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A Systematic typology of granitoid rocks from major element composition. I: The Upper Silica Range

Tipología sistemática de granitoides a partir de su composición en elementos mayores. I: El rango más alto de Si

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The composition of granitic rocks is a complex function of many parameters, among which the nature of source materials, P-T-Xvolatiles conditions of partial melting, and the efficiency of melt segregation are of remarkable importance. All these factors, in turn, are closely related to the geotectonic environment where granites originated. The recognition of such relationship gave a great impulse to the understanding of granitic rocks variety (Pitcher, 1982), and is the basis of granite typology as it is currently understood (Pitcher, 1979; Pitcher, 1982), which establishes the following fundamental granite typologies: I- and S- types (Chappell and White, 1974, A-type (Loiselle and Wones, 1979) and M-type (Pitcher, 1983). This S-I-A-M scheme reflects in a simple way broad genetical concepts concerning the source rocks in spite of the, sometimes troublesome, indetermination in their characteristic and definition (Miller, 1985; Clarke, 1992). The classification focuses as well attention on granite types, tectonic setting, source mineralogy and sometimes, metallogenic specialization regardless of whether or not the ore specialization of granites depends upon other criteria (Hannah and Stein, 1990).

This paper is the first result of a worldwide survey on granite chemistry undertaken in order to recognize the different compositional types of granites of the S- I-A- M- types on a statistical basis. It focuses on the silicic margin of the granitoids compositional spectrum. A data set of 4,200 samples with SiO_2 > 70 wt. % from all over the world has been worked out. Only major elements from this data set were used in the classification. We tested three methods of distiguishing between granites: The raw major elements, their normative components and various petrochemical parameters. The best results have been obtained by using four parameters: (a) Aluminium Saturation Index, ASI= mol. (Al_2O_3/[CaO+Na_2O+K_2O]); (b) Calc-Alkaline Index, CAI = mol. (CaO/[CaO+Na_2O+K_2O]); (c) Potassium-Sodium Index, KNaI = mol. (K_2O/[K_2O+Na_2O]); and (d) Iron-Magnesium Index, FeMgI= mol. (FeO/[FeO+MgO]). In order to reduce the dimensionality of the problem, we performed a principal components analysis on these four parameters. Scores of samples on the Principal Components are given by:

FD1=10*(0.1601*ASI-0.0354*CAI+0.048*KNaI-0.026*FeMgI); [1]

FD2=10*(0.0061*ASI-0.0434*CAI+0.0145*KNaI+0.1236*FeMgI); [2]

The first principal component is dominated by the Aluminium Saturation Index and accounts for almost 50 % of the total variance of the system. The second principal component is dominated by the Iron-Magnesium Index and accounts for nearly 30% of the total variance. The plane defined by both principal components is used as the main tool for classification. The plot of a subset of samples whose typology is well known allows one to split this area into five regions, in which to plot different granite types: (a) Primitive-types; (b) A-types; (c) I-types; (d) SC-types (low Fe/[Fe+Mg] S-types); (e) SG-types (high Fe/[Fe+Mg] S-types). Discrimination between primitive-types, is also possible by means of a K_2O vs Na_2O plot, in which fields for M-types, I-types, Magnitogorsk-type granites and ophiolitic plagiogranites are clearly identified.

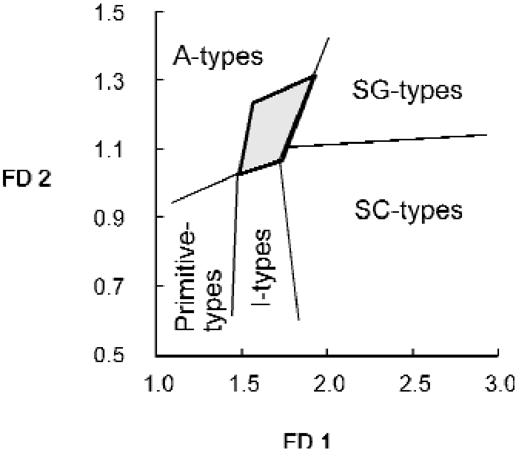

Figura 1.

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