

# **Syenite hosted-REE mineralization in the Ediacaran Tioueine granitoid ring-complex, western Hoggar (Tuareg shield), southern Algeria.**

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Modern technologies require critical minerals, including rare earth elements; these are crucial raw components needed for green energy applications. Despite their worldwide significance, only limited exploration has been conducted in Algeria to reveal its potential for REE mineralization. Here, we characterize REE mineralization in the Tioueine ring- complex (TRC) through optical and scanning electron microscopy (SEM), whole-rock geochemistry using ICP-AES and ICP-MS, and zircon U-Pb geochronology using laser ablation ICP-MS.

The TRC is made of two nested units; the peripheric one is alkaline, mainly made of alkali feldspar granites, whereas the central unit is calc-alkaline and made of monzogranite-granodiorite. A ring dyke system intersects the peripheric unit and contains quartz-alkali feldspar syenite (QAFS) hosted-REE mineralization. Accessory REE ore minerals are allanite-(Ce), apatite, xenotime-(Y), monazite, and REE-fluorocarbonates. Allanite-(Ce) is the main REE mineral; it is patchy-zoned, with grains up to 2.5 mm long. REE-Fluorocarbonates replace allanite along margins, apatite forms 50 to 250  $\mu\text{m}$  inclusions in mafic minerals, xenotime-(Y) occurs as thin inclusions up to 70  $\mu\text{m}$  long in biotite and anatase while monazite remains rare. The QAFS has high total REE concentrations (~540 – 1700 ppm), with anomalous high LREE content [(La/Lu)<sub>N</sub> = 16.3 – 37.2]. Zircon U–Pb geochronology yields Ediacaran crystallization age at  $597 \pm 5$  Ma.

Primary REE mineralization [allanite-(Ce)-apatite-xenotime-(Y)] is interpreted as a product of magmatic fractionation of volatiles-rich evolved alkaline magma, whereas REE-fluorocarbonates are the results of mineral-fluid interaction between late hydrothermal F-CO<sub>2</sub> rich fluids and primary allanite-(Ce) resulting local metasomatic texture.

The TRC REE-related mineralization showcases new perspectives on rare earth's exploration in the Hoggar area (Tuareg shield), and its implications can impact the revealing of the Algerian underground potential in strategic metals.