



Drilling Information System (DIS) and Core Scanner

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Abstract: The Drilling Information System is a modular structure of databases, tailored user applications as well as web services and instruments including appropriate interfaces to DIS. This tool set has been developed for geoscientific drilling projects but is applicable to other distributed scientific operations. The main focuses are the data acquisition on drill sites (ExpeditionDIS), and the curation of sample material e.g., in core repositories (CurationDIS). Due to the heterogeneity of scientific drilling projects, a project-specific DIS is arranged and adjusted from a collection of existing templates and modules according to the user requirements during a one week training course. The collected data are provided to the Science Team of the drilling project by secured Web services, and stored in long-term archives hosted at GFZ. At the end the data sets and sample material are documented in an Operational Report (e.g., Lorenz et al., 2015) and published with assigned DOI (Digital Object Identifier) and IGSN (International Geo Sample Number; for physical samples) by GFZ Data Services.

1 Introduction

Data management in scientific drilling projects such as the Ketzin pilot site for CO₂ storage and programs such as the International Ocean Discovery Program (IODP) and the International Continental Scientific Drilling Program (ICDP) is essential to support two functions: firstly, the capture of drilling and scientific data and secondly, the long-term storage and dissemination of these data. The data capture in scientific drilling expeditions takes place in two phases using the ExpeditionDIS. During the drilling phase, drilling, curation, logging, and basic scientific data are captured at the drill site. In the post-drilling phase the detailed measurements, descriptions, images and log data for cores and/or cuttings are captured within a laboratory setting and the data subsequently transferred to the long-term data storage system. Another component of the DIS, the CurationDIS has been developed to manage the gained sample material from scientific drilling expeditions (Conze et al., 2007).

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The Bremen Core Repository (BCR, Bremen, Germany), the repository of the Bremen Geosciences Institute (GeoB, Bremen, Germany) and the National Core Repository of the Federal Institute for Geosciences and Natural Resources (BGR, Berlin-Spandau, Germany) are currently the main users of the CurationDIS. It feeds into the IODP Sample Materials Curation System (SMCS) as well as into the Virtual Core Repository of the German Scientific Earth Probing Consortium e.V. (GESEP, <http://www.gesep.de>). All these DIS versions are flanked by training courses, web services, and specific instruments. Scientific drilling projects can apply for it in a full proposal to ICDP (<http://www.icdp-online.org/proposals/>), the Core Scanner can be rented for a short maintenance fee and the unavoidable shipping costs.

2 Typical Applications

2.1 Methods

- Drilling and/or coring on land, on ice, on lakes, and oceans
- Water column sampling, and dredging along the water/sediment interface

2.2 Geological settings

- Hard rock
- Soft sediments and soils
- Ice
- Water/Sediment Interface

2.3 Scientific themes in the framework of key societal challenges

- Climate and Ecosystems
- Sustainable Georesources
- Natural Hazards

... with respect to the ICDP main topics such as Paleoclimate, Deep Life, Impact Structures, Volcanoes, Faults, Element Cycles, Plate Margins.

3 Technical Data - Specifications

3.1 DIS Setup

- **DIS server and DIS clients** (Fig. 1)
Windows XP, Windows Vista, Windows 7, 8.x, 10 32- or 64-bit
MS ACCESS 2010 (part of MS Office Professional 2010), English, 32-bit
- **DIS server only**
MS SQL Server 2008 R2 Express (English) SP2 for a single expedition and not more than 3 simultaneous users, 32-or 64-bit
MS SQL Server 2008 R2 Developer (English) SP2 for one or more expeditions and more than 3 simultaneous users, 32- or 64-bit
- **Others**
Wireless or wired local area network (Ethernet)
Uplink to the Internet according to availability (a BGAN satellite system for far remote sites on request available)
Backup storage capacities (about 1 Terabyte for a single expedition)
Dual monitor screens of each DIS station
Color laser printer
Plain color scanner
Label printer (should be Zebra compatible for QR-codes)

