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*.

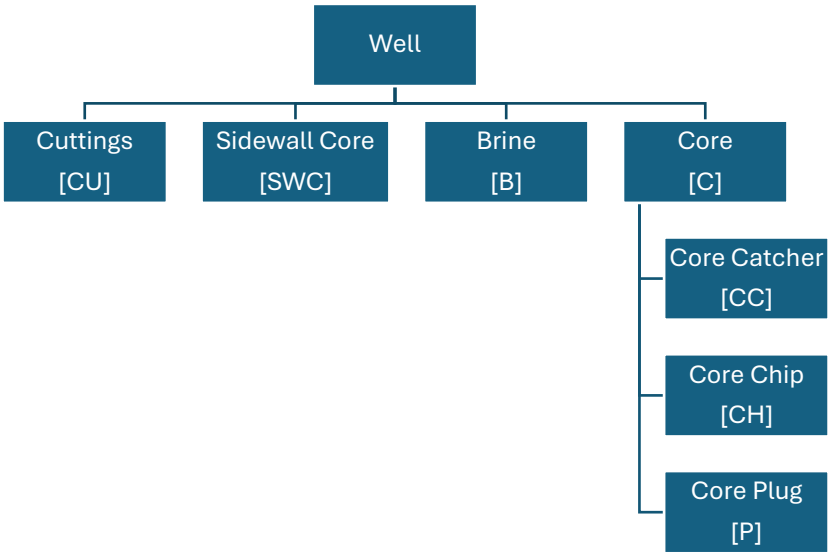


Figure 1. Relationship diagram between entities in the database.

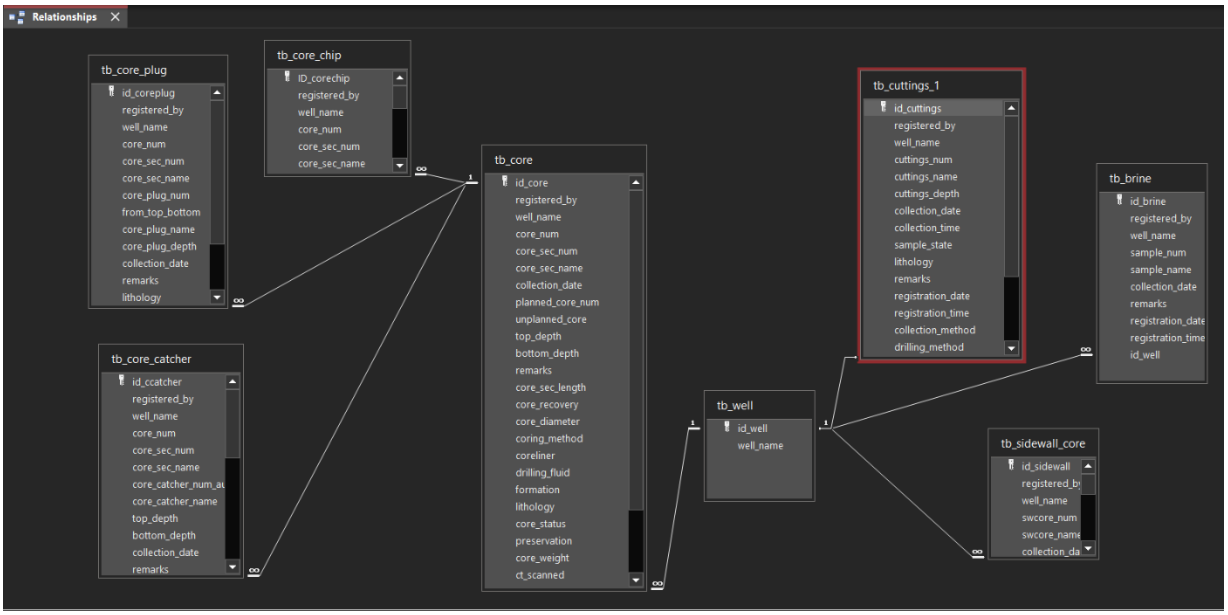


Figure 2. One-to-many relationships between entities in the sample database.

