Strongly reduced gases emitted during flood magmatism and their environmental consequences

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We use thermodynamic calculations to show that high-temperature interaction between basaltic magma and organic matter can profoundly affect the redox state of the magma and of the gases in equilibrium with it. Our calculations simulate the incorporation into the gas-melt system of organic compounds like CH and CH_2 and take into account S-H-O-C gaseous species at temperatures and pressures in equilibrium with a basaltic liquid. We predict that the assimilation of less than 1 wt% organic matter produces gases with very unusual compositions that are CO-dominated and have H_2O and CO_2 as minor constituents. The crystallization of graphite and native iron is also predicted as a consequence of CH or CH_2 incorporation.

We combine our calculations with existing petrological observations on the Siberian Traps to assess the relevance of this process for the emplacement of voluminous magmatic intrusions in the coaliferous sediments of the Tunguska Basin. Critical is the presence of magmatic graphite and native iron in igneous mafic rocks, which allows to constrain the minimum amount of organic matter assimilated and the composition of the produced gases. We also present an estimation of the fluxes of the exceptional CO-dominated gas emissions, which are likely to have been produced by the emplacement of the Siberian intrusions. We finally evaluate the fate of such gases during their diffusion in the atmosphere, by using a regional 3D atmospheric model coupled to a tropospheric chemistry one.

The chemistry and the environmental impact of the Romanian phosphogypsum

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The aim of this paper is the mineralogical and geochemical description of phosphogypsum from a Romanian location for an accurate assessment of its environmental impact. Phosphogypsum is a technogenic (mineralurgic) by-product from the extraction of phosphoric acid from raw phosphate ore, consisting mainly of apatite [ideal formula: $Ca_5 (PO_4)_3$ (F, OH, Cl)]. The extraction technology uses normally the sulfuric acid to attack the apatite mineral. The phosphogypsum contains (in weight percentages) 32% CaO, SO_3 45% and 15% water of crystallization, with approximately 8% of impurities.

The chemical composition of phosphogypsum is influenced by three factors: 1) by the type of phosphate rock (apatitic rock) used as primary material, and olso by the nature and distribution of the trace elements of the rock; 2) by the processes of manufacturing of the phosphoric acid: the extraction process of the phosphogypsum, having as an intermediar product the calcium dehidrate, leads to the formation of some phosphogips, witch have a high level of contamination than their homologue, in some compounds as: Mn_2O_3, MgO, Fe_2O_3, Al_2O_3, Na_2O, K_2O, SiO_2, P_2O_5; 3) by the dumps age or stored phosphogypsum deposits, which, due to the percolation of the meteoric wather, have the tendancy of lousing, through solubilisation, a part of some trace elements. Some of the chemical, mineralogical and radiometric characteristics of the phosphogypsum, but also its use as a primary material can directly influence its impact on the environment and also on the human health collectivises.

The main factors, that have a major impact on the environmental safety, but also on the phosphogypsum recycling, are the radioactivity, the toxic elements contents, pore water acidity, mineral's impurity, the contents in rare elements.

The pollutants emitted from the phosphogypsum dumps have a potential impact on the environment, affecting both the people and the animals. The potential pathways of human exposure to these pollutants include: the irradiation with gamma rays; the content in toxic elements; contaminated dust and other elements which can provoce the cancer; the ingestion of contaminated groundwater.