

# SAPHYR

## The Swiss Atlas of PHYSICAL Properties of Rocks

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### Data and samples collection

**Literature data**

**Measurements on existing samples**

**New sample collection and measurements**

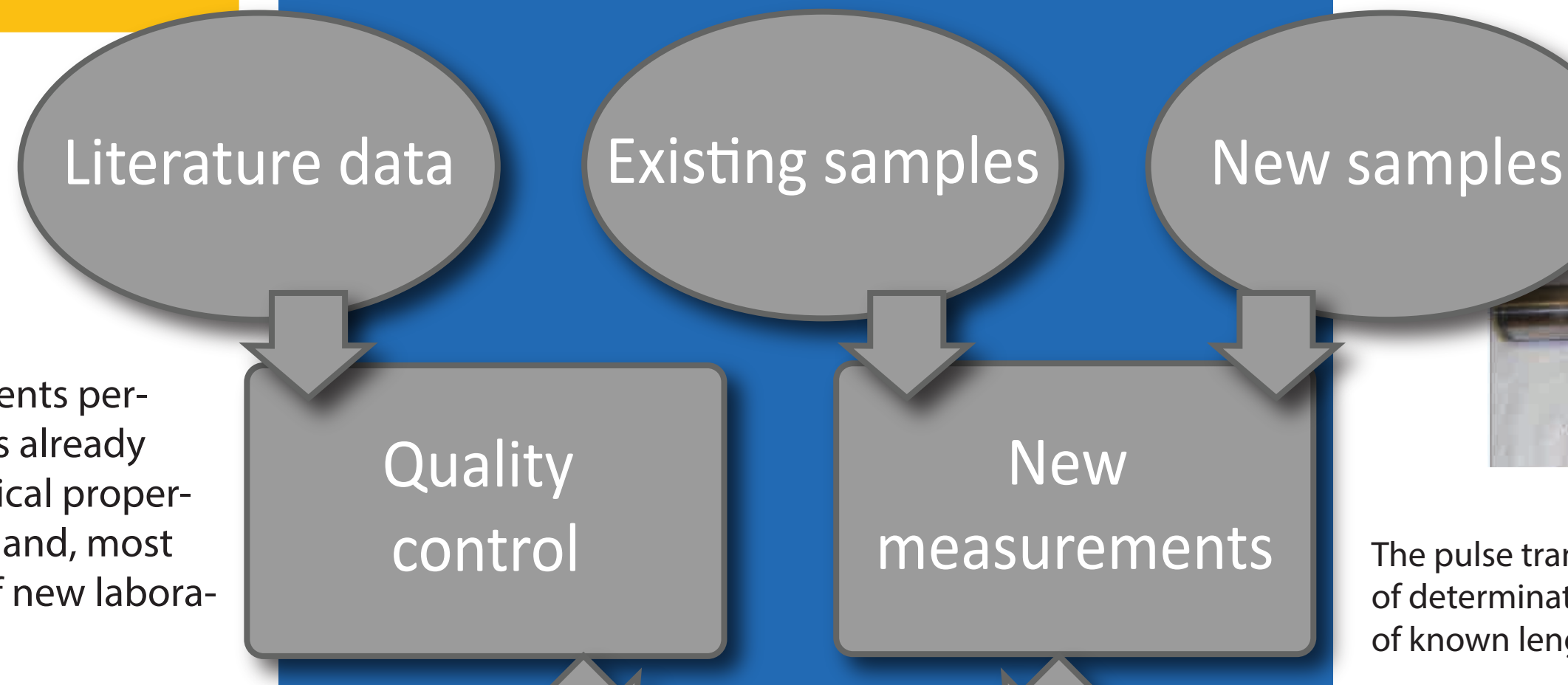
The data that populate our database have distinct sources: scientific literature, public reports from industry or governmental bodies, unpublished data (upon agreement), new measurements performed on sample collections already available from previous physical properties measurement campaigns, and, most important, a great number of new laboratory measurements.

