

Database of physical samples from the geothermal wells DEL-GT-01 and DEL-GT-02

Summary

This database is a simple and easy-to-use tool that facilitated the initial registration of samples collected by TU Delft staff at the drilling site. It has been created as a desktop application using Access, the database management system from Microsoft, with a graphical user interface customised for the geothermal well project.

Database structure

The sample database consists of nine tables, one for each of the entities shown in the relationship diagram (Figure 1). The relationship between the samples and the corresponding well are also depicted in Figure 2. Note that the relationships are *one-to-many*, which means that for **one well** there are **many sample types** or that for **one sample type** there are **many samples**. Every entity is a table, which organizes and stores information into rows and columns. A row is a record in the table containing all the data fields for a sample type, while a column contains the data of a specific field for each record. Table names start with *tb* (for *table*) followed by the entity name, such as *tb_well* or *tb_cuttings*.

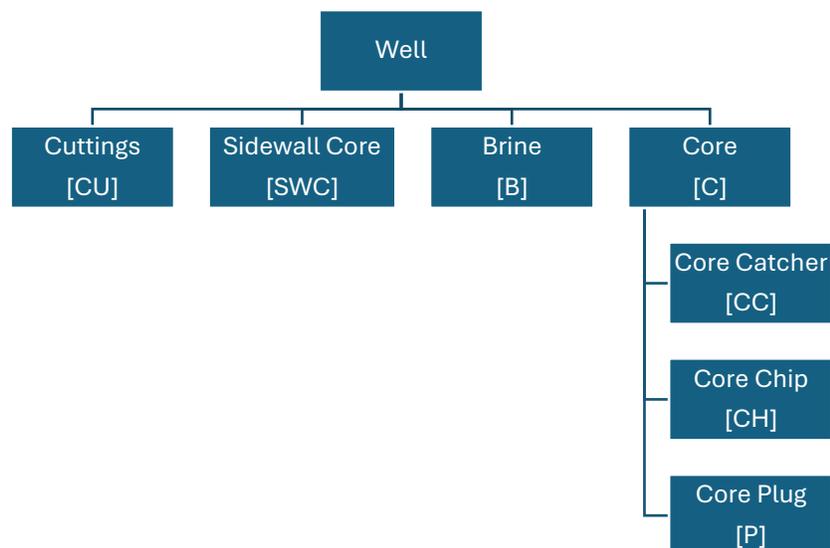


Figure 1. Relationship diagram between entities in the database.

