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Geostatistics-based automated geochemical mapping of igneous rocks: introducing IG-Mapper toolbox by application to the Squillace pluton (Serre Batholith, southern Italy)

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IG-Mapper[1] (Igneous rock Geochemical Mapper) is a new GIS-based automated tool we developed to provide geospatial representations of the value distribution of petrological parameters within igneous rock complexes, through the application of either deterministic (i.e., Inverse Distance Weighting) or stochastic (i.e., Ordinary Kriging) interpolation technique. The geostatistical approach allows mapping to be extended to areas where igneous rocks are hidden under sedimentary or vegetation cover, also providing an estimate of the interpolation reliability. The program, which is user-friendly, fast and effective, can generate three main types of outputs: 1) interpolation maps of major and trace elements, isotopic compositions, geochronological data and various derived petrological parameters, to provide a geospatial vision of trends and clusters, facilitating the analysis of the genetic relationships between the mapped rock types and the identification of compositions suggestive of specific processes at the magma source; 2) lithological maps, that are based on the interpolation of major element data and mirror the main geochemical classification diagrams of plutonic rocks (TAS[2,3], R_1-R_2^4, Q-ANOR[5], Ab-An-Or[6]). In particular, the automated lithological mapping function is an entirely new tool, based on five original python scripts; and 3) interpolation checking maps, which provide an estimate of the geostatistical interpolability for one specific parameter at a time. This last output is expressed in the form of an empirical index (Stochastic Interpolation Index), which highlights the randomness level of a specific value distribution. All these geostatistical lithological and interpolation maps may highlight the possible presence of rock units or buried tectonic structures that are not detected by conventional mapping and, therefore, supplement and/or address focused field surveys and samplings. This work presents the methodology and functionalities of the developed software by using a portion of the Serre Batholith in central Calabria (southern Italy), to illustrate the technique and the potential of this automated procedure to become a powerful complementary tool in the investigation of granitoid rocks and, more in general, to open new research perspectives in the petrological exploration of the geological world.

[1]Fiannacca P. et al. (2017) Chem. Geol. 470, 75-92. [2]Middlemost E.A.K. (1985), Longman, 266 pp. [3]Middlemost E.A.K. (1994) Earth Sci. Review 37, 215-224. [4]De La Roche H. et al. (1980) Chem. Geol. 29, 183-210. [5]Streckeisen A.L. & Le Maitre R.W. (1979) Neues Jb. Mineral. Abh. 136, 169–206. [6]Barker (1979) Elsevier, 659 pp.