Chemical and mineralogical data and processing methods management system prototype with application to study of the North Caucasus Blyb Metamorphic Complex metamorphism PT-condition

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Abstract

Applied research in petrology and mineralogy includes the following range of tasks:

- systematisation and storage of analytical data;
- identification of minerals and mineral paragenesis;
- calculation of characteristic coefficients;
- determination of PT-parameters of mineral assemblage;
- visualisation of results.

In this work we present the toolkit prototype for solving these tasks. It is accomplished by automatization of routine procedures and time reduction between obtaining and interpreting data.

The toolkit consists of four major components: mineral identification system, package of calculation methods, geosensors database, visualisation toolkit. The prototype provides automatic and semiautomatic data import from different formats such as spreadsheet and microprobe output.

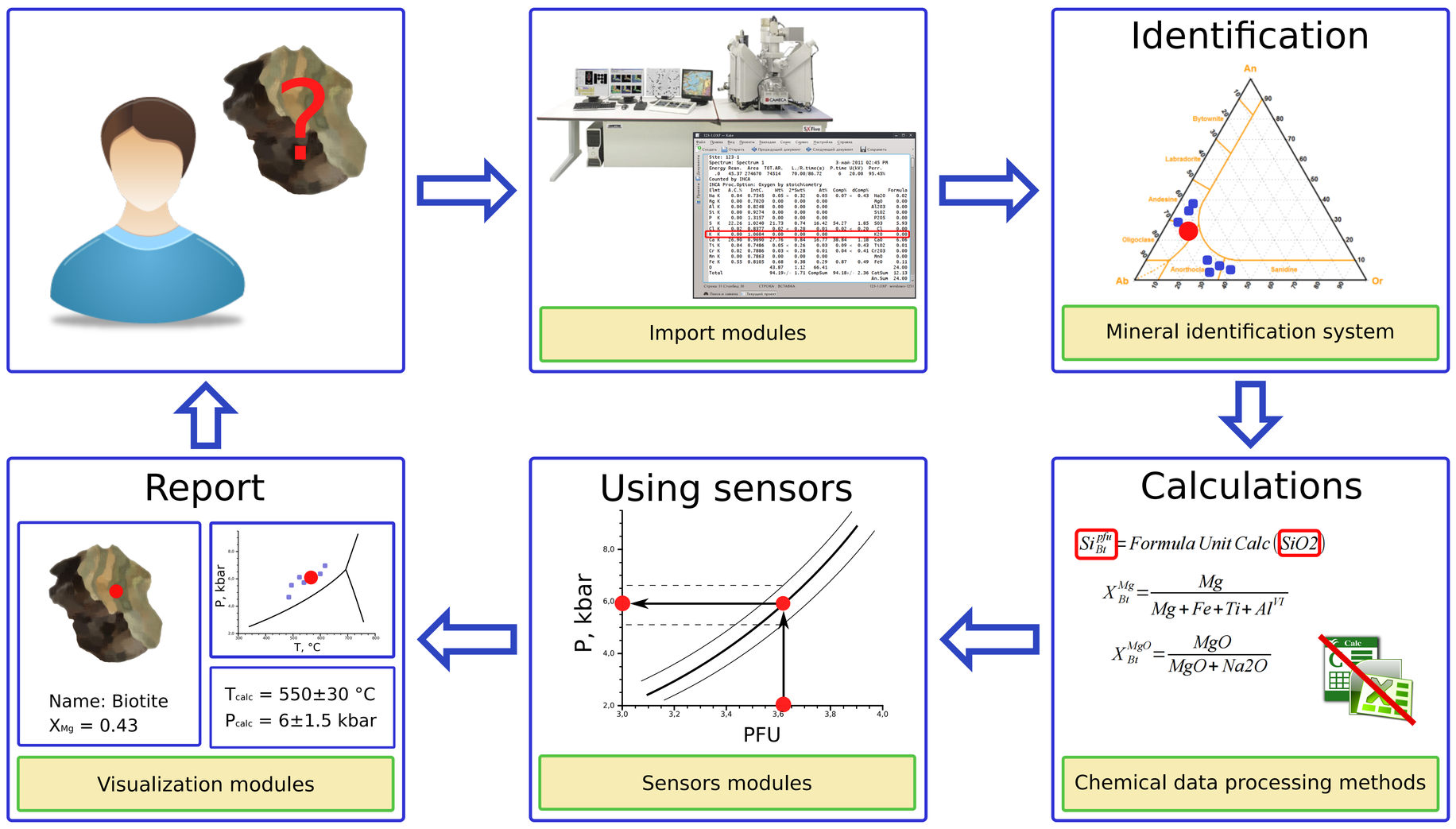
Geosensor database is a collection of thermometers, barometers, fugometers, based on TPF project geosensors set (A.N. Konilov IEM RAS).

Most petrological software have a monolithic architecture. Sometimes their source code is closed which does not allow users to modify programs or even understand how they work. The main differences between that software of our project are: modularity, web-desktop portability, and open source code.