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()
tb_brine	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
tb_core	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 inche.
	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
tb_core_catcher 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 chore 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
	id_core	Long Integer	4		
				Attributes:	Fixed Size
				Description:	Foreign key to link to tb_core table.
tb_core_plug	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:	Foreing key to link to tb_core table.
tb_cuttings	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
tb_sidewall_core	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).

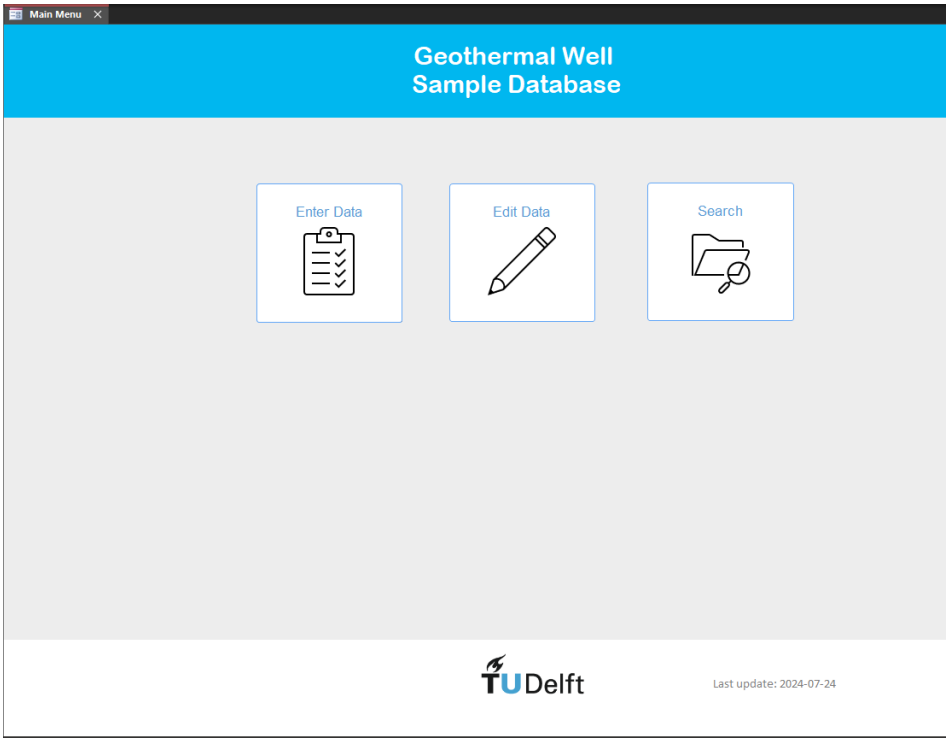


Figure 3. Sample database main menu

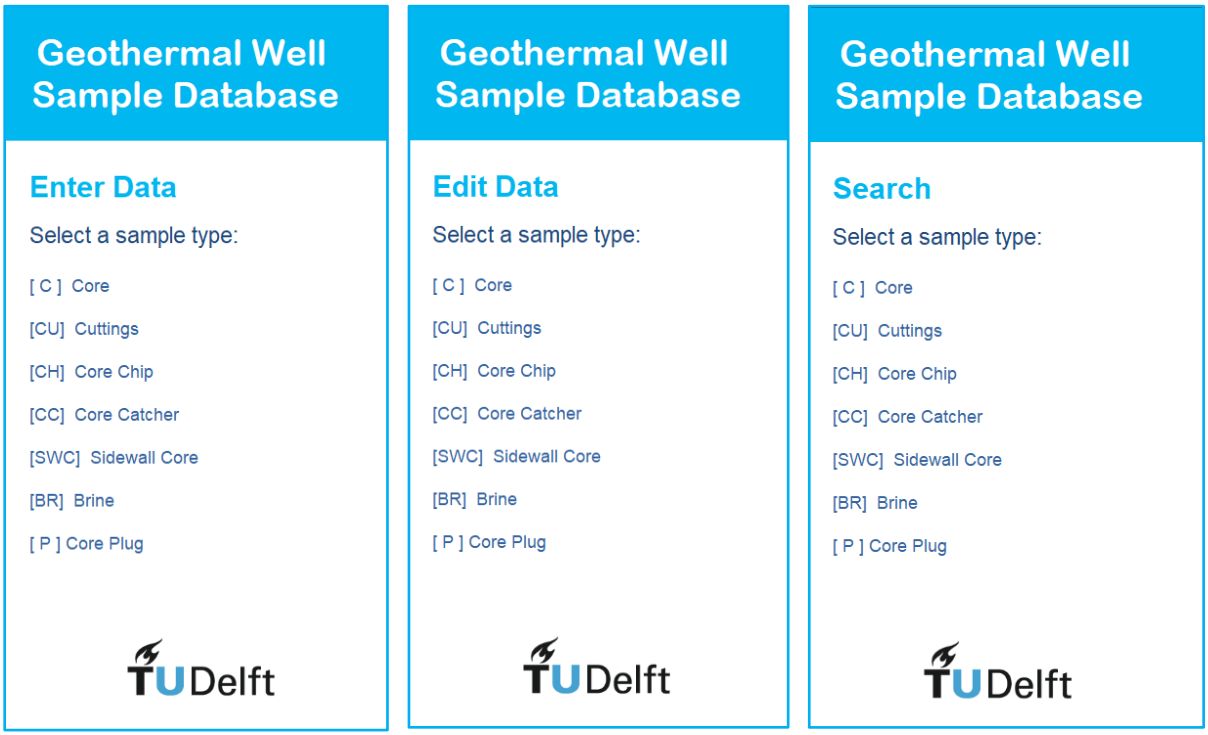


Figure 4. The database allows to make a) Enter data, b) Edit data or c) Search Data.

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).

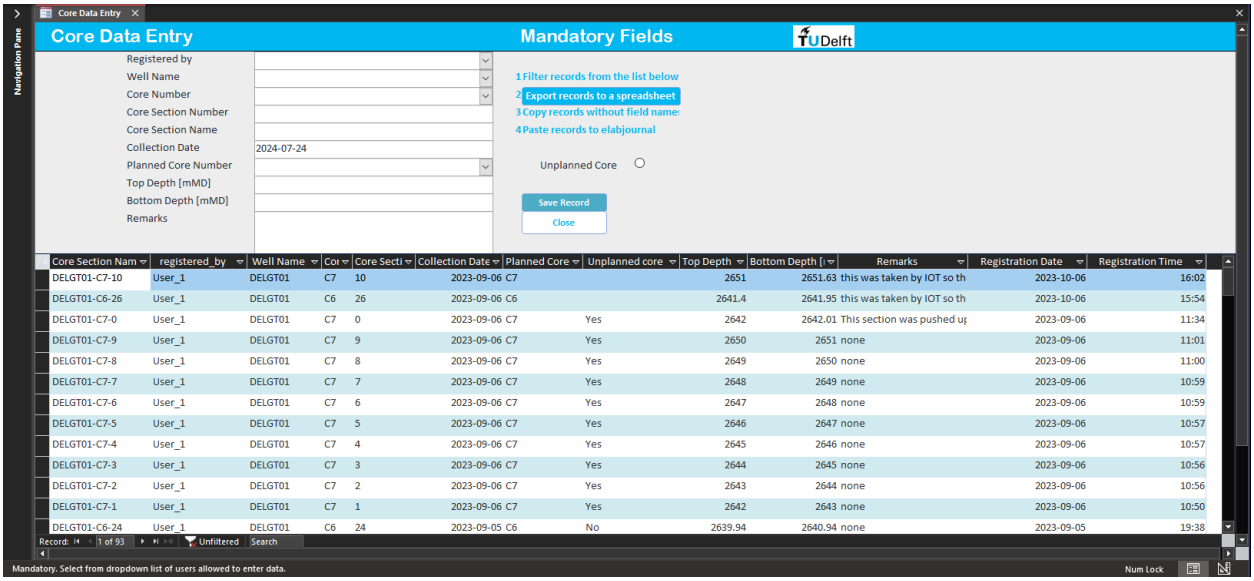


Figure 5. Form for data entry of cores. The layout is similar for all data entry forms.