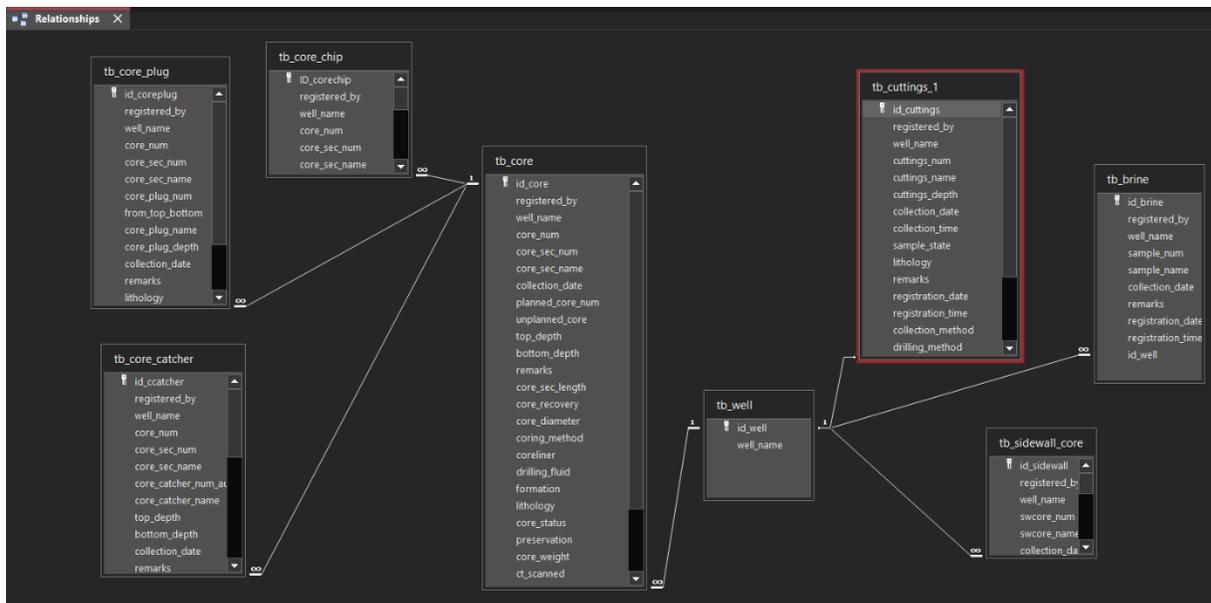


Figure 2. One-to-many relationships between entities in the sample database.

Tables and fields

Each table has a set of fields relevant to the each sample type (Table 1). Some fields are common to all samples, such as *registered_by*, *well_name*, *collection_date*, *registration_date*, and *registration_time*. This data redundancy was implemented on purpose, so that data would be checked by the register on the spot.

Table 1. Description of fields contained in each table.

Table	Field	Type	Size	Property	Value
Common to all tables	registered_by	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. Name of the person registering samples
	well_name	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. Select from well dropdown list.
	collection_date	Date With Time	8	Attributes:	Fixed Size
				Description:	Mandatory. Short date format YYYY-MM-DD.
	remarks	Long Text		Attributes:	Variable Length
				Description:	Mandatory. Free text describing sample collection conditions
	registration_date	Date With Time	8	Attributes:	Fixed Size
				Description:	Auto populated. Default Value: Date()
	registration_time	Date With Time	8	Attributes:	Fixed Size

				Description:	Auto populated. Default Value: Time()
<i>tb_brine</i>	id_brine	Long Integer	4	Attributes:	Fixed Size, Auto-Increment
				Description:	Primary key. Automatically generated database identifier for each brine record.
	sample_num	Long Integer	4	Attributes:	Fixed Size
				Description:	Mandatory. Sample number automatically generated
	sample_name	Short Text (Calculated)	243	Attributes:	Variable Size
				Description:	Mandatory. Autocompleted field: [well_name] & "-BR-" & [sample_num]
	id_well	Long Integer	4	Attributes:	Fixed Size
				Description:	Foreign key to link up to table: tb_well
<i>tb_core</i>	id_core	Long Integer	4	Attributes:	Fixed Size, Auto-Increment
				Description:	Primary key. Automatically generated database identifier for each core record.
	core_num	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. Core number as assigned during coring activities. Format: integer number.
	core_sec_num	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. User enters sequential number corresponding to each 1m-core section. Format: integer number.
	core_sec_name	Short Text (Calculated)	243	Attributes:	Variable Length
				Description:	Mandatory. Automatically generated, human readable name for a core that is printed on labels. This name is unique across all samples. Name convention is [well_name] & [core_num] & [core_section].
				Description:	Mandatory. Select a date from data picker. Format DD-MM-YYYY
	planned_core_num	Short Text	255	Attributes:	Variable Length
				Description:	Optional. Select from: "Yes" or "No"
	unplanned_core	Short Text	255	Attributes:	Variable Length
				Description:	Optional. Select from: "Yes" or "No"
	top_depth	Double	8	Attributes:	Fixed Size
				Description:	Mandatory. Measured depth (MD) in meters
	bottom_depth	Double	8	Attributes:	Fixed Size
				Description:	Mandatory. Measured depth (MD) in meters
	core_sec_length	Single (Calculated)	4	Attributes:	Variable Length
				Description:	Optional. Calculated field as the difference of [bottom_depth]-[top_depth]
	core_recovery	Double	8	Attributes:	Fixed Size
				Description:	Optional. Core recovery in meters.

