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Garnet composition and provenance analysis: towards accurate source assignment of single grain analyses

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Nature of divalent cation exchange (Fe^{2+}, Mg, Mn, Ca) in common rock-forming garnets largely relates to lithology and metamorphic evolution. This variability is retained in the compositions of detrital garnet and thus routinely used for characterizing sediment provenance. To date, source rock assignment has been mostly done by a simple visual examination of data plots, with boundaries of inferred lithologies intuitively fitted by eye. This approach does not allow a precise description of sediment provenance, as actually most compositional fields merge or overlap, which may result in an erroneous classification of many grains.

We provide a preliminary, alternative procedure, based on a statistical treatment of a large dataset of detrital garnet from orogenic (Dinarides, n$\sim$1800) and cratonic (India and Siberia, n$\sim$500) sediments that well represents the major crust-forming rock types.

Three groups can be reasonably separated in the data set: Ca-Mg-rich almandine; Mn-poor almandine-pyrope; and Ca-Mg-poor almandine with variable Mn content, corresponding to amphibolite and higher grade metabasites, granulite facies metapelites and lower-grade Barrow-type metapelites respectively.

A multinomial logistic regression is applied to compute the probabilities of membership to each group of every composition in the Fe^{2+}–Mg–Ca plane, by using maximum likelihood estimation. Adding Mn to the model does not significantly improve the discrimination. Points having equal probability to belong to two neighbouring groups define the boundary among petrogenetic fields.

By using probabilities instead of naive boundaries, one can further: (i) assess the un-

certainty with which a single garnet analysis is assigned to any of the petrogenetic fields, (ii) estimate the proportion of contribution of each metamorphic source to the sediment.