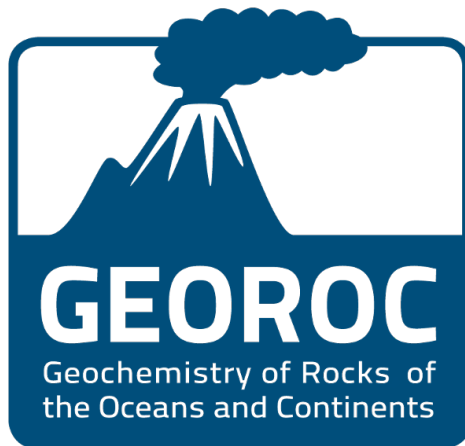


# Introduction to the GEOROC database

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\*based on 'Kompaktkurs 2000' by Bärbel Sarbas and Mukul Sharma held at the Max Planck Institute for Chemistry, Mainz

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# 1 Introduction

GEOROC stands for *Geochemistry of Rocks of the Oceans and Continents*. The GEOROC database contains published geochemical analyses of whole rocks, glasses, minerals and inclusions from eleven different geological settings. Figure 1 shows the distribution of these samples across the world. The database provides free access to >34 million individual values of major and trace element concentrations, radiogenic and nonradiogenic isotope ratios as well as analytical ages. In addition to the chemical analyses, extensive additional information (metadata) is stored: geographic location of samples (with latitude and longitude), rock class and type, alteration grade, texture of the sample, information on sampling technique, analytical method and laboratory, measurement accuracy, analysis of reference materials and bibliographic data.

With this global data compilation, GEOROC regularly contributes to the generation of new scientific knowledge in the Earth Sciences as well as other disciplines. For example, the database is used for data discovery in specific geographic regions, development of

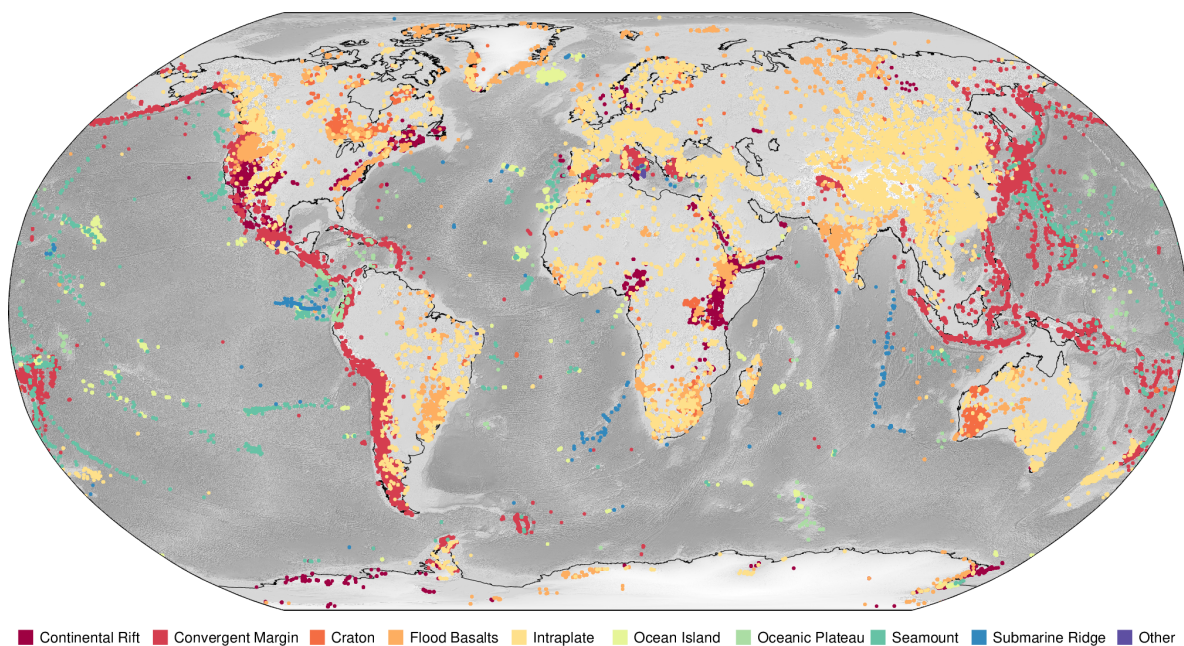


Figure 1: Global distribution of samples compiled in the GEOROC database, coloured by geological setting.

new methods for data analysis and filtering, or to link seemingly unconnected datasets from, e.g., medicine or archaeology to the composition of rocks or minerals. To date, GEOROC has been acknowledged in more than 3,400 peer-reviewed publications, many of which have appeared in high-ranking journals.

Datasets in GEOROC are cross-linked with GeoReM, a database for geological and environmental reference materials at the Max Planck Institute for Chemistry, Mainz (Germany). GEOROC is a key contributor and integral part of the EarthChem platform, hosted by the Interdisciplinary Earth Data Alliance (IEDA) at the Lamont-Doherty Earth Observatory (USA). The GEOROC database is currently maintained by the Digital Geochemical Data Infrastructure (DIGIS) initiative at the University of Göttingen. It can be accessed at <https://georoc.eu>.