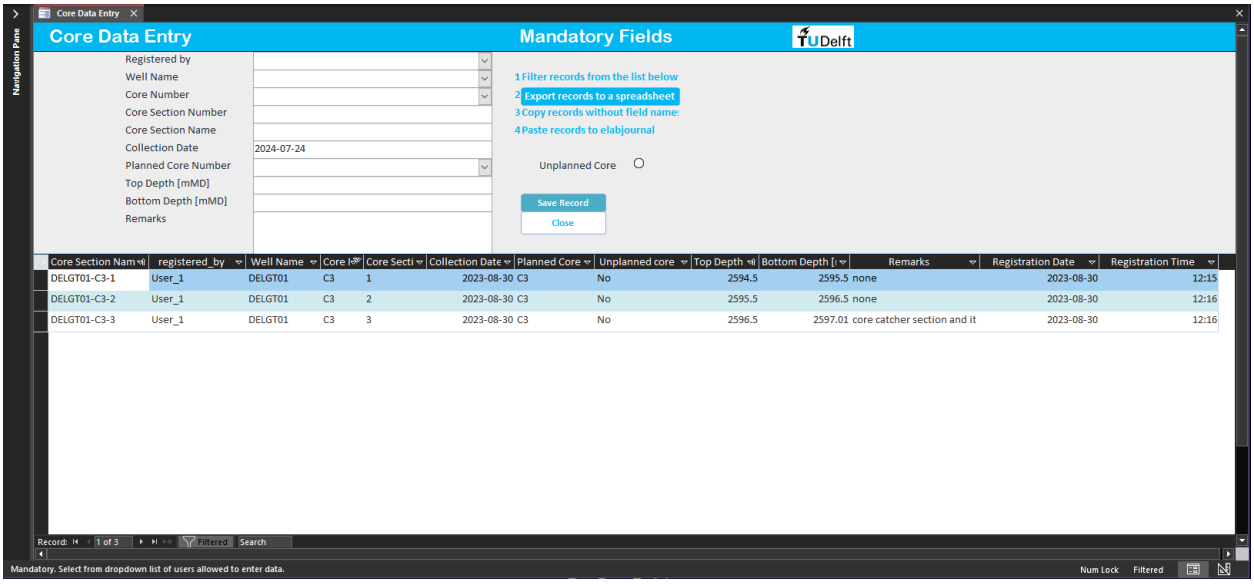
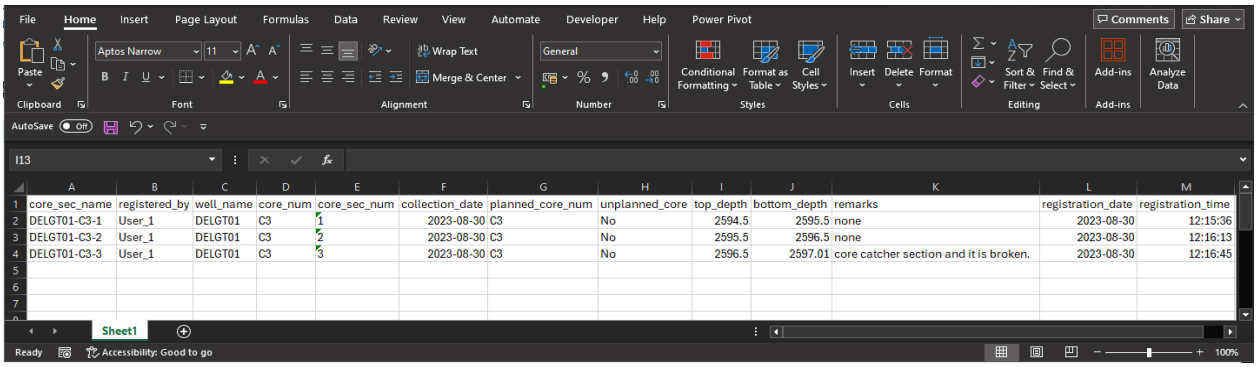


Figure 6. Filtered records on the Entry Data form ready to be exported.



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.