**DATA SOURCES**

Parameter	From Literature	From Boreholes	New Measurements
Bulk density (g/cm <sup>3</sup> )	884	1186	330
Grain density (g/cm <sup>3</sup> )	379	748	322
Porosity (%)	639	748	290
Permeability (md)	21	185	0
Thermal conductivity (W/mK)	638	862	0
Vp0 (km/s)	378	338	0
Vs0 (km/s)	46	0	0
Vp/Vs	332	0	0
Magnetic susceptibility (mSI/m <sup>3</sup> )	346	0	0

SAPHYR is a representative database containing the major physical parameters of rocks, with full coverage for continental crustal rocks, which can be used from the scientific communities as an instrument for investigating geological processes, as well as from the wide public with interests in land and resources planning.

### The concept

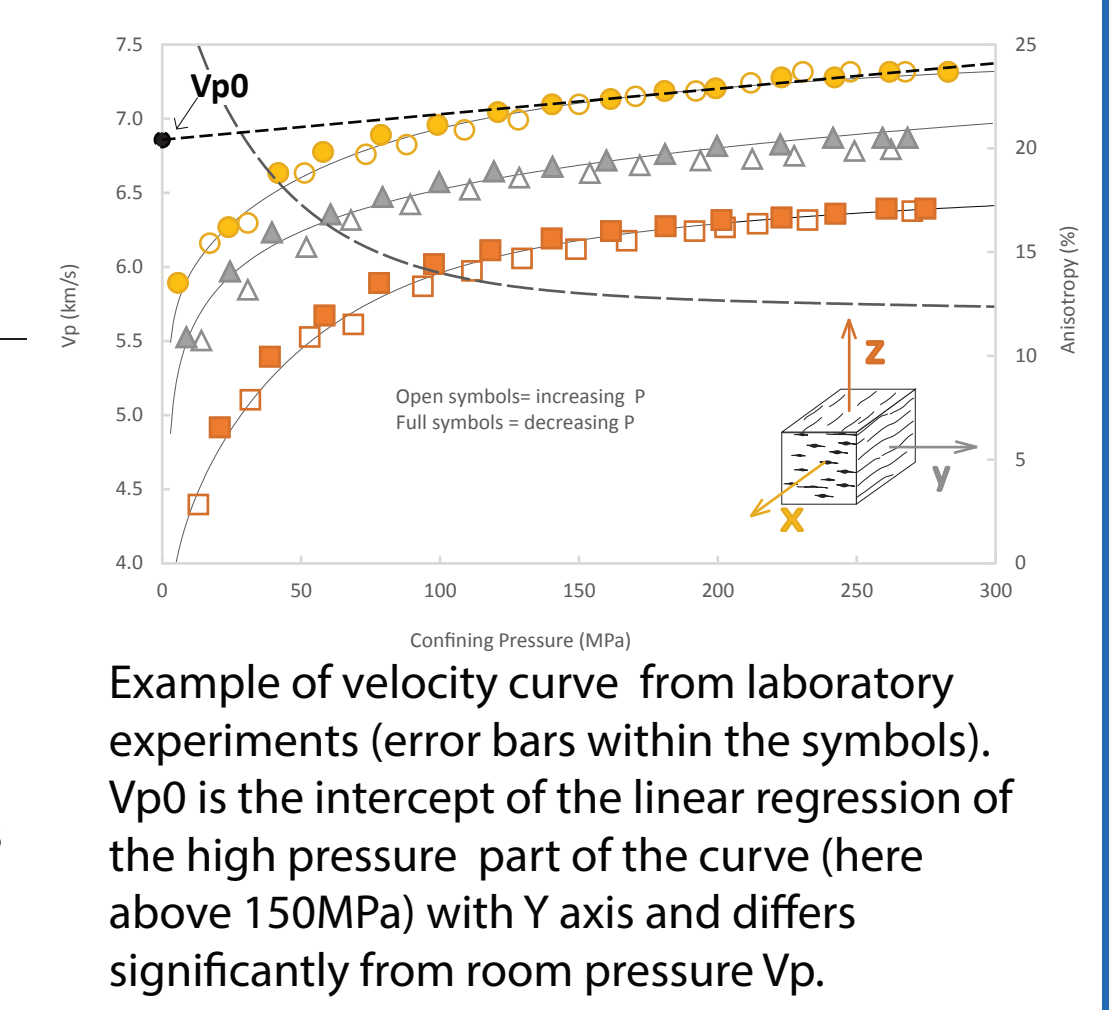


### Measurements and Parameters

**Parameters collected in the database**

Physical property	Parameters
Density	Bulk $\rho$ (dry conditions) Bulk $\rho$ (saturated conditions) Grain $\rho$
Porosity	Absolute $\phi$ Effective $\phi$
Permeability	Effective permeability Hydraulic conductivity
Thermal properties	Conductivity $\lambda$ (dry conditions) Conductivity $\lambda$ (saturated conditions) $\lambda$ Anisotropy Specific heat capacity
Heat production	<sup>238</sup> U, <sup>235</sup> U, <sup>232</sup> Th, <sup>40</sup> K content Volumetric heat generation
Magnetic properties	Bulk Susceptibility $\chi$ Anisotropy
Seismic properties	Velocity P waves at room pressure - Vp0 Vp-Pressure derivative Vp-Temperature derivative Velocity S waves at room pressure - Vs0 (fast and slow S) Vs-pressure derivatives Vs-Temperature derivatives Vp and Vs anisotropy

We aim to assess a complete suite of the main physical parameters. Measurements campaigns on density, permeability, porosity, magnetic susceptibility and ultrasound velocities have been performed in the last years to cover under-represented rock types. Especially velocities measurements were carried out at increasing confining pressure and temperature (the latter only on a limited number of samples). The aim was to define pressure and temperature derivatives in order to extrapolate the results at different crustal in situ conditions.



### Data Treatment

Each measured sample is linked to a specific rock type described in the SGK geotechnical map of Switzerland. The 69 rock types originally described on the map have been grouped into 28 general lithology groups. Data are treated statistically in each lithology group: the mean and the variance of each data group are collected together with max, min and average values. The narrowest data range spanning > 70% probability is identified. The mean value is then assigned to the lithology group and plotted on maps (in the "Results" box below is the example of the Vp0 map).

The data originated from boreholes and tunnels are kept separate from the outcrops data. The effect of lithostatic pressure and temperature over geological time is quite evident on most of the physical parameters.