## 1.1 History of the Database

The construction of the GEOROC database under the direction of Bärbel Sarbas began in January 1998 in the former Geochemistry Department of the Max Planck Institute for Chemistry, Mainz. Professor Albrecht Hofmann, then Director of the Geochemistry Department, took on six former employees of the Gmelin Institute (Frankfurt) that had just been discontinued by the Max Planck Society. GEOROC has been available online since the end of 1999. The database structure was developed in close cooperation with the group of PetDB, a petrological database of primarily ocean floor basalts started at a similar time at the Lamont-Doherty Earth Observatory of Columbia University, New York.

The content of the GEOROC database was initially limited to geochemical analyses of ocean island basalts, but was soon expanded to include samples of volcanic rocks from other tectonic environments and the mantle xenoliths they contain. Since 2017, data of all igneous rocks (plutonic and volcanic) are recorded.

After Professor Hofmann retired, the GEOROC group joined the Biogeochemistry department, then the newly Climate Geochemistry department of the Max Planck Insti-

tute for Chemistry. However, due to the contractual situation of the former Gmelin employees their number has steadily decreased. The last member of the original GEOROC group, Bärbel Sarbas, retires at the beginning of 2022.

In August 2021, the GEOROC database was formally transferred to the Georg-August-Universität Göttingen. The new DIGIS group, including Bärbel Sarbas, is continuing to maintain and grow the database. In addition, DIGIS is modernising the database infrastructure and expanding its international connectivity, which will be released under the brand of GEOROC 2.0 in 2024.



## 1.2 GEOROC 2.0: Plans for the Future

GEOROC 2.0 is envisioned as a connected platform capable of meeting future challenges of digital data-based research and the evolving needs of the community. The primary objective is to realign the database with current and future demands in digital geochemical research, especially regarding the FAIR data principles (findable, accessible, interoperable, reusable). This service will be provided with future-ready, adaptable IT infrastructure.

To facilitate better data discovery, GEOROC 2.0 will integrate additional universal identifiers such as data DOIs (i.e. where data are published separately from a journal publication), author ORCIDs and the International GeoSample Number (IGSN).

DIGIS will implement an interoperable metadata model as well as data and metadata exchange via standardised application interfaces (APIs). This means that data can be

more readily harvested and exchanged with other data services. The API will allow new ways of querying the database from the command line and (user-written) research software. A beta-version of the GEOROC 2.0 API was released for testing in January 2023 and is documented at <https://api-test.georoc.eu/api/v1/docs/index.html>.

The DIGIS concept for GEOROC 2.0 further includes new pathways for data entry using end-to-end text and data mining and facilitating user submissions of data. To this end, the **GEOROC Data Repository** was set up in October 2021 which publishes new geochemical data submitted by authors. Note that all data submissions have to be linked to a journal manuscript, however this manuscript does not yet need to be published. A confidential review-link and provisional dataset DOI is provided to authors for the manuscript review process by a scientific journal. All data published within the **GEOROC Data Repository** will automatically be considered for inclusion into the GEOROC database. A joint submission portal for the DIGIS and EarthChem data systems is currently in development. The two data systems are also collaborating to develop a web service that supports submission of data extracted from any previously published in a peer-reviewed journal article, allowing the community to contribute missing data records to the GEOROC and PetDB databases.

The GEOROC database is built exclusively from analytical data published in peer-reviewed journals. As such, the database relies on the geochemical community as much as the geochemical and other communities rely on GEOROC. Data access and best practises for data reporting and citation are, therefore, fundamental pillars of GEOROC 2.0. DIGIS is one of the founding members of the OneGeochemistry initiative that seeks to build and maintain consensus-driven standards that make geochemistry research data globally findable and accessible, and truly interoperable and reusable to both humans and machines. For more details and updates on GEOROC 2.0 see the DIGIS website: <http://digis.geo.uni-goettingen.de>.

## 2 Content of the Database

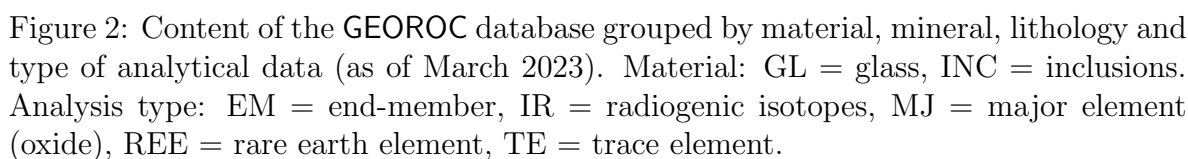
The GEOROC database currently contains approximately 1.7 million mineral analyses, 500,000 whole rock analyses, 74,000 inclusion analyses, and 50,000 glass analyses (as of March 2023; Fig. 2). These analyses include over 34 million individual values from around 21,000 publications. Table 1 shows how these analyses are distributed over samples of the different geological settings.

Due to GEOROC’s initial focus on volcanic rocks, and ocean island basalts in particular, data from volcanic samples are most comprehensive (i.e. almost all published analyses are entered). Plutonic rocks are only recorded for publication dates after 2015, so that a significant portion of analyses across all geological settings may not be included. Currently published works are regularly supplemented.

