Miville)*

Open discussion on equipment standards and personnel

**12:30 – 13:30 Lunch**

**13:30-17:30 Afternoon**

Open discussion on image treatment standards and storage solutions

Formulate statements derived from the discussions.

**15:30 – 16:00 Tea / Coffee break**

*Datamodels& Metadata*

**Comparing the datamodels and understanding the differences between JANUS and J-CORES**

How can metadata from the different platforms be mapped into a single metadata system.

Introduction (Miville)

Discussion

**17:30 End**

## February 3rd

**Chair: B. Miville**

**8:30 - 10:00 Start**

**Defining standards on metadata collection for IODP**

Introduction to IODP-MI's metadata vision (Miville/Soeding)

ESO Presentation on Pangaea metadata (~15 min) + Question and Answer

ESO Presentation on DIS metadata (~15 min) + Question and Answer

**10:30 – 11:00 Tea / Coffee break**

USIO Presentation on JANUS Metadata (~15 min) + Question and Answer

CDEX Presentation on J-CORES Metadata (~15 min) + Question and Answer

*Discussion on the metadata standards (ISO, Dublin Cores etc.)*

Discussion Intro (Soeding/Miville)

**12:30 – 13:30 Lunch**

**13:30-17:30 Afternoon**

*Discussion on an IODP Metadata Schema*

Intro (Soeding/Miville)

*Discussion on packaging tools (XML, SHTML, etc.)*

Intro (Soeding/Miville)

*Discussion on contributions to the open archive initiative(s), and Search engine standards (i.e. ISO23950, Z39.50, SOAP, ...)*

Intro (Soeding/Miville)

*Data Interoperability/Interportability (XML, ...)*

Intro (Soeding/Miville)

**15:30 – 16:00 Tea / Coffee break**

**Discuss and compile a task list of data management standards for IODP**

Introduction (15 min) (Soeding/Miville)

Discussion

**Discuss a standard procedure on the Lithology / VCD handling**

Introduction (10 min) (Soeding/Miville)

Discussion

**Other matters**

**17:30 End of the Data Management Coordination Meeting**

## February 4th (For those who are still available)

**Chair: HC Larsen (if available)**

**8:30 – 12:30**

**IODP-MI will initiate the session with some questions regarding the ISC / Data Management visions presented by the IOs.** (Larsen/Miville/Soeding)

- IODP-MI questions, IOs respond / discuss
- Other questions and discussion

**Finalize the compilation of the report to SciMP.**

Continue discussion on the unresolved topics, as attendance allows.

# Final Minutes
# Data Management Coordination Group Meeting #1
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**Observer:**

| | | |
|---|---|---|
| Jun Fukutomi | (AESTO) | fukutomij@aesto.or.jp |
| Kazuho Fujine | (CDEX) | fujinek@jamstec.go.jp |

## Agenda:

### February 2nd

**Chair: E. Soeding**

**8:30 - 10:00 Start**

**1. Response to SciMP on the standard procedure handling digital images**

Introduction by the IO's

**10:30 – 11:00 Tea / Coffee break**

Discussion intro: Brief summary of options

Open discussion on equipment standards and personnel

**12:30 – 13:30 Lunch**

**13:30-17:30 Afternoon**

Open discussion on image treatment standards and storage solutions

Formulate statements derived from the discussions.

**15:30 – 16:00 Tea / Coffee break**

**Datamodels& Metadata**

**2. Comparing the datamodels and understanding the differences between JANUS and J-CORES**

How can metadata from the different platforms be mapped into a single metadata system.

Discussion

**17:30 End**

## February 3rd

**Chair: B. Miville**

**8:30 - 10:00 Start**

**3. Defining standards on metadata collection for IODP**

Introduction to IODP-MI's metadata vision

ESO Presentation on Pangaea metadata (~15 min) + Question and Answer

ESO Presentation on DIS metadata (~15 min) + Question and Answer

**10:30 – 11:00 Tea / Coffee break**

USIO Presentation on JANUS Metadata (~15 min) + Question and Answer

CDEX Presentation on J-CORES Metadata (~15 min) + Question and Answer

*Discussion on the metadata standards (ISO, Dublin Cores etc.)*

**12:30 – 13:30 Lunch**

**13:30-17:30 Afternoon**

*Discussion on an IODP Metadata Schema*

*Discussion on packaging tools (XML, SHTML, etc.)*

*Discussion on contributions to the open archive initiative(s), and Search engine standards (i.e. ISO23950, Z39.50, SOAP, ...)*