### Data distribution

**Statistical treatment** → **Physical parameter specific processing** → **"Rock-physical" map**

**Lithologic map** → **Grouping criteria** → **"Rock-physical" map**

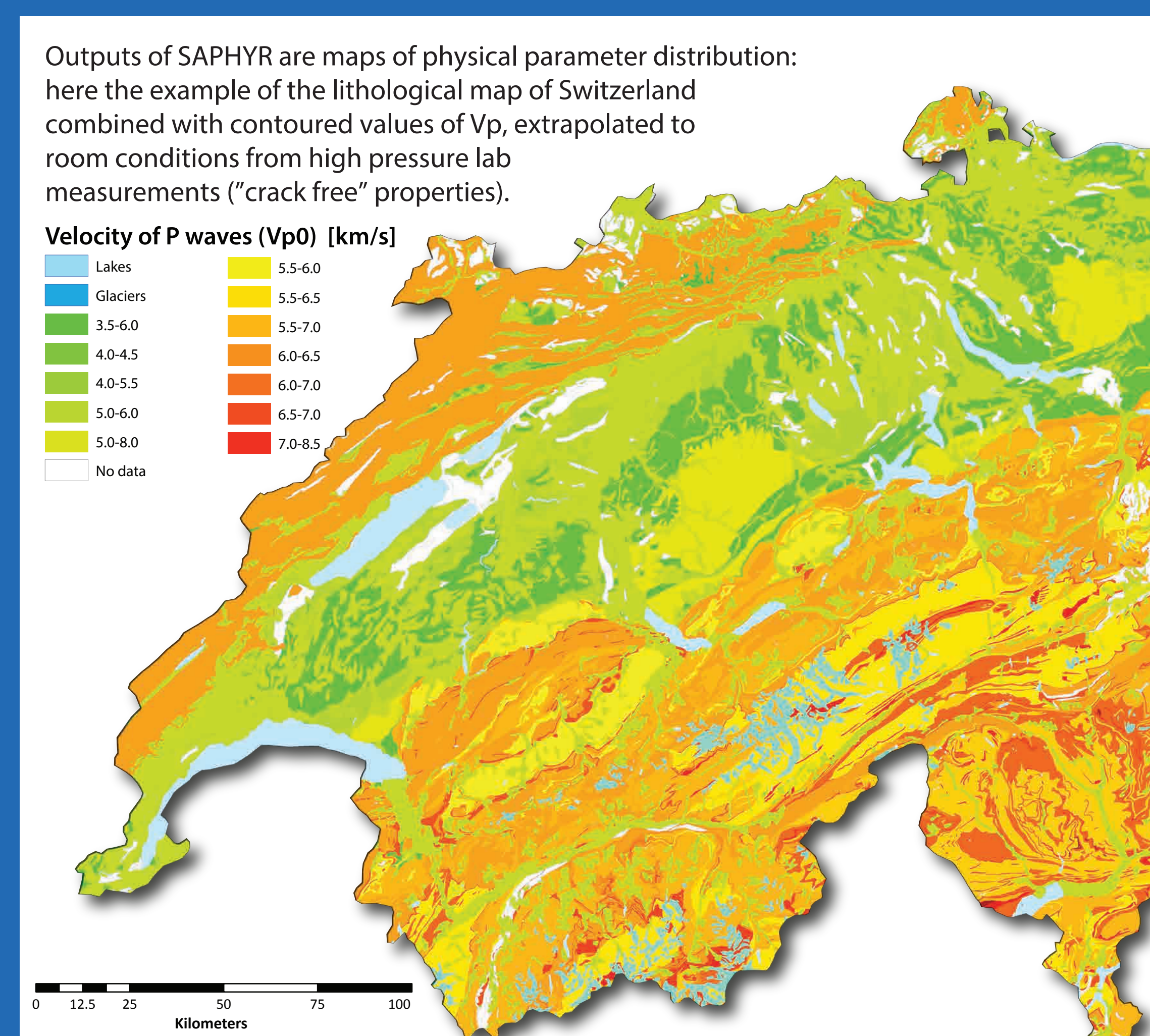
**Database** → **"Rock-physical" map**

**Metadata**, **Density, Velocity maps and distribution**, **Point data**

**Interactive user interface - Swiss Atlas**

The database is strongly "rock type" oriented; the starting point of the data collection has been the detection and recognition of main lithologies on the basis of mineral composition and texture, as the main representative components of a complete continental crust.

### Results



### The products

The aim of this database is to be an open source of data to a wide public. It has to maintain a high scientific content, but need to be accessible not only to academia and for scientific purposes, but also to local authorities, and common people. The database will be published as Atlas and will be online on the Swisstopo portal.

### Visualization

Data from boreholes and tunnels (deep source data) can be visualized as datapoints. Here on the left is the example of parameters measured on a sample from a borehole at 385.07 m depth. Data from boreholes are not statistically treated, and no extrapolation is performed.

Data from outcrops can also be visualized as datapoints, the whole collection of parameters measured on a specific sample is available