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Reliable radiogenic heat production of representative lithological groups

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Determining the temperature distribution within the lithosphere requires the knowledge of the radiogenic heat production (RHP) distribution within the crust and the lithospheric mantle. RHP of crustal rocks varies considerably at different scales as a result of the petrogenetic processes responsible for their formation and therefore RHP depends on the considered lithologies.
In this work we address RHP variability of some common lithological groups from a compilation of a total of 2188 representative U, Th and K concentrations of different worldwide rock types derived from 102 geochemical and geophysical datasets previously published. To optimize the use of the generated RHP database we have classified and renamed the rock-type denominations of the original works following a petrologic classification scheme with a hierarchical structure. To compute RHP a reasonable average density was assigned for each lithologic group. The RHP data of each lithological group is presented in cumulative distribution plots, and we report a table with the mean, the standard deviation, the minimum and maximum values, and the significant percentiles (10th, 25th, 50th, 75th and 90th) of these lithological groups. In general, for each lithological group exists a wide zone around the median value with a constant slope indicating RHP values with the same probability of occurrence. This zone usually includes the RHP range defined by the 25th and the 75th percentile. When compare previuos RHP estimates of representative lithological groups with our results it is observed that most of them fall between the 25th and 75th percentiles obtained.
We integrate our results in a schematic model of the differentiation processes undergone by lithospheric rocks. This model allows us to discuss the RHP variability for the different igneous, sedimentary and metamorphic lithological groups from a petrogenetic viewpoint. Finally we give some useful guidelines to assign RHP values to lithospheric thermal modeling. The 50th percetile RHP of the different lithological groups can be assigned to crustal layers to compute average geotherms; and the 25th and 75th percentiles can be used to adress the uncertainty of these geotherms. Taking into account their importance the 25th-50th-75th percentile RHP obtained of the main lithological groups used in the study are the following values: 0.031-0.111-0.438 μWm-3 for igneous ultramafic rocks, 0.179-0.345-0.722 μWm-3 for gabbros, 0.551-0.862-1.199 μWm-3 for diorites, 0.611-1.043-2.195 μWm-3 for tonalites, 1.438-1.879-2.511 μWm-3 for granodiorites, 1.741- 2.429-3.233 μWm-3 for granites, 0.077-0.214-0.533 μWm-3 for basalts, 0.472-0.818-1.094 μWm-3 for andesites, 1.847-2.551-3.433 for rhyolites, 0.968-1.442-1.657 μWm-3 for mudrocks, 0.548-0.993-1.212 μWm-3 for wackes, 0.536-0.816-1.206 μWm-3 for sandstones, 0.216-0.416-0.618 μWm-3 for carbonatic rocks, 0.242-0.529-2.024 μWm-3 for low-medium grade metaigneous rocks, 1.210-1.842-2.765 μWm-3 for low-medium grade metasedimentary rocks, 0.352-0.753-1.613 μWm-3 for granulites emplaced in upper crustal domains and 0.06-0.247-0.435 μWm-3 for eclogites.