*Data Interoperability/Interportability (XML, ...)*

**15:30 – 16:00 Tea / Coffee break**

**4. Discuss and compile a task list of data management standards for IODP**

**5. Discuss a standard procedure on the Lithology / VCD handling**

**6. Other matters**

**17:30 End of the Data Management Coordination Meeting**

# 1. Response to SciMP on the standard procedure handling digital images

The background of this discussion lies in one of the action items from SciMP:

**Action Item 03-12-07:** Digital imagery issues regarding, standards, calibration, archival, and implementation need to be urgently reviewed by SciMP. We request a coordinated single report from the three IOs to be presented to SciMP during the next SciMP meeting, with specific information on:

- Equipment and resolution of digital imagery, and comparison with present archival imagery,
- Protocol of imagery acquisition during core flow process,
- Personnel requirements for different possible scenarios,
- Standards and calibration to ensure imagery homogeneity both during the duration of program and across platforms (riser, non-riser, MSPs).

Takahashi, Blum and Graham gave presentations on what imaging equipment was/is/will be used on their platforms specifying technical options/limitations of the instruments. They described their standard procedure of image processing, and made suggestions on standards and calibrations to maintain homogeneous imaging storage across platforms and repositories.

The following discussion resulted in the document appended to this minutes. It explains, which procedures are currently used or will be used on the different platforms. It also summarizes of what the IO's think what the minimum requirements are, and what way some of the standard procedures of handling digital images are. This includes basic standards on processing and storing digital images into a long term archive, as well as way making them available from the archive.

This response has been presented to SciMP on their meeting in Hawaii.

**Action Items:**

1. Creating a set of image metadata elements as part of a broader IODP metadata catalog for all IODP data. The metadata must include information about the image source; capture system and associated processes and opeators; data owner and curator; quality control; descriptions and annotations; processing, if applicable; etc.
2. Work out a roadmap, to establish a representative online archive of images for technical documentation, and education and outreach, featuring facilities, equipment, and processes. IODP will need to take into account legal issues related to online distribution of such images.

Actions need to be taken by the IO's before and on a subsequent meeting.

# 2. Comparing the datamodels and understanding the differences between JANUS and J-CORES

Bernard Miville showed, that an initial comparison of the data-models of JANUS and J-CORES reveals a generally similar content, however they are very differently implemented. A short discussion on the differences, and the actual impacts on the data management followed, however the full assessment of the structures, and its implications hasn't been finished. It is clear though, that this issue affects the planned metadata database, as the common metadata schema has to be mapped from both databases. This was discussed in more detail on the following day.

# 3. Defining standards on metadata collection for IODP

## 3.1 IOs Presentations

The IO's first reported on metadata collection within their respective data management systems. Collin Graham reported on the DIS data handling system. It turns out, that DIS is actually not collecting significant metadata. All necessary metadata, to fulfill the standards is added in a later stage, namely when the data is transferred into the Pangaea System. It was not clear, how precisely Pangaea is handling metadata.

**Action Items:**

Request to M. Diepenbroek, R Conze:
What metadata is actually stored in DIS, what is in Pangaea, what standard is used?
Does the metadata schema from Pangaea match the potential IODP Schema?
How ist data/metadata being transferred from DIS to Pangaea, how can it be transferred into an IODP metadatabase?

The USIO collects many different sets of metadata in JANUS. Rakesh Mithal gave an overview of these datafields and explained, where and how they are stored. In addition to metadata stored in the JANUS database, USIO is currently developing a Laboratory Information (Management) System (LIMS) for QA/QC purposes, which records status, maintenance and documentation for all devices and instruments onboard JR. This can also be considered metadata, as it contains significant information on the quality of measurements.

**Action Item:**

Explore how these standards and this system can be implemented on the other platforms.

Shigemi Matsuda subsequently introduced to the J-CORES metadata, which is organized in a hierarchical fashion.

## 3.2 Metadata discussion

The future content and need for IODP metadata was discusses. Which standards to use, action items etc. are summarized here.

**What is metadata?**

Metadata is basically information about data. It describes the what, when, where and who for the data. It generally does not include any data itself but direct or indirect links to the data. Typically it includes the following information:

- Title of datasets
- Contact Person or Institution
- Date/Time of data collection
- Location of data collection
- Content of data collection (what has been measured)
- Link to the data or information on how to obtain the data

In order to make metadata practical and interportable certain rules and standard should be followed for its structure and content. There are many metadata standards currently in use but only a few suitable for geoscience data.