**NOTE:** *Submarine Ridge* data are not systematically entered into the GEOROC database. The database PetDB (<https://search.earthchem.org/>) should be used for geochemical data of mid-ocean ridge basalts (MORBs).

Geological Setting	Whole Rocks	Minerals	Inclusions	Glass
Archaean Craton	31,130	74,891	282	2
Complex Volcanic Settings	2,850	57,022	1,257	238
Continental Flood Basalt	52,944	129,902	8,537	2,257
Convergent Margin	145,530	410,064	29,013	21,674
Intraplate Volcanics	158,538	820,328	15,932	2,401
Ocean Island	54,181	117,818	11,776	11,457
Ocean-Basin Flood Basalt	1,269	822	42	63
Oceanic Plateau	3,758	6,185	265	503
Rift Volcanics	29,207	109,767	5,454	6,999
Seamount	7,977	18,863	1,221	2,573
Submarine Ridge	1,229	877	11	831

Table 1: Number of analyses collected in GEOROC by geological setting and type of material (as of March 2023).





### 3 Querying the GEOROC database

Currently, there are five categories via which to start your search of the GEOROC database:

- by Bibliography
- by Geological Setting
- by Geography
- by Chemistry
- by Petrography.

Owing to the large number of data holdings, precompiled search results are also available for direct download. **Precompiled files** are provided for each of the geological settings, lithologies, minerals and for inclusion data.

In addition, GEOROC hosts a number of **expert datasets**. These files are not related to the content of the database, but instead are provided by members of the community as curated compilations of special interest.

#### 3.1 Query by Bibliography

The **bibliographic query** begins with an alphabetical list of authors from which one or more names can be selected (Fig. 3). You can combine this selection with one or more years of publication.

The next window shows the publications of the selected authors currently recorded in the database, regardless of the position of the names in the author order (Fig. 4). These publications can be used as a further selection criterion. In addition, the data tables of the individual publications can also be viewed and downloaded.

The next step is a window listing a set of metadata that can be used to further refine the query (Fig. 5). This list is created dynamically, i.e. only the information that is available for the previously selected samples is shown. The most important criterion,

**Bibliographic Query**

Select author(s) (either as first or as co-author) and/or publication year(s)\*

ALAMINIA Z.  
AL-AMRI A. M.  
ALANIZ-ALVAREZ S. A.  
ALANSARI A.  
ALARD O.  
ALASINO P. H.  
ALATORRE-IBARGÜENGOITIA M.  
ALAVIJEH B. S.  
ALBA-ALDAVE L. A.  
ALBANESE S.  
**ALBAREDE F.**  
ALBEE A. L.  
ALBEKOV A. YU.  
ALBERS J.  
ALBERT C.  
ALBERT H.  
ALBERT J.  
ALBERT P. G.  
ALBERTI A.  
ALBERTI E.  
ALBERTINIG

Add =>

<= Remove

ALBAREDE F.

2003  
2002  
2001  
2000  
**1999**  
1998  
1997  
1996  
1995  
1994  
1993  
1992  
1991  
1990  
1989  
1988  
1987  
1986  
1985  
1984  
1983

Clear

Papers

Clear

Figure 3: Query by Bibliography: select author(s) and year(s).

and one that should probably always be used, is **TYPE OF MATERIAL**. This criterion defines the type of material analysed on a sample: whether it is a whole rock analysis or the analysis of a mineral, an inclusion (glass, fused or mineral inclusion) or a volcanic glass. The criterion **ROCK TYPE** is also important. Here you can limit the search to samples of volcanic rocks, for example.

As an example, if you have selected the criteria **TYPE OF MATERIAL** and **ROCK TYPE**, two lists with the corresponding entries open in the next window (Fig. 6). By default, the criteria of the two lists are linked with an **AND** operator. However, an **OR** operator can also be selected. Their different functions are best explained using an example. If the search is limited to samples from a particular publication, a query with the criteria 'volcanic rock' **AND** 'whole rock' leads to the whole rock analyses of volcanic rocks from this publication. In contrast, selecting 'volcanic rock' **OR** 'whole rock' will select all volcanic analyses (i.e. whole rock, glass, mineral and inclusions analyses) plus all available whole rock analyses from all existing rock types.

Check paper(s) to go to sample criteria or click Table(s) to see data tables		Check all
GEOROC-ID 7076 <input type="checkbox"/> <a href="#">Table(s)</a>	BLICHERT-TOFT J., ALBAREDE F., ROSING M. T., FREI R., BRIDGWATER D.:   GEOCHIM. COSMOCHIM. ACTA 63   [1999] 3901-3914 TITLE: THE Nd AND Hf ISOTOPIC EVOLUTION OF THE MANTLE THROUGH THE ARCHEAN. RESULTS FROM THE ISUA SUPRACRUSTALS, WEST GREENLAND, AND FROM THE BIRIMIAN TERRANES OF WEST AFRICA doi: 10.1016/S0016-7037(99)00183-0	
GEOROC-ID 1300 <input type="checkbox"/> <a href="#">Table(s)</a>	BLICHERT-TOFT J., ALBAREDE F.:   GEOPHYS. RES. LETT. 26   [1999] 935-938 TITLE: Hf ISOTOPIC COMPOSITIONS OF THE HAWAII SCIENTIFIC DRILLING PROJECT CORE AND THE SOURCE MINERALOGY OF HAWAIIAN BASALTS doi: 10.1029/1999GL900110	
GEOROC-ID 2820 <input type="checkbox"/> <a href="#">Table(s)</a> <a href="#">GeoReM 4579</a>	BLICHERT-TOFT J., FREY F. A., ALBAREDE F.:   SCIENCE 285   [1999] 879-882 TITLE: Hf ISOTOPE EVIDENCE FOR PELAGIC SEDIMENTS IN THE SOURCE OF HAWAIIAN BASALTS doi: 10.1126/science.285.5429.879	

Papers found: 3

[Continue](#) to sample criteria [Clear](#)

Figure 4: Query by Bibliography: select publication(s).