core_diameter	Long Integer	4	Attributes:	Fixed Size
			Description:	Optional. Core diameter is constant in this project. Default value 4 inches.
coring_method	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Select from dropdown list. Options: "Rotary" or "Motor"
coreliner	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Default value: "Aluminium"
drilling_fluid	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Drilling fluid is constant in this project. Default value: "Oil-based mud (OBM)"
formation	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Free text for geological formation.
lithology	Long Text		Attributes:	Variable Length
			Description:	Optional. Free text for lithological description.
core_status	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Indicate if core is preserved or has been opened. Default value: Preserved core
preservation	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Select from dropdown list. Refers to the conditions cores are being stored.
core_weight	Double	8	Attributes:	Fixed Size
			Description:	Optional. Weight in core barrel in kg
ct_scanned	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Indicate if this sample has been CT scanned.
gamma_ray	Short Text	255	Attributes:	Variable Length
			Description:	Optional. Indicate if gamma ray measurements were taken.
radiation	Double	8	Attributes:	Fixed Size
id_well	Long Integer	4	Attributes:	Fixed Size
			Description:	Foreign key to link up to table: tb_well
<i>tb_core_catcher</i> Same fields as for core except for sample number and sample name	id_ccatcher	Long Integer	4	Attributes: Fixed Size, Auto-Increment
	core_num	Short Text	255	Attributes: Variable Length
				Description: Mandatory. Core number as assigned during coring activities. Format: integer number.
	core_sec_num	Short Text	255	Attributes: Variable Length
				Description: Mandatory. User enters sequential number corresponding to each 1m-core section. Format: text
	core_sec_name	Short Text (Calculated)	243	

				Attributes:	Variable Length
				Description:	Mandatory. Automatically generated, human readable name for a core. This name is unique across all samples. Name convention is [well_name]-[core_num]-[core_section].
	core_catcher_num	Double (Calculated)	8		
				Attributes:	Variable Length
				Description:	Mandatory. Automatically generated to ensure numbering of samples is sequential and unique. Based on id_
	core_catcher_name	Short Text (Calculated)	243		
				Attributes:	Variable Length
				Description:	Mandatory. Auto populated. Name Convention: [core_section_name]+[core_chip_num]+[Top/Bottom]
tb_core_chip	id_corechip	Long Integer	4		
				Attributes:	Fixed Size, Auto-Increment
				Description:	Automatically generated database identifier for a core chip, unique number. Primary key
	core_num	Short Text	255		
				Attributes:	Variable Length
				Description:	Mandatory. Core number as assigned during coring activities. Format: integer number.
	core_sec_num	Short Text	255		
				Attributes:	Variable Length
				Description:	Mandatory. User enters sequential number corresponding to each 1m-core section. Format: text
	core_sec_name	Short Text (Calculated)	243		
				Attributes:	Variable Length
				Description:	Mandatory. Automatically generated, human readable name for a core that is printed on labels. This name is unique across all samples. Name convention is [well_name]-[core_num]-[core_section].
	core_chip_num	Short Text	255		
				Attributes:	Variable Length
				Description:	Mandatory. Sequential sample number assigned while sampling core chips.
	from_top_bottom	Short Text	255		
				Attributes:	Variable Length
				Description:	Mandatory. Insert T if core chip comes from the Top of the core or B if it comes from the Bottom of the core.
	core_chip_name	Short Text (Calculated)	243		
				Attributes:	Variable Length
				Description:	Mandatory. Auto populated. Name Convention: [core_section_name]&[core_chip_num]&["Top"/"Bottom"]
	core_chip_depth	Double	8		
				Attributes:	Fixed Size
				Caption:	Depth Interval [mMD]
				Description:	Mandatory. Measured depth (MD) in meters
	collection_date	Date With Time	8		
				Attributes:	Fixed Size
				Description:	Mandatory. Select a date from data picker. Format DD-MM-YYYY Mandatory. Date format DD-MM-YY
	remarks	Long Text			
				Attributes:	Variable Length
				Description:	Mandatory. Free text describing onsite conditions or related with the core chip
	debris	Short Text	255		
				Attributes:	Variable Length