**Why IODP data needs metadata?**

The purpose of metadata for IODP will be to integrate into one web based catalogue, all information about IODP data regardless of their database of origin. This will allow:

- One web based interface entry point for users to easily find all IODP and legacy data based on specific search criteria.
- It will facilitate the exchange and participation to the content of other geoscience metadata database, hence increasing the visibility of IODP to other scientific community.
- By using an international standard for the metadata, all IODP implementation offices (IOs) need to agree on the content and structure of the metadata. This process will be the starting point of the integration and collaboration effort between the different IOs.

**IODP-MI recommendations about IODP metadata**

The IODP-MI data management group met in Kochi at the beginning of February and recommends the following:

- All IOs agreed on the need for an IODP metadata database
- IODP metadata should be compliant with the ISO 19115 metadata standard
- XML should be used to package the metadata
- A first draft of the metadata content has been discussed and documented

Future action items:

- IODP-MI will further refine and document the first draft of the IODP metadata content and request additional feedback from all IOs
- IODP-MI with create an IODP metadata profile and schema compliant with the ISO 19115 metadata standard
- IODP-MI will request from the IOs to provide metadata for all ODP and IODP data based on the IODP metadata schema
- IODP-MI will implement an IODP metadata prototype database using the metadata provided by the IOs (as a proof of concept)
- IODP-MI will investigate the development needed to open the IODP metadata database to other geoscience metadata database

**References**

**About metadata and standard:**


- GRDC about Metadata: http://grdc.bafg.de/servlet/is/2377/
- FGDC about Metadata http://www.fgdc.gov/metadata/metadata.html
- WMO ISO 19115 metadata profile: http://www.wmo.int/web/www/WDM/Metadata/WMOCore_v0-2_040916/
- GCMD Directory Interchange Format (DIF): http://gcmd.gsfc.nasa.gov/User/difguide/difman.html
- Land Information New Zealand (LINZ): http://www.linz.govt.nz/rcs/linz/pub/web/root/core/Topography/ProjectsAndProgrammes/geospatialmetadata


**Other metadata databases:**

- MARGINS: http://www.marine-geo.org/link/?initiative=MARGINS
- Pangaea: http://www.pangaea.de/
- Global Change Master Directory (GCMD): http://gcmd.gsfc.nasa.gov/
- OAIster project: http://oaister.umdl.umich.edu/o/oaister/

# 4. Discuss and compile a task list of data management standards for IODP
# 5. Discuss a standard procedure on the Lithology / VCD handling
# 6. Other matters

These optional topics were generally skipped on the meeting, to provide time for a more intense discussion on metadata. Actions on these topics will be defined through the email- data management coordination group, and finalized on a subsequent meeting.

# 7. Next Meeting

It was agreed, that these data management coordination meetings are excellent chances, to facilitate coordination issues among the IO's, as well as to identify operational problems, which might feedback to SciMP (now STP). We therefore see this group as the operational counterpart of SciMP.

It is therefore anticipated, to hold these meeting a couple of weeks before SciMP, to be able to feedback or request input from the SAS through SciMP as necessary. The next meeting is tentatively targeted for late June - early July. It will take place at an ECORD location, possibly in Edinburgh.

# IODP Imaging Report to the Scientific Measurement Panel

Kochi, 4 February 2005

## IODP Imaging Working Group Participants:


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## Introduction

**At their June 2004 meeting, the Scientific Measurement Panel (SciMP) issued the following action item:**

"Action Item 04-06-24: **SciMP supports the creation of an archive that contains images of the highest quality possible. To this end, SciMP supports and encourages continued communication between the different IOs regarding the quality of archival images, and asks that they report on progress at the next SciMP meeting.**
**Action to be taken by: *IO's."***

**An IODP Data Management Coordination Group meeting was held in Kochi, February 2-4, with one day dedicated to discussing the topic of imaging and prepare a joint report to the SciMP in Kona, February 8-10. Peter Blum and Shin'ichi Kuramoto were tasked to present the report to the panel on behalf of the group.**

## Standards Agreed Upon by IODP Implementing Organizations

3. The following image acquisition systems should be considered the "IODP Imaging Minimum Requirement" and all images captured with these systems in IODP facilities should be archived and made available to the community:

   - Digital core section line-scan system with at least 1024 pixel sensor array (~10 pixels per mm of core; 30 Mb of data per meter of core); preferred array is 2048 pixels if the increased resolution warrants the doubling of storage facilities (~20 pixels per mm; 60 Mb per meter of core).
   - Digital microimage cameras mounted on microscopes for petrographic thin sections and smear slides as well as epi-fluorescence images for microbiological work. (The current, user-preferred SPOT cameras on the riserless vessel use 1600x1200 pixel, or 1.92 Mpixel, image capture.)
   - Thin section overview imaging system. Currently, a convenient and cost-effective flatbed scanner is used on the riserless vessel.
   - Close-up imaging system with at least a 5 Mpixel array for imaging small interval core sections, rock pieces, and other specimens of interest.
   - Good quality camera(s) for imaging facilities (e.g., drilling and laboratory systems), processes, events, and people used in documentation and education.

4. The following third-party imaging systems have been used on the riserless vessel in the past. The X-ray CT system is permanently installed on the Chikyu. If implemented and operated as routine systems in the future, standards will have to be established for these systems:
    - Whole-round core section surface imaging system for structural and other analysis of hard rock cores. Imaging occurs while core is being rotated around its axis in increments.
    - X-ray computed tomography (X-ray CT scan) system to image the internal density structure of whole-round cores. The system must include (existing) software application to process the 3D data and adequate archiving solutions
    - Thermal (IR) imaging system for the detection of gas hydrates and other subtle thermal structures, including adequate processing and analysis tools.
5. Current image archiving and distribution formats are listed for each IO in Table 1. The IOs recommend the following standard archiving and distribution protocol:
    - Store RAW data, if available, as a permanent archive offline (current USIO practice). Preserve the original 16-bit format, if available, since that provides more flexibility n processing images for optimum tonal range and qualtiy, even if the images are subsequently reduced to 8-bit TIFF files.
    - Store TIFF images offline as a permanent archive and make them available on request. Online access to TIFF imaes may be considered at a later time if user requirements warrant the cost for such a service.
    - Create JPEG copies of the TIFF images and make them available online on ship and shore without delay The JPEG image files are typically an order of magnitude smaller than the TIFF files, yet contain sufficient information for all but the most special use cases. Scientists generally prefer the smaller JPEG images because they are more convenient to use.
6. The IOs are currently in the process of establishing a set of image metadata elements as part of a broader IODP metadata catalog for all IODP data. The metadata must include information about the image source; capture system and associated processes and opeators; data owner and curator; quality control; descriptions and annotations; processing, if applicable; etc.
7. Color Quality Control:
    - Image a color standard along with all core images (except microphotographs). At a minimum, include a patch made up of white (Munsell notation N 9.5/), medium gray (N 5/) and black (2/). This standard will allow for calibration of the data capture device as well as for normalization/editing of the data after capture.
    - Adopt the Adobe RGB 98 color space as a standard because it is strongly supported in the imaging industry. It has a large enough gamut to easily encompass the scope of the two primary methods of viewing images, the monitor and the print.
8. Monitor Calibration: Calibrate a reasonable number of CRT monitors and printers used for viewing and printing images to a color-conversion settings standard using adequate instrumentation and software, e.g., Gretag-McBeth. (USIO recommends a Sony Artisan CRT monitor at each IO as a standard.)
9. Operational Quality Control: Trained IODP staff should in general calibrate, operate, maintain, and troubleshoot imaging systems, and be responsible for assuring image quality according to established minimum standards.
10. The IOs agree on a first order image processing protocol, applicable in particular to close-up images and miscellaneous purpose images. This protocol may be modified and refined as needed in the future. (Line scan images taken with the GeoTek imaging systems do not output RAW files and the proposed protocol can therefore not be applied.)
    - Open 16-bit RAW file on calibrated CRT monitor
    - Adjust for dynamic range by accurate placement of highlight and shadow using standards included in the images
    - Color-balance using 123-123-123
    - Convert to 8-bit TIFF file
    - Sharpen
    - Create JPEG files for online distribution