After refining the search using the sample metadata, the chemical elements and isotope ratios available for the selected samples are listed (Fig. 7). These are divided into groups: major elements, trace elements with the rare earth elements as a separate list, radiogenic isotope ratios, isotope (ratios) of the U-decay series, stable isotope ratios, noble gases and the analytically determined age. Entire groups or individual entries can be selected. Furthermore, on this page you can specify whether the analytical method and laboratory should also be displayed.

In the next window, the metadata is selected that should be included in the search result in addition to the chemical analyses (Fig. 8). Standard fields, which are always

Check at least one criterion for sample selection.	
<input type="checkbox"/> SAMPLE NAME <input type="checkbox"/> SAMPLING TECHNIQUE <input type="checkbox"/> LAND/SEA (SAMPLING) <input type="checkbox"/> ROCK NAME <input type="checkbox"/> ROCK TYPE <input type="checkbox"/> TYPE OF MATERIAL <input type="checkbox"/> MINERAL / COMPONENT <input type="checkbox"/> CRYSTAL <input type="checkbox"/> RIM / CORE (MINERAL GRAINS) <input type="checkbox"/> INCLUSION TYPE <input type="checkbox"/> MINERAL (INCLUSION) <input type="checkbox"/> HOSTMINERAL (INCLUSION)	<p>Note</p> <p><b>TYPE OF MATERIAL = material analysed (whole rock, volcanic glass, mineral, inclusion)</b></p> <p><b>SAMPLE NAME = sample name as given in the original paper</b></p> <p><b>ROCK NAME = rock species (e.g., alkali basalt, tholeiite, rhyolite) as given in the original paper</b></p> <p><b>ROCK TYPE = rock group (e.g., volcanic, plutonic)</b></p> <p><a href="#">Continue</a> to sample criteria <a href="#">Clear</a></p>

Figure 5: Select which metadata to use for further refining the query.

☒ AND   ☐ OR  
 (See below for instructions)

ROCK TYPE	TYPE OF MATERIAL
<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           MANTLE XENOLITH            PLUTONIC ROCK            VOLCANIC ROCK         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           VOLCANIC GLASS            INCLUSION            MINERAL / COMPONENT (INCL. GROUNDMASS)  <b>WHOLE ROCK</b> </div>

to chemical criteria  

Figure 6: Further refine query by TYPE OF MATERIAL and ROCK TYPE.

The following chemical items are available for the samples you selected:

Major Elements	Trace Elements	RE Elements	Radiogenic Isotope Systems	Disequilibrium Series Isotopes	Nonradiogenic Isotopes	Rare Gases, Volatiles	Analytical Age
<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           AL2O3 BAO CAO CL CO2         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           BA BE CO CO2 CR         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           CE DY ER EU GD         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           AR38_AR36 AR40_AR36 EPSILON_W182 EPSILON_W183 HF176_HF177         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           PA231_U235 PA231_U235_ACT PB210_ACT PB210_U238 RA226_TH230_ACT         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           D18O D25MG D26MG MY_W182         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           AR40         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>	<div style="border: 1px solid #ccc; padding: 5px; min-height: 100px;">           AGE         </div> <div style="text-align: center; margin-top: 5px;"> <input type="checkbox"/> All         </div>

 
 ☐ With analytical method(s)  
 ☒ Without analytical method(s)  
 Items combined by:  
 ☒ Or  
 ☐ And  
 ☐ Compiled ?

to select additional data  

Figure 7: Select which analytes to display.

## Choose Metadata

☐ STANDARD OUTPUT
 

Most of the sample metadata available in GEOROC will be downloaded as standard fields. Useful if you have to split your query.

### INDIVIDUAL OUTPUT

Individual sample metadata (*besides* the standard fields reference and sample name) will be downloaded. The list contains only the available fields.

- ☐ LOCATION
- ☐ LOCATION COMMENT
- ☐ LATITUDE (MIN.)
- ☐ LONGITUDE (MIN.)
- ☐ LATITUDE (MAX.)
- ☐ LONGITUDE (MAX.)
- ☐ ELEVATION (MIN.)
- ☐ ELEVATION (MAX.)
- ☐ SAMPLING TECHNIQUE
- ☐ LAND/SEA (SAMPLING)
- ☐ ROCK TYPE
- ☐ ROCK NAME
- ☐ ROCK TEXTURE
- ☐ SAMPLE COMMENT
- ☐ AGE (MIN.)
- ☐ AGE (MAX.)
- ☐ ERUPTION YEAR
- ☐ ALTERATION
- ☐ TYPE OF MATERIAL

recommended for large tables

Figure 8: Choose metadata to include in the result along with the chemical analyses.

displayed, are the sample name, a unique sample ID and the reference. You may also choose ‘standard output’ which displays most of the metadata available in GEOROC and ensures a common download format.