				Description:	Optional. To distinguish the core debris type of sample.
	lithology	Long Text		Caption:	Lithology Description
				Description:	Optional. Free text for lithological description.
	drilling_fluid	Short Text	255	Attributes:	Variable Length
				Description:	Optional. Drilling fluid remains unchanged. Default value: Oil-based mud (OBM)
	formation	Short Text	255	Attributes:	Variable Length
				Attributes:	Fixed Size
	id_core	Long Integer	4	Description:	Foreign key to link to tb_core table.
<i>tb_core_plug</i>	id_coreplug	Long Integer	4	Attributes:	Fixed Size, Auto-Increment
	core_num	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. Core number as assigned during coring activities. Format: integer number.
	core_sec_num	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. User enters sequential number corresponding to each 1m-core section. Format: text
	core_sec_name	Short Text (Calculated)	243	Attributes:	Variable Length
				Description:	Mandatory. Automatically generated, human readable name for a core that is printed on labels. This name is unique across all samples. Name convention is [well_name]-[core_num]-[core_section].
	core_plug_num	Long Integer	4	Attributes:	Fixed Size
				Description:	Mandatory. Sequential plug number assigned by user when they are extracted from the core.
	from_top_bottom	Short Text	255	Attributes:	Variable Length
				Description:	Mandatory. Insert T if chore chip comes from the Top of the core or B if it comes from the Bottom.
	core_plug_name	Short Text (Calculated)	243	Attributes:	Variable Length
				Description:	Mandatory. Calculated: [core_section_name] & [core_plug_num] & [Top/Bottom]
	core_plug_depth	Double	8	Attributes:	Fixed Size
	lithology	Long Text		Attributes:	Variable Length
				Description:	Optional. Free text for lithological description.
	formation	Short Text	255	Attributes:	Variable Length
				Description:	Auto populated. Default Time: Time()
	id_core	Long Integer	4	Attributes:	Fixed Size
				Description:	Foreign key to link to tb_core table.
<i>tb_cuttings</i>	id_cuttings	Long Integer	4	Attributes:	Fixed Size, Auto-Increment

			Description:	Automatically generated database identifier for a core. This identifier is guaranteed to be unique across all cores. This is the primary key of the tb_cuttings table.	
cuttings_num	Short Text	255	Attributes:	Variable Length	
			Description:	Mandatory. Core number as assigned during coring activities. Format: integer number.	
cuttings_name	Short Text (Calculated)	243	Attributes:	Variable Length	
			Description:	Mandatory. Automatically generated, human readable name for a core that is printed on labels. This name is unique across all samples. Name convention is [well_name] & "-CU-" & [cuttings_num]	
cuttings_depth	Double	8	Attributes:	Fixed Size	
			Description:	Mandatory. Measured depth (MD) in meters	
sample_state	Short Text	255	Attributes:	Variable Length	
			Description:	Mandatory. Select from dropdown list.	
			RowSource:	"Wet washed";"Wet unwashed";"Dry washed"	
lithology	Long Text		Attributes:	Variable Length	
			Description:	Optional. Free text for lithological description.	
collection_method	Short Text	255	Attributes:	Variable Length	
			Description:	Optional. Select from dropdown list.	
drilling_method	Short Text	255	Attributes:	Variable Length	
			Description:	Optional. Select from dropdown list	
			RowSource:	"Rotary";"Motor";"Both"	
drilling_mud	Short Text	255	Attributes:	Variable Length	
			Description:	Optional. Select from dropdown list	
			RowSource:	"Oil-based mud";"Water-based mud"	
id_well	Long Integer	4	Attributes:	Fixed Size	
			Description:	Foreign key to link up to tb_well	
<i>tb_sidewall_core</i>	id_well	Long Integer	4	Attributes:	Fixed Size, Auto-Increment
			Description:	Primary Key	
	swcore_num	Long Integer	4	Attributes:	Fixed Size
			Description:	Mandatory. Core number assigned by the coring company. Format: integer number.	
	swcore_name	Short Text (Calculated)	243	Attributes:	Variable Length
			Description:	Mandatory. Autocompleted. Well Name + Core Number	
	depth	Double	8	Attributes:	Fixed Size
			Description:	Mandatory. Measured depth (MD) in meters	
	lithology	Long Text		Attributes:	Variable Length