11. The USIO will cease to collect film photographs at the end of Phase 1 and will acquire digital images only starting with Phase 2; no film photography wet laboratory will be required on the newly converted Scientific Ocean Drilling Vessel (SODV). Neither CDEX nor ESO plan to implement film photography. Rationale:
    - Digital image quality now meets or surpasses that of film photography.
    - Image quality control can be applied more rigorously to digital images than to film photography.
    - Scientists prefer to use digital images and all ODP/IODP film photographs from the past several years were digitized for that reason.
    - Increasing difficulty and cost of obtaining photographic chemicals and paper.
12. The USIO and ESO will continue to collect one-shot core table layout images with a digital array camera in addition to the core section line scan images. This system configuration will remain in place until the line scan system has evolved to a level of technical and operational maturity that makes the "one-shot" image completely redundant.
13. Images processed by scientists to enhance the scientific information content of images for potential publication (color alteration, annotation, etc.) should be archived. This is relevant for microimages from thin sections, micropaleontological slides, etc. The image metadata will contain a description of the processing steps and algorithms used as well as a reference to the original image used for the processing.
14. The IOs plan to create representative online archives of images for technical documentation, and education and outreach, featuring facilities, equipment, and processes. IODP will need to take into account legal issues related to online distribution of such images.

Table 1. Current IODP imaging capabilities.

| ***Image Type*** | | ***CDEX*** | ***ESO*** | ***USIO*** |
|---|---|---|---|---|
| **Visual Light (VIS)** | | | | |
| VIS Core Section Split Surface | ***Camera*** | Geoscan III, dichroic filter, three 1024/2048 pixel arrays | Geoscan III, dichroic filter, three 1024/2048 pixel arrays | Geotek I, dichroic filter, three 1024/2048 pixel arrays |
| | ***Calibration Standards*** | White ceramic tile, lens cap black | White ceramic tile, lens cap black | Color scale, white, black, neutral gray patch |
| | ***Output*** | BMP, ~30 Mb per m of cores | BMP, ~30 Mb per m of cores | TIFF, ~30 Mb per m of cores |
| | ***Archive & Distribution*** | BMP on tapes offline; JPG online | BMP on CDs and hard disk offline; JPG online | TIFF on tapes offline; JPG online |
| VIS Close-Up | ***Camera*** | N/A | Olympus | Nikon D1X |
| | ***Standards*** | | White ceramic tile, lens cap black | White, black, medium gray patch in each image |
| | ***Output*** | | RAW | RAW 48 bit color, 31 Mb per image |
| | ***Archive*** | | RAW and SHQ in Bremen archive system offline; JPG online | RAW on DVD; TIFF 24 bit color 17 Mb on tape offline; sharpened JPG online |
| VIS Core Table Layout | ***Camera*** | N/A | Same as Close-Up | 4x5 (film) view camera, 105 mm Fujinon lens |
| | ***Standards*** | | Same as Close-Up | White, black, medium gray patch in each image |
| | ***Output*** | | Same as Close-Up | Film, TIFF from drum scans |
| | ***Archive*** | | Same as Close-Up | Film cabinet at TAMU; TIFF on DVDs offline; PDF online |
| Micro | ***Camera*** | Zeiss Axiocam up to 60 Mb per image | [Information not currenty available]] | (1) SPOT (Diagnostic); (2) Zeiss Axiocam |
| | ***Standards*** | N/A | | White balance |
| | ***Output*** | TIFF up to 60 Mb per image | | (1) SPOT: TIFF 24 bit color 6 Mb per image; (2) TIFF up to 60 Mb per image |
| | ***Archive*** | | | TIFF on disks offline; JPG online |
| Miscellaneous (technical documentation; education and outreach; public relations; etc.) | ***Camera*** | N/A | Miscellaneous cameras; broadcast quality video system | (1) Nikon D1X; (2) miscellaneous cameras |
| | ***Standards*** | N/A | N/A | N/A |
| | ***Output*** | N/A | Miscellaneous | (1) RAW 48 bit color, 31 Mb per image; (2) miscellaneous |
| | ***Archive*** | N/A | Various directories, not structured; video | RAW on DVDs offline; (2) various |

| | | | | |
|---|---|---|---|---|
| | | | on tape and DVD offline | directories, not structured |
| **Non-Visual Light** | | | | |
| Core X-ray CT | ***Device*** | GE Lightspeed Ultra 16 | N/A | Planned (e.g., Visicon) |
| | ***Standards*** | Pure water and air | | |
| | ***Output*** | DICOM, ~1.2 Gb per meter | | |
| | ***Archive*** | Axial slices on tape offline; coronal/sagittal sections 0.5 Mb per core section online | | |