

Introduction

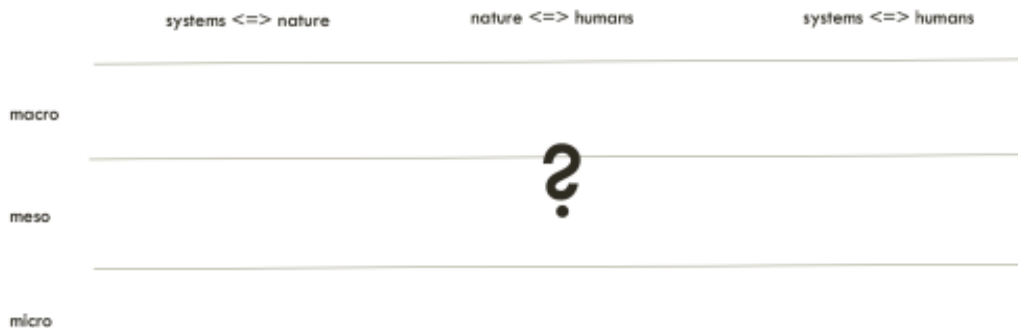


1. Why do we talk about phosphorus ?

- 1 of the 9 planetary limits
- 1 of the 3 planetary limits exceeded
- What is phosphorus ?
- What is its cycle ?
- In which human activities is it used ? How to return to a "normal" situation ?



During the course, think about the different interactions between humans, nature and systems involving phosphorus.



2. How was phosphorus discovered ?

According to you, how did humans discovered phosphorus ?

A. By looking for the Philosopher's Stone

B. By doing caving (spéléologie)

C. By observing a carp population in a lake

A - Complete answer :

By looking for the Philosopher's Stone AND analyzing urine. Yes.

Who ? Hennig Brand

When ? 1669

Why ? By looking for the Philosopher's Stone

How ? By analyzing large quantities of urine

Properties :

- it is phosphorescent
- it ignites spontaneously on contact with air

1769 : Scheele discovery

(Gervy, 1970)

(Joseph Wright, 1771)

3. What is phosphorus ?

According to you, where can we find phosphorus ?

- A. In our DNA
- B. In our Smartphones
- C. In our clothes

ELEMENTS OF A SMARTPHONE

ELEMENTS COLOUR KEY: ALKALI METAL, ALKALINE EARTH METAL, TRANSITION METAL, GROUP 13, GROUP 14, GROUP 15, GROUP 16, HALOGEN, LANTHANIDE

SCREEN

- In (Indium) and Sn (Tin) are used in a transparent film in the screen that conducts electricity.
- Al (Aluminum) and Si (Silicon) are used in the glass used on the majority of smartphones.
- A variety of Rare Earth Element compounds are used in small quantities to produce the colours in the smartphone's screen.

ELECTRONICS

- Copper (Cu), Gold (Au), and Silver (Ag) are used for wiring in the phone.
- Nickel (Ni) is used in the microphone as well as for other electrical connections.
- Pure silicon (Si) is used to manufacture the chip in the phone.
- Tin (Sn) and Lead (Pb) are used to solder electronics in the phone.

BATTERY

- Li (Lithium), Co (Cobalt), and C (Carbon) are used in the majority of phones.
- Magnesium (Mg) compounds are alloyed to make some phone cases.

CASING

- C (Carbon), Br (Bromine), and Ni (Nickel) are used in some phone cases.

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(Compound Interest, 2014)

Phosphorus

← Pnictogen

atomic number: 15

symbol: P

electron configuration: [Ne]3s²3p³

name: phosphorus

atomic weight: 30.974

acid-base properties of higher-valence oxides: Weakly acidic

crystal structure: Cubic

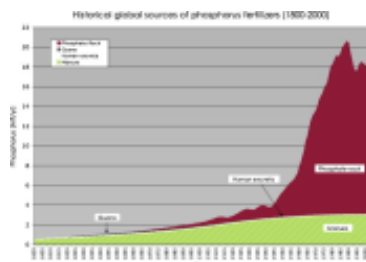
physical state at 20 °C (68 °F): Solid

Classification: Other nonmetals

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(Sanderson, 2018)