The result of the query can be downloaded directly or viewed as an HTML table before

CITATION	SAMPLE NAME	UNIQUE_ID	LOCATION	ROCK NAME	RB(PPM)	SR(PPM)
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	EV01	7839-EV01	PARANA / SOUTHERN PARANA PROVINCE	BASALT	33	260 \ 242
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	G-215	7839-G-215	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	40	150
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	G-402	7839-G-402	PARANA / SOUTHERN PARANA PROVINCE	BASALT	17	210
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	G-648	7839-G-648	PARANA / SOUTHERN PARANA PROVINCE	BASALT	18	120
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	IO2	7839-IO2	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	48	200
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	MO1	7839-MO1	PARANA / SOUTHERN PARANA PROVINCE	BASALT	34	220
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	MO2	7839-MO2	PARANA / SOUTHERN PARANA PROVINCE	BASALT	40	110
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	MO3	7839-MO3	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	14	260
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	MRO3	7839-MRO3	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	73	170
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS16	7839-RS16	PARANA / SOUTHERN PARANA PROVINCE	BASALT	18	190
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS20	7839-RS20	PARANA / SOUTHERN PARANA PROVINCE	BASALT	19	120
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS26	7839-RS26	PARANA / SOUTHERN PARANA PROVINCE	BASALT	22	290
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS30	7839-RS30	PARANA / SOUTHERN PARANA PROVINCE	RHYODACITE	140	140
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS37	7839-RS37	PARANA / SOUTHERN PARANA PROVINCE	BASALT	22	230
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS50	7839-RS50	PARANA / SOUTHERN PARANA PROVINCE	RHYOLITE	210	50
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS60	7839-RS60	PARANA / SOUTHERN PARANA PROVINCE	BASALT	25	220
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS65	7839-RS65	PARANA / SOUTHERN PARANA PROVINCE	RHYODACITE	120	150 \ 161
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS68	7839-RS68	PARANA / SOUTHERN PARANA PROVINCE	BASALT	19	470
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS69	7839-RS69	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	69	290
CITATION	SAMPLE NAME	UNIQUE_ID	LOCATION	ROCK NAME	RB(PPM)	SR(PPM)
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS70	7839-RS70	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	67	110
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS71	7839-RS71	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	33	300 \ 214
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS73	7839-RS73	PARANA / SOUTHERN PARANA PROVINCE	BASALT	24	470
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS76	7839-RS76	PARANA / SOUTHERN PARANA PROVINCE	BASALT	35	130
<a href="#">HUGHES S. S. (1986)</a> <a href="#">[1827]</a> <a href="#">Standards/Precision(Info)</a>	RS80	7839-RS80	PARANA / SOUTHERN PARANA PROVINCE	ANDESITE, BASALTIC	26	240

(Alternative values are separated by an \*\*)

[GEOROC-ID 1827 Tables] HUGHES S. S., SCHMITT R. A., WANG Y. L., WASSERBURG G. J.; | GEOCHEM. J. 20 [1986] 173-189  
TRACE ELEMENT AND SR-ND ISOTOPIC CONSTRAINTS ON THE COMPOSITIONS OF LITHOSPHERIC PRIMARY SOURCES OF SERRA GERAL CONTINENTAL FLOOD BASALTS, SOUTHERN BRAZIL | doi:  
10.2343/geochemj.20.173

Figure 9: Example of a query result displayed as an HTML table.

download (Fig. 9). This table contains the reference in short form, the sample name, further metadata selected by the user and the selected analysis data including the respective unit. In GEOROC, concentrations are always entered in the unit given in the original reference. This can result in a query result for an item containing two or more columns with the concentrations in each unit.

If element concentrations or isotope ratios have been determined several times in a work on a sample, these values are given in one field, separated by a forward slash (/). It is then up to the user to decide whether to use one of these values or to calculate an average. In addition to the reference, there is also the ‘Standards/Precision’ link. This link takes you to the values measured in the respective work on reference samples and to information on the measurement accuracy. The complete references are listed below the table.

### 3.2 Query by Geological Setting

The **geological query** starts with a list of different **geological settings** to which the individual localities are assigned. Localities of a **geological setting** are described in GEOROC by certain **location types**. Table 2 shows some examples.

The sample selection in the locality-based query starts with the most general hierarchy and can then be further restricted to samples from an island, volcano, or sometimes even to samples from a rock series, a rift zone or a specific volcanic stage. An example for the Hawaiian Islands is shown in Fig. 10. The level of detail supported within the search depends on the respective locality. In the case of the Hawaiian Islands, it makes sense to search for samples from individual volcanoes, since all samples recorded in the database can be assigned to a volcano. In the case of oceanic islands such as Iceland or the Canary Islands, a significant proportion of the samples cannot be assigned to any

<b>Geological Setting</b>	<b>Location Type</b>	<b>Example</b>
Ocean Island	ocean-island group	Hawaiian Islands
	ocean island	Hawaiian
	volcano	Kilauea
	flow/formation/series	Puna Basalt
	rift zone	East Rift Zone
	volcanic stage	Shield Stage
Oceanic Plateau	plateau	Manihiki Plateau
	plateau subunit	High Plateau
	site	Site 317
	flow/formation/series	
Continental Flood Basalt	province	Paraná
	province subunit	Southern Paraná Basin
	flow/formation/series	Guatá - Bom Jardim Series

Table 2: Examples of **location types** within **geological settings**.

