New Rare Earth Elements Found In Amazon Estuary? Science Trends

Olivier Pourret

New rare earth elements resource large of Amazonia?

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The industry is nowadays more and more demanding of many metals, among these many metals, rare earths and more particularly some of them. These elements (e.g., neodymium, Nd) are used in particular to produce powerful permanent magnets that are used in wind turbines, electric motors ... (Figure 1). Others such as europium are used as luminophors. These rare earths are thus part of the materials considered strategic for the economy.

Figure 1 Rare earth elements used in a car (source Toyota)

But what exactly are they?

The rare earths are in the strict sense the 14 lanthanides, elements of the periodic table (Figure 2) whose atomic numbers go from 57 to 71. The yttrium of atomic number 39 is often added there because it has chemical properties close to these. Their atoms have an external electronic configuration that includes 14 orbitals on the layer 4f, at the origin of this family of 14 lanthanides. Their particular electromagnetic properties come from the fact that the 4f orbitals do not properly mask the nucleus field. Rare earths have similar chemical properties because of their three valence electrons.

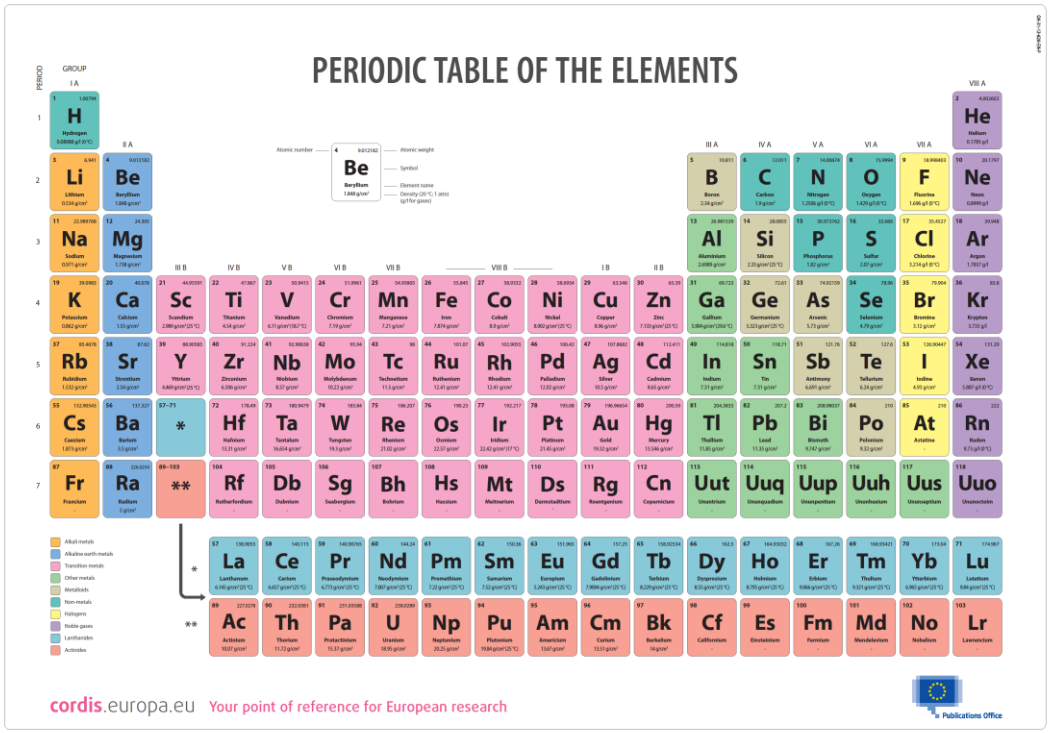

Figure 2 Periodic table of the elements

Contrary to what their name suggests (rare earths), they are not so rare. However, they are strategic materials for the global economy (i.e. critical metals; Figure 3).

