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Commentary

Earth Phosphogypsum Deposits and their Statistical Analysis

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DESCRIPTION

Apatite $Ca_5(PO_4)_3(OH,CL,F)$, one of the phosphate compounds that naturally occur on earth, is widely used in the fertilizer business. Fertilizers with phosphoric bases have made significant contributions to agriculture. However, the production of phosphogypsum as a byproduct is connected to the manufacture of fertilizer. Phosphogypsum is a global environmental problem; each year, over 300 Mt is produced; handling varies by country, but only about 15% is recycled, with the majority remaining in abandoned stacking places.

Stacking locations for phosphogypsum are typically located close to coastlines, where they are exposed to weather and erosive agents and could constitute a risk to human health and the environment. From Imbituba in Brazil, which has about 4 Mt of phosphogypsum, to Huelva in southeast Spain, which has 1200 ha completely covered by this by-product, these stacking regions may be found all over the world.

Depending on its geological origin, apatite has different physical and chemical characteristics (i.e., sedimentary or igneous). Around the world, phosphate rock is mined (e.g., in the Middle East, Morocco, India, China, USA, Brazil). Every year, Florida in the USA produces 19 Mt of phosphate rock; as a result, the amount of phosphogypsum rises, worsening the environmental problem.

The wet acid method, which is mostly comprised of acidulating the rock with a strong acid, is used in the fertiliser sector. The most commonly used strong acid is sulfuric acid. Sulfuric acid plus phosphate rock results in phosphoric acid and phosphogypsum. Five tonnes of phosphogypsum, primarily made of precipitated calcium sulphate ($CaSO_4 \cdot 2H_2O$) and trace components that could be dangerous to the environment and human health, are obtained for every tonne of phosphoric acid. Phosphate rock has varying amounts of natural radiation depending on its geological genesis. Between 40 and 5,000 Bq kg^{-1}, apatite of volcanic origin has less radioactivity than sedimentary origin. Depending on the origin of the phosphate rock (sedimentary) used as the input for the industrial process, phosphogypsum obtains heavy metals, radionuclides such as ^{238}U, ^{232}Th and its daughter nuclides, and ^{40}K. It's possible that heavy metals may be available and will move to nearby urban and agricultural areas. Thus, as the phosphogypsum's natural radiation values rise, long-term exposure to it may have negative effects on human health.

There are a number of shallow geophysical techniques that were previously unaffordable due to their high costs. These days, environmental studies frequently use near surface geophysics as a tool. Electrical Resistivity Tomography (ERT) is one of them. By infusing controlled electrical currents and measuring the difference in potential externally, this method uses electricity to produce electromagnetic fields. Due to its affordability, flexibility in the field, and speedy data processing, ERT is frequently used by researchers to conduct environmental studies. Electrical currents are used by ERT to evaluate the subsoil.

A portable Geiger Radex RD1503 was used to obtain approximate or coarse measurements of the equivalent environmental dose rate in Sv h-1, as a guide to identify the zones of interest, and to quickly locate areas with significant gamma radiation above the background radiation by adjusting the alarm level.

In order to identify mineral characteristics, geophysical equipment that makes use of natural gamma and spectral gamma probes is frequently used in the mining sector. The radiological characterization is carried out using the chemical analysis of the drilled boreholes. This process made it possible to measure the thickness of the phosphogypsum layer and locate the areas with varying radiation activity.

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