			Description:	Optional. Free text for lithological description.
core_status	Short Text	255		
			Attributes:	Variable Length
			Description:	Optional. Select from dropdown list. Whether core remains preserved or has been opened. Default value: Preserved core
preservation	Short Text	255		
			Attributes:	Variable Length
			Description:	Optional. Select from dropdown list. Refers to the conditions cores are being stored.
id_well	Long Integer	4		
			Attributes:	Fixed Size
			Description:	Foreign key to link to well
tb_well				
	id_well	Long Integer	4	
			Attributes:	Fixed Size, Auto-Increment
			Description:	automatically generated id number
	well_name	Short Text	255	
			Attributes:	Variable Length
			Description:	Well name or borehole name.

User guidelines

Upon opening the sample database, the following Main Menu appears showing three possibilities to use the database (Figure 3): Data Entry, Data Editing, and Data Search. Each of them shows a list of the sample types in the database (Figure 4).

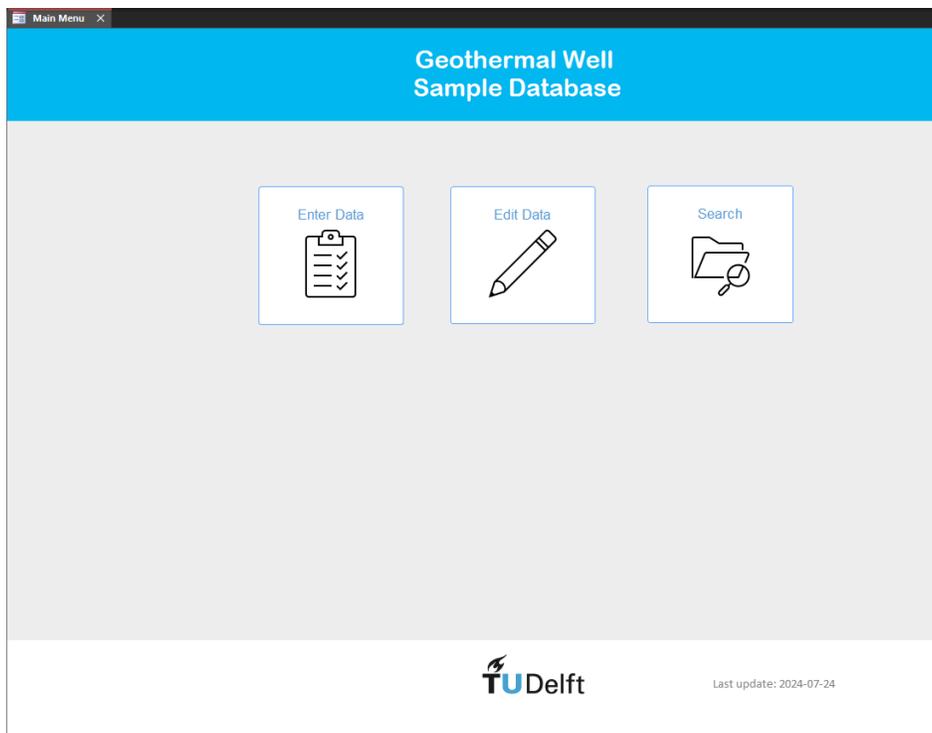


Figure 3. Sample database main menu

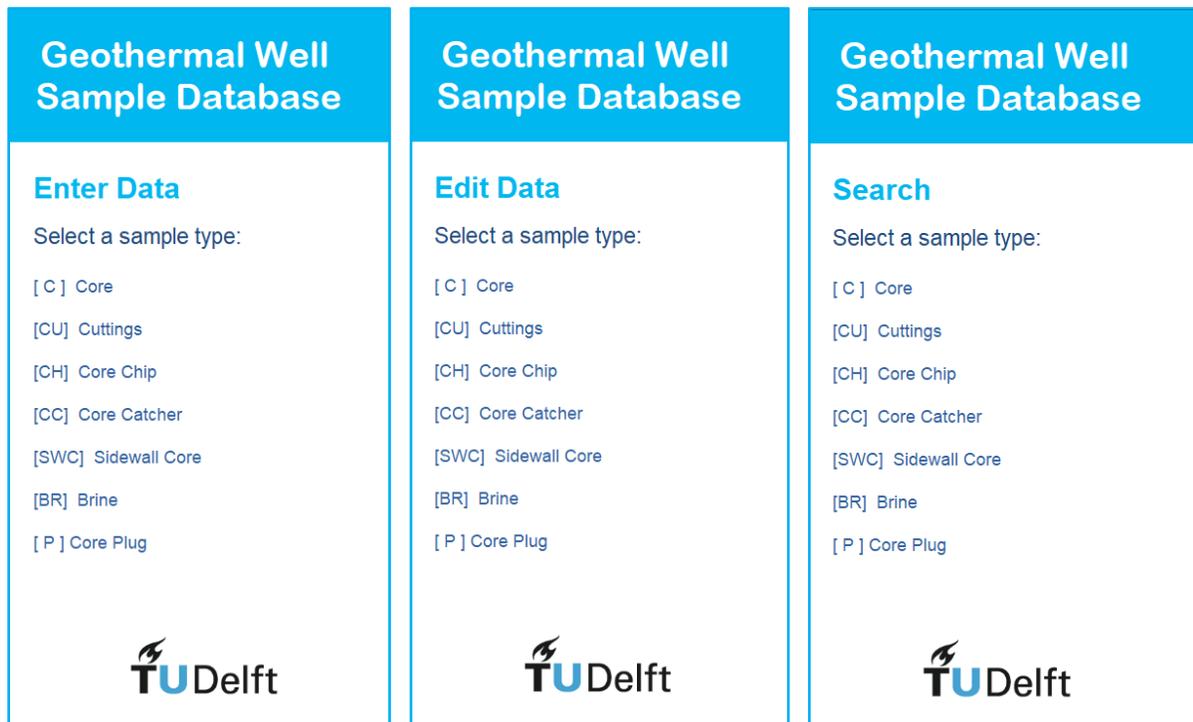


Figure 4. The database allows to make a) Enter data, b) Edit data or c) Search Data.

Data Entry

All forms for data entry consist of a split window, showing on the top only the mandatory fields to register a new sample and on the bottom the full list of samples already being registered. This is to allow different users to see which samples have been already registered, by whom, and when (Figure 5). This layout was chosen to make it easy to filter (Figure 6) and export records to a spreadsheet file (Figure 7) to the electronic notebook for further label printing. Note the numbered sequence of steps for this purpose: 1) Filter records from the list below, 2) Export records to a spreadsheet, 3) copy records without field name, and 4) Paste records to elabjournal.

Note that to print sample labels, sample records were imported into a sample management system connected to a zebra label printer, outside of the scope of this user guide.

The purpose of designing a data entry form was to streamline the data collection process, on one side, and to validate data from the collection stage, on the other side. Various fields were already prefilled with information already known, such as names of those registering samples on-site, the well name, core numbers (which were on the coring plan). Other fields were automatically calculated based on the information previously typed in. This is the case for *core_section_name*, which uses the *well_name*, *core_number*, and *core_section_number* to enforce the sample naming convention. In this way, typos or human mistakes could be avoided. Data entry forms are also helpful to validate data, for example, some registering a sample will not be allowed to insert

a negative value for any depth field, or will send an error if the remarks field would be empty (Figure 8).