### Query by Geological Setting

1

Please choose Geological setting

List of locations and Geological settings

Archean Cratons (incl. Greenstone Belts)

Complex Volcanic Settings

Continental Flood Basalts

Convergent Margins

Intracontinental Volcanics

Ocean Islands

Seamounts

2

HAINAN ISLAND

HAWAIIAN ARCH VOLCANIC FIELDS

HAWAIIAN ISLANDS

HAWAIIAN-EMPEROR CHAIN

HEARD

ICELAND

3

or select Ocean Island(s)\*

HAWAII

KAHOOLAWE;HAWAIIAN ISLANDS

KAUAI;HAWAIIAN ISLANDS

KAULA;HAWAIIAN ISLANDS

LANAI;HAWAIIAN ISLANDS

Continue to location criteria Clear

4

Your selection was: Query by Geological Setting: Ocean Island - HAWAIIAN ISLANDS - HAWAII

Do not further constrain location and

Continue to sample criteria

or select Volcano(es)\*

HUALALAI;HAWAII

KILAUEA;HAWAII

KOHALA;HAWAII

MAUNA KEA;HAWAII

MAUNA LOA;HAWAII

Refine your query by

☒ Flow/Formation/Series ☐ Rift Zone ☐ Volcanic Stage

Continue to sample criteria Clear

Figure 10: Query by Geological Setting: steps 1 through 4 selecting geological setting and location type.

particular volcano. It is therefore advisable to go straight from the island level to the sample selection and possibly make further restrictions there.

After selecting the desired geological setting and location type, the query continues with sample and metadata selection as described for the bibliographic query above (Sec. 3).



### 3.3 Query by Geography

If you are interested in a certain geographic region that transcends several geological settings, you can define your region of interest by specifying latitude and longitude (Fig. 11). If the coordinates are known, they can be directly entered into the respective fields for minimum and maximum latitude/longitude. Make sure to enter the values in decimal degrees.

## Query by Geography

Please note: Coordinates in GEOROC are given as decimals.

Enter min. latitude:

Enter max. latitude:


Enter min. longitude:

Enter max. longitude:

Search

Clear

Set Coordinates by Interactive Map



[Search by Location Names](#)   [Search Expeditions](#)

Figure 11: Query by Geography: set coordinates of region of interest.

Alternatively, a rectangular region can be defined on an interactive map (Fig. 12). The map shows the distribution of sample locations available in the database. At low zoom levels, multiple locations are grouped (indicated by round, coloured circles). At high zoom, individual locations are shown and a pop-up box displays additional information about the samples at this location. Several options are available as the base map, including satellite and topographic maps.

In both cases, after confirming your selection this search route takes you straight to the sample and metadata selection as described for the bibliographic query above (Sec. 3).