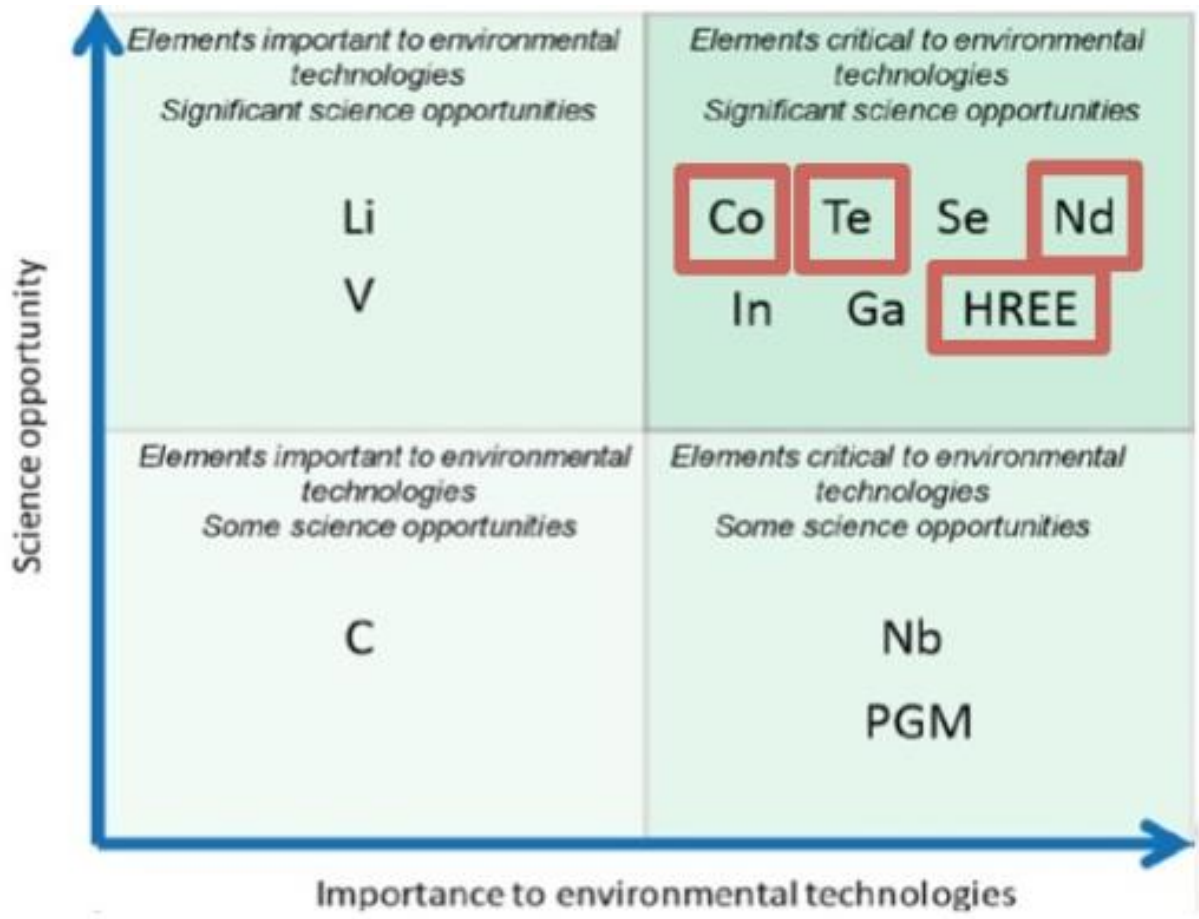

Figure 3 Criticity of metals

It is important to distinguish between light rare earth elements (LREE) and rare earths (HREE); defines these two groups as follows:
- LREE: La, Ce, Pr, Nd, Sm;
- HREE: Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu (plus Y).

There is no single rare earth primary deposit, but mineral deposits containing several rare earths, predominantly either light rare earths or heavy rare earths. However, deposits rich in HREE are much rarer than deposits rich in LREE. For the moment, the main exploited deposits of HREE are located in the south of China, which leads to a monopoly situation (in 2010, respectively 99% and 87% of the supply of HREE and LREE came from China) and creates risks for supply, which are exacerbated by Chinese export quotas that emerged in 2011.

Moreover, in a 100% electric vehicle world, the commodity demand will increase by ~655% (Figure 4, source UBS).

