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**Review of the Habilitation thesis "*Kinetic disequilibrium processes, (radioactive) trace elements fractionation, and phase equilibria as a tool to constrain pre- and syn-eruptive conditions*", submitted by Dr. Alessandro Fabbrizio, Charles University in Prague**

The submitted work presents a collection of well-defined research topics which are mutually linked and improve our understanding of key volcanological processes and phenomena. Volcanism and eruptions are the most eminent processes modifying the morphology of Earth's surface and are the target of extensive research, both via experiments and natural samples. This is due to wide-spread manifestation of such events during the entire history of the mankind as well as through Earth's history as such because volcanism was one of the major drivers in building continents, formation of life-important niches and climate change.

The Thesis is divided into three thematic parts, covering the following fields of expertise: (i) kinetic disequilibrium processes, (ii) (radioactive) trace element fractionation, and (iii) phase equilibria. Nine published papers have been attached and for seven out of nine papers, Dr. Fabbrizio is the first author. At present, 19 papers are listed in WoS database where Dr. Fabbrizio is either the first author or a co-author and high-rank journals have been targeted such as, for example, *Geochimica et Cosmochimica Acta*, *Earth and Planetary Science Letters*, *Contributions to Mineralogy and Petrology*, *Lithos*, *Chemical Geology*, *American Mineralogist*, *European Journal of Mineralogy*, or *Journal of Volcanology and Geothermal Research*.

The first section deals with partitioning of trace and major elements among coexisting phases under a variety of conditions relevant to pre- and syn-eruptive eruptive phase of either an issue of magma or expeditious volcanic eruptions, followed by subsequent formation of kinetic profiles in selected mineral phases. The conditions of producing such element profiles across crystals are highly diverse and depend upon a number of variables, such as eruption temperature, composition of magma/lava, volatile inventory. This means that any generalization in producing the observed elemental profiles and calculating the edge conditions cannot be made and particular conditions for a well-defined system must be considered. Closed-system Kilauea Iki Lava Lake is one such example for which a number of studies have shown kinetic effects, including novel stable isotope systems. Therefore, studies by Fabbrizio et al. may help constrain kinetic effects, volatile loss and timing of cooling.

The second section is focused to experimental determination of partitioning of radium (Ra) in several magmatic systems (silica-undersaturated magma, feldspar, phlogopite), all relevant to recent volcanic events, some of which have had a tremendous effect on mankind. Estimating the timescales of modern volcanic eruptions is an uneasy task and recent results show that the period from the complete quiescence to volcanic outbreak is on order of hours to very few days, a profound implication for assessing volcanic hazards. Radium, as a fast-decaying element, can thus provide a high-resolution proxy although its analytical chemistry is non-trivial. Several well-known eruptive events from very modern to those that took place at the dawn of mankind, were re-dated using $^{226}Ra$–$^{230}Th$ disequilibria and the newly determined partitioning coefficients for Ra. The open system behaviour post-eruption indicates significant modifications to the previous ages of crystallization.

The third section is dedicated to the investigation of magma storage using phase equilibria. Again, the results support the assertions from the preceding sections in that the rates of magma ascent are fast. This is underscored by detailed experimental survey of the fugacity of water, and the key role of water (and carbon dioxide, to a minor extent) to crystallize mineral assemblages typical for natural samples and their utilization in providing constraints on the depths and pressures of crystallization. Estimating the volatile contents which ultimately trigger the eruptions is central to predicting volcanic hazard assessment and preparing security measures for population.

Combined with other work published during the last few years by Dr. Fabbrizio, I am confident that he will successfully defend the thesis and will also develop and/or collaborate in further establishing innovative research pathways for investigating key volcanic phenomena. The Habilitation thesis fulfils the criteria for acceptance and promotion of Dr. Alessandro Fabbrizio to the position of the Associate Professor at the Charles University.

Sincerely,

Tomas Magna