Fluid inclusions - Petrography and genetic interpretation of fluid inclusions. Application of Cathodoluminescence techniques

Monday, August 27 until Friday, August 31, 2012

Departamento de Ciencias Geológicas. Facultad de Ciencias Exactas y Naturales. Universidad de Buenos Aires

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Fluid inclusions are small volumes of paleofluid trapped in minerals and the only direct evidence of the role of the fluid in geological processes. This short course gives an overview of fluid inclusions in different disciplines of earth sciences and related analytical techniques.

The textural relationship between fluid inclusions and the host rock is the subject of “fluid petrography”, an essential part of any rock study and an important issue in this course. Cathodoluminescence techniques have shown to be helpful in the study of paleofluids and are also included here.

Attention is paid to the physico-chemical properties of the most important geological fluid systems, which are essential for interpreting fluid inclusion data sets. Microthermometry, the study of phase transitions in fluid inclusions at varying temperature under the microscope is fundamental for any fluid inclusion study. Therefore the principles of this technique and related computer programs are explained in more detail. Special attention is also paid to Laser-Raman microspectrometry, a technique which has proved to be highly powerful for fluid inclusion analysis.

Fluid inclusions provide indispensable information about geological processes, from high temperatures at depth towards low temperatures near the Earth’s surface. Discussed are examples of magmatic fluids, hydrothermal ore deposits, metamorphism, and diagenesis.

The course is meant for any earth scientist, student or professional, who has not been in touch with fluid inclusions so far and wants to include this interesting and varied topic in her/his future research.

Program

Monday, August 27, 2012

9:00-13:00 Introduction. Definitions, historical notes, literature, classification of fluid inclusions, daughter phases, mechanisms of fluid inclusion forming, Roedder’s rules, primary and secondary inclusions, fracture healing, post-trapping modification of fluid inclusions, autoclave experiments

14:00-18:00 Training: microscopy exercises.

Tuesday, August 28, 2012

9:00-13:00 Working procedure (sample preparation, equipment), destructive and non-destructive fluid inclusion analysis, crushing stage, acoustic emission analysis, Laser ablation ICPMS, principles of microthermometry, isochore definition, computer programs, Raman analysis
14:00-18:00 Fluid inclusion petrography, fluid-rock interaction, fluid-induced textures. Water-salt (ionic) systems with KCl, NaCl, and CaCl$_2$ in different geological environments.

Training: Microthermometry, crushing stage, software (isochore calculation), videos.

**Wednesday, August 29, 2012**

9:00-13:00 Water-gas systems. Clathrate hydrate stability, fluid-mineral equilibria and graphite stability, oxygen fugacity in rocks, COHN equilibria calculations, non-aqueous systems CO$_2$-CH$_4$ and CO$_2$-N$_2$, working with VX diagrams

14:00-18:00 Training: Microthermometry, software (COHN), videos.

**Thursday, August 30, 2012**

9:00-13:00 Basic principles of cathodoluminescence microscopy and application to fluid petrology. Equipment. "Cold” and "hot” cathodoluminescence. Crystalline materials. Activators, sensitzers, quenchers. Wavelength, energy.

14:00-18:00 Microstructures as a result of fluid-rock interaction: fluid pathways, paleoporosity, diffusional textures, healed microfractures. Examples.

**Friday, August 31, 2012**

9:00-13:00 Fluid inclusions in the granitic-pegmatitic system, fluid inclusions in ore deposits, fluid inclusions in metamorphic rocks (examples).

14:00-18:00 Free exercises, presentations of participants and discussion. Examination.

**Literature selection**

**Textbooks**


De VIVO B, FREZZOTTI ML (1994) Fluid inclusions in minerals: methods and applications. Short course of the working group (IMA) "Inclusions in Minerals" (Siena) Fluids Research Laboratory, Department of Geological Sciences, YPI, Blacksburg


Regular issues


Literature selection "geofluids"

TOURET JLR (1992) CO$_2$ transfer between the upper mantle and the atmosphere: temporary storage in the lower continental crust Terra Nova 4, 87-98.

Fluid systems


ZHANG YG, SCHWARTZ JD (1989) Experimental determination of the compositional limits of immiscibility in the system CaCl$_2$-H$_2$O-CO$_2$ at high temperatures and pressures using synthetic fluid inclusions. Chem. Geol. 74, 269-308.

**Equations of state /technical**

BAKKER RJ (2001) FLUIDS: new software package to handle microthermometric data to calculate isochores (available from the author)


**Fluid inclusion experiments**