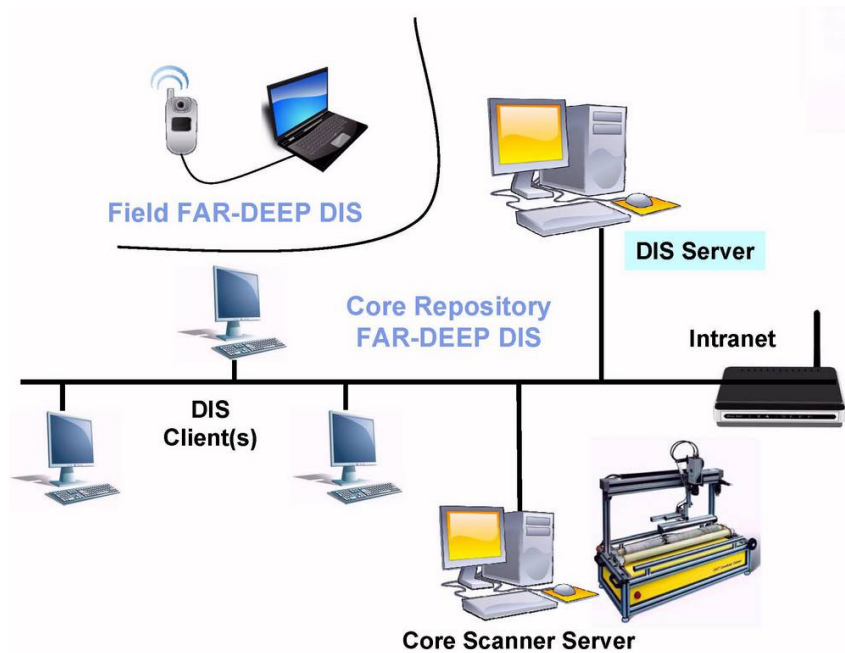


Figure 1: Typical setting of a DIS local area network in the field and a laboratory - see also: <http://www.icdp-online.org/support/service/data-sample-management/technical-requirements/>.

3.2 Core Scanner

These are line scanning devices for whole round and split hard rock cores and for split soft rock cores, both without liner. The used core diameter range lies between 4 and 22 cm. The maximum length of a core section is 1m. Two DMT Core Scan Color (1998-2000), and one DMT Core Scan3 (2011) are available (see Figure 2).

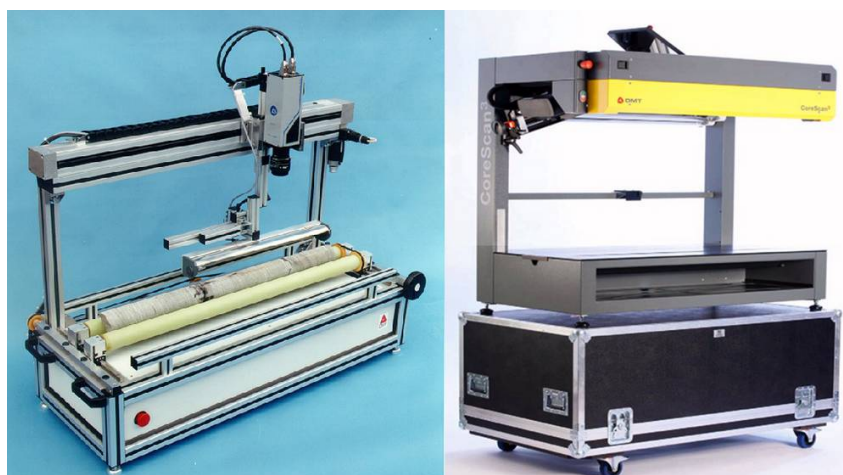


Figure 2: Line scanning devices producing digital core images: DMT Core Scan Color (left), DMT Core Scan3 (right) - see also: <http://www.icdp-online.org/support/equipment/core-scanner/>.

Especially on a drill site environment, an Uninterruptible Power Supply (UPS) should be added. The scanner use voltages between 110 VAC and 250 VAC, 50/60 Hz, the maximum power is about 500 VA. The power supply must be separate from the drill rig or other comparable high-level consumers. The devices are robust, dust-protected and can stand even sprinkle water.

They should be placed in a roofed container or house with almost constant light conditions, any spot lights or direct sun should be avoided.

4 Typical Applications and Services Offered

The two typical characteristics of the DIS are (1) the toolbox allowing flexible designs for individual drilling projects, and (2) the main focus on data acquisition and documentation. According to this there are typical use cases for the field and lab work as well as for the work in repositories, for offline and online work. For each scenario the corresponding versions and features can be selected, flanked by training and technical support services.