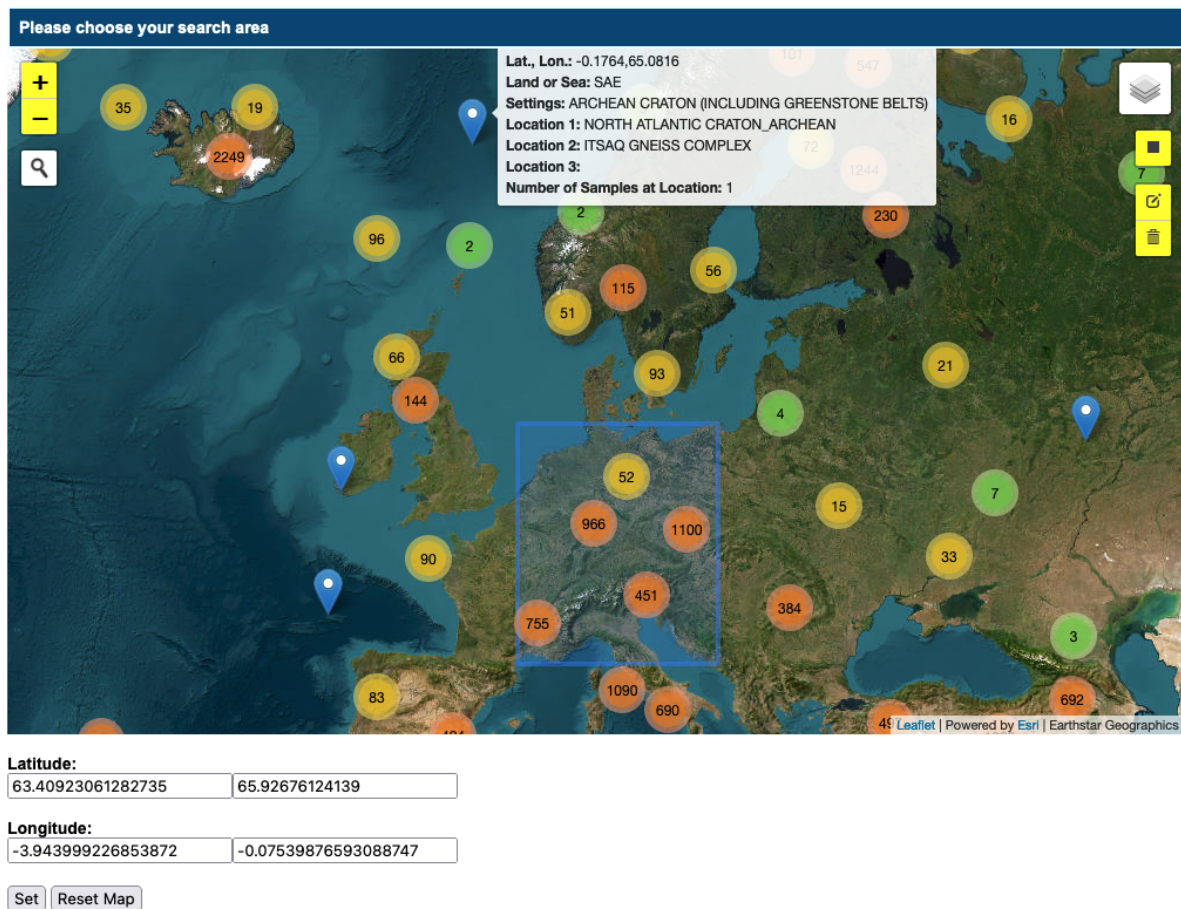


Figure 12: Query by Geography: select region of interest on interactive map showing sample distribution.

### 3.4 Query by Petrography

The **petrographic query** in GEOROC starts with rock or sample data. You can either select rocks of a rock type, search directly for a specific rock name or for a specific sample or group of samples (Fig. 13).

If you select a rock type, for example *Volcanic Rocks*, the next window shows a list of rock names of this type. If you move the cursor over these names, a sub-menu with additional rock names that fall within these groups may open (Fig. 14). You can either select a general name in the list on the left or one of the specific entries on the right.

**NOTE:** rock names in GEOROC always correspond to those of the original publication.

When entering a rock name in the field provided, it is recommended to only enter a

### Query by Petrography

Note: Rock names are those of the original paper.

Please choose rock type

1. Volcanic Rocks

(with classification by  $[\text{Na}_2\text{O} + \text{K}_2\text{O}]/\text{SiO}_2$ )

2. Plutonic Rocks
3. Mantle Xenoliths
4. Precompiled Files

Or search by mineral content: OLIVINE >= <=

Search Clear

Or enter ROCK NAME (full name or start of the name, case insensitive):

Or search SAMPLE NAME (case insensitive) start of field any part of the field exact match

If you want only Samples with Rock Mode Analyses, check the Box Search Clear

It is recommended to enter names only partly (as a substring), e.g., entering andesit returns both andesite and andesitic, entering andesite doesn't return andesitic!

Figure 13: Query by Petrography: select rock type or specific sample(s).

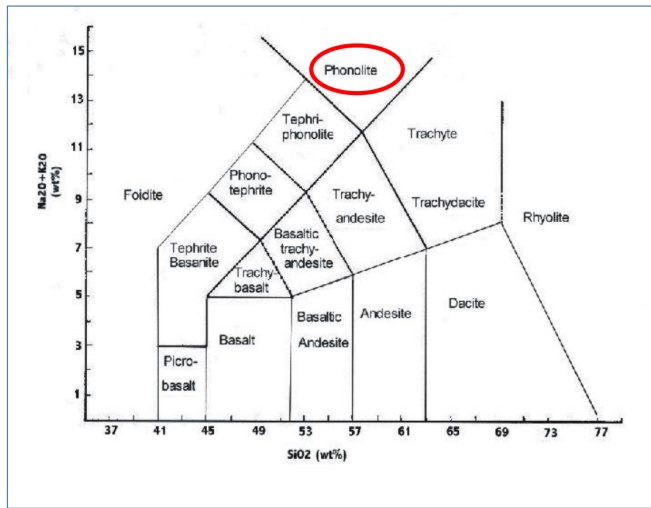


Figure 14: Query by Petrography: select rock name.

part of the name (a substring), for example *andesit* instead of *andesite*. The result will then contain samples with the designation *andesite*, but also others such as *basalt*, *andesitic* or *andesite*, *boninitic*. The query for a rock name is primarily recommended for exotic rock types. Searches for names like *basalt* should be avoided if possible since the result will likely contain thousands of values.

Another option in the petrographic query is to search by sample name (Fig. 13). Here, too, you can enter an exact sample name or a substring, for example *ML* to select a specific group of samples from Mauna Loa volcano. The next window shows a list of all samples with the letter combination *ML* in the sample name. From this list (which will not only contain Mauna Loa samples) the desired samples can be selected.