The screenshot shows the 'Core Data Entry' form with a table of records. The table has the following columns: Core Section Name, registered by, Well Name, Core No, Core Sect, Collection Date, Planned Core, Unplanned core, Top Depth, Bottom Depth, Remarks, Registration Date, and Registration Time. The records are as follows:

Core Section Name	registered by	Well Name	Core No	Core Sect	Collection Date	Planned Core	Unplanned core	Top Depth	Bottom Depth	Remarks	Registration Date	Registration Time
DELGT01-C7-10	User_1	DELGT01	C7	10	2023-09-06	C7		2651	2651.63	this was taken by IOT so th	2023-10-06	16:02
DELGT01-C6-26	User_1	DELGT01	C6	26	2023-09-06	C6		2641.4	2641.95	this was taken by IOT so th	2023-10-06	15:54
DELGT01-C7-0	User_1	DELGT01	C7	0	2023-09-06	C7	Yes	2642	2642.01	This section was pushed up	2023-09-06	11:34
DELGT01-C7-9	User_1	DELGT01	C7	9	2023-09-06	C7	Yes	2650	2651	none	2023-09-06	11:01
DELGT01-C7-8	User_1	DELGT01	C7	8	2023-09-06	C7	Yes	2649	2650	none	2023-09-06	11:00
DELGT01-C7-7	User_1	DELGT01	C7	7	2023-09-06	C7	Yes	2648	2649	none	2023-09-06	10:59
DELGT01-C7-6	User_1	DELGT01	C7	6	2023-09-06	C7	Yes	2647	2648	none	2023-09-06	10:59
DELGT01-C7-5	User_1	DELGT01	C7	5	2023-09-06	C7	Yes	2646	2647	none	2023-09-06	10:57
DELGT01-C7-4	User_1	DELGT01	C7	4	2023-09-06	C7	Yes	2645	2646	none	2023-09-06	10:57
DELGT01-C7-3	User_1	DELGT01	C7	3	2023-09-06	C7	Yes	2644	2645	none	2023-09-06	10:56
DELGT01-C7-2	User_1	DELGT01	C7	2	2023-09-06	C7	Yes	2643	2644	none	2023-09-06	10:56
DELGT01-C7-1	User_1	DELGT01	C7	1	2023-09-06	C7	Yes	2642	2643	none	2023-09-06	10:50
DELGT01-C6-24	User_1	DELGT01	C6	24	2023-09-05	C6	No	2639.94	2640.94	none	2023-09-05	19:38

Figure 5. Form for data entry of cores. The layout is similar for all data entry forms.

The screenshot shows the 'Core Data Entry' form with a table of filtered records. The table has the following columns: Core Section Name, registered by, Well Name, Core No, Core Sect, Collection Date, Planned Core, Unplanned core, Top Depth, Bottom Depth, Remarks, Registration Date, and Registration Time. The records are as follows:

Core Section Name	registered by	Well Name	Core No	Core Sect	Collection Date	Planned Core	Unplanned core	Top Depth	Bottom Depth	Remarks	Registration Date	Registration Time
DELGT01-C3-1	User_1	DELGT01	C3	1	2023-08-30	C3	No	2594.5	2595.5	none	2023-08-30	12:15
DELGT01-C3-2	User_1	DELGT01	C3	2	2023-08-30	C3	No	2595.5	2596.5	none	2023-08-30	12:16
DELGT01-C3-3	User_1	DELGT01	C3	3	2023-08-30	C3	No	2596.5	2597.01	core catcher section and it	2023-08-30	12:16

Figure 6. Filtered records on the Entry Data form ready to be exported.

core_sec_name	registered_by	well_name	core_num	core_sec_num	collection_date	planned_core_num	unplanned_core	top_depth	bottom_depth	remarks	registration_date	registration_time
DELGT01-C3-1	User_1	DELGT01	C3	1	2023-08-30	C3	No	2594.5	2595.5	none	2023-08-30	12:15:36
DELGT01-C3-2	User_1	DELGT01	C3	2	2023-08-30	C3	No	2595.5	2596.5	none	2023-08-30	12:16:13
DELGT01-C3-3	User_1	DELGT01	C3	3	2023-08-30	C3	No	2596.5	2597.01	core catcher section and it is broken.	2023-08-30	12:16:45

Figure 7. Filtered records are then exported to a spreadsheet.