Modularity allows to combine different data processing methods or add the new ones. The core of the toolkit is written in Python programming language and works on all popular operating systems (Windows, Linux, MacOS). It includes written in Javascript user interface. The toolkit may be used as a web-service or as desktop application through the web browser.

The toolkit has a prototype/technical preview status. The main part of toolkit modules for most popular methods and geosensors are under development. However, separate parts of the toolkit, such as minerals identification system and geosensors database have been used in metamorphism of North Caucasus Blyb Metamorphic Complex investigation.

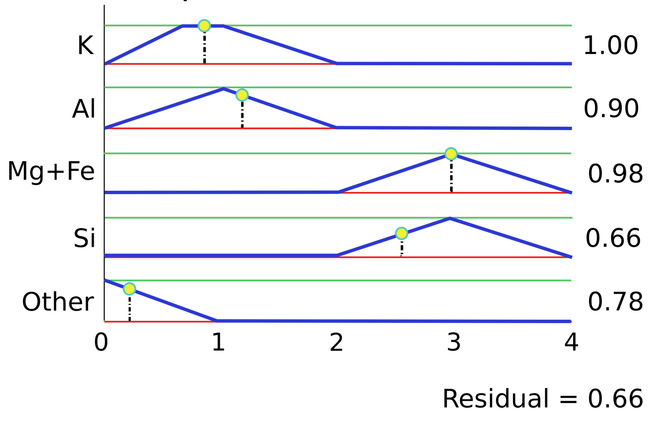
Petrochemical data life circle



Petrochemical study step by step: obtaining local and whole-rocks data → identification, verification, selection → calculation p.f.u. and special coefficients → usage geosensors → visualization of results → interpretation.

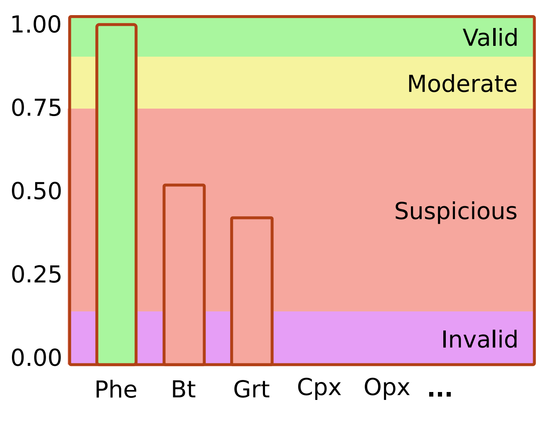
Details

Example of identification rules



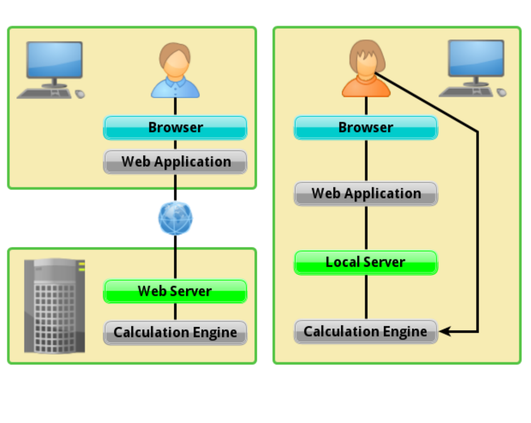
Identification rules for biotite and application to real data (residual = 0.66 - it is not a biotite or invalid stoichiometry calculation).

Identification results



Examples of identification results. Residual for different minerals. Identification is successful completed, phengite detected.

Web-Desktop portability



Software may be launched in server side with zero user setup, or may be launched on user computer through embedded web-server.

References

Toolkit

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Application

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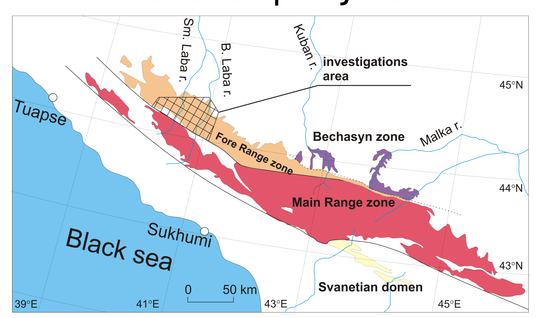
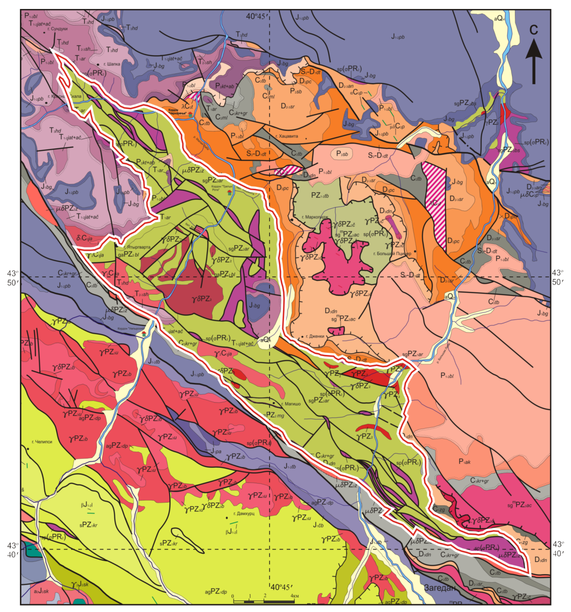
Object summary

