1. Research activity (max 1.000 words)

Specific objective

The main focus of this PhD project is the quantification of magmatic variables (e.g., pressure, temperature, volatile content, and oxygen fugacity) and their changes over time, with the aim to better understand basaltic to rhyolitic magma dynamics at Vulcano island (Aeolian Arc, Italy).

Overall objective

The study carried out on the magmatic system of Vulcano island will offer the opportunity to extend the petrological and volcanological outcomes to other islands of the Aeolian archipelago to elucidate whether the magmatic source and plumbing system are the same or the evolution of the islands has been driven by different petrogenetic paths. It would be also interesting to analyze the magmatism of the island arc with the intent to link its physicochemical characteristics to the geodynamic evolution of the arc setting.

State of the art

Vulcano island is an active volcanic system located at the center of the Aeolian archipelago, a Quaternary volcanic arc generated by subduction of the oceanic Ionian plate underneath the Calabrian arc. Vulcano has developed along the NNW-SSE trending Tindari-Letojanni strike-slip fault system and the magmatic evolution is related to the activity of a shear zone. Exposed products are dated starting from ca. 120 ka; the last eruption occurred from August 1888 to March 1890 at “La Fossa Cone”. The exposed part of Vulcano is built up of high-K calc-alkaline, shoshonitic, and

potassic rocks that vary in the degree of evolution from mafic to sialic compositions. The mineral assemblage consists of clinopyroxene, plagioclase, olivine, and opaque oxides. Vulcano rocks show alkali contents increasing with time. Change of composition from mafic to more sialic rocks is the result of a complex interplay between fractional crystallization, crustal assimilation, and magma mixing processes. The variation of magma over time is interpreted to reflect the migration of magma accumulation zones. Pressure, temperature, oxygen fugacity, and dissolved volatile contents in the melt can be estimated through the knowledge of mineral composition and textural relationship. Minerals are typically chemically zoned in volcanic units and determining which phases-compositions were growing in equilibrium is central to an accurate characterization of magmatic variables. Previous studies suggested a magma storage polybaric system consisting of magma chambers located at different depths, decreasing with time. The objective of this PhD project is to enhance those studies through the microanalysis of major/trace elements and isotopes in olivine, clinopyroxene, and plagioclase, as well as the characterization of intensive variables with the aim of estimate the depth and temperature of the polybaric magmatic chambers in which crystallization took place and reconstruct the evolution of the plumbing system of Vulcano island.

Materials and methods

During this PhD project I will sample new products from Volcano island that will integrate those already provided by Dr. PhD Gianfilippo De Astis during my master thesis. The rocks were sampled from several key areas in which the eruptive units show different volcanological and petrological characteristics, i.e., La Sommata Formation, Spiaggia Lunga Formation, Casa Lentia Formation, Mt. Lentia Formation and Saraceno Formation. My sampling campaign will involve the largest possible number of rocks from basaltic to rhyolitic compositions, reflecting as much as possible the magmatic evolution of the volcano. The most consistent part of this project will be dedicated to prepare and analyse rock samples using the following analytical techniques: 1) thin sections preparation in laboratory; 2) Field Emission Scanning Electron Microscope (FESEM JEOL JSM-6500F) for high resolution images; 3) Electron Probe Micro-Analyser (EPMA JEOL JXA-8200) for major element concentrations in minerals and glasses; 4) Laser-Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS) for trace element concentrations of all the phases; 5) Inductively Coupled Plasma Mass Spectrometry (ICPMS) for isotopic determinations. Thermometers, barometers,

hygrometers and oxygen barometers, which requires knowledge of mineral composition and textural relationship, have been commonly used to estimate the intensive variables (pressure, temperature, volatile content, and oxygen fugacity) of a magmatic system. Only equilibrium compositions will be used as input data for thermometers, barometers, oxygen barometers and hygrometers.

2. Research products