PROGRAM
of
Dottorato/PhD
Dinamica Interna dei Sistemi Vulcanici e Rischi Idrogeologico-Ambientali
Internal Dynamic of Volcanic Systems and Hydrogeological-Environmental Risks
Earth Sciences School "G. De Lorenzo"
University of di Napoli Federico II, Napoli, Italy
(Coordinatore Prof. B. De Vivo)

Short Course
Fluids in the Earth
October 25 – 29th, 2011

Presented by
R. J. Bodnar
Virginia Tech, Blacksburg, VA, U.S.A.
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at
Università di Napoli Federico II
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Largo S. Marcellino 10, 80138 Napoli, Italy

Classroom: Historic Library of the Dept, 1st Floor,
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October 25th, 2011

"Introduction to phase equilibria and thermodynamics" (Bodnar & Danyushevsky; 3 hours) (Time: 9.00 - 12.00)

The Gibbs Phase Rule; the Clausius-Clapeyron relationship; activity, fugacity; chemical potential and equilibrium; the definition of free energy and how it can be estimated from PVT data; solubility and saturation of volatiles in melts and fluids; melting diagrams for solid solutions; equilibrium between melts and simple solid solutions, the effects of changing melt/crystal proportions on the compositional evolution of solid solutions during crystallization; the effect of volatiles on crystallization temperatures of primitive magmas as a function of pressure

The geohydrologic cycle (Bodnar; 1 hours) (Time: 12.00 - 13.00)

The whole Earth system can be divided into the following reservoirs for H_2O: atmosphere, biosphere, oceans, surface water, groundwater, glaciers and polar ice, continental crust, oceanic crust, upper mantle, transition zone, lower mantle and core. The amount of H_2O contained in each

of these reservoirs will be discussed, as well as the fluxes of H_2O between reservoirs and residence times for H_2O in the different reservoirs.

Introduction to fluid Inclusions and fluid phase equilibria (Bodnar; 3 hours) (Time: 15.00 – 18.00)

Identification, analysis and application of fluid inclusions to geologic problems.

October 26th, 2011

Fluids in near-surface environments, including sedimentary basins and Mississippi Valley-type deposits (Bodnar; 2 hours) (Time: 9.00 – 11.00)

As sediments are deposited and compacted during basin evolution, fluids of varying composition are generated and expelled from sediments during diagenesis. The compositions of fluids in sedimentary basins and origin of basinal brines will be discussed.

Deep Crust and Upper Mantle – Metamorphic and mantle fluids (Bodnar; 2 hours) (Time: 11.00 – 13.00)

The compositions of metamorphic and mantle fluids show distinct and systematic variations as a function of metamorphic grade and host rock composition. Most metamorphic and mantle fluids are reasonably well approximated by the COH system, and the fluid speciation is controlled by the oxygen fugacity.

The role of fluids in deformation and geophysics (Bodnar; 1 hour) (Time: 15.00 – 16.00)

The strength of minerals and rocks varies as a function of the amount of water present. The role of H_2O in rock deformation will be discussed, as well as geophysical techniques for identifying the presence of water in the crust.

Fluids in magmatic – hydrothermal ore deposits (Bodnar; 2 hours) (Time: 16.00 – 18.00)

Fluids in magmatic – hydrothermal systems transport and deposit metals to generate economic mineral deposits. Our current understanding of the role of fluids in the ore forming process in orogenic lode gold deposits, porphyry copper deposits, and epithermal precious metals deposits will be summarized.

October 27th, 2011

Thermodynamics and physics of melt-fluid ± mineral systems (Webster; 4 hours) (Time: 9.00 – 13.00)

Water and carbon dioxide are the primary magmatic volatile constituents, but sulfur and chlorine are also important magmatic volatiles. The phase relations of fluid exsolution from silicate melt, and the influences of these volatiles on magma evolution, fluid geochemistry, and the generation of mineralizing magmatic-hydrothermal fluids will be addressed.

Thermodynamics and physics of melt-fluid ± mineral systems, continued (Webster; 1 hour) (Time: 15.00 – 16.00)

Volatile components in silicate melts influence melting temperatures and melt viscosity. Volatile components also influence the stability of minerals and fluids and consequently control larger processes including magma rheology and explosivity. The role of H_2O and CO_2 in these processes will be discussed.

Introduction to melt inclusions (Danyushevsky; 2 hours) (Time: 16.00 – 18.00)

Melt inclusions are small portions of melt trapped by crystals growing during magma evolution, and thus can represent 'snapshot' of the conditions that existed during crystallisation. In this lecture, trapping mechanisms of melt inclusions, their post-entrapment modifications, and experimental studies of melt inclusions will be discussed.

October 28th, 2011

Introduction to melt inclusions, continued (Danyushevsky; 1 hour) (Time: 9.00 – 10.00)

Melt inclusions are small portions of melt trapped by crystals growing during magma evolution, and thus can represent 'snapshot' of the conditions that existed during crystallisation. In this lecture, trapping mechanisms of melt inclusions, their post-entrapment modifications, and experimental studies of melt inclusions will be discussed.

Using melt Inclusions to constrain the origin of phenocrysts in strongly-phyric volcanic rocks (Danyushevsky; 1 hour) (Time: 10.00 – 11.00)

An important implication of melt inclusions is to assess whether crystals in volcanic rocks crystallised from the same magma type as represented by the transporting melt (i.e., the groundmass of the rock), or are xenocrysts. Different examples from subduction-related volcanic suites will be shown.

Timing crystallisation processes using melt inclusions; Using melt Inclusions to determine komatiite melt compositions; Melt inclusion studies on Vesuvius (Danyushevsky; 2 hours) (Time: 11.00 – 13.00)

Post-entrapment re-equilibration of melt inclusions with their hosts can be used to assess crystallisation rates of individual phenocrysts. Melt inclusions can be a powerful tool for recovering melt compositions in ancient volcanic suites, when the groundmass in the lavas is chemically modified by alteration. A summary of melt inclusion studies of Vesuvius will be presented.

Melt inclusions in intermediate to felsic magmas (Webster; 1 hour) (Time: 15.00 – 16.00)

The use and misuse of geochemical data from silicate melt inclusions of felsic continental and subduction-zone magmas will be described. Interpreting magma behaviour with melt inclusion compositions and experimentally determined volatile solubilities.

Exam on material covered in the short course (2 hours) (Time: 16.00 – 18.00)