Origin of the Manleluag hyperalkaline hot spring, Philippines

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The origin of the Manleleuag Hyperalkaline Hot Spring is a unique occurrence in the Philippines. It is characterized by hyperalkaline (pH10 to 11.5) and highly reducing waters (-200 to 300mV) with little dissolved oxygen present (<1mg/L). Active gaseous exhalation could be methane or hydrogen gas due to its combustible nature.

Its origin is puzzling to most and has been widely attributed to a nearby volcanic plug. Here we present an alternative origin of the Manleleuag Hyperalkaline Hotspring – it is produced by the dissolution of underlying gabbros of the Zambales Ophiolite. Its alkalinity is due to the hydrolysis of Mg-rich rocks (i.e. gabbros) while the hydrolysis and oxidation of iron in minerals (e.g. pyroxenes) accounts for its highly reducing state. A geochemical reaction path model (i.e. Geochemist's Workbench) was used to elucidate the chemical reactions that took place to produce this unique natural occurrence in the Philippines.

Uranium stability in near-surface environments: Lessons from the study of depleted uranium munitions

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Depleted uranium (DU), a by-product of nuclear fuel enrichment, is used in armour piercing munitions. Military activities have left a legacy of DU contamination in near-surface environments (soils, sediments, bodies of fresh and sea water). We have undertaken a multidisciplinary study of laboratory model systems aimed at understanding the processes involved in DU decomposition and dispersion. These studies also inform our general understanding of the biogeochemistry of uranium. Model systems representative of a wide range of natural environments (loamy, sandy or cementitious soils; estuarine sediments of differing salinities) and specific conditions (aerobic or anaerobic, abiotic or with fungi or bacteria present) have been studied and show significant differences in behaviour. For example, we show that whereas fungi can thrive with DU and transform it to stable minerals capable of long term uranium retention, bacteria are surprisingly ineffective at promoting DU corrosion, with aerobes being no more effective than equivalent abiotic systems and anaerobes even less effective. In grassland soils, water content and biogeochemistry have marked influence on corrosion rates which are 40 times faster under moist conditions than in waterlogged soils. In estuarine sediments, salinity has little or no influence on corrosion rates under sub-oxic conditions, whereas under sulfate-reducing conditions corrosion ceases due to passivation. These experiments provide information on rates of uranium decomposition and the nature of the breakdown products in key environments.