On the use of geochemical data to construct geothermal models of the crust

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Igneous rocks of SW Iberia (Portugal) covering a wide petrographic range, from ultramafic (peridotites) through mafic (gabbros) to felsic (highly differentiated) facies, like granites and syenites (including peralkaline types), were chemically analysed in order to obtain U, Th and K_2O weight contents, giving the following results: U, 0.021 to 20.659 ppm, Th, 0.050 to 57.372 ppm, and K_2O, 0.06 to 4.28 % [1].

From a geophysical point of view, radiogenic heat production is of fundamental importance to estimate the thermal regime of the crust and upper mantle (geotherms). In Portugal we have been using gamma-ray spectroscopy [2] to determine the contents in U, Th and K of rock samples to estimate the heat production per unit volume which, with thermal conductivity values, can be included into solutions of the heat conduction equation, subjected to the appropriate boundary conditions, to estimate the distribution of temperature to lithospheric depths not reached by boreholes.

Depending on the type of chemical analysis, it is possible to use the contents of U, Th and K to determine the heat production of rock samples. This study shows an example on the use of elemental geochemistry of igneous rocks to estimate the thermal regime in southern Portugal. The heat production values (in $\mu W/m^3$) obtained for peridotites (0.009-0.042; mean: 0.025), gabbros (0.012-0.079; mean: 0.046), granites (0.671-0.993; mean: 0.832) and syenites (0.446-9.183; mean: 2.161) reflect the large petrographic range, as expected from a geochemical point of view, taking into account the high incompatibility of these elements relative to the mantle mineralogy.

Many elemental chemical analyses exist already for several rock types and so can be used to help to constrain geotherms and thermal regimes of the crust or lithosphere.

[1] Lopes (2004) *PhD. Thesis, Universidade de Évora,* **505**.
[2] Correia (1995) *Com. Inst. Geol. Min.* **81**, 39-46.

Arsenic-rich airborne particles associated with gold mine tailings: Particle size, mineralogy and texture

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Windblown and vehicle-raised dust from unvegetated mine tailings can be a human health risk. Airborne particles from As-rich abandoned gold mine tailings from Nova Scotia, Canada have been characterized in terms of particle size, As concentration, As oxidation state, mineral species and texture. Samples were collected in seven aerodynamically fractionated size ranges (0.5 to 16 μm) using a cascade impactor deployed at three tailings fields, one during a recreational vehicle racing event.

Total concentrations of As in the < 8 μm fraction varied from 65 to 1040 ng/m^3 as measured by proton-induced X-ray emission spectroscopy (PIXE) analysis. The same samples were analysed by synchrotron-based X-ray absorption (microXANES) and diffraction (microXRD) and found to contain multiple As-bearing mineral species, including arsenopyrite and As(V)-bearing weathering products such as scorodite ($FeAsO_4 \cdot 2H_2O$).

Field observations demonstrate that vehicle activity disaggregates near-surface tailings naturally cemented with arsenate minerals, suggesting that recreational activities not only increase exposure but increase the risk to human health by generating a increased number of fine particles.

Results from this study can be used to help assess the potential human health risks associated with exposure to airborne particles from mine tailings and to develop new methods of characterizing particle composition.