Location: Noth-West section of the Fore Range Zone. *Length of outcropped area* is more than 50 km. Width up to 12 km. *Volume:* more than 212 square kilometers.
Height above the sea level: from 900 up to 3000 meters.
Stratigraphy: Lower, mafic Balkan unit and upper sialic Armov unit
Compositon: amphibolites (including garnet bearing varieties), eclogitic amphibolites, eclogites, hornblende plagiogneisses, orthogneisses, quartz-garnet micaceous, kyanite bearing and hornblende-garnet-white mica shists.
Metamorphism: Eclogitic. Up to18 kbar and 680-700ºC on the peak, and 9 kbar and 600 ºC on the retrograde stage.
Ages: Protolite D3-C1
Age of metamorphism: C1

Tectonic sheme of Greater Caucasus pre-Jurasic



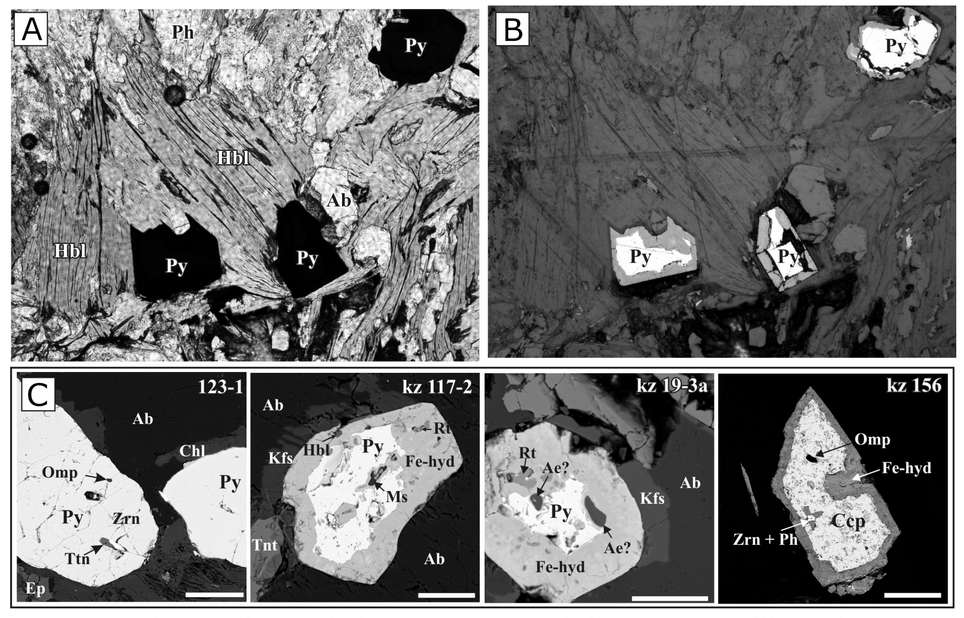
Geological map of Blyb metamorphic complex



According to Lavrishev 2002 with changes.

Measurements

Examples of ompacite inclusions in Pyrites in orthogneisses of Blyb



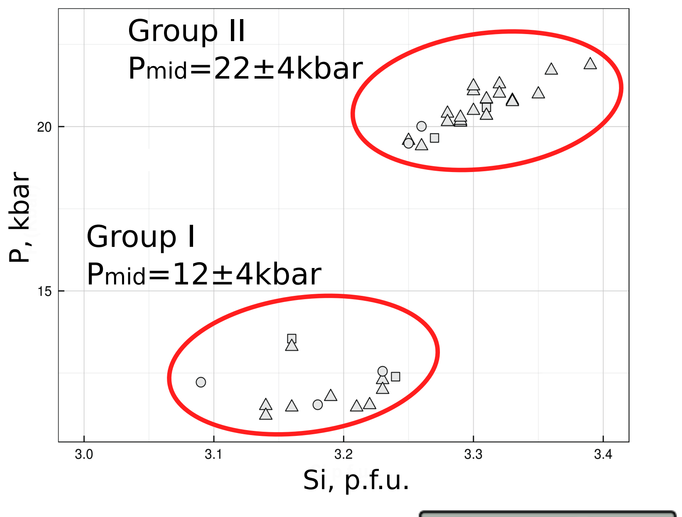
A - in transmitted light; B - in reflected light; C - microzond BSE photos.

For the first time the evidenses of high grade metamorphism for gneisses which include eclogite bodies was obtained. According to our discovery of role of sulfides as a containers to minerals of eclogitic association, on prograde stage pressure rises more than up to 13 kbars. Monomineral phengitic barometer shows even more higher results.

Toolkit prototipe used in the following steps of this work:

- import data from Oxford Instruments Microprobe OXF files;
- minerals identification and stycheometry validation;
- phengite barometry.

Result of monomineral phengitic barometer



According to Perhcuk, PT conditions for eclogites from Blybare 18 kbar and 670ºC. Our results do not contradicts to these evaluations.

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