4.1 Utilization and Training

DIS is a community-owned software and tool package available for similar operations. Although the system is user friendly and highly adaptable to various applications, introductory courses to the system will be required for new users. A DIS training is offered and recommended for the project data manager(s) a few months before the start of the actual drilling operations. The training comprises usually five full days. Technical requirements for the setup are at least one MS Windows system and basic licenses for that system and the DIS (see 3.1 for more information).

4.2 ExpeditionDIS

The ExpeditionDIS is used for one individual scientific drilling project. It is typically installed on a laptop using it as a mobile server on the drill site during the drilling operations and in the laboratory and/ or repository in the post drilling phase. The main task is the in-time data acquisition and documentation of the technical drilling operations, and of the recovered sample material together with the scanned images captured by the Core Scanner. All sample material and samples taken will be uniquely identified and registered by International Geo Sample Numbers (IGSNs, www.igsn.org). For the IGSN registration, a specific tool generates a defined set of metadata, compiles these into an xml-file, which can be send to the responsible Allocation Agent for registration. Registered IGSN metadata is publicly accessible via the internet. GFZ Data Services is the Allocating Agent for all GFZ- and ICDP-IGSNs. An example for ICDP IGSNs can be found via <http://hdl.handle.net/10273/ICDP5054EEW1001>.

4.3 CurationDIS

The CurationDIS is used for many individual scientific drilling projects. It is typically installed on a persistent larger server system in repositories for different kinds of sample material. The main task is to collect and integrate the basic data of the available sample material from ExpeditionDIS systems or from other sources if no ExpeditionDIS has been used beforehand. The CurationDIS includes a flexible storage management system, and also assigns IGSNs on inventorying sample material and taking samples (in a same way as described in 4.2).

4.4 Evaluation and Visualisation

DIS does not provide specific tools for the evaluation or visualization of the data and images beside a few basic graphical logs such as for numerical measurements, sample spots, and the lithological column. Print reports for tabular data views can be adjusted for specific needs. All data tables and data views can be exported as tab delimited text files which can be used to import the data into external user preferred tools. Beside spread sheet software such as MS Excel, Origin, Igor, other tools such as MatLab, WellCad, Strater are often used. Open access tools such as Corelyzer and Correlator (see

also: <http://www.corewall.org>) and PSICAT (see also: <https://github.com/laccore/coretools/releases>) are commonly used for evaluation or visualization tasks.

4.5 DIS Web Services

- **eXtended DIS (XDIS)**

For certain management reasons, the eXtended DIS interface (X-DIS) provides secured remote access to the operational DIS. The configuration of the eXtended DIS interface is part of the corresponding ExpeditionDIS or CurationDIS. The DIS-Administrator defines which data are shown, which forms, reports, or data views can be selected, and who is authorized to edit (insert, overwrite, delete) which subset of data.

- **Project outreach within ICDP**

Within the conceptual design of the ICDP Web site each project gets the same space and weight initially. Each project is described on a project profile which derives from the proposals. Topics such as News, Scientists, Press & Media, Publications, Workshop, etc. are updated as they become relevant. Most of these topics are public and therefore a big outreach issue (see also: <http://www.icdp-online.org/projects/>)

- **Project data**

In ICDP and IODP, project data are usually confidential and under secure access for registered science team members only during a moratorium period. This protected area serves as knowledge transfer platform within the science team, and is very useful for selecting samples. The content of the DIS data tables are provided as tab-delimited text-files, Excel work sheets, and in some cases also as xml-files. Images are available as jpg-files in three levels of resolution, beside the original image files.

5 Availability

DIS and the Core Scanner are parts of the ICDP Equipment Pool of the Operational Support Group (OSG). The tools will be provided to ICDP projects as needed. Requests are to be made as early as possible (first-come first-serve policy). The OSG usually introduces on-site scientists of individual projects to the use of these devices in special training courses. Scientific drilling projects granted through other funding sources can also apply for it. Depending on available budgets and the actual schedule of ICDP operations these tools can be provided under the same conditions and policies.

6 Policies and Licenses

In chapter 12 of the ICDP Primer 2.0 (Harms, 2015) the data and reporting policies are described in detail. These policies are also valid for other scientific drilling projects using the DIS technology. ICDP and GFZ scientific drilling projects can use the DIS with a free license. Other projects may need to buy an appropriate license (contact: smartcube GmbH, Berlin, Germany <http://www.smartcube.de>, info@smartcube.de).

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