Samples of volcanic rocks can also be selected using the  $\text{SiO}_2 - (\text{Na}_2\text{O} + \text{K}_2\text{O})$  classification diagram (TAS diagram). It will be particularly apparent here that the rock name of the sample stored in the database corresponds to that of the original reference and may occasionally differ significantly from the name assigned based on the TAS diagram. Figure 15 shows an example for *phonolite*.



after LE BAS et al. [1985]

CITATION	SAMPLE NAME	UNIQUE_ID	ROCK NAME	ND143_ND144
WEIS D. (1993) [1008] Standards/Precision(Info)	LVLK121		PHONOLITE	0.51265 ± 8e-5(2σ)
WEIS D. (1993) [1008] Standards/Precision(Info)	LVLK81	3019-LVLK 81	PHONOLITE	0.51256 ± 2e-5(2σ)
WEIS D. (1993) [1008] Standards/Precision(Info)	LVLK83		PHONOLITE	0.51256 ± 3e-5(2σ)
WEIS D. (1993) [1008] Standards/Precision(Info)	LVLK86		PHONOLITE	0.51251 ± 2e-5(2σ)
DEVEY C. W. (1990) [1457] Standards/Precision(Info)	4-124		BASALT	0.51261 ± 2.3e-5(2σ)
DEVEY C. W. (1990) [1457] Standards/Precision(Info)	4-126		BASALT	0.512607 ± 2.3e-5(2σ)
DEVEY C. W. (1990) [1457] Standards/Precision(Info)	4-2	35082-4-2	BASALT	0.512582 ± 3.1e-5(2σ)
DEVEY C. W. (1990) [1457] Standards/Precision(Info)	4-3	35082-4-3	BASALT	0.512612 ± 2.2e-5(2σ)
MARQUES L. S. (1999) [1498] Standards/Precision(Info)	MV-2	5648-MV-2	PHONOLITE, PERALKALINE	0.512879 ± 3.9e-5(2σ)
MARQUES L. S. (1999) [1498] Standards/Precision(Info)	TR-88	1455-TR-88	PHONOLITE	
MARQUES L. S. (1999) [1498] Standards/Precision(Info)	TR-97		PHONOLITE	
MARQUES L. S. (1999) [1498] Standards/Precision(Info)	TR-98	1455-TR-98	PHONOLITE	0.512826 ± 4.2e-5(2σ)
LE ROEX A. P. (1998) [2421] Standards/Precision(Info)	OKJ-24		TINGUAITE	
LEBRON M. C. (1994) [2633] Standards/Precision(Info)	RU-20		TRACHYTE	0.512831

Figure 15: Query by Petrography: select samples based on TAS diagram.

### 3.5 Query by Chemistry

The **chemical query** is divided into two parts: measured concentrations (or isotopic ratios) and normalised trace element values can be queried. Several literature sources are available for the various reservoirs used for normalisation (Fig. 16).

The query for measured values begins with a list of all available chemical elements and isotopic ratios (Fig. 17). If you choose normalisation instead, you will only see a lists of trace elements and rare earth elements. In both cases, a publication period and the analysed material must be selected on this page. The query is then carried out for the samples of a particular **geological setting**. If frequently measured element concentrations or isotope ratios are requested, it is advisable to split the search over several publication periods. The individual result files can be easily combined again if

### Query by Chemistry

**Abundances**

---

**Normalized Values**

Select preferred literature source of values for normalization.

CHONDRITE (CI)	CHONDRITE (ORD.)	CONT.CRUST	E-MORB	N-MORB	PRIMA
ANDERS & GREVESSE (1989)	NAKAMURA (1974)	RUDNICK & FOUNTAIN (1995)	SUN & MCDONOUGH (1989)	HOFMANN (1988)	HOFMANN (1988)
SUN & MCDONOUGH (1989)		TAYLOR S. & MCLENNAN (1985)		SUN & MCDONOUGH (1989)	MCDONOUGH & SUN (1995)
PALME & BEER (1993)					
EVENSEN ET AL. (1978)					
MCDONOUGH & SUN (1995)					
WASSON & KALLEMEYN (1988)					

Figure 16: Query by Chemistry: search measured or normalised concentrations.

Choose chemical data to display. If you select more than one item: ☒ AND ☐ OR ☐ COMPILED ?

Major Elements	Trace Elements and Rare Gases	RE Elements	Isotopes and Isotope Ratios
AL2O3 AS2O3 AS2O5 B2O3 BAC03 BAO	AG AG107 AG109 AL AL27 AR	CE CE140 DY ER EU EU151	DD HE3 HE3_AR36 HE3_HE4 HE3_AR40 HE4

Constrain by rock type and material/component

☒ Volcanic Rocks

☐ Plutonic Rocks

☐ Mantle Xenoliths

☐ Ore

☐ All Rock Types

☒ Whole Rock (+ Volcanic Glass)

☐ Volcanic Glass

☐ Minerals (incl. Ground Mass)

☐ Inclusions

Continue to select geological setting

Continental Flood Basalts	Oceanic Plateaus
Convergent Margins	Seamounts
Ocean Basin Flood Basalts	Submarine Ridges
Ocean Islands	Archean Cratons
Rift Volcanics	Intracontinental Volcanics
Complex Volcanic Settings	All Geological Settings

Clear

Figure 17: Query by Chemistry: refine search by choosing analytes, rock types and geological setting.

the same or the standard output format is chosen (see Sec. 3 and Fig. 8).

In the next window, all locations of samples are listed for which the selected elements have been measured or are recorded in the database. The location selection is hierarchical again. Before the search result is displayed, you only have to select the metadata that is to be displayed with the result (see Sec. 3).