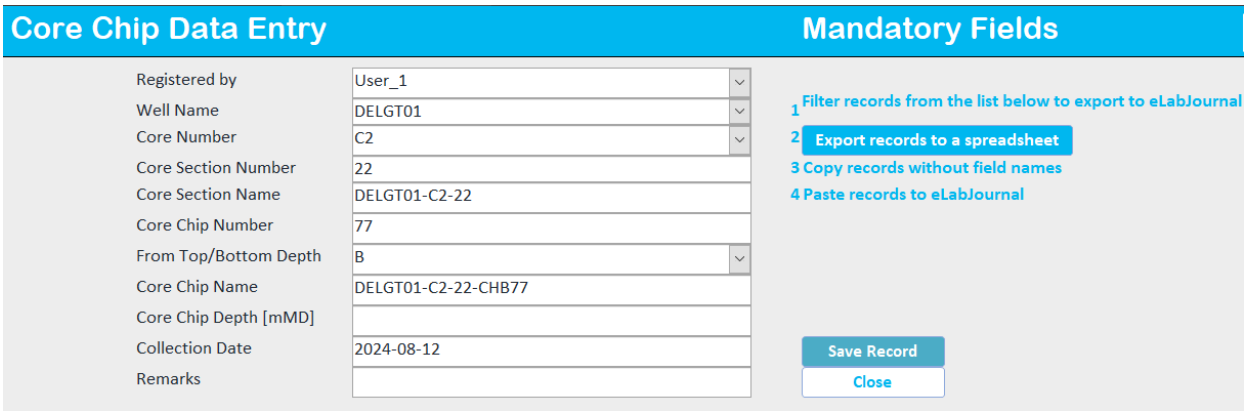


Figure 8. Data entry on-site was aided by prefilled fields (e.g. Well Name) using dropdown menus or auto-calculated fields from previously inserted information (e.g. Core Section Name). Example for a core chip.

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*.

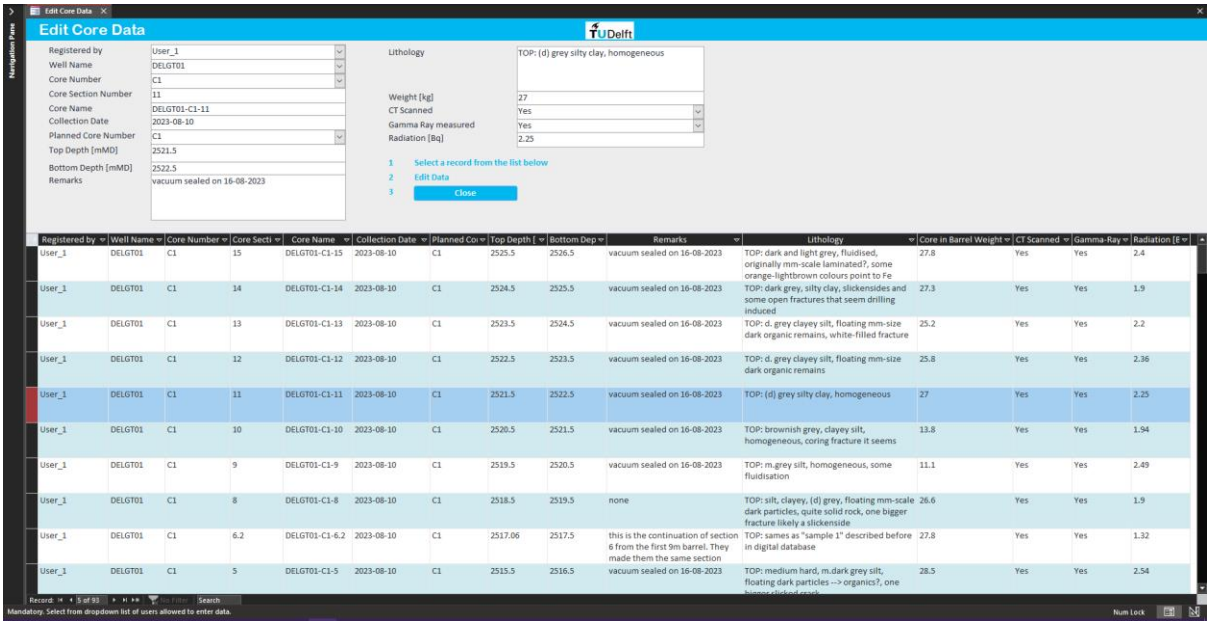


Figure 9. Data editing form for records that are already stored in the database.

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).

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