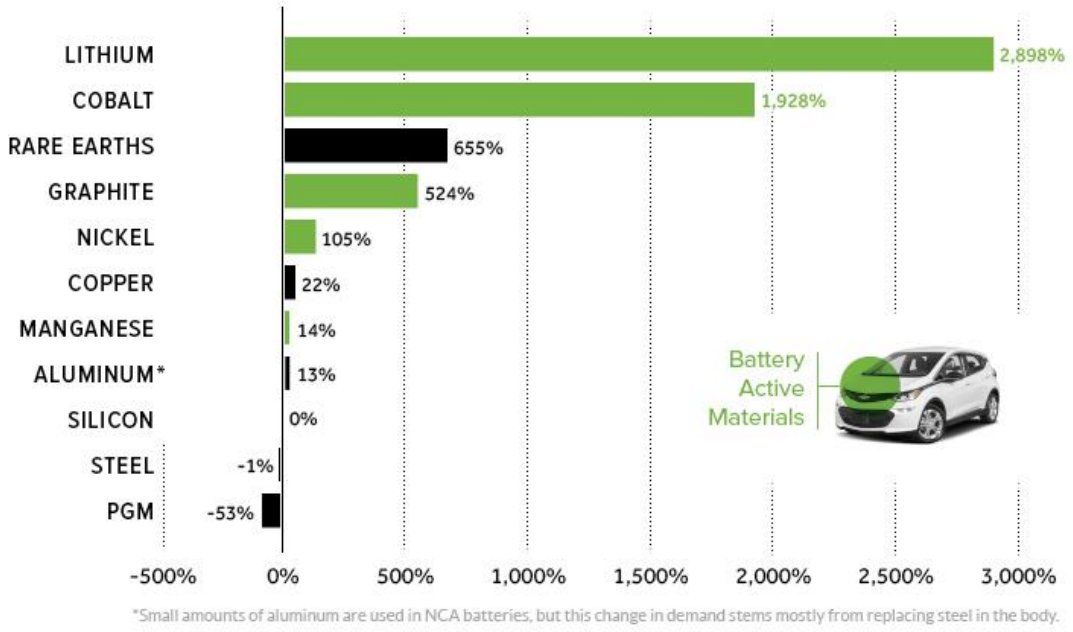

Figure 4 Incremental commodity demand in a 100% electric vehicle world (proportion of actual's global production; source UBS, 2017).

In this context, several researchers around the world are working on discovering new potential resources. Pourret and Tuduri (2017) recently proposed to explore continental shelves, especially in Atlantic Ocean front of Amazon estuary (Figure 5).

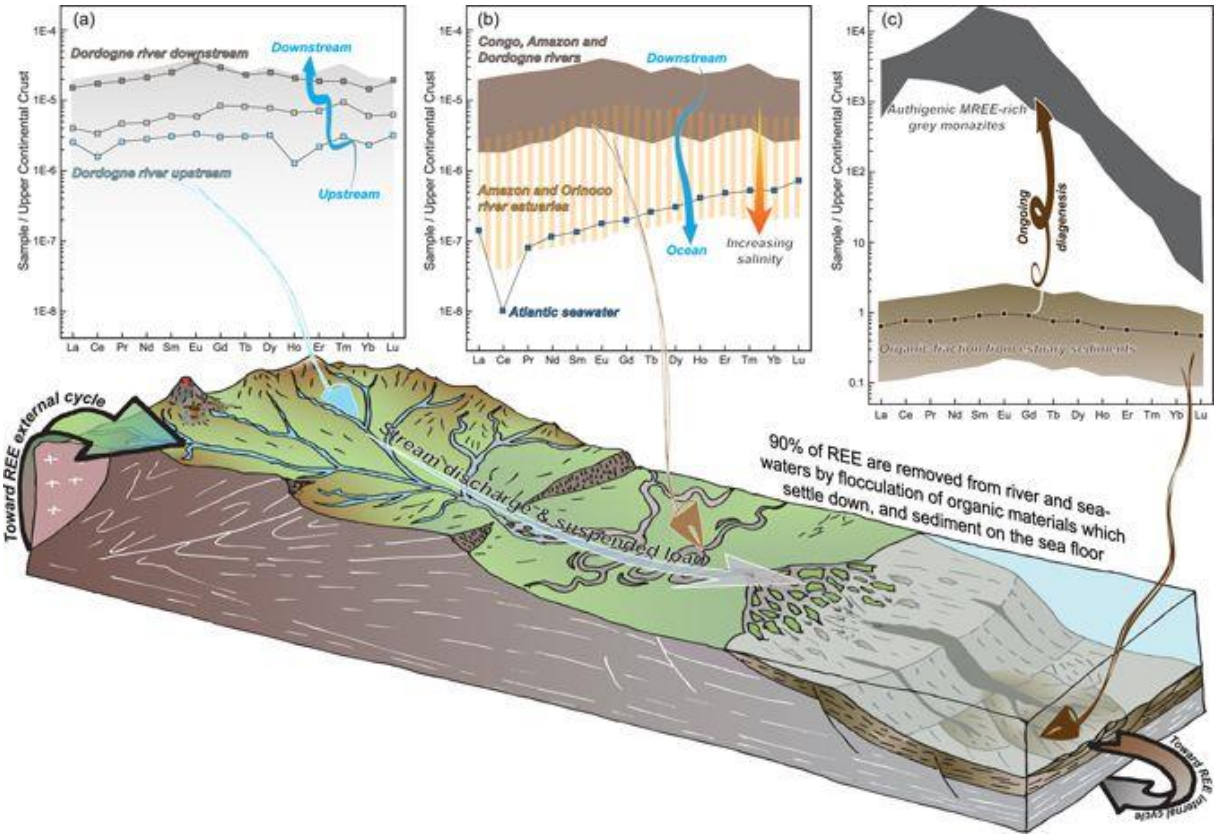

Figure 5 Sketch illustrating the REE external cycle and summarizing the processes responsible for REE fractionation from river water to organic sediments (see details in Pourret and Tuduri 2017).

These findings are described in the article entitled Continental shelves as potential resource of rare earth elements, recently published in the journal *Scientific Reports*. This work was conducted by Olivier Pourret from UniLaSalle and Johann Tuduri from BRGM.

Reference

Pourret, O. and Tuduri, J. (2017) Continental shelves as potential resource of rare earth elements. Scientific Reports 7, 5857.