

Title: Mineralogy and geochemistry of alkaline complexes associated with carbonatites in the Alto Paranaíba Igneous Province, Brazil and their enrichment in strategic elements such as REE, Nb, Ta, Zr, and Hf.

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Research program

The proposed research project will focus on the petrological, mineralogical, and geochemical study of alkaline and alkaline-carbonatite intrusions in Brazil.

The Mesozoic alkaline and alkaline-carbonatite complexes of southern Brazil are located around the border of the Paraná Basin. Strongly alkaline (kamafugites, kimberlites, lamprophyres), alkaline/peralkaline, and carbonatite rocks have been identified along this area. These complexes were formed over a wide period of time (~60-150 Ma). Most of them have their own economic potential, in terms of high proportion of minerals and precious elements for industrial purposes, such as diamonds in kimberlites, or P, Zr, Hf, Nb, Ta, Ti, and REE elements. This has attracted the interest of a large number of researchers, who have proposed various models to explain the origin and petrological evolution of igneous rocks in this area.

The main focus of this study will produce a considerable amount of data that will be used for: 1) determination of mineralogical, chemical and isotopic characteristics of alkaline and carbonatite rocks; 2) characterization of the mantle sources; 3) determination of the main mechanisms of magmatic differentiation; 4) determination of the chemical and physical parameters governing the evolution of these magmas (crystallization temperature, crystallization pressure, fugacity of dissolved volatiles in magmas and their influence); 5) definition of areas where alkaline and carbonatite rocks are particularly enriched in elements such as P, Zr, Hf, Nb, Ta, Ti, and REE up to economic concentrations, and 6) clarify the role played by hydrothermal fluids on REE enrichment in rocks. The data acquired on these objectives represent the knowledge base on which applied resource and raw material research is based. Publications, oral and poster presentations based on the project results will be prepared and presented for prestigious national and at international scientific journals and conferences.

Proposal for a PhD position

A PhD position will be applied for a candidate who can research the mineralogical, petrographic and geochemical characterization of alkaline intrusions also with associated carbonatites placed in the Alto Paranaíba Igneous Province (Brazil). The doctoral project will be concentrated over a period of three years. The project is articulated, following the classical and most innovative analytical methodologies used in the Petrology and Petrography field. The project will be developed through the study of thin sections, chemical analyses (XRF, ICP-MS and Nd-Sr-Pb isotopes) on total rock, a detailed in situ geochemical study on the characterizing mineral phases using EDS/WDS and LA-ICP-MS, U-Pb dating, and Sr-Nd-Pb-Hf-O-C isotopes. The analytical program will be carried out using the analytical methodologies of DiSTAR at the University of Naples Federico II, where the Ph.D. student will have the opportunity to acquire technical skills in mineralogical and petrographic methods, such as chemical

analysis (XRF), polarized light and scanning electron microscopy with microanalysis (EDS/WDS), and Sr-Nd-Pb isotope analysis. "Doctoral School" training courses will also be available for the student at the host university to enhance his or her knowledge on various topics.

A period of about 1-6 months of study both at home and abroad is also included for the Ph.D. student to learn different analytical methods (isotopes of Sr-Nd-Pb-Hf-O-C, LA-ICP-MS, and U-Pb) and to have useful discussions with other scholars for a chance to further develop his or her career. The candidate's fees for activities related to the doctoral project will be covered by DiSTAR funds.

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