The Power of the Multi-disciplinary Approaches to the Study of Minor and Trace Element Incorporation in Geo- and Technological Materials

S. Quartieri[1], R. Oberti[2] , M. C. Dalconi[3], F. Boscherini[4], G. Iezzi[5], M. Boiocchi[6], *[1]Dip. di Scienze della Terra, Messina, Italy. [2]CNR, Istituto di Geoscienze e Georisorse, Pavia, Italy. [3]Dip. di Scienze della Terra, Ferrara, Italy. [4]INFM and Dip. di Fisica, Bologna, Italy. [5]Dip. di Scienze della Terra, Chieti, Italy. [6]Centro Grandi Strumenti, Pavia, Italy.* E-mail: simonaq@unimo.it

Much of our knowledge of the origin and differentiation of the terrestrial planets arises from the study of trace elements behaviour. Interpreting and modelling trace element data requires quantitative information on how elements partition between coexisting mineral and melt phases, which in turn requires understanding of the mechanisms of trace-element incorporation. This goal can be achieved combining various experimental (X-ray diffraction, spectroscopic methods, microbeam analysis) and computational techniques. This combined multidisciplinary approach allows integration of structural information at both short- and long-range scale, and provides greatly enhanced interpretative and modelling tools for geochemistry and, in general, for material sciences. In fact, a correct model of the incorporation and local environment of dopants is crucial to interpret many technological properties and to design innovative materials. A number of case studies (mainly based on electron microprobe analyses, single-crystal and powder X-ray diffraction, XANES and EXAFS spectroscopy applied to natural and synthetic garnets) will be discussed. They mainly concern: i) changes in the local environment of cations along solid solutions; ii) multiple mechanisms of incorporation and partitioning of minor and trace elements in mineral structures with multiple sites with different coordination geometries.

Keywords: XRD, absorption spectroscopy, trace elements