Core Chip Data Entry
Mandatory Fields

Registered by	User_1	
Well Name	DELGT01	
Core Number	C2	
Core Section Number	22	
Core Section Name	DELGT01-C2-22	
Core Chip Number	77	
From Top/Bottom Depth	B	
Core Chip Name	DELGT01-C2-22-CHB77	
Core Chip Depth [mMD]		
Collection Date	2024-08-12	
Remarks		

- 1 Filter records from the list below to export to eLabJournal
- 2 Export records to a spreadsheet
- 3 Copy records without field names
- 4 Paste records to eLabJournal

Save Record
Close

Figure 8. Data entry on-site was aided by prefilled fields (e.g. Well Name) using dropdown menus or auto-calculated fields from previously inserted information (e.g. Core Section Name). Example for a core chip.

Data Editing

Similarly, all forms for data editing consist of a split window. On the top are displayed both mandatory and optional fields for one record, which can be selected from the list at the bottom of the form. Thus, information can be modified or added to the fields shown on top (Figure 9). Note that the Entry Data form must be closed to be able to Edit Data, this is because both forms access the same table *tb_core*.

Figure 9. Data editing form for records that are already stored in the database.

Search Data

Alternatively, forms to search for data display all the records stored in the database for that type of sample, from which samples can be organised, filtered, and exported in the user's preferred format for further processing (Figure 10).

Registered by	Well Name	Core Number	Core Secti	Core Name	Collection Date	Planned Cori	Top Depth [m]	Bottom Dept	Remarks	Core Section Length	Core Recovery [m]
User_1	DELGT01	C1	3	DELGT01-C1-3	2023-08-10	C1	2513.5	2514.5	vacuum sealed on 16-08-2023		1
User_1	DELGT01	C1	2	DELGT01-C1-2	2023-08-10	C1	2512.5	2513.5	none		1
User_1	DELGT01	C1	1	DELGT01-C1-1	2023-08-10	C1	2511.5	2512.5	vacuum sealed on 16-08-2023		1
User_1	DELGT01	C1	6.1	DELGT01-C1-6.1	2023-08-10	C1	2516.5	2517.06	none		0.56
User_1	DELGT01	C1	7	DELGT01-C1-7	2023-08-10	C1	2517.5	2518.5	vacuum sealed on 16-08-2023. I placed the core almost vertical		1
User_1	DELGT01	C2	7	DELGT01-C2-7	2023-08-28	C2	2581.13	2581.38	This is a section from the top of the second 9m barrel that was sticking		0.25
User_1	DELGT01	C2	2	DELGT01-C2-2	2023-08-29	C2	2577	2578	The barrel of core 2 was shifted during sawing trying to adjust the		1

Core Diamet	Coring Method	Coreliner	Drilling Mud	Geological Fr	Lithology	Core Status	Preservation Conditions	Core in Barre	CT Scanned	Gamma-Ray	Radiation [Bq]
4	Rotary	Aluminum	Oil-based mud		TOP: dark and light grey, fluidised, originally mm-	Preserved	Core rack at room conditions	28.1	Yes	Yes	1.9
4	Rotary	Aluminum	Oil-based mud		TOP: light grey (dried color), coarse silt, few	Preserved	Core rack at room conditions	27.6	Yes	Yes	1.73
4	Rotary	Aluminum	Oil-based mud		TOP: very hard, coarse silt, m-grey-brown, dark-grey	Preserved	Core rack at room conditions	26.3	Yes	Yes	1.75
4	Rotary	Aluminum	Oil-based mud		TOP: hard, slicked, dark grey, coaly silty clay	Preserved	Core rack at room conditions	25.5	Yes	Yes	3.16
4	Rotary	Aluminum	Oil-based mud		TOP: (d) grey, clayey silt, fluidised, floating d.grey	Preserved	Core rack at room conditions	24.4	Yes	Yes	1.74
4	Rotary	Aluminum	Oil-based mud		same as 2581.38, coarse silt that is close to very	Preserved	Core rack at room conditions	25	Yes	Yes	1.91
4	Rotary	Aluminum	Oil-based mud		TOP:relatively hard rock, some smearing of cutting	Preserved	Core rack at room conditions	29.5	Yes	Yes	2.2

Figure 10. Data Search form showing all records for the chosen type of sample.