4. Where is phosphorus ?



(Cordell, 2009)

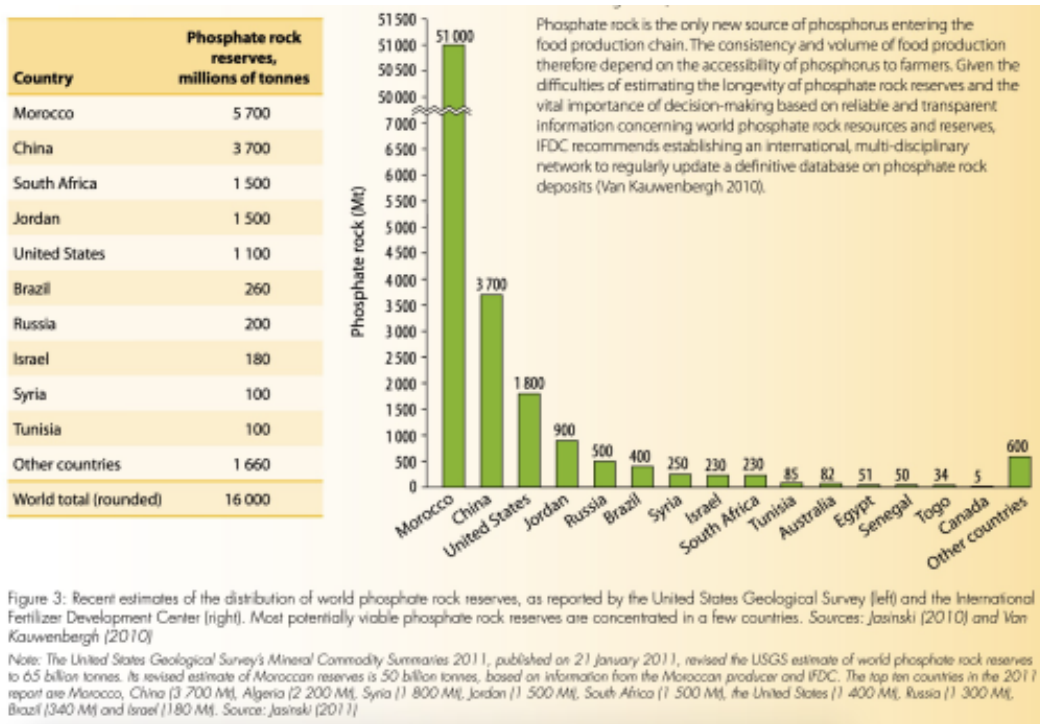


Figure 3: Recent estimates of the distribution of world phosphate rock reserves, as reported by the United States Geological Survey (left) and the International Fertilizer Development Center (right). Most potentially viable phosphate rock reserves are concentrated in a few countries. Sources: Jasinski (2010) and Van Kauwenbergh (2010)
 Note: The United States Geological Survey's Mineral Commodity Summaries 2011, published on 21 January 2011, revised the USGS estimate of world phosphate rock reserves to 65 billion tonnes. Its revised estimate of Moroccan reserves is 50 billion tonnes, based on information from the Moroccan producer and IFDC. The top ten countries in the 2011 report are Morocco, China (3 700 Mt), Algeria (2 200 Mt), Syria (1 800 Mt), Jordan (1 500 Mt), South Africa (1 500 Mt), the United States (1 400 Mt), Russia (1 300 Mt), Brazil (340 Mt) and Israel (180 Mt). Source: Jasinski (2011)

(Syers, 2011)

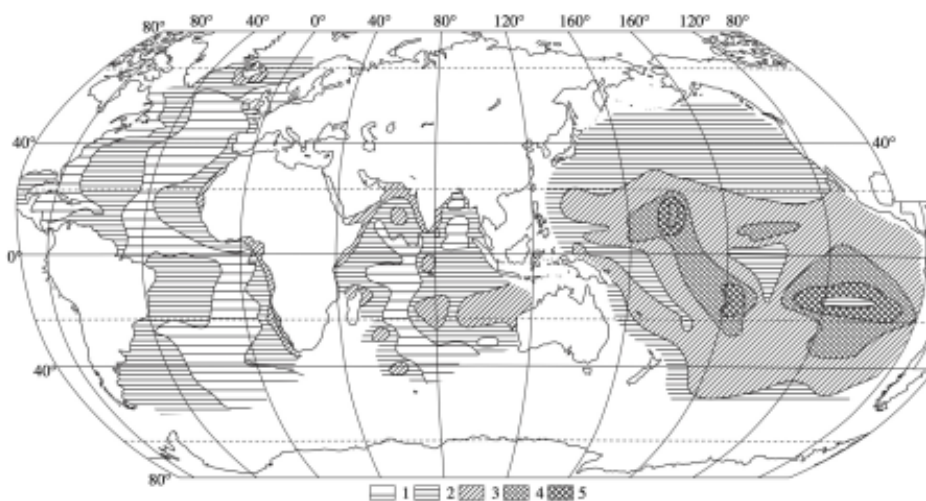


Fig. 1. Phosphorus distribution (%) in the upper sediment layer of the World Ocean, based on data from (Baturin, 1988; Baturin and Sevast'yanova, 1986; Baturin et al., 1995; Eimel'yanov and Romankevich, 1979). (1) <0.05%; (2) 0.05-0.1%; (3) 0.1-0.2%; (4) 0.2-0.3%; (5) >0.3% (for the Indian ocean: (2) 0.05-0.08%; (3) >0.08%).

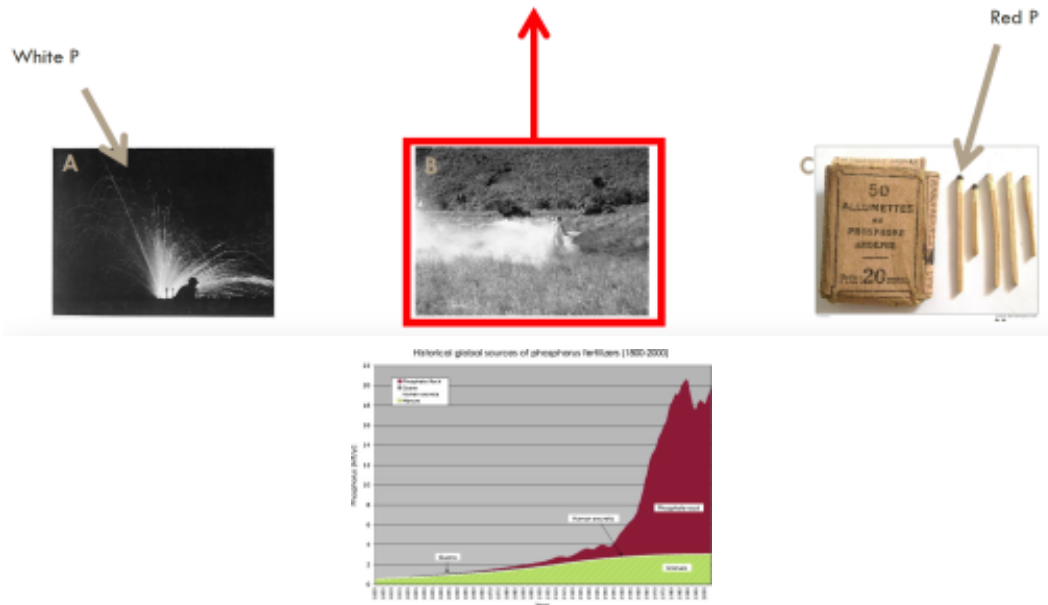
(Baturin, 2003)

5. Why and how humans use phosphorus ?

According to you, why do we use phosphorus ?

- A. To create bombs
- B. To create fertilizers
- C. To create match scrapers (grattoirs pour allumettes)

90% of global demand for phosphorus is for food production



(Cordell, 2009)

And HOW ?

Use of phosphates before their discovery :

1. Use of bones
2. Use of guano

According to you, what is guano ?

- A. A plant that can be smoked
- B. A typical Latin American outfit

C. A pile of excrement

Seabirds and bats dropping are full of phosphorus !

2 reasons to use guano :

- Both live in large colonies
- High